

# Plant Support Engineering

## Program Overview

### Program Description

Safe, reliable, cost-effective nuclear plant operation is supported by detailed, technically sound engineering practices. Engineering analysis, for example, is important in assessing 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 Support Engineering Program performs research to support the long-term, cost-effective operation of the nuclear fleet, addressing key equipment issues and enhancing the effectiveness of plant engineering programs. Issues addressed include product and vendor quality, cable aging, workforce and skill 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 Support Engineering Program provide engineering-based guidance that enables nuclear plants to reduce capital and operations and maintenance costs and improve equipment reliability. PSE participants gain access to the following:

- Definitive cable condition assessment methods that enhance the ability to identify, assess, and manage aging.
- Enhanced validation of product 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 plant and system performance through more accurate assessment methods and test protocols.
- Enhanced workforce skills development tools to address gaps in utility training programs, validate worker skills prior to use, and facilitate worker movement between sites.

### Approach

The Plant Support 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.

- Identify management and mitigation options to address cable aging, coating aging, service water system degradation, heat exchanger performance, and other life-limiting issues.
- Define procurement and product quality standards to maintain high equipment reliability.
- Develop long-term planning tools to guide life-cycle decisions for key components.
- Conduct plant thermal performance assessments to identify engineering-based opportunities for performance improvements.
- Develop tools to address component aging and obsolescence management.
- Develop training and workforce skills assessment tools to safely and reliably operate and maintain nuclear power plants.
- Support license renewal and life extension through an array of engineering products.

## Accomplishments

Electric Power Research Institute's (EPRI's) Plant Support 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.

- Completed long-term planning and replacement guides for key components such as switchgear, feedwater heaters, and transformers.
- Developed a rigorous knowledge and skills proficiency evaluation process for validating supplemental workforce skills.
- Developed a dedication process for commercial-grade equipment and components.
- Developed guidance and training for cable aging management.
- Produced a *Thermal Performance Engineer's Handbook* to assist plant engineers in assessing and implementing thermal performance actions.
- Identified industry status, gaps, and recommendations for meeting license renewal commitments
- Developed Environmental Qualification-related products, such as the *Environmental Qualification Reference Manual*, the industry's key document for maintaining and managing a site's Environmental Qualification program.
- Developed and continue to update a Seismic Qualification and Testing database of completed test records for replacement power plant components.

## Current Year Activities

Plant Support Engineering Program R&D for 2010 will focus on cabling, obsolescence, life-cycle planning guidance, and training/qualification. Specific efforts will include the following:

- Continue research and development efforts associated with low- and medium-voltage electrical cables in support of the nuclear industry's cable aging management efforts.
- Develop long-term planning guidance for additional critical asset nuclear plant components.
- Update the *Guideline on Nuclear Safety-Related Coatings*, a key industry resource for the qualification, selection, application, and maintenance of qualified coatings in nuclear power plants.
- Develop guidance to support the nuclear industry's ability to manage obsolescence and to identify and manage the existence of counterfeit parts.
- Environmentally qualify additional motor rewind insulation systems for both form wound and random wound motors.
- Complete additional modules for engineering-discipline-specific training as well as engineering-fundamentals training.
- Continue operation of the Seismic Qualification and Testing Standardization program to cost-effectively pool industry testing needs.
- Develop training, templates, and guidance to enhance product quality and supply chain workforce skills.

## Estimated 2010 Program Funding

\$5.1 million

## Program Manager

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## Summary of Projects

Project Number	Project Title	Description
41.05.02e	PSE - Member Requested Support (QA)	When requested, EPRI personnel will travel to member sites to provide direct support in solving problems or performing self assessments.
P41.05.02.02	PSE Procurement and Quality Issues (Supplemental)	This project set provides a methodology for the industry to collaborate on seismic testing and to implement equipment obsolescence solutions.
P41.05.02.02h-i	PSE - Seismic Qualification Reporting and Testing Standardization (SQRSTS) (QA)	The Seismic Qualification and Reporting and Testing Standardization (SQRSTS) program addresses nuclear plant replacement part obsolescence and attendant seismic qualification issues. Its membership is comprised of nuclear power plant utility owners and operators with the objective of sharing equipment seismic testing costs and test results.
P41.05.02.02k	Standardized Task Evaluations for Portable Qualifications (formerly Task Proficiency Evaluations)	Standardized task evaluations can help reduce or eliminate the 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.
P41.05.02.03	PSE Technical Assistance and Support (Supplemental)	Provides forums for the exchange of information on industry issues and trends associated with these key areas. Serves as an input conduit for the identification of new research projects
P41.05.02.03g	PSE - EQMS Users Group (QA)	The EQMS User Group maintains the EQMS Software and provides continuing support for users of the software. The EQMS software has become a key tool for documenting environmental qualification.
P41.05.02.05	PSE Technical Training and Proficiency (Supplemental)	Engineering fundamentals training modules delivered via computer-based training are used by plant training organizations to orient new plant engineers. Knowledge and skills proficiency testing modules are used by the industry in assessing the skills and knowledge of supplemental workers for pre-defined outage maintenance tasks.
P41.05.02.05c	PSE - Engineering Technical Training Modules	Engineering training CBTs are being developed to meet increasing industry needs for position-specific and continuing training as new personnel are brought on board and seasoned personnel take on new assignments.
P41.05.02.05f	PSE EQ Training Products Development	EQ Training Products project products include the following: <ul style="list-style-type: none"> <li>• Web-based EQ training product that provides guidance for nuclear procurement/supply chain personnel</li> <li>• Web-based EQ training product that provides guidance for nuclear system/design engineering personnel</li> <li>• Updates (as required) of the existing web-based EQ training product that provides guidance for nuclear maintenance personnel</li> </ul>
P41.05.02.06	PSE Equipment Performance, Monitoring and Degradation (Supplemental)	This project supports user groups that collaborate to address cable system aging management issues as well as advances in heat exchanger testing methodologies. The Electric Power Research Institute (EPRI) also offers heat exchanger testing using EPRI's Single Tube Test Device used to determine heat exchanger performance when plant system installations prohibit meaningful testing.

Project Number	Project Title	Description
P41.05.02.06a	PSE - Cable Program	The Plant Support Engineering (PSE) 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.
P41.05.02.06d	PSE - Heat Exchanger Performance Users Group (HXPUG)	This project offers a forum for industry personnel to improve the reliability, availability, and operational capability of heat exchangers through user group meetings and reports.
P41.05.02.07	PSE Technical Assistance and Support (Base)	This project provides technical assistance and user groups in equipment qualification, plant thermal performance enhancements, and nuclear coatings.
P41.05.02.08	PSE Long Term Planning (Base)	This project develops containing tools and information to support long-term and contingency planning related to long-lived system and component end-of-life, and to eliminate or mitigate the effects of failure. Products include long-term plans (sourcebooks) for key components and reports identifying end of expected life, related monitoring, and logistics issues (end-of-expected-life reports).
P41.05.02.09	PSE Engineering Processes (Base)	Through collaboration and benchmarking, as well as industry forums, best practices that directly support equipment reliability are shared. When identified, existing products are updated or new products are developed directly supporting equipment reliability processes.
P41.05.02.10	PSE Equipment Performance, Monitoring and Degradation (Base)	This project develops guidance on resolution of generic and specific aging issues, including identification, evaluation, and resolution of equipment and system aging issues. Both theoretical and practical guidance is developed including aging models, data, and acceptance criteria for components and cables; field guides for walkdowns and inspections; and development of condition monitoring techniques.
P41.05.02.11	PSE Procurement and Quality Issues (Base)	Provides a utility forum (JUTG) for sharing procurement-related concerns and experience. Conducts research on actions to enhance vendor quality, develop common specifications, establish vendor surveillance, and detect counterfeit items. Provides support of an industrywide approach to prioritization and management of obsolete items.
P41.05.02.12	PSE Strategic Development and Tech Transfer (Base)	This project supports activities associated with advisory meetings, emerging regulatory issues such as cable submergence, international support, and technology transfer to EPRI members.
P41.05.02.13	PSE Technical Training and Proficiency (Base)	Develop training tools for engineers that can be delivered via computer-based training methodologies. Develop a methodology to validate knowledge and skills competencies and record successful completion in an industry database.

## PSE - Member Requested Support (QA)

### Key Research Question

Reduced engineering staffs, aging plants, and dwindling vendor and architect/engineer support make solving engineering system and component problems more difficult for operating nuclear plants. In this environment, industry engineers need a variety of tools to assist them with problem resolution. This project provides plant personnel with information and technology solutions that decrease the time and cost needed to resolve specific technical issues.

## Approach

Electric Power Research Institute (EPRI) Plant Support Engineering (PSE) provides on-site member-requested support to PSE participants. The activities are consistent with the overall objectives of the PSE program and may include support when implementing PSE products, responding to emergent technical issues, or assisting with or conducting peer reviews of engineering-related programs or processes. Specific examples of PSE support include the following:

- Program-specific support (equipment qualification, life-cycle management, procurement activities, service water performance, cable program) that provides feedback on specific utility or plant programs
- Coordination of peer reviews of program-specific support activities, where the Electric Power Research Institute (EPRI) leads the team of utility peer reviewers
- Specific technical issue support and resolution on issues such as cable aging, raw water fouling or corrosion, equipment qualification, procurement practices, and American Society of Mechanical Engineers programs.

## Impact

EPRI personnel represent thousands of years of experience in all facets of nuclear plant operations and engineering. This experience, combined with EPRI's portfolio of products, provides unique technical expertise capable of solving challenging plant and industry issues.

## How to Apply Results

These support efforts are packaged in one-week blocks to accommodate travel time, time on site, and follow-up correspondence. EPRI personnel provide initial feedback prior to departing the facility and supply a detailed post-trip report with results and recommendations as applicable.

## **PSE Procurement and Quality Issues (Supplemental) (065798)**

### Key Research Question

Product quality, obsolescence, and commercial-grade dedication management represent ongoing plant issues. In some cases, collaborative projects provide the most cost-effective solution to addressing the issue or supporting component-specific evaluation.

## Approach

Plant Support Engineering (PSE) offers two supplemental activities to address procurement and quality issues. The first involves the Seismic Qualification Reporting and Testing Standardization project (SQRSTS). SQRSTS provides access to a shake table to test components for nuclear application using a bounding seismic spectra that encompasses all plants. The project shares results with all members and provides access to a library of about 2000 items.

The second activity supports collaborative solutions to obsolescence issues. A pilot project will continue into 2010; participating utilities will be able to efficiently share solutions to specific obsolescence cases and populate a centralized database.

## Impact

- Provide significant leverage to evaluate specific quality and obsolescence issues
- Reduce component qualification expenses through collaborative testing and reporting
- Enhance insight into the application of a specific product by sharing experience and results

## How to Apply Results

Results from these collaborative activities are shared among members. Specific results can then be used to determine the acceptability of a component or obsolescence solution in an individual plant. Additionally, the test results can be used to support equivalency or similarity evaluations in the plant when components need to be changed out.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
Collaborative Development of Obsolescence	12/23/10	--Blank--

## PSE - Seismic Qualification Reporting and Testing Standardization (SQURTS) (QA) (004414)

### Key Research Question

Component obsolescence remains an industry challenge in the maintenance of an aging nuclear fleet, and with the prospect of even longer term operation, replacement parts for existing facilities will continue to drive higher costs. 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

The SQURTS program has three main elements:

- **Seismic Testing:** Component testing is provided at a service vendor facility nominally 6 to 8 weeks per year. Utility participation in program implementation is critical:
  - Develop a generic test specification
  - Create specific component test procedures
  - Provide test representative to witness actual test performance
  - Approve test reports
  - Participate in user meetings (typically twice per year)
  - Participate in program initiatives (for example, database upgrades)
- **Test Report Database:** The Electric Power Research Institute (EPRI) manages a seismic test report database comprised of SQURTS-performed test results and individual member test reports (should they choose to enter them). Members have access to the database library.
- **EPRI Stewardship:** 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.

### Impact

Goals of the program include reduced component seismic testing costs through leveraging utility economies of scale, and a shared database that members can use for component evaluations. Member value is realized by employing the EPRI collaborative model managed by Plant Support Engineering (PSE).

## 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 the usual customers of the SQRSTS program.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
SQRSTS User Group Meeting	12/31/10	Technical Resource

## Future Year Products

Product Title & Description	Planned Completion Date	Product Type
SQRSTS User Group Meeting	12/31/11	Technical Resource

## Standardized Task Evaluations for Portable Qualifications (formerly Task Proficiency Evaluations) (005354)

### Key Research Question

EPRI's Standardized Task Evaluation (STE) 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. STEs 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.

Supplemental personnel have become a critical element in a plant's ability to conduct quick-turnaround refueling outages. Recent trends show a disproportionate occurrence of events associated with supplemental personnel. Considering these trends, EPRI's STE 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.

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

### Approach

More than 60 evaluations have been developed within the STE Program and are available on [www.epri.com](http://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](http://www.epri.com), to be used by participating organizations with specific task needs.
- Accessing evaluations available on INPO's NANTeL System (<http://www.nantel.org>), to be used by participating organizations for on-line testing and for reporting results.
- Accessing the registry of qualified personnel on [www.epri.com](http://www.epri.com).
- EPRI Report 1015074, *Administration Protocol for Portable Practicals (AP3) in Task Proficiency Evaluations*

## PSE Technical Assistance and Support (Supplemental) (065797)

### Key Research Question

Specific technical issues that have emerged in the nuclear industry warrant broader examination to share operating experience, lessons learned, and to provide venues for technology transfer. Also, for certain issues, further research needs to be identified and conducted.

### Approach

Plant Support Engineering (PSE) operates technical assistance programs to support transfer of research results, address member questions, and provide inputs for additional research in these areas. Current assistance programs include the following:

- Equipment Qualification Management Software User Group

### Impact

- Reduce operations and maintenance costs by streamlining equipment qualification record keeping and collaborative sharing of equipment qualification records.
- Reduce operations and maintenance costs through proper application of cable condition assessment methods.
- Provide a forum for sharing field experience.

## How to Apply Results

Members apply the results from this project through insights gained from attending user group meetings; installing and applying relevant software (Equipment Qualification Management Software, EQMS); or applying deliverable information to testing procedure and protocols.

## PSE - EQMS Users Group (QA) (007529)

### Key Research Question

The Environmental Qualification Management System (EQMS) is a state-of-the-art, integrated software management tool designed to assist utilities in managing their environmental qualification (EQ) programs more efficiently and cost-effectively. EQMS also integrates the calculations required to support the documentation of EQ directly in the software, which simplifies the evaluation process and further reduces the effort required to maintain EQ files.



## Approach

The two primary functions of the EQMS User Group are continued maintenance and upgrade of the EQMS software and periodic user group meetings in which issues related to the use and improvement of the software and methods for its best implementation are discussed. The maintenance and upgrade of the software includes documenting identified problems, periodically considering desired modifications, developing and testing approved changes, and guiding the software through the Electric Power Research Institute's (EPRI's) software quality assurance process.

**Quality Assurance Statement:** EPRI develops and maintains the EQMS, which is considered a nuclear safety-related product, in accordance with Title 10, Code of Federal Regulations, Part 50, Domestic Licensing of Production and Utilization Facilities (10CFR50), Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, and Part 21, Reporting of Defects and Noncompliance (10CFR21).

## Impact

The EQMS Software allows users to do the following:

- Document their environmental qualification records in a consistent fashion
- Evaluate changes to environmental changes quickly
- Manage generic and plant-specific information from corporate offices or from individual sites
- Share environmental qualification files between plant sites and utilities
- Significantly reduce the effort required to maintain EQ files.

## How to Apply Results

Nuclear plant owners use the EQMS database to document environmental qualification. The EQMS database includes four basic modules for storing EQ-related data:

- Generic Qualification Evaluation (GQE) module
- Plant Qualification Evaluation (PQE) module
- Environments module
- Equipment module

In the GQE module, EQ test reports are evaluated to establish the parameters to which a piece of equipment has been qualified. In the PQE module, plant requirements are evaluated against the qualification levels established in the GQE to document the qualification of equipment for applications at a particular plant. Plant-specific environmental requirements are stored in the environments module and are imported into the PQE. Test report temperature and pressure profiles from the GQE are imported into the PQE and compared with profiles imported from the environments module. The equipment module contains the EQ master list and system component evaluation worksheets. EQMS also includes procurement requirements sheets, maintenance requirements sheets, and an update center that is used for importing and exporting selected database records. Arrangements have been made for EQMS User Group funders to have access to and the ability to download nonproprietary GQEs through the Sciencetech EQDB website (<http://eqdb.sciencetech.com>).

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
Annual EQMS Users Group Meeting	11/30/10	Workshop, Training, or Conference

## PSE Technical Training and Proficiency (Supplemental) (059574)

### Key Research Question

Turnover of nuclear plant technical staff will be significant in the next five to ten years. During the same time frame, nuclear utilities will be training personnel to support construction and operation of new nuclear plants. Pressures to reduce operations and maintenance costs often result in reductions in training budgets. In this environment, nuclear plants need cost-effective ways to develop and deliver high-quality, effective training.

### Approach

Computer-based training methods are attractive to younger staff entering the workforce. This project develops content to orient new engineering workers to the issues specific to the nuclear plant environment.

- Web-based modules are being developed for engineering fundamentals orientation training to address nine technical topics. Although 2009 represents the last year of this effort, discussions have begun regarding additional content.
- The engineering fundamentals orientation modules also are being delivered over the Institute of Nuclear Power Operations' National Academy for Nuclear Training e-Learning (NANTeL). An earlier module is being revised for delivery through NANTeL.
- This project area also contributes to the development of Standardized Task Evaluation (STE) tests to assess worker skills and qualifications for performing specific tasks. Development, adjustment, and formatting are required to transfer this activity from the supplemental efforts in STE to the base-funded, NANTeL delivery.
- When sufficient funding exists, computer-based training modules will be developed for procurement/supply chain engineers and design/system engineers. These modules will serve to impart fundamental knowledge specific to the job function.

### Impact

- Enable individual training without the logistical and resource concerns associated with classroom training
- Address training needs associated with new nuclear plants as well as those at existing nuclear power plants
- Through the STE Program, make it easier to share industry workers among participating sites and validate worker skills prior to plant use

### How to Apply Results

Results from this project can be applied in company- or plant-specific training and evaluation programs. Additionally, the Electric Power Research Institute (EPRI) has collaborated with the Institute of Nuclear Power Operations to make the Fundamentals Training and selected Task Proficiency Evaluations available through INPO's National Academy for Nuclear Training e-Learning (NANTeL) project.

## PSE - Engineering Technical Training Modules (005556)

### Key Research Question

As new engineering personnel are brought into the workforce and as individuals are moved into different assignments, it is important to have position- specific training modules available that individuals can access when needed. If training modules are not readily available to meet the needs in these cases, the organization is challenged with developing a specialized course or trying to find a course offering somewhere in the industry. Unless the topic is one that is routinely offered, the availability of a course will not likely meet the schedule needs.

## Approach

Electric Power Research Institute (EPRI) computer-based training (CBT) modules can be used for position-specific and continuing training needs for selected topics. Forty-five modules were developed some years ago using PowerPoint slides and companion Word documents. This information is being used as a basis for the new modules; however, the content is being updated and photographs and graphics are being used along with interactive features to enhance the training. The CBT modules are much more in line with expectations of new engineers entering the workforce. Seventeen modules were previously converted and more will be converted in 2010. Modules are being selected on a priority basis to meet industry needs. This work must be continued to meet the increasing needs of various engineering groups.

## Impact

Based on today's demographics, personnel turnover will be considerable in the coming years. The need for this training is increasing as new personnel are hired and seasoned employees are reassigned as a result of personnel turnover. These CBTs have the following attributes:

- Can be down-loaded for use when needed from <http://www.epri.com>
- Provide basic position-specific training for new hires and individuals reassigned to new jobs
- Can be used for continuing training

## How to Apply Results

Engineering supervisors and training personnel should be aware of these modules and use them for position-specific and continuing training as appropriate.

## **PSE EQ Training Products Development (064143)**

### Key Research Question

Plant Support Engineering (PSE) developed and released a web-based training course related to equipment qualification (EQ) activities titled Environmental Qualification (EQ) for Maintenance, Version 1.0. This training material is focused on increasing maintenance workers' awareness of a nuclear plant's EQ program. Several utilities have recently reviewed this training product and have requested that similar packages be developed to support EQ program awareness for procurement/supply chain engineers and design/system engineers.

## Approach

Industry personnel will be engaged to identify job tasks that have the potential to impact or interface environmentally qualified equipment. Using this information, training objectives will be developed and training materials produced. The materials will underscore the importance of environmentally qualified components, discuss the nature of environmental qualification, and describe how workers can unintentionally impact the soundness of an environmentally qualified component.

## Impact

Plant maintenance, operator, or engineering workers must recognize a component that is environmentally qualified and understand how their activities can adversely impact the qualified condition of a plant component. This training will educate targeted plant workers on how to recognize these factors, potentially preventing the unintentional violation of a component's environmental qualification

## How to Apply Results

Computer-based training or lecture-style classroom materials will be developed and made available to members of this supplemental program.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Web-Based EQ CBT course for Engineers/Designers:</b> Web-Based EQ CBT course package targeted for Nuclear Plant Engineers and Design personnel.	12/23/10	Software

## Future Year Products

Product Title & Description	Planned Completion Date	Product Type
<b>Web-based EQ CBT for supply chain personnel:</b> Computer-based training course targeted at supply chain personnel.	12/20/11	Software

## PSE Equipment Performance, Monitoring and Degradation (Supplemental) (065795)

### Key Research Question

Application experience is often needed to refine guidance provided in basic research projects. Pilot or demonstration projects enable the guidance contained in the basic research to be tested, validated, and refined.

### Approach

This project supports pilot application of developed guidance or guidelines. Pilot offerings vary in scope, size, duration, and importance. Potential pilot applications could include following:

- Medium-voltage cable program development
- Low-voltage cable program development
- Heat Exchanger Performance User Group
- Heat Exchanger Thermal Performance Testing through the use of the Single Tube Test Device (STTD)
- EQ motor rewind systems

### Impact

- Validate technical approach with industry peers and experts
- Support regulatory commitments often associated with license renewal
- Improve understanding of conditions and aging in key plant systems
- Provide technical leadership development in a specific application area

### How to Apply Results

Application of results is highly dependent upon the project area and needs. Most of the application effort will consist of developing a plant-specific aging management or condition assessment program in a specific area, including extent of condition determination, mitigating strategies, and repair/replacement strategies.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>The P-NTUI Method (Heat Exchanger Thermal Performance Calculation technique):</b> This technical report will describe an additional methodology for performing heat exchanger thermal performance testing and calculations.	06/30/10	Technical Report
<b>Computer Based Training: Engineering Technical Training Modules - Topic 5</b>	01/29/10	Software
<b>Computer Based Training: Engineering Technical Training Modules - Topic 6</b>	01/29/10	Software

## PSE - Cable Program (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 how cable systems age 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.

As funding permits, technical reports will be generated on cable-aging-related topics of interest to program members. In 2010, the Cable Program will support increased understanding and data transfer between the industry and the Nuclear Regulatory Commission (NRC) during the development of a Regulatory Guide on cable condition monitoring and the modification of NRC inspection guidance. 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 advise on cable 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.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Cable Users Group Meeting:</b> At least one Cable User Group meeting will be held in 2010 to discuss research results, industry experience, test practices, and cable replacements.	12/23/10	Workshop, Training, or Conference

## **PSE - Heat Exchanger Performance Users Group (HXPUG) (45060)**

### 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 and boilers). The project allows participants to share experiences and to resolve technical issues associated with heat exchangers.

The project in 2010 will clarify the modern classical heat exchanger analysis methodology and introduce the use of the P-NTU<sub>j</sub> method. The report will focus on performance rating with examples of using the calculations on varying types of plant heat exchangers.

### Approach

- Information sharing with Heat Exchanger Performance User Group (HXPUG) members
- Technical investigations into high-priority technical issues as directed by the membership
- Plant support and services as related to heat exchanger testing
- Report creation on topics that are of value to the group as related to 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.

- Improved testing methods through collaboration with industry personnel and Electric Power Research Institute (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
- Information sharing with HXPUG members
- 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 take lessons learned and information generated in this group and implement the results into their plant. Examples include improved heat exchanger performance testing methods, new approaches to calculating end of life for plant heat exchangers, or avoiding issues experienced at other plants.

## **PSE Technical Assistance and Support (Base) (065800)**

### Key Research Question

Specific technical issues that have emerged in the nuclear industry warrant broader examination to share operating experience, lessons learned, and to provide venues for technology transfer. Also, for certain issues, further research needs to be identified and conducted.

### Approach

Plant Support Engineering (PSE) operates several technical assistance programs from base funds to support transfer of research results, address member questions, and provide inputs for additional research in these areas. These specific assistance programs include the following:

- Equipment Qualification Assistance Program (addresses Environmental Qualification [EQ] related questions)
- Plant Performance Enhancement Program (shares insights to improve plant output)
- Nuclear Coatings Council (supports guidance and ongoing issues with nuclear coatings)

Several supplementally funded activities address other specific industry issues, including the Cable User Group, Heat Exchanger User Group, and Equipment Qualification Management System User Group.

### Impact

- Reduce operations and maintenance costs by streamlining equipment qualification record keeping and collaborative sharing of equipment qualification records
- Increase plant output by providing tools and insights into MWe losses
- Reduce operations and maintenance costs and increase safety by understanding critical attributes of coatings failures

### How to Apply Results

Members factor lessons learned and technology transfer into plant operational guidance and procedures. Members also evaluate and revise inspection and assessment practices based on project activities.

### 2010 Products

Product Title & Description	Planned Completion Date	Product Type
Equipment Qualification Assistance Program	12/31/10	Technical Resource
Plant Performance Enhancement Program	12/31/10	Technical Resource
Nuclear Coatings Council	12/31/10	Technical Resource

## PSE Long Term Planning (Base) (052462)

### Key Research Question

Nuclear plants contain many large, expensive, long-lived components that may or may not provide satisfactory service through the end of the plant's operating life. The ability to determine if and when these components need refurbishment or replacement is critical to long-term operation. Methods are needed for identifying end-of-life conditions and selecting the best alternative with regard to continued use, refurbishment, or replacement. Information also is needed on end-of-life failure mechanisms, applicable monitoring information, industry failure experience, and logistics of refurbishment and replacement needed.

### Approach

This project develops tools and information to support long-term and contingency planning related to long-lived system and component end-of-life, and to eliminate or mitigate the effects of failure. Products include long-term plans (sourcebooks) for key components and reports identifying end of expected life, related monitoring, and logistics issues (end-of-expected-life reports).

### Impact

By using the results from this project, participants can develop timely, cost-effective strategies for managing the life cycles of capital-intensive power plant components.



## How to Apply Results

Members will use the reports to determine when long-term planning should be started; to obtain industry operating experience on state-of-the-art maintenance and condition monitoring approaches; and to determine how to select the best life-cycle management plan.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Large Motor Replacement Guide:</b> This guide will provide insights into when large electric motors should be replaced and provide purchase specification development guidance	02/26/10	Technical Report
<b>End of Life Guide - TBD</b>	12/23/10	Technical Report

## Future Year Products

Product Title & Description	Planned Completion Date	Product Type
<b>Sourcebook - Subject TBD</b>	12/17/10	Technical Report
<b>Component Replacement Guide - Subject TBD</b>	12/17/10	Technical Report
<b>End of Life Guide - Subject TBD</b>	12/17/10	Technical Report

## PSE Engineering Processes (Base) (052471)

### Key Research Question

Improved engineering processes are needed at nuclear power plants to ensure efforts are commensurate with and properly focused on plant needs. Developing guidance, benchmarking, and good practice recommendations is important in refining these processes and helping plants improve performance.

### Approach

This project supports Electric Power Research Institute (EPRI) benchmarking to evaluate targeted processes at selected plants and identify best practices, lessons learned, and the need for additional industry guidance. Recent examples where EPRI has or is providing guidance include optimization of the engineering change process and equivalency versus design change guidance. Also, EPRI convenes an annual Equipment Reliability Forum where member utilities can discuss successes and challenges in addressing equipment reliability issues.

### Impact

- Optimize engineering costs by identification and dissemination of best process
- Reduce costs through appropriate use and application of limited engineering resources
- Improve effectiveness and standardization in use of engineering resources

### How to Apply Results

Members will evaluate best practices and lessons learned to determine how to incorporate this information into their programs to improve effectiveness and performance. If additional guidance is issued, members will need to incorporate enhancements into their programs as appropriate.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>EQ Reference Manual Update:</b> The <i>EQ Reference Manual</i> is the "bible" for a station's environmental qualification (EQ) engineer. This manual has not been updated for several years; this will be done under this project set.	02/28/10	Technical Report
<b>Equipment Reliability Forum</b>	10/29/10	Workshop, Training, or Conference

## PSE Equipment Performance, Monitoring and Degradation (Base) (065799)

### Key Research Question

Material degradation reduces the inherent design margins in plant equipment. Unanticipated or unaccounted for degradation has led to equipment failures, affecting critical plant functions and representing a major threat to achieving equipment reliability goals. In many cases, aging models and condition monitoring techniques do not exist, and where they do they exist, readily understandable acceptance criteria may not exist. When replacements are necessary, superior materials or components may not have been identified or recognized as acceptable for nuclear service.

### Approach

This project develops guidance on resolution of generic and specific aging issues, including identification, evaluation, and resolution of equipment and system aging issues. Both theoretical and practical guidance is developed including aging models, data, and acceptance criteria for components and cables; field guides for walkdowns and inspections; and development of condition monitoring techniques. New materials such as plastic piping are evaluated for use in nuclear applications. Information is disseminated through industry meetings such as the Equipment Reliability Forum.

### Impact

- Avoid in-service failures and potential plant outages through improved detection of component degradation
- Predict remaining life and evaluate the seriousness of equipment degradation through access to aging data, interpretation of that data, and acceptance criteria
- Enhance ability to identify, assess, and manage aging through field guides and aging management guidance
- Assure broad distribution degradation research results and information through meetings such as the Equipment Reliability Forum
- Improve assessment techniques to identify components and materials prone to early aging

### How to Apply Results

Because multiple tasks are performed under this project, member applications vary. Field guides and aging management guides are applied directly. In other cases, information is provided in the Equipment Reliability Forum to promote understanding and availability of research results, or incorporated into training courses.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>System Monitoring Guidance</b>	03/15/10	Technical Report
<b>Coatings Aging</b>	12/23/10	Technical Report
<b>Cable System aging Management Revision 1</b>	12/23/10	Technical Report
<b>Medium Voltage Aging Management</b>	12/23/10	Technical Report
<b>In-Plant Demo of LIRA</b>	12/23/10	Technical Report
<b>EQ Motor Rewind - Random Wound Thermal Aging</b>	12/23/10	Technical Report

## PSE Procurement and Quality Issues (Base) (065801)

### Key Research Question

Product 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. Additional focus and guidance are needed to better understand the root causes of poor product quality and needed actions to improve quality, particularly for hardware and hardware refurbishments. Guidance and sharing of experiences also is needed to more effectively use the supply chain and procurement engineering functions at nuclear power plants. Finally, as plants age, additional emphasis is needed on developing collaborative solutions to obsolescence.

### Approach

This project consists of three principal elements: 1) continuing support of utility forums for sharing procurement-related concerns and experience through the Joint Utility Task Group (JUTG) and the Nuclear Supply Chain Strategic Leadership Council (NSCSL); 2) research on the root cause and corrective actions to enhance vendor quality, with possible spin-off projects addressing common procurement specifications, source surveillance templates, and guidance on detecting fraudulent and counterfeit items; and 3) support of an industrywide approach to prioritization and management of obsolete items, including a pilot project to demonstrate methods being developed.

### Impact

- Reduce procurement-related costs for components
- Improve equipment reliability and performance through better understanding and improvement of product quality
- Reduce procurement costs through application of commercial-grade dedication processes
- Access to cost-effective, collaborative solutions to parts obsolescence

### How to Apply Results

Members use project information to enhance procurement programs, develop improved supplier partnerships, improve specification development, and solve obsolescence issues. Members also gain insights into needed engineering process changes (such as equivalency versus design change).

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
Operation of Procurement Technical Assistance Program	12/31/10	Technical Resource
Enhanced Receipt Inspection and Source Verification Templates	02/19/10	Technical Report

## PSE Strategic Development and Tech Transfer (Base) (065803)

### Key Research Question

Coordination, collaboration, and integration of numerous activities are required to ensure the overall Plant Support Engineering (PSE) Program is addressing priority issues impacting near-term and longer-term plant reliability. Through strategic input and sharing of industry experience, members advise the Electric Power Research Institute (EPRI) on targeting research toward the most important plant or fleet needs.

### Approach

PSE hosts two advisory meetings each year to solicit input and direction from its advisors on key research topics and issues. A number of multi-year technical initiatives are developed, refined, and presented to advisors, along with a planned scope of work.

### Impact

- Facilitate strategic development of program research around key industry issues such as inaccessible cable aging management, long-term planning for key components, product quality, and workforce skill development and training
- Drive improvement in plant reliability as plants and the supporting workforce ages
- Shape execution of needed research

### How to Apply Results

Members apply results from this project through active engagement with the Plant Support Engineering Program. Input and advice result in better alignment of research activities with nuclear plant needs, in formats that can be readily incorporated into long-term planning activities.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
PSE Subcommittee Meeting and Program Planning: Similar in scope and scale to 2009 products	12/31/10	Technical Resource

## PSE Technical Training and Proficiency (Base) (065802)

### Key Research Question

Turnover of nuclear plant technical staff will be significant in the next five to ten years. During the same timeframe, nuclear utilities will be training personnel to support construction and operation of new nuclear plants. Pressures to reduce operations and maintenance costs often result in impacts to training budgets. Also, fewer and fewer skilled supplemental workers are available for working power plant outages. Often, as the supplemental outage workers travel from plant to plant, they receive the same training and examinations

at each plant. In this environment, nuclear plants need cost-effective methods to develop and deliver high-quality, effective training and be able to quickly validate the skills competencies of the supplemental workers.

### Approach

Computer-based training technology can improve the effectiveness of engineering training and reduce the costs associated with providing this training. Plant Support Engineering (PSE) is engaged in developing computer-based training for nine engineering fundamentals topics included in the Institute of Nuclear Power Operations (INPO) guidelines for orientation of new engineers. PSE also is converting materials related to its Standardized Task Evaluations onto NANTeL. Industry personnel have identified 180 tasks that are typically assigned to supplemental outage workers. Working with power plant personnel, the Electric Power Research Institute (EPRI) has developed knowledge examinations and skills proficiency demonstration examinations that power plant personnel can administer to supplemental workers to verify skills competencies. EPRI is now converting the examination materials into a format compatible with INPO's NANTeL system; several have been successfully uploaded and are available on NANTeL. Any power plant that has access to NANTeL may download the examination materials, administer the examinations, and record an individual's successful completion within the NANTeL system. This will serve as a basis for accepting prior qualification testing in lieu of re-administering knowledge and skills training and examination.

### Impact

Stations are using the engineering computer-based training (CBT) modules in lieu of classroom-conducted training sessions to provide orientation training to new engineers. This results in fewer disruptions for engineering organizations and also frees up instructor time associated with class lecture and examination preparations. By verifying prior completion of knowledge and skills qualification-related examinations using the NANTeL or EPRI databases, utilities are experiencing cost savings associated with streamlining the in-processing, training, and qualification of supplemental personnel.

### How to Apply Results

The content of the engineering training modules will be available both from EPRI as well as an industry web-based training delivery system (INPO's NANTeL system) where students can complete the CBT and also take the exam course examination. This approach will make them widely available for implementation, providing the *required* fundamentals in an effective, timely, and consistent manner such that new staff can be trained while minimizing utility training infrastructure costs. (Web-based delivery costs are a small fraction of classroom delivery).

For qualification of outage supplemental personnel, knowledge examinations and skills proficiency demonstration examinations can be accessed via NANTeL, administered, and results recorded within the NANTeL database. Once the record of successful completion is recorded in the database, the record of successful completion can be used by other utilities as a basis for exempting their examination requirements when the supplemental worker shows up at their station for outage work. This results in an overall savings in contractor costs and training organization costs.

### 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Computer Based Training: Engineering Fundamentals - Core Protection</b>	03/31/10	Software