

Repair & Replacement Applications Center

Program Overview

Program Description

The Repair & Replacement Applications Center (RRAC) 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.

Industry Needs and Issues Addressed

- Safe, effective, and reliable repair techniques that contribute to shorter outages and meet or exceed all code, regulatory, and design requirements
- Technologies that enable repairs to be made more quickly while the plant is off-line
- Technologies that enable repairs to be made while the plant is on-line
- Broader dissemination and application of industry lessons learned and benchmarking practices

Impact

- Repair options for key components, supplemented by application guidelines, procedures, and training
- Access to materials, welding, and repair experts across the Electric Power Research Institute (EPRI) and the nuclear industry
- Reduced repair costs, reduced component downtime, and increased plant availability
- Demonstrated repair techniques and technologies that improve material performance and enable component life extension

Key Accomplishments

- New, advanced technology for repair of power plant components
- Technical support for implementing new technology and meeting immediate needs, including application guides for advanced welding methods, guidelines for installing and examining dissimilar metal weld overlays, and repair/mitigation of socket weld fatigue failures
- Benchmarking programs, including self-assessment and best practice guidelines for Repair/Replacement Program and Welding Program procedures
- Peer support through industry technical experts, providing rapid response to emerging issues for materials, code, welding, and repair challenges
- Technology to reduce need for forced outages and to limit outage duration
- Development of realistic code rules, including new code cases to reduce post-weld examination hold times and support use of dissimilar metal weld overlays for stress corrosion cracking mitigation
- Projects addressing emerging plant issues, including development of guidance for overlay applications, procedures for gas-metal arc welding, and review of new plant build specifications

Current Year Objectives

- Improved productivity welding methods to address large-scale applications (weld overlays)
- Repair of fuel pool leakage
- Mitigation of stress corrosion cracking in low-alloy steels and austenitic materials
- Development of advanced welding systems to reduce downtime and improve quality
- Evaluation of advanced filler/welding materials for critical plant repair applications

- Benchmarking of utility repair programs
- Failure analysis and stress measurements to assist members in repair decisions
- *Welding and Repair Technology for Power Plants* conference.

Industry Involvement

Estimated 2009 funding: \$3.7

Program Technical Lead

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Summary of Projects

Project Number	Project Title	Value
	RRAC Subscriber Requested Assistance (Supplemental)	The benefit of the Subscriber Requested Assistance (SRA) project is that it provides members with Immediate access to repair experts and technology available through the Electric Power Research Institute's (EPRI's) RRAC program. It also assists in obtaining peer support from the utility repair community. The SRA project provides members support in development of new repair and welding procedures, including support for implementation of EPRI RRAC developed technology.
	RRAC Codes & Standards (Base)	The benefits of this project include the following: <ul style="list-style-type: none">• availability of realistic code rules reduces the cost and complexity of repairs and reduces reliance on highly skilled staff in the application of more complex requirements and• engagement with code and regulatory bodies during the development of new technologies assists in reducing the time and cost for implementation of new technologies and repair rules.
	RRAC Best Practices & Case Histories (Base)	<p>The products from this project can provide substantial savings in time and money associated with program improvement. In many cases, the project products can assist in ensuring compliance with the latest code or regulatory requirements. Other benefits include access to the RRAC SharePoint site, which provides continuously updated information on utility procedures, administration documents, repair and replacement (R&R) programs, welding programs, experience reports and provides members with the ability to share information among themselves to support benchmarking activities.</p> <p>Through this project, RRAC members have rapid access to information, peer support, benchmarking services, program support, and technical assistance aimed at assisting in reducing the time and cost associated with repair activities.</p>

Project Number	Project Title	Value
	RRAC Codes & Standards (Supplemental)	The benefits of this project include <ul style="list-style-type: none"> • reducing the cost and complexity of repairs through the availability of realistic code rules and reducing reliance on highly skilled staff in the application of more complex requirements and • engagement with code and regulatory bodies during the development of new technologies assists in reducing the time and cost for implementation of new technologies and repair rules.
	RRAC Best Practices and Case Histories (Supplemental)	<p>The products from this RRAC member-driven project can provide substantial savings in time and money associated with program improvement. In many cases, the project products can assist in ensuring compliance with the latest code or regulatory requirements. Other benefits include access to the RRAC SharePoint site, which provides continuously updated information on utility procedures, administration documents, repair and replacement programs, welding programs, experience reports and provides members with the ability to share information among themselves to support benchmarking activities.</p> <p>Through this project, RRAC members have rapid access to information, peer support, benchmarking services, program support, and technical assistance aimed at assisting in reducing the time and cost associated with repair activities.</p>
	RRAC Welding Materials Issues (Base)	The result of this project can lead to reduced outage time for repairs of critical pressure boundary components. Improved welding material performance can have a direct influence on the service life of key components, assisting in life extension efforts and mitigation of degradation.
	RRAC Small Diameter Pipe Applications (Base)	The benefits of this project are improved small diameter piping reliability due to fewer failures from conditions such as high-cycle fatigue of socket welds. This also includes on-line repair methods that can markedly reduce the need to reduce power production for repair activities.
	RRAC Equipment Development (Base)	This project will provide advanced repair equipment and technology to assist RRAC members in achieving their plant availability goals by <ul style="list-style-type: none"> • reducing the time and cost of performing repairs, • providing significant life extension of repaired components due to improved process controls and quality, and • improving the ease of use and effectiveness of specialized processes, such as temperbead welding.
	RRAC Welding Materials Issues (Supplemental)	The result of this RRAC member-directed project can lead to reduced outage time for repairs of critical pressure boundary components. Improved welding material performance can have a direct influence on the service life of key components, assisting in life extension efforts and mitigation of degradation.

Project Number	Project Title	Value
	RRAC Small Diameter Pipe Applications (Supplemental)	The benefits of this RRAC member-directed project are improved small diameter piping reliability due to fewer failures from conditions such as high-cycle fatigue of socket welds. This also includes on-line repair methods that can markedly reduce the need to reduce power production for repair activities.
	RRAC New Process Development (Supplemental)	This project will assist RRAC members in achieving their plant availability goals: <ul style="list-style-type: none"> • reduce the time and cost of performing repairs by using demonstrated technology to improve the execution of repair/replacement applications • use of advanced technology for repairs can provide significant life extension of repaired components, further reducing the cost as compared to replacements • improved repair quality assists in reducing the cost of post-repair examinations and future monitoring of components
	RRAC Advanced Weld Application (Supplemental)	The availability of advanced welding and repair technology will assist RRAC members in achieving their plant availability goals: <ul style="list-style-type: none"> • reduce the time and cost of performing repairs by using demonstrated technologies, • provide significant life extension of repaired components, • reduce the cost of post-repair examinations and future monitoring with improved weld quality, and • reduce the cost and critical path time to repair components and systems with specialized processes, such as temperbead welding .
	RRAC Equipment Development (Supplemental)	This RRAC member-directed project will provide advanced repair equipment and technology to assist RRAC members in achieving their plant availability goals by <ul style="list-style-type: none"> • reducing the time and cost of performing repairs, • providing significant life extension of repaired components due to improved process controls and quality, and • improving the ease of use and effectiveness of specialized processes, such as temperbead welding.
	RRAC Materials Evaluation (Base)	The technology available from this project will assist in determining the cause of failures and the role of materials in mitigation and repair of existing degradation mechanisms. This can lead to substantial savings related to improved equipment reliability and enhanced life extension performance.
	RRAC Materials Evaluation (Supplemental)	The technology available from this member-directed project will assist in determining the cause of failures and the role of materials in mitigation and repair of existing degradation mechanisms. This can lead to substantial savings related to improved equipment reliability and enhanced life extension performance.

Project Descriptions

RRAC Subscriber Requested Assistance (Supplemental) (065821)

Issue

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.

Description

Subscriber Requested Assistance (SRA) enables members to access services and technical support for individual application of RRAC technology and 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.

Value

- Immediate access to repair experts and technology
- Assistance in obtaining peer support from the repair community
- Access to welding and repair procedures to meet new challenges
- Support development of new repair and welding procedures
- Support repair issues and implementation of EPRI RRAC-developed technology

How to Apply Results

Subscriber Requested Assistance project results directly support utility member needs. Each product is tailored to meet the request of a participating member or groups of members.

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Subscriber Requested Assistance Services provided to RRAC members: Subscriber Requested Assistance provides members quick access to technical support and individualized research to meet plant needs and address emerging issues. Through direct RRAC staff support and peer expertise, this project provides significant savings by reducing the cost and time required to perform repair and replacement activities.	2010	Technical Resource

RRAC Codes & Standards (Base) (065822)

Issue

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.

Description

This project supports RRAC 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. 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 temper bead 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. Additional work will include expansion of initial code-approved actions to address other reactor pressure vessel and piping components.

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.

Value

- Ensure availability of approved code and regulatory rules permitting 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Development of Technical Basis Data and Information to Support Code Revisions. : This project will continue to develop the technical data and information to support revision of code rules for repair and replacement activities. This project will focus on technical issues and limitations of current code rules and support updates to the rules based on new technology and materials.	12/31/2009	Technical Update

RRAC Best Practices & Case Histories (Base) (065823)

Issue

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.

Description

RRAC 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.

Value

- Realize substantial time and cost savings through implementation of key products such as the Welding Programs ~ 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 RRAC 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 RRAC members through email and web-based communication and document sharing tools. These tools provide quick access to case history information, RRAC reports, and procedures/practices used by other members. Members realize value by integrating such information into plant procedures or practices.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Project selected by RRAC Members	12/31/2009	Technical Resource
Website Document/Case History Sharing and Technical Support	12/31/2009	Technical Resource
Benchmarking/Self-Assessment of Welding and Repair Programs for RRAC Member utilities – by request	12/31/2009	Technical Resource
Technical Support Product selected by RRAC Members	12/31/2009	Technical Resource
Information Request/Exchange Service to support emerging repair needs	12/31/2009	Technical Resource
Technical Support Product selected by RRAC Members	12/31/2009	Technical Resource
Information Request/Exchange Service to support emerging repair needs	12/31/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Website Document/Case History Sharing and Technical Support	2009	Technical Resource
Benchmarking/Self-Assessment of Welding and Repair Programs for RRAC Member utilities – by request	2009	Technical Resource
Website Document/Case History Sharing and Technical Support	2010	Technical Resource

Product Title & Description	Planned Completion Date	Product Type
Benchmarking/Self-Assessment of Welding and Repair Programs for RRAC Member utilities – by request	2010	Technical Resource
Information Request/Exchange Service to support emerging repair needs	2010	Technical Resource
Information Request/Exchange Service to support emerging repair needs	2010	Technical Resource
Technical Support Product selected by RRAC Members: 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.	2010	Technical Resource

RRAC Codes & Standards (Supplemental) (065810)

Issue

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.

Description

This project supports RRAC 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. 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 temper bead 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. Additional work will include expansion of initial code-approved actions to address other reactor pressure vessel and piping components.

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 to reduce the cost, time, and schedule impact of repairs on the availability of critical nuclear components.

Value

- Ensure availability of approved code and regulatory rules permitting 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Development of Realistic Code Rules to Support Repair of Nuclear Plant Components and Systems.: This project will continue to support the development of realistic code rules aimed at reducing the cost and enhancing the safety and reliability of nuclear plant repairs. These efforts include development of appropriate data and associated basis documents to gain code and regulatory approval.	12/31/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Development of Realistic Code Rules to Support Repair of Nuclear Plant Components and Systems.: This project will continue to support the development of realistic code rules aimed at reducing the cost and enhancing the safety and reliability of nuclear plant repairs. These efforts include development of appropriate data and associated basis documents to gain code and regulatory approval.	2010	Technical Resource

RRAC Best Practices and Case Histories (Supplemental) (065816)

Issue

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.

Description

RRAC 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.

Value

- Realize substantial time and cost savings through implementation of key products such as the Welding Programs ~ 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 RRAC 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 RRAC members through email and web-based communication and document sharing tools. These tools provide quick access to case history information, RRAC reports, and procedures/practices used by other members. Members realize value by integrating such information into plant procedures or practices.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Benchmarking/Self-Assessment of Welding and Repair Programs for RRAC Member utilities – by request: Series of best practices, case histories, and technical support documents and products based on nuclear plant, vendor, and other experience related to repair and replacement activities		
Website Document/Case History Sharing and Technical Support		

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Benchmarking/Self-Assessment of Welding and Repair Programs for RRAC Member utilities – by request: Series of best practices, case histories, and technical support documents and products based on nuclear plant, vendor, and other experience related to repair and replacement activities		
Website Document/Case History Sharing and Technical Support		

RRAC Welding Materials Issues (Base) (065819)

Issue

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.

Description

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.

Value

- 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Development of Advanced Welding Materials for Component Life Extension: Products will focus on emerging welding materials issues to support or enhance life extension of nuclear plant components.	12/31/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Development of Advanced Welding Materials for Component Life Extension: Future products will focus on emerging welding materials issues to support or enhance life extension of nuclear plant components.	2010	Technical Update

RRAC Small Diameter Pipe Applications (Base) (065812)

Issue

Installation and repair of pipe assemblies typically requires socket welded connections in areas characterized by poor accessibility, high vibration, and prone to fatigue failure. In addition, alternate connection methods are needed to accommodate low-clearance joints and to reduce the time associated with welding activities (inspection, preparation, weldcraft) during critical path outage work.

Description

This project supports the development of improved installation and repair methods for small-bore piping. Refined socket fitting designs and weld geometries could reduce fatigue loading on components. A new system for joining pipe assemblies could benefit nuclear plant applications. Validation of this process has been limited to low-cycle fatigue tests and burst testing; additional high-cycle fatigue tests are needed to establish a direct comparison to socket-welded connections and butt welds.

Value

- Improve the life and performance of socket weld joints
- Reduce the time and cost associated with installation and repair of socket-welded fittings
- Provide alternative methods of joining small-bore piping in limited access locations and where more rapid assembly is necessary
- Provide acceptance criteria for advanced non-welded connections

How to Apply Results

Members will apply new welding technologies through implementation of guidance offered in technical documentation.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Small Bore Piping, Welding and Repair Technology: 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.	12/31/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Small Bore Piping, Welding and Repair Technology: 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.	2010	Technical Resource

RRAC Equipment Development (Base) (065820)

Issue

Advanced repair technology and equipment to address emerging applications can improve plant availability. Challenges encountered in maintaining 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 equipment and methods can directly reduce downtime while improving the quality/reliability of repairs.

Description

The project will support the development of 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 includes the development and evaluation of 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 investigate special methods such as temperbead welding to further reduce critical path time for repairs.

Value

- 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
- 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Technology for improving quality and reduce cost of repairs: This project will develop new technology to meet emerging repair needs driven by member requests and objectives.	12/31/2009	Technical Update

RRAC Welding Materials Issues (Supplemental) (065811)

Issue

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.

Description

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.

Value

- 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Development of Advanced Welding Materials for Component Life Extension: Products will focus on emerging welding materials issues to support or enhance life extension of nuclear plant components.	12/31/2009	Technical Update

Product Title & Description	Planned Completion Date	Product Type
Development of Advanced Welding Materials for Component Life Extension: Products will focus on emerging welding materials issues to support or enhance life extension of nuclear plant components.	12/31/2009	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Development of Advanced Welding Materials for Component Life Extension: Products will focus on emerging welding materials issues to support or enhance life extension of nuclear plant components.	2010	Technical Resource
Development of Advanced Welding Materials for Component Life Extension: Products will focus on emerging welding materials issues to support or enhance life extension of nuclear plant components.	2010	Technical Resource

RRAC Small Diameter Pipe Applications (Supplemental) (065812)

Issue

Installation and repair of pipe-to-pipe, flange-to-pipe, and T-to-pipe assemblies typically requires socket-welded connections in areas characterized by poor accessibility, high vibration, and prone to fatigue failure. In addition, alternate connection methods are needed to accommodate low-clearance joints and to reduce the time associated with welding activities (inspection, preparation, weldcraft) during critical path outage work.

Description

This project supports the development of improved installation and repair methods for small-bore piping. Refined socket fitting designs and weld geometries could reduce fatigue loading on components. A new system for joining pipe assemblies could benefit nuclear plant applications. Validation of this process has been limited to low-cycle fatigue tests and burst testing; additional high-cycle fatigue tests are needed to establish a direct comparison to socket-welded connections and butt welds.

Value

- Improve the life and performance of socket weld joints
- Reduce the time and cost associated with installation and repair of socket-welded fittings
- Provide alternative methods of joining small-bore piping in limited access locations and where more rapid assembly is necessary
- Provide acceptance criteria for advanced non-welded connections

How to Apply Results

Members will apply new welding technologies through implementation of guidance offered in technical documentation.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Small Bore Piping, Welding and Repair Technology: 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.	12/31/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Small Bore Piping, Welding and Repair Technology: 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.	2010	Technical Resource

RRAC New Process Development (Supplemental) (065813)

Issue

Advanced repair technology 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.

Description

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.

Value

- 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Development of Advanced Repair Techniques and Processes: 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.	12/23/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Development of Advanced Repair Techniques and Processes: 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.	2010	Technical Update

RRAC Advanced Weld Application (Supplemental) (065815)

Issue

Advanced repair technology 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.

Description

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.

Value

- 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Development of Advanced Repair Processes: Products for future years will be based on emerging technology and plant repair/reliability issues.	12/23/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Development of Advanced Repair Processes: Products for future years will be based upon emerging technology and plant repair/reliability issues.	2010	Technical Update

RRAC Equipment Development (Supplemental) (065818)

Issue

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.

Description

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

Value

- 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.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Technology for improving quality and reduce cost of repairs: This project will develop new technology to meet emerging repair needs driven by member requests and objectives.	12/31/2009	Technical Update

RRAC Materials Evaluation (Base) (065817)

Issue

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.

Description

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

Value

- 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 RRAC staff and facilities also may be utilized.

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Guidelines for Root Cause Analysis of Pressure Equipment Failures, Revised as requested by members: 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 RRAC members.	2010	Technical Resource

RRAC Materials Evaluation (Supplemental) (065814)

Issue

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.

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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 RRAC staff and facilities also may be utilized.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Guidelines for Root Cause Analysis of Pressure Equipment Failures, Revised: The product will be based on plant and industry experience with pressure system failures. Case histories will expand the institutional knowledge available to RRAC members.	12/23/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Guidelines for Root Cause Analysis of Pressure Equipment Failures, Revised: 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 RRAC members.	2010	Technical Resource