Plant Engineering (QA)

Program Overview

Program Description

Technically sound engineering practices are essential contributors to safe, reliable, cost-effective nuclear plant operation. Engineering analysis, for example, helps assess the condition of plant components and whether they should be replaced or repaired. Engineering also is critical when investigating life-limiting conditions, evaluating plant performance improvements, and assessing component and vendor quality.

The Plant Engineering Program performs research to inform decisions related to the continued safe, reliable and cost-effective operation of nuclear power plants. Research activities address key equipment issues and the effectiveness of plant engineering programs. Issues addressed include equipment and component reliability, product and vendor quality, cable aging, buried piping, flow-accelerated corrosion, workforce and skills development, life-cycle management, and obsolescence. The program also supports technology transfer through technical assistance programs, training, and user group workshops.

Research Value

Research results from the Plant Engineering Program provide engineering-based guidance that enables nuclear plants to improve equipment reliability, potentially contributing to improved plant safety and performance and reduced operations and maintenance costs. Participants gain access to the following:

- Strategic roadmaps outlining research gaps confronting key issues—such as cable aging and underground pipe integrity— and the collaborative actions needed to address these gaps.
- Definitive cable condition assessment methods that enhance the ability to identify, assess, and manage aging. Cable specification guidance, for example, provides common specifications for cable requisitions, consolidating 50-60 specifications into 5-10.
- Enhanced validation of procured item quality and improved procurement specifications to reduce procurement costs, solve obsolescence issues, and define needed engineering process changes.
- Improved long-term planning on key components to avoid in-service failures and potential plant outages.
- Enhanced workforce skills development tools to address gaps in utility training programs, validate worker skills prior to use, and facilitate worker movement between sites. Shortening the time required for on-site orientation and qualification from six days to three days could save 2,250 work-hours for a single outage.
- Technical results enabling the use of high-density polyethylene pipe as a replacement option for degraded metal pipe.
- Risk-ranking software and inspection and mitigation technology to characterize and address buried pipe and buried pipe coating degradation.
- Inspection and mitigation technologies for components susceptible to flow-accelerated corrosion (FAC). Improved guidance and predictive software can potentially reduce the number of FAC-related piping inspections by up to 25% over a six-year period, saving $250,000 per plant.

Approach

The Plant Engineering Program investigates engineering process improvements to more effectively inform and respond to plant, system, and component issues. The program targets issues such as unanticipated material degradation deficiencies that can reduce the inherent design margins in plant equipment and impact equipment reliability.

Base research encompasses equipment reliability, engineering processes, procurement, vendor quality, balance-of-plant corrosion, and workforce skills development.

- Equipment Reliability and Engineering Processes: Sustained equipment reliability at nuclear plants depends on attention to both near-term and long-term degradation mechanisms that can lead to failure, unacceptable performance, or premature replacement. This research area develops guidance on generic and specific aging issues to support emergent and end-of-life component decisions. Both theoretical and practical guidance is developed, including aging models, data, and acceptance criteria for components and cable; field guides for walkdowns and inspections; condition-monitoring techniques; and sourcebooks for gauging end-of-expected life.
- Procurement and Quality Issues: Procured item quality issues have negatively impacted plant reliability and costs for replacement items. Causes of poor product quality include loss of vendor expertise, lack of vendor understanding, and poor specification development. This research area consists of three elements: 1) Continued support of forums for sharing procurement-related concerns and experience, through the Joint Utility Task Group and Nuclear Supply Chain Strategic Leadership Council; 2) Research on the root cause and corrective actions to enhance vendor quality, common procurement specifications, source surveillance templates, and to provide guidance on detecting fraudulent and counterfeit items; and 3) Prioritization and management of obsolete items, including a pilot project to demonstrate methods being developed.
- Workforce Skills, Knowledge and Assessment: Substantial nuclear plant personnel turnover in the next 5-10 years will result in widespread training of new personnel to continue operating existing plants safely and to support new plant construction and operation. Moreover, the availability and skills level of supplemental workers for power plant outages is less certain. Computer-based training can improve the effectiveness of engineering training and reduce the associated costs. Plant Engineering has developed computer-based training for nine engineering fundamentals topics. For supplemental workers, EPRI continues to develop knowledge exams and skills proficiency demonstration exams that can be administered to verify skills competencies and make such competencies portable.
- Balance-of-Plant Corrosion: Corrosion in the secondary system of nuclear plants can negatively impact plant reliability and can result in annual costs of up to $25 million per plant related to flow-accelerated corrosion, degradation of service water systems, and degradation in raw water heat exchangers. Through guidance for effective underground piping programs, risk-ranking software, flow-accelerated corrosion, and interactive communications, this research area develops tools for addressing corrosion issues and improving the service life of balance-of-plant piping and components. This research area also investigates alternatives to steel pipe, such as high-density polyethylene, and develops improved inspection techniques for assessing the health of piping systems.

To address strategic objectives established for each of its programs, EPRI has developed roadmaps to plan, coordinate, and execute needed research among multiple entities. For the Plant Engineering Program, roadmaps have been developed to address cable aging management and the integrity of underground piping and tanks. These roadmaps guide Plant Engineering research and help communicate ongoing strategies in addressing these key issues. Additional roadmaps will be developed as conditions warrant.

Through separately funded projects, participants can gain access to a wide range of engineering support programs, user groups, and additional training tools. The cable program, for example, provides up-to-date information on cable aging and cable aging management practices from both a technical and regulatory perspective. User groups address underground piping, heat exchanger performance, environmental qualification, and EPRI's CHECWORKS program for flow-accelerated corrosion. The Service Water Assistance Program provides a forum for sharing information pertinent to the operation and maintenance of nuclear plant service water systems. The Seismic Qualification and Reporting and Testing Standardization program provides a collaborative mechanism through which participants can share component seismic testing specifications, costs, and test results.

Accomplishments

The Electric Power Research Institute's (EPRI’s) Plant Engineering Program produces an array of guidance documents, training tools, and assessment methodologies that support safe, reliable nuclear plant operation and reduce risks associated with extended plant operation.

- Published electrical cable testing matrices that recommend testing technologies for various families of electrical cables and provide recommended criteria for evaluation of test results.
- Produced guidelines for managing the aging of control relays in power plant control circuits.
- Issued guidance that provides reference information on many elements of a successful heat exchanger program
- Formulated a 15-step process for implementing a critical spares program at nuclear power plants based on industry responses to a benchmarking questionnaire and in-depth reviews of successful critical spares programs at two nuclear plants.
- Continued to develop engineering training modules on water and steam properties, throttle valves, medium-voltage system protection and coordination, jet impingement, and flow measurement,. Also developed site-wide training courses on the principles of equipment reliability (based on AP-913).
- Established a Cathodic Protection User Group to help the industry address long-term problems associated with inoperable or depleted cathodic protection systems.
- Continued to compile interim results of slow crack growth rate testing of high-density polyethylene piping to support technical justification for use of high-density polyethylene for safety and non-safety piping systems (American Society of Mechanical Engineers [ASME] Code Case N-755).

Current Year Activities

Plant Engineering Program research and development for 2013 will focus on cabling, obsolescence, life-cycle planning guidance, secondary plant and buried piping corrosion phenomena, and training/qualification. Specific efforts will include the following:

- Develop and assess electrical cable aging management strategies, research accelerated cable aging methodologies, explore qualification of various cable types for use in submerged environments, and explore effects of simultaneous heat and radiation on electrical cable aging
- Continue development of long-term planning products for identifying replacement needs associated with major plant components
- Provide clear and succinct product quality strategies necessary to address the issues of substandard, counterfeit, and fraudulent materials, revisions to regulations governing commercial grade dedication processes, and procurement specification and in-process vendor inspection strategies.
- Complete the project to develop advanced heat exchanger performance analysis techniques
- Continue projects to understand and deal with electrical relay aging issues, both protective and control relays; expand this component aging effort to potential and current transformers
- Conduct high-density polyethylene (HDPE) materials research supporting efforts to develop a regulator-accepted code case permitting the use of HDPE in code applications
- Support research to identify and develop technologies for interrogating buried pipe and buried pipe coatings to discern their condition
- Provide the nuclear industry with materials and technologies useful in restoring the health of cathodic protection systems or designing and installing new or replacement systems
- Complete the Environmentally Qualified (EQ) Motor Project Rewind System suite of products to provide cost-effective replacement options for EQ motors
- Continue to develop reference materials and calculation tools pertaining to pipe and component erosion phenomena involving liquid droplet impingement, flashing, and cavitation

Selected reports and products may be prepared in whole or in part in accordance with the EPRI Quality Program Manual that fulfills the requirements of 10CFR50 Appendix B and 10CFR21. The QA status of reports and products will be marked and identified.

Estimated 2013 Program Funding

$8.0 million

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Summary of Projects

Project Number	Project Title	Description
P41.05.02.05g	Seismic Qualification Reporting and Testing Standardization (supplemental) (QA)	The Seismic Qualification and Reporting and Testing Standardization (SQURTS) program addresses nuclear plant replacement part obsolescence and attendant seismic qualification issues. Nuclear power plant members share equipment seismic testing costs and test results. A “library-only” membership option provides access to past completed component test reports, but without participation in the active testing program.
P41.05.02.05i	Standardized Task Evaluations for Portable Qualifications (supplemental)	Standardized task evaluations can help reduce or eliminate industry's duplication of effort in assessing an individual's competency and subsequent tracking of their status, which is an important element in the industry's portable qualification efforts. This program also provides guidelines for administering practical qualifications.
P41.05.02.06a	Cable Program (supplemental)	The Cable Program provides the nuclear industry with up-to-date information on cable aging and cable aging management practices from both a technical and regulatory perspective.
P41.05.02.06b	Submergence Qualification for Medium-Voltage Cable (supplemental) (QA)	The effort will establish a qualified life for the submergence of medium voltage cable starting with Kerite HTK insulation. Okonite Okoguard pink EPR insulation will be added to the program at a later date.
P41.05.02.06c	Heat Exchanger Performance Users Group (supplemental)	The Heat Exchanger Performance Users Group offers a forum for industry personnel to improve the reliability, availability, and operational capability of heat exchangers through user group meetings and reports.
P41.05.02.06d	Plant Thermal Performance Enhancement Program (supplemental)	
P41.05.02.07b	Buried Pipe Integrity Group (supplemental)	The Buried Pipe Integrity Group (BPIG) provides a forum for exchanging plant experience and supporting the implementation of advanced buried pipe assessment and mitigation technologies.
P41.05.02.08a	CHECWORKS User Group - CHUG (supplemental)	The CHECWORKS User Group (CHUG) applies experience from about 260 nuclear plants worldwide to address existing and emerging issues related to flow-accelerated corrosion. CHUG provides training to new and reassigned personnel, maintains and provides updates to the CHECWORKS software, operates a dedicated website, and sponsors related research as requested by members.
P41.05.02.09c	Service Water Assistance Program (supplemental)	This project provides several forums for acquiring or sharing information pertinent to the successful operation and maintenance of nuclear plant service water systems.

Seismic Qualification Reporting and Testing Standardization (supplemental) (QA) (004414)

Key Research Question

Component obsolescence remains an industry challenge in the maintenance of nuclear plants, and with the prospect of even longer-term operation, replacement parts for existing facilities will continue to drive costs higher. Component qualification to individual utility design specifications constitutes a significant cost in the dedication of replacement parts. The Seismic Qualification and Reporting and Testing Standardization (SQURTS) program, conceived in the early 1990s to address nuclear plant component obsolescence issues, applies the economies of scale of member utility owners and operators to share component seismic testing specifications, costs, and test results.

Approach

Seismic testing conducted through the SQURTS program involves component testing at a service vendor facility nominally eight weeks per year. Utility participation is critical in developing generic test specifications and component test procedures, witnessing test performance and approving test reports, and participating in user meetings.

Members also have access to a seismic test report database comprised of SQURTS-performed test results and individual member test reports (should they choose to enter them). EPRI provides project management for the program, including contracting test services, budget forecast, tracking and reporting, database management, test report distribution, user communication, initiative coordination, and member meetings.

EPRI provides an option for membership in the Library only; this provides access to past completed component test reports. However, participation in the active testing program is not permitted if only this option is selected.

Impact

The program enables members to reduce component seismic testing costs through economies of scale and the shared database that members can use for component evaluations.

How to Apply Results

Results are generally implemented immediately by participants. Testing is driven by the needs of the members, and the database is accessed on member demand. Design engineers, seismic subject matter experts, and procurement engineers are typical customers of the SQURTS program.

Selected reports and products may be prepared in whole or in part in accordance with the EPRI Quality Program Manual that fulfills the requirements of 10CFR50 Appendix B and 10CFR21. The QA status of reports and products will be marked and identified.

Standardized Task Evaluations for Portable Qualifications (supplemental) (005354)

Key Research Question

Utility and supplemental personnel are critical to a plant's ability to conduct quick-turnaround refueling outages. Recent trends show a disproportionate occurrence of events associated with supplemental personnel. EPRI's Standardized Task Evaluation program (formerly called the Task Proficiency Evaluation program) provides a proven knowledge and skills evaluation process to efficiently evaluate the capabilities of entry-level, incumbent, and contractor personnel. The program is working within the framework of the Nuclear Energy Institute's Workforce Issues initiative and with the Institute of Nuclear Power Operations' National Academy for Nuclear Training e-Learning (NANTeL) portable qualification project to establish an infrastructure that ensures the competency of the industry's craft and technician workforce. The standardized task evaluations are not restricted to U.S. applications; utilities in France, South Africa, and Canada have expressed interest in adapting such evaluations to their own countries.

Additionally, the need to implement an industry consensus for standards for administering practical qualifications has been identified.

Approach

Standardized task evaluations are used to ensure that the workforce is competent to reliably perform the many tasks associated with operating and maintaining industry facilities. Program participants continue to collaboratively develop evaluation tests that support high-priority industry needs. More than 60 evaluations have been developed within the STE program and are available on www.epri.com. These evaluations, which cover tasks performed by utility and supplemental workforce during outage work, include a task analysis and objectives, written test items, and performance (practical) evaluations. Additionally, the results from these evaluations are documented into a national registry of personnel who have demonstrated competency in specific task areas.

Impact

Participating organizations can use the STE evaluations to assess the competency of their workforce, thus eliminating unnecessary training or retraining. Further, because the modules were developed according to EPRI's Administration Protocol for Portable Practicals (AP3), they reflect industry consensus standards for administering practical evaluations.

How to Apply Results

Training and maintenance managers can directly access the STE modules through multiple channels:

- Identifying and downloading evaluations through www.epri.com for use by participating organizations with specific task needs
- Accessing evaluations available on INPO's NANTeL System (http://www.nantel.org) for use by participating organizations for on-line testing and for reporting results
- Accessing the registry of qualified personnel on www.epri.com
- EPRI Report 1021072, *Administration Protocol for Portable Practicals (AP3) in Standardized Task Evaluations*

Cable Program (supplemental) (005614)

Key Research Question

The aging of medium- (4160 V+) and low-voltage (<1000 V) cable systems has raised regulator interest in the ability of these systems to perform their safety and support functions. This program supports the industry by disseminating information on cable systems aging mechanisms and the best means for detecting and mitigating aging effects.

Approach

This project offers a forum to the industry to address issues related to cable-system-aging management through the Cable User Group, which transfers cable research results to members in practical terms and supports the identification, discussion, and resolution of cable system issues. Feedback from the Cable User Group meetings is used to guide cable research on aging model and condition monitoring development. In 2013, the focus of meetings will be on cable aging management with a focus on supporting very long-term operation.

As funding permits, technical reports will be generated on cable-aging-related topics of interest to program members. In 2013, the Cable Program will continue to develop computer-based training packages that describe cable aging management methods and technology. These will only be available to Cable Program members.

In addition, the program provides access to Electric Power Research Institute (EPRI) personnel conversant in cable-aging management issues allowing utility personnel to discuss plant problems and their resolution.

Impact

Benefits accrue through direct access to experts in cable-aging management and cable condition monitoring. Participants also help shape the path of cable-aging management research to ensure its pertinence to nuclear plant applications.

How to Apply Results

Cable User Group attendees have direct access to EPRI and industry experts in condition monitoring, cable manufacture and installation, and the discussion of the latest industry issues and practices.

Research results are provided in EPRI research reports and meeting minutes from the Cable User Group meetings.

Submergence Qualification for Medium-Voltage Cable (supplemental) (QA)

Key Research Question

Submergence of medium-voltage (4160 V+) cables has raised regulatory concern regarding the ability of these cables to perform their safety and support functions. EPRI is developing an environmental qualification program that could allow continued use of cables subjected to long-term submergence.

Cable failures in non-safety applications have caused plant shutdowns and trips, primarily traced to pre-1975 cables. While later-generation Kerite brown ethylene propylene rubber (EPR) cables and Okonite pink EPR cables have not experienced submergence-related failures, the Nuclear Regulatory Commission (NRC) has determined that submergence was not part of the original design. Accordingly, the NRC is requesting that nuclear plants licensees drain—and keep drained—all manholes, vaults, and ducts. For physical and economic reasons, not all plants can do so. Cable relocation into new ducts could cost $5 million or more for design and installation. The alternative is to develop an environmental qualification for energized cables that have been submerged either continuously or for long durations.

Approach

This project will develop an environmental qualification for submergence of non-shielded brown Kerite medium-voltage cable and Okonite non-shielded pink EPR cable.

The qualification will be based on two methods described in IEEE Standard 323-1974: Operating Experience (Section 5.2) and Ongoing Qualification (Section 5.5). The methodologies defined in these sections are endorsed by the NRC in Regulatory Guide 1.89, Revision 1 without exception.

Environmental qualification of Kerite cable for harsh environment applications exists under the manufacturers' environmental qualification. That qualification, however, does not cover long-term, normal condition submergence of energized cables. The proposed project, therefore, will develop a qualification for segments of energized cables subject to long-term submergence.

Although the submerged portions of cables do not experience a change in environment as a result of design basis accidents, it is possible that they would be de-energized by a loss of offsite power and re-energization concurrent with a design basis accident. The project will simulate re-energization and the associated switching surges to evaluate such scenarios.

The "operating experience" portion of the qualification will be based on assessment and testing of a 30-year-old cable removed from an operating power plant that has been submerged for a period of time. Once the condition of this cable is fully characterized, a qualification by "operating experience" will be established for 30 years. The tests will include breakdown testing to determine the ratio of the breakdown voltage to the operating voltage.

To establish "ongoing qualification," the breakdown fault will be removed from the cable and 30-ft. specimens will be prepared and subjected to long-term energized accelerated aging.

The ongoing qualification and the operating experience qualification will determine the qualified life of the cable, which will be incremented for each year of satisfactory function and periodic test results under accelerated submerged conditions. For example, after the first year of laboratory aging, the qualification would result in a 32- to 40-year qualified life. After the second year, the qualified life would increase to 34 to 50 years, and so on.

In 2012, Okonite Okoguard pink EPR specimens were added to the program. During 2013, long-term accelerated aging of the Kerite and Okonite specimens will continue. Yearly, updates detailing results of quarterly and yearly tests will be issued at the end of each year of accelerated aging until failures occur or a decision is made to terminate the test program.

Impact

Plants with non-shielded brown Kerite and pink Okonite EPR medium-voltage cables will gain access to a qualification demonstrating that the cables can withstand long-term submergence while subjected to operating voltage. Conversely, if the qualification program identifies end-of-life at some point during testing, nuclear plant owners will know when to plan for cable replacement.

Participation would enable nuclear plant owners to

- save millions of dollars in design and implementation costs for cable relocation if cable ducts and manholes cannot be drained,
- determine a qualified life for cables that can't be tested using available condition monitoring techniques, and
- assess whether periodic or continuous submergence causes unacceptable shortening of cable life.

How to Apply Results

The results can be used to establish a period for which the cable can remain submerged without undue degradation. This will be the base report that will be followed by periodic reports on the accelerated, laboratory-based, submergence qualification that will extend the base period.

Selected reports and products may be prepared in whole or in part in accordance with the EPRI Quality Program Manual that fulfills the requirements of 10CFR50 Appendix B and 10CFR21. The QA status of reports and products will be marked and identified.

Heat Exchanger Performance Users Group (supplemental) (045060)

Key Research Question

This project offers a forum for industry personnel to improve the reliability, availability, and operational capability of heat exchangers (with the exception of steam generators). The project allows participants to share operational experiences and to resolve technical issues associated with heat exchangers.

Approach

- Information sharing with Heat Exchanger Performance User Group (HXPUG) members
- Technical investigations and research on issues related to heat exchangers that are a high-priority to the group
- Annual meetings and quarterly webcasts to share information and keep membership engaged
- Availability of information sharing through website and surveys to benchmark other utilities in the operation and maintenance of heat exchangers
- Collaboration on common industry problems and solutions as they relate to heat exchanger testing and performance

Impact

The project offers an estimated cost savings of $25,000 to $100,000 annually per plant using the information available through the HXPUG group facilitating the following:

- Improved testing methods through collaboration with industry personnel and use of EPRI guidelines
- Avoided costs through the reduction of unnecessary heat exchanger testing
- Improved plant performance through improved thermal performance of the feedwater heater, moisture separator reheater, and condenser
- Improved efficiency in heat exchanger program implementation and maintenance practices from guidance issued by the group
- Collaboration on common industry problems and solutions as they relate to heat exchanger testing and performance

How to Apply Results

Participating members in the Heat Exchanger Performance User Group can implement the lessons learned and information generated in this group. Examples include improved heat exchanger performance testing methods, guidance for heat exchanger program owners and system owners for maintaining exchanger reliability, and avoiding issues experienced at other plants.

Plant Thermal Performance Enhancement Program (supplemental)

Key Research Question

Nuclear Plant Thermal Performance Program (P2EP) engineers are responsible for the management of their respective thermal performance programs. As such, they are responsible for programmatic documents, as well as monitoring and enhancing the thermal efficiencies of their plants. This program supports the community of thermal performance engineers with forums for sharing of information on current and future issues that may have substantial impact on their units. Research is conducted and results published providing tools, reference materials, and technologies related to monitoring and improving thermal efficiencies.

Approach

This project offers an annual forum to the industry to address issues related to plant thermal performance including good practices and lessons learned at member utilities. The identification, discussion, and resolution of industry thermal performance issues is a central focus. Feedback from the P2EP meetings is used to identify thermal performance research and development needs. In 2013, the meeting will continue focus on identifying relevant issues based on member input. Issues will be prioritized and funded accordingly during the 2014 research cycle.

As funding permits, technical reports will be generated on thermal performance related topics of interest to program participants. In addition, the program provides access to Electric Power Research Institute (EPRI) personnel and industry experts conversant in thermal performance issues allowing utility personnel to discuss plant problems and their resolution.

Impact

Benefits accrue through direct access to experts in thermal performance programs. Participants also help shape the path of thermal performance enhancement research to ensure its pertinence to nuclear plant applications.

How to Apply Results

Results are generally implemented immediately by participants who have direct access to EPRI and industry experts in the area of thermal performance enhancements and the discussion of the latest industry issues and practices.

Research results are provided in EPRI research reports and meeting minutes from the P2EP meetings. A P2EP website is maintained that contains historical information such as a technical library, survey results, peer contact list, and links to upcoming meeting information and past meeting minutes.

Task:

- The program provides a forum for engineers responsible for thermal performance programs
- Access is provided to training seminars provided by their peers or recognized industry experts
- Networking opportunity to develop peer interrelationships
- Annual sharing of Plant Heat Rates

Buried Pipe Integrity Group (supplemental) (066523)

Key Research Question

Buried piping has become a more visible issue with regulatory emphasis on material aging issues and plant life extension requirements. Due to aging of external protective coatings as well as a multitude of internal and external piping corrosion mechanisms, each nuclear plant's buried pipe infrastructure is susceptible to leaks and failures. Leaks can be difficult to locate. Also, some may contribute to contamination of groundwater. All buried pipe leaks can be expensive to repair due to accessibility issues. Some leaks may require a plant shutdown for repair. A broad-based and comprehensive program is needed to support plant efforts to reduce the probability and consequences of failure to an acceptable level.

Each year the Buried Pipe Integrity Group (BPIG) program participants help identify research needs. The program then sponsors and manages the R&D effort required to address the needs.

Approach

BPIG provides a forum for exchanging plant experience and provides counsel and recommendations on the implementation of advanced buried pipe assessment and corrosion mitigation technology.

Impact

- Assess the health of existing piping and piping coatings and determine remaining service life.
- Develop methods to repair buried piping in situ.
- Select and qualify alternative materials and service environments (for example, high-density polyethylene, water treatment, and cathodic protection).
- Provide a forum for the buried pipe services industry to interface with buried pipe engineers from participating utilities.
- Collaboration with the broad group of BPIG participants that includes all United States nuclear operators and several international utilities.

How to Apply Results

Participants will apply the results of this project in developing effective buried pipe integrity programs and in assessing and maintaining existing buried piping systems.

CHECWORKS User Group - CHUG (supplemental) (Augmented Quality)

Key Research Question

Although industry efforts have been effective in reducing the number of piping and equipment failures caused by flow-accelerated corrosion (FAC), piping and components remain susceptible to degradation as plants age. Refined guidance on where to inspect, chemistry improvements to reduce damage rates, and material upgrades for replaced components is needed to offset challenges posed by economic considerations, short outages, and personnel turnover.

Mechanical pipe degradation caused by cavitation, liquid droplet impingement, flashing, and solid particle erosion can affect personnel safety and cause power losses. Damage caused by these mechanisms is nonlinear with time and often results from off-normal operations.

Approach

The CHECWORKS™ User Group (CHUG) applies experience from approximately 260 nuclear plants worldwide to address existing and emerging issues related to flow-accelerated corrosion. CHUG provides training to new and reassigned personnel, maintains and provides updates to the CHECWORKS™ software, operates a dedicated website, and sponsors related research as requested by members. This includes research and guidance to address detection of mechanical degradation or erosion type mechanisms in high-energy piping systems.

Impact

- Minimize risk to personnel by reducing the probability of large-bore pipe ruptures
- Reduce forced power reductions through FAC mitigation
- Reduce the number of necessary piping inspections through improved guidance, predictive software, and strategic piping replacements
- Develop practical tools to optimize FAC programs, such as NDE data evaluation techniques and application guidance for material alloy analyzers that can be used to reduce the overall number of inspections
- Identify new FAC vulnerabilities before leaks occur
- Train new and reassigned plant engineers on FAC identification, monitoring, and mitigation
- Facilitate interaction with industry peers and ease access to reports and other information

How to Apply Results

Members use the CHECWORKS™ software to predict plant degradation and reduce unneeded piping inspections. Technical guidance related to pipe alloy analyzers, mechanical degradation, and low-temperature FAC provide members with information to optimize inspection locations. Members can access training for new and reassigned personnel and can use the CHUG website to facilitate communications between FAC personnel at member plants.

Selected reports and products may be prepared in whole or in part in accordance with the Augmented Quality portion of the EPRI Quality Program Manual. The QA status of reports and products will be marked and identified.

Service Water Assistance Program (supplemental) (070808)

Key Research Question

Nuclear plant service water systems are complex systems that can provide engineers with day-to-day challenges. Service water system performance can be improved by providing engineers with access to a collaborative environment where thoughts, ideas, and solutions can be readily available and shared.

Each year the Service Water Assistance Program (SWAP) participants help identify research needs. The program then sponsors and manages the R&D efforts required to address the needs.

Approach

Project participants gain access to the SWAP web page, which includes the SWAP technical library, SWAP surveys, a listing of SWAP coordinators, and easy access to SWAP products. Members also can query the nuclear industry on service water problems through industry SWAP surveys. Members also can obtain personal assistance from EPRI personnel via phone or email. EPRI also sponsors an annual meeting of SWAP coordinators for sharing operating experience and discussing solutions to field problems. Training courses for service water engineers are available on heat exchangers, piping, and corrosion mechanisms.

Impact

The SWAP technical library, which contains more than 2350 documents on 300 subjects, can be searched by subject, author, and date. Many of the titles are available for download as PDF files. The annual meeting and access to EPRI experts provide opportunities to discuss plant issues and identify potential solutions.

How to Apply Results

The SWAP coordinators serve as the point of contact between the EPRI SWAP program and the plant. Active participation facilitates technology transfer and maximizes benefits received. A SWAP Coordinator's Manual helps guide access to SWAP resources and services.