

Safety Risk Technology and Application

Program Overview

Program Description

The Safety Risk Technology and Application program develops the risk assessment tools necessary to enhance safety and improve the economics of existing and future nuclear power plants. Greater understanding of the risks related to safety, coupled with support of a comprehensive risk and safety culture, is essential in providing the foundation through which risk-based safety tools can be developed, tested, and deployed.

Industry Needs and Issues Addressed

- Refined probabilistic risk assessments (PRAs) to guide effective design, operation and asset management decisions for critical plant issues (for example, fire, seismic)
- Technical analyses supporting continued regulatory acceptance of risk-informed activities
- Analytical and software tools for safety evaluations, configuration risk management, fault tree analysis, and security assessments
- Greater availability of trained nuclear risk professionals

Impact

- Research results and technical input that foster a risk-informed regulatory environment
- Tools and methodologies that increase plant safety and reduce plant and regulatory resource requirements
- Shortened outages, fewer unnecessary shutdowns, reduced inspections and testing, and special treatment of low-safety significant safety-related equipment
- Robust, plant-specific framework for more focused and stable regulatory interaction

Key Accomplishments

- Guidelines for developing consistent high-quality PRAs and risk-informed regulatory submittals
- State-of-the-art computational software tools that reduce the burden of developing and maintaining PRAs
- Consensus standards to assess the scope and quality of PRAs
- Support to key industry initiatives coordinated by regulatory and industry entities such as the Nuclear Energy Institute and Nuclear Regulatory Commission.
- Formal training of the next generation of risk professionals
- Key architect of the U.S. Department of Homeland Security's critical asset protection security assessments

Current Year Objectives

- Human reliability analysis methods for fire PRAs
- *Internal Flooding Guide*
- Treatment of loss-of-offsite-power in PRAs
- Software to manage and simplify documentation associated with PRAs
- Definition and development of high-priority configuration risk management tools
- Seismic Issues Resolution Workshop
- Guidelines for managing risk from loss-of-offsite-power and station blackout
- Risk and safety management computer-based learning modules
- *Education of Risk Professionals* training sessions

Industry Involvement

- Estimated 2009 funding: \$6.1

Program Technical Lead

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Summary of Projects

Project Number	Project Title	Value
	Fire Risk Methods	This project aims to provide a uniform set of methods and tools for performing risk-informed fire protection. The project pursues consensus methods for 1) performing fire risk analysis, 2) creating a "living" fire events database, 3) developing risk-informed application methods, 4) developing automation tools, and 5) providing training.
	PRA Scope and Quality	This project provides guides on selected PRA scope and quality issues. In addition, this project provides a workshop to provide for project implementation and technology transfer.
	Advanced Probabilistic Risk Assessment Methods-Supplemental	This project advances development of PRA DocAssist, a software tool that reduces the resources required to develop and maintain PRA documentation. The tool further serves as a knowledge capture tool, which is important given aging workforce issues.
	PRA Scope and Quality-Supplemental	This supplemental project identifies technical issues related to PRA scope and quality, prioritizes the issues, and develops guides for the treatment of selected generic issues in the PRA. The purpose of these guides is to provide technical, pragmatic solutions that can be broadly and consistently implemented.
	Fire Risk Methods-Supplemental	This project aims to confirm the practicality of the Fire PRA methods by testing them in several pilot applications. The methods will be exercised by the Electric Power Research Institute (EPRI), Nuclear Regulatory Commission's (NRC's) Office of Nuclear Regulatory Research (RES), and the engineers at the pilot plants.
	Advanced PRA Methods	This project performs research and develops products related to the next generation of PRA tools. These tools reduce the simplifications and resource burdens of current methods and pave the way for the future of risk technology.
	Tech Support to Industry on Risk-Informed Regulation	These activities provide technical analysis and support for risk-informed and performance-based applications. The applications include both generic activities through the Nuclear Energy Institute and Nuclear Regulatory Commission, and specific activities at pilot plants to provide plant-specific exemption efforts with generic applicability.
	Risk Management Modeling and Assessment	Effective nuclear safety risk management provides a cornerstone for safe and economical operation. Use of a structured assessment process specifically designed to evaluate and trend the effectiveness of risk management provides plant management with vital information to identify process and program strengths and weaknesses, develop and prioritize improvement actions, and track implementation effectiveness.

Project Number	Project Title	Value
	Grid Risk and Reliability	The Grid Risk and Reliability project assesses the probability of losses of offsite power, develops methods to monitor the real-time loss-of-offsite-power (LOOP) potential, and improves communication between providers of transmission services and plant.
	Configuration Risk Management	The Configuration Risk Management Forum (CRMF) provides a venue to exchange technical information on configuration risk and approaches to the management of that risk. An annual meeting facilitates exchange of information and a quarterly newsletter provides a periodic update.
	Seismic Risk Methods	The Seismic Risk Methods project provides simplified and extensive seismic risk methods that are designed to be "used and useful." Seismic risk methods, including both seismic PRA and seismic margins analysis, are playing an increasingly important role in risk-informed regulation.
	Grid & SBO Issues	The Grid and Station Blackout (SBO) project develops the concept of "zone of vulnerability" around a nuclear plant and switchyard. This will encompass methods to assess the effects of component failures, identify relaying zone protection schemes to improve the ability to assess potential problems, and isolating transmission system faults as they occur.
	Risk Framework for New Plants, 10CFR50-53	The licensing framework for existing plants is deterministic. Recently, some aspects of the licensing basis have become risk-informed, reducing costs, and improving performance and safety. New plants could have a risk-informed licensing basis encompassing design and operational programs. This project supports collaboration with the Nuclear Energy Institute (NEI) to enhance regulatory acceptance of risk-informed treatment.
	RSM Qualifications and Curriculum	The Risk and Safety Management (RSM) Qualifications and Curriculum project is performing the vital task of educating the next generation of risk professionals by 1) identifying necessary training and available materials; 2) determining gaps in available training materials; and 3) completing course material and providing risk professional training.
	Safety Analysis Codes for Licensing Basis Calculations	The Safety Analysis Codes project supports existing safety analyses and develops new models for the standard safety/licensing codes GOTHIC and RETRAN/VIPRE. The software will be updated to function on new operating systems. Benchmarking of existing and new experiments will be used to further validate the software. Training for new users will be provided.
	MAAP4 and MAAP5 UG and Development	The MAAP (Modular Accident Analysis Program) code is used to investigate severe accident phenomena and to support the beyond-design-basis assessments in PRAs. While the NRC occasionally requests the use of an alternate code, this project supports the use of MAAP in risk-informed submittals.

Project Number	Project Title	Value
	ORAM-SENTINEL	ORAM-SENTINEL focuses on nuclear safety risk during plant shutdown conditions. This project supports the development of the American Nuclear Society (ANS) Low Power / Shutdown PRA Standard and focuses on qualitative methods (defense-in-depth and diversity) to manage safety risk during shutdown conditions.
	SQUG and SEQUAL	EPRI initiated SQUG to resolve NRC unresolved safety issue A-46, "Seismic Qualification of Equipment in Older Nuclear Power Plants," applying experience-based methods that use equipment performance data following earthquakes. The SQUG/ SEQUAL project continues to add to the database, add new equipment, and develop methods for experience-based seismic qualification of replacement parts.
	PRA Applications Users Groups	Nuclear plants and EPRI have developed software tools to aid in risk management and safety. These tools need continuous updating and improving, and new tools are needed as new risk applications are introduced. This project improves existing tools and provides new tools to enable cost-effective applications of risk technology.
	Security Vulnerability Assessment	Nuclear plant security must be assessed for all types of threats, including the deliberate crashing of a commercial aircraft into a nuclear plant. Other threats include armed attack. This project addresses the range of threats and designs mitigation strategies.
	Security Probabilistic Risk Assessment	The nuclear industry has performed many analyses in response to September 11, 2001. These analyses have been largely deterministic. There is growing desire to risk-inform future security decisions by industry, Department of Homeland Security (DHS), and other stakeholders. To this end, EPRI is adapting and applying PRA methods for security applications.
	Emergency Planning Protective Action Strategies	The NEI Emergency Planning Working Group (EPWG) has recognized the need to update the Emergency Planning (EP) technical basis, which is currently rooted in analysis technology 30 years old. An updated EP technical basis would be risk-informed and would account for the great increase in knowledge built from 30 years of experience.
	Security Probabilistic Risk Assessment-Supplemental	The nuclear industry has performed many analyses in response to September 11, 2001. These analyses have been largely deterministic. There is growing desire to risk-inform future security decisions by industry, Department of Homeland Security (DHS), and other stakeholders. To this end, EPRI is adapting and applying PRA methods for security applications.

Project Descriptions

Fire Risk Methods (052482)

Issue

There is a strong interest, by regulators in particular, to risk-inform fire protection at existing and new nuclear power facilities. This is evident from various NRC and industry documents such as the voluntary risk-informed fire protection rule and NEI 00-01—*Fire Protection Significance Determination Process and Guidelines for Post-Fire Safe Shutdown Analysis*. In addition, need is arising in other risk-informed applications (for example, the Maintenance Rule and Risk-Informed Technical Specification, or RITS) to address the potential contribution from fire. The National Fire Protection Association (NFPA) has developed NFPA 805 to define deterministic and probabilistic rules for nuclear plant fire protection, and the American Nuclear Society is developing a Fire Probabilistic Risk Assessment Standard. The Nuclear Regulatory Commission (NRC) has developed a new rule to allow nuclear plants to transition to the NFPA methodology.

Description

This project will develop consensus methods to facilitate the transition to NFPA 805 through 1) robust methods for fire risk analysis that can withstand regulatory scrutiny, 2) a “living” fire events database to provide actual fire data for establishing fire probabilistic risk assessment parameters, 3) risk-informed applications methods that provide the industry with guidance for using risk information, 4) automation tools that can make time-efficient and cost-effective use of these products, and 5) training to encourage and facilitate product use. The approach is to develop fire modeling and probabilistic risk assessment methods and associated guidance and training to establish use in routine maintenance and improvement of plant fire protection programs.

Value

- Reduce compliance costs, provide regulatory stability, and improve safety through use of risk-informed/performance-based approaches to fire protection
- Facilitate assessments of plant fire programs and define the fire risk significance of plant changes

How to Apply Results

Members will participate in training courses to learn how to develop fire scenario models and perform fire PRA’s in-house. The results of these efforts will be used to make risk-informed decisions on plant changes and program aspects and to concentrate effort on the most risk significant areas. NRC is expected to require such techniques in the immediate future.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Fire Modeling Course: Training course on fire modeling methods and use of computer programs	10/31/2008	Technical Resource

PRA Scope and Quality (057868)

Issue

The Nuclear Regulatory Commission (NRC) and other stakeholders are currently questioning the scope of the probabilistic risk assessment (PRA) required for use in regulatory applications based on advances in PRA capabilities and recent regulatory experience. Quality issues also are being discussed in relation to PRAs. The future of risk-informed initiatives depends on assuring that the PRA used to support regulatory changes have the appropriate scope and quality. Risk-informed initiatives, both current and future, represent the clearest opportunity for nuclear plants to achieve cost-beneficial changes to the regulatory environment while maintaining or increasing the level of safety.

Description

The PRA Scope and Quality project solicits input from nuclear plant operators, regulators, and the public on the current technical issues facing risk-informed regulation. These issues are prioritized by the PRA Scope and Quality Advisory Committee and then resolved through a combination of research and development and consensus building among the stakeholders. The result is a consensus guide that provides a clear, cost-effective and consistent approach for addressing specific technical issues.

Value

- Enable risk-informed applications
- Create consistency and stability in the regulatory environment
- Foster a safety and risk-informed culture

How to Apply Results

Through workshops and seminars on the more significant products of the PRA Scope and Quality Committee, members and their utility risk analysts incorporate guidance into the plant-specific PRA. Members also can request individual expert support for more sophisticated guidance.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Resolution of One PRA Scope and Quality Issue: Technical report that documents the proposed method of resolving issues identified by EPRI members	12/19/2008	Technical Report
PRA Scope and Quality Workshop: Workshop to discuss the issues facing risk-informed regulation, the development of risk-informed applications, and the results of latest PRA Scope and Quality methods	12/19/2008	Workshop, Training, or Conference

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Resolution of Additional PRA Scope and Quality Issues: Continue to resolve issues of PRA Scope and Quality including those associated with Internal Event PRAs and fire and seismic risk studies	2010	Technical Report

Advanced Probabilistic Risk Assessment Methods-Supplemental (052467)

Issue

As logic models become more complex and regulatory use of risk technology increase, there is increased demand for high-quality documentation. Developing and maintaining such documentation is resource-intensive.

Description

This project supports development of the DocAssist software tool to control and simplify the documentation associated with PRA. DocAssist allows the risk analyst to connect model information directly to written documentation, eliminating manual entry that is time consuming and prone to errors. Existing documents are easily ported into the software, which can connect to various external sources.

Value

- Save resources associated with updating the PRA
- Reduce resources associated with peer reviews
- Reduce resources associated with development and maintenance of PRA applications
- Increase quality of PRA documentation

How to Apply Results

DocAssist can easily be implemented by a risk analyst, administrative person, or even a student intern. EPRI provides training for the software on a periodic basis. Resources used in implementing the program are directly proportional to the benefits received. Implementation can be phased over a significant time period if desired.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
PRA DocAssist – Release 3: PRA DocAssist full capability software release 3 is the final developmental version of PRA DocAssist.	12/31/2009	Software

PRA Scope and Quality-Supplemental (52470)

Issue

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Description

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Value

- Enable risk-informed applications
- Create consistency and stability in the regulatory environment
- Foster a safety and risk-informed culture

How to Apply Results

The PRA Scope and Quality committee meets several times a year to review, prioritize, and resolve PRA scope and quality issues. The research and development activities are accomplished using a collaborative process to develop issue-specific guidance, subject to peer review and pilot evaluation. Members apply the resulting risk guidance in plant-specific PRAs and risk-informed applications.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Data Analysis for Nuclear Power Plant PRAs: The two guidelines proposed for 2009 are more comprehensive than previous guides and represent the collection and expansion of previously performed research. The guides will enable the development of consistent initiating event and analysis portions of the PRA.	12/18/2009	Technical Report
Guideline for the Development of Initiating Event Analysis for Nuclear Plant PRAs: The two guidelines proposed for 2009 are more comprehensive than previous guides and represent the collection and expansion of previously performed research. The guides will enable the development of consistent initiating event and analysis portions of the PRA.	12/18/2009	Technical Report

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Two addition PRA Scope and Quality Guides: Two additional PRA scope and quality guides will be developed to resolve PRA technical issues.	2010	Technical Report

Fire Risk Methods-Supplemental (061405)

Issue

EPRI and NRC have developed state-of-the-art fire PRA methods, as documented in a joint EPRI/NRC report titled, *Fire PRA Methodology for Nuclear Power Plants* (EPRI-100959/NUREG-6850). These methods need to be piloted to ensure they provide a consistent and complete methodology for performing a fire PRA. Lessons learned from recent pilot projects need to be incorporated into revised guidance.

Description

This project will confirm the practicality of fire PRA methods by testing them in pilot applications at several nuclear power plants and revising as necessary. The methods have been exercised by EPRI, NRC, and engineers at the pilot plants.

Value

- Provide the template for other plants to perform fire probabilistic risk assessments
- Provide plants engineers with the confidence needed to undertake a fire PRA
- Complete revisions to the guide to improve performance of fire PRAs and make the results more realistic

How to Apply Results

Members will use the results of the pilot studies as a guide in performing fire PRAs. About half the U.S. plants have committed to transition to NFPA 805 and will require a FPRA before being able to undertake any risk-informed performance-based decision making.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Pilot Application of EPRI 100959/NUREG-6850: A report on the performance of a fire PRA on the Nine Mile 2 nuclear plant	10/23/2009	Technical Report
Pilot Application of EPRI 1011989/NUREG-6850: A report on the performance of a fire PRA on the Nine Mile 2 nuclear plant, supporting a draft revision of EPRI 1011989/NUREG-6850	10/23/2009	Technical Report
Draft revision of EPRI 1011989/NUREG-6850	11/30/2009	Technical Update
Pilot Application of EPRI 1011989/NUREG-6850: A report on the performance of a fire PRA on the Nine Mile 2 nuclear plant, supporting a draft revision of EPRI 1011989/NUREG-6850	10/23/2009	Technical Report
Draft revision of EPRI 1011989/NUREG-6850	11/30/2009	Technical Update

Advanced PRA Methods (052488)

Issue

Logic models built to support probabilistic risk assessments (PRAs), risk monitors, and trip and generation risk models are based on a fault and event tree approach developed in the 1970s. Modern applications of risk technology have introduced issues not easily solved using traditional techniques. These issues include the treatment of time-phased modeling, multiple models for internal and external events, the phenomenological modeling of Level 2 PRAs, and the treatment of recovery and human actions.

Description

This project develops next-generation software PRA tools to address these complex issues, divided into three categories: Advanced Logic Modeling (Declarative Modeling), Advanced Quantification (Direct Probability Calculation (DPC) & Binary Decision Diagram (BDD)), and Documentation Assistance (PRA DocAssist). These tools are developed using a long-term, low-cost, evolutionary approach.

Value

- Reduce simplifying assumptions used in the analysis resulting in a higher quality result
- Reduce the burden associated with PRA development and application
- Reduce the resources associated with PRA documentation

How to Apply Results

Members gain access to software tools that integrate the current software tools in use today and that can be applied in minor or major implementation depending on the risk analyst's desire to achieve the appropriate resource balance.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Declarative Modeling Software: The Declarative Modeling software serves as an add-in to the existing PRA client software. The software allows for assignment of attributes to the existing PRA model, adding a new dimension to the model and facilitating the modeling of more complex issues.	12/18/2009	Software
MC-BDD Quantification Engine: The MC-BDD Quantification Engine allows for the quick determination of near-exact probability of PRA. This is applicable to real-time tools such as EOOS and to other important calculations that need a quicker calculation than DPC.	12/18/2009	Software

Tech Support to Industry on Risk-Informed Regulation (061357)

Issue

Sustained use of risk-informed and performance-based approaches for nuclear plant applications depends on detailed technical analysis. These applications are both generic applications proceeding through the Nuclear Energy Institute, the Nuclear Regulatory Commission, and pilot plants and plant-specific exemption efforts with generic applicability.

Description

Many risk-informed industry initiatives have progressed to a critical point where their feasibility has been demonstrated, but their benefit to individual nuclear plants hinges on the technical details and timing of their implementation. Such efforts include Risk-Informed Tech Specs, 10CFR50.69, redefining the design basis large loss of coolant accident (LOCA), and applications to digital instrumentation and control systems. Furthermore, NRC decisions on probabilistic risk assessment adequacy for plant applications and compliance to Regulatory Guide 1.200 require careful industry attention. Finally, the ongoing American Nuclear Society and ASME activities on PRA standards are critical elements for successful risk-informed applications.

Value

- Demonstrate robust application of PRA methods, tools, and results to support risk-informed regulatory initiatives
- Permit plant management to effectively prioritize and allocate resources to improve plant safety and economic performance

How to Apply Results

EPRI research in risk-informed industry initiatives often results in documentation that serves as implementation guidance for members. Methods and results also are communicated in various forums, including conferences, industry meetings, and specific application workshops and training sessions.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Participation on Digital I&C Working Groups: Provide support for risk-informed regulatory treatment of digital instrumentation and control (I&C) for new and existing plants	12/18/2009	Technical Resource
Participation on ASME and ANS Standards Committees: Provide support for the writing committees of the ASME and American Nuclear Society (ANS) PRA Standards. This support includes participation on the committee as well as the development of various research projects to inform understanding of risk technology.	12/18/2009	Technical Resource

Risk Management Modeling and Assessment (052485)

Issue

Effective nuclear safety risk management provides a cornerstone for safe and economical operation. Additionally, risk-informed regulatory initiatives are increasing the importance of risk management. Use of a structured assessment process specifically designed to evaluate and trend the effectiveness of risk management provides plant management with vital information to identify process and program strengths and weaknesses, develop and prioritize improvement actions, and track implementation effectiveness.

Description

Application of the *Risk Management Effectiveness Assessment Application (RMEA) Guide* provides plant management a detailed evaluation of the effectiveness of all processes and programs that impact nuclear safety risk. The process utilizes targeted interviews to obtain detailed knowledge of process interfaces, strengths, and weaknesses. From this, a prioritized set of recommendations for improvement is developed.

Value

- Provide plant management a detailed evaluation of the effectiveness of all processes and programs that impact nuclear safety risk
- Permit plant management to effectively prioritize and allocate resources to improve plant safety and performance

How to Apply Results

EPRI provides on-site member support in performing a risk management effectiveness assessment. This approach facilitates effective technology transfer to plant personnel and ensures assessment findings are owned by the implementing plant, resulting in improved follow-up and implementation of the assessment recommendations.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
TBD – Project / deliverable to be determined based on RSM Advisor input at 7/08 and 1/09 Nuclear Advisory Meetings: TBD – Project / product to be determined based on advisor input at 7/08 and 1/09 Nuclear Advisory Meetings	12/31/2009	Technical Update

Product Title & Description	Planned Completion Date	Product Type
Support utility RMEA evaluations.	12/31/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
TBD – Project / deliverable to be determined based on RSM Advisor input at 7/09 and 1/10 Nuclear Advisory Meetings: TBD – Project / product to be determined based on advisor input at 7/09 and 1/10 Nuclear Advisory Meetings	2010	Technical Update
Support utility RMEA evaluations. Support utility risk management effectiveness assessment (RMEA) evaluations	2010	Technical Resource

Grid Risk and Reliability (057869)

Issue

Losses of offsite power (LOOP) and grid unreliability affect plant safety, curtail power to emergency equipment, and can result in lost generation. Recent events, including the south Florida event in 2008 and the Palo Verde event in 2004, have heightened regulatory concern relative to availability of offsite power for emergency equipment.

Description

The Grid Risk and Reliability project assesses the probability of losses of offsite power, develops methods to monitor the real-time LOOP potential, and improves communication between transmission providers and nuclear plants. The project coordinates with NEI to identify specific industry needs, works with EPRI’s Power Delivery & Utilization sector to develop innovative technologies to support grid voltage near nuclear units, and performs event analyses to identify trends or identify new causes of LOOPs.

Value

- Reduce the frequency and effect of transmission-grid-related events on operations and safety
- Avoid non-beneficial hardware and operational constraints resulting from implementation of the NRC generic letter, including station blackout and coping time issues
- Provide an interface between plant risk monitors and transmission grid state estimators/contingency analyzers

How to Apply Results

Members build models using EPRI software tools and databases to enable equipment configuration risk monitoring in the plant as well as configuration risk monitoring of the switchyard and for the transmission load center.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Loss of Off Site Power Event – through 2008: Update of loss of offsite power experience through 2008	12/31/2009	Technical Report
Transmission Grid FMEA Pilot Project(s): Development and implementation of failure modes and effects analysis (FMEA) tools for transmission grid monitoring projects	12/31/2009	Technical Report

Configuration Risk Management (057870)

Issue

Continued updates and improvements to configuration risk management processes can improve the safety and efficiency of plant maintenance activities. Configuration risk management supports the planning and scheduling of equipment outages, both at-power and during plant outages. Configuration risk management enables evaluation of equipment configurations from a safety risk standpoint and provides valuable information about possible risk management actions associated with the configurations.

Description

This project supports global dialogue on configuration risk management. The Configuration Risk Management Forum (CRMF) provides a forum for configuration risk management experts to coordinate the needs of the configuration risk management community and identify ways to enhance capabilities and benefits at nuclear power plants. This project also supports low-power and shutdown qualitative risk assessment methods, including participation in industry PRA standards development that impacts risk assessment methods.

Value

- Improve effectiveness of plant configuration risk management programs
- Improve regulatory compliance

How to Apply Results

Members apply results through participation in CRMF meetings. The Configuration Risk Management Forum includes an annual meeting of all configuration risk management stakeholders, technical research, and development activities sponsored by the Risk/Safety Management Program or by supplemental funding and regular meetings of the CRMF Steering Committee to consider industry issues. The CRMF Steering Committee identifies and prioritizes areas where research and development is needed to enhance nuclear plant capabilities/competitiveness or to address emerging regulatory requirements.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Configuration Risk Management – Products and Forum: Technical report describing results from CRM research performed at the direction of the CRMF Steering Committee	12/31/2009	Technical Report

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Configuration Risk Management – Products and Forum: Technical report describing results from CRM research performed at the direction of the CRMF Steering Committee	2010	Technical Report

Seismic Risk Methods (061358)

Issue

Seismic issues arise periodically due to regulatory concerns or actual seismic events. These issues are almost always generic to the industry and expose plants to significant economic risk. Although the use of risk-informed methods associated with internal events is fairly well established, those for external events are much less so. The two established methods for assessing seismic risk are seismic PRA (SPRA) and seismic margins assessments (SMA). Both have been used in the past, but not on a routine day-to-day basis or to support risk-informed applications to reduce unnecessary costs. Neither has been integrated with the internal events PRAs on which they depend.

Description

This project maintains and improves seismic methods to resolve issues and decrease the cost of seismic assessments and seismic equipment qualification. Project activities focus on simplified and extensive external risk methods integrated and "used and useful" by plant engineers and regulators, SMA methods useful for developing plant seismic risk insights without SPRA, and approved RISC-3 equipment seismic qualification methods. The project also monitors and informs NRC programs to ensure nuclear plants are not forced to conform to costly new programs and methods in the seismic area.

Value

- Members perform or manage seismic PRAs for their plants, allowing risk-informed decisionmaking to span all internal and external events.

How to Apply Results

Member engineers will use the products to perform or manage seismic PRAs and /or seismic margins assessments.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Seismic PRA Training Course: Training course on performance of seismic PRA	11/28/2008	
Seismic PRA Training Course: Training course on performance of seismic PRA	11/17/2008	Workshop, Training, or Conference

Grid & SBO Issues (061364)

Issue

Losses of offsite power and grid unreliability affect plant safety, curtail power to emergency equipment, and can result in lost generation. Because transmission grid and switchyard events can have major financial and operational impact on nuclear plants, continued work is necessary to define and manage risk factors.

Description

This project involves a four-year effort to develop the concept of “zone of vulnerability” around a nuclear plant and switchyard. Project activities encompass methods to assess the effects of component failures, relaying zone protection schemes to improve the ability to assess potential problems, and isolation of transmission system faults as they occur.

Value

- Improve ability to assess vulnerabilities in the vicinity of a nuclear unit, where system faults can disrupt plant operations or result in a station blackout
- Enable plants to conduct maintenance and equipment configuration control to reduce risk of plant trip and loss of offsite power

How to Apply Results

Members will use project methodologies and results from pilot studies to develop tools for assessing local grid vulnerability and related impacts on nuclear plants.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Risk and Reliability Module to support ZOV: Report on how to assess the zone of vulnerability for grid disturbances that lead to a plant trip and/or a loss of offsite power. Strategies to prevent or mitigate these risks will be presented.	12/31/2009	Software

Risk Framework for New Plants, 10CFR50-53 (061883)

Issue

Most of the design and operational decisions at existing nuclear power plants were driven by deterministic requirements. Improved understanding of plant risk has enabled some of the licensing basis to become risk-informed, reducing costs and improving performance without adversely impacting safety. By applying this capability at the conceptual stage, design and operational programs could be risk-informed from the start, minimizing initial design and construction costs, reducing subsequent operating costs, while ensuring plant reliability and safety. NEI recognized this possibility in its document, NEI 02-02, *A Risk-informed Framework for New Nuclear Plants*.

Description

This project involves collaboration with NEI and their Risk-informed Framework for New Plants Task Force to inform rulemaking for a new 10CFR Part 53. Project activities will address the many technical issues associated with a new risk-informed framework and support pilot application of the concepts and specific requirements for both design and operations.

Value

- Provide a risk-informed licensing framework for advanced nuclear plants
- Identify and resolve technical issues associated with reliability assessment of passive safety features

How to Apply Results

Members will review project activities for applicability to existing plants and risk-informed applications (for example, passive safety system reliability). Members also will use project results to inform regulatory issues for existing and new plants.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
TBD – Project / deliverable to be determined based on RSM Advisor input at 7/08 and 1/09 Nuclear Advisory Meetings	12/31/2009	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
TBD – Project / deliverable to be determined based on RSM Advisor input at 7/09 and 1/10 Nuclear Advisory Meetings	2010	Technical Update

RSM Qualifications and Curriculum (061904)

Issue

Nuclear plants face challenges in maintaining and expanding PRA staffs to support risk and safety management. Some of the nuclear industry's trained personnel have left for other industries, been hired by NRC, or will retire in the near future. Because university-based PRA training programs are rare, nuclear plants must devote resources to on-site development of engineering staffs and 'conceptual' training for managers and operational personnel. Improved training and qualification programs are needed to more effectively develop trained and certified PRA personnel to perform risk management tasks, support operations through equipment configuration risk management, and support risk-informed applications and NRC submittals.

Description

This project consists of a multi-faceted approach to develop risk professionals: 1) survey the industry to identify current needs and existing training materials; 2) establish a bibliography of important references; 3) inventory existing training materials and define gaps; and 4) develop training courses and materials as necessary. Work will be coordinated with owners groups, user groups, and vendors to prevent duplication and overlap of efforts.

Value

- Produce courses, tools, and training materials for development of PRA professionals and for training of managers and operational personnel

How to Apply Results

Members access EPRI training courses and instructors to develop well-trained and qualified risk and safety management personnel. EPRI Risk Professional Training will provide the formal training portion, including “hands-on” exercises necessary to obtain a qualification card. Members will need to provide mentoring during portions of the qualification process.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Provide 5 training classes – Education of Risk Professionals: EPRI has developed a training curriculum designed for “entry-level” PRA analysts to be taken consecutively in a set of six week-long sessions. The goal of the training is to accelerate the qualification time of new PRA analysts and risk professionals. This program is designed to complement nuclear plant mentoring and qualification requirements.	12/31/2009	Technical Resource

Safety Analysis Codes for Licensing Basis Calculations (052466)

Issue

The ongoing licensing of existing plants, including uprates, and the design of new plants require safety analysis codes that are validated and verified according to NRC standards.

Description

This project develops new models for the standard safety/licensing code GOTHIC. Project activities include software updates to function on new operating systems, benchmarking to further validate the software, and training for new users.

Value

- Improve software to support NRC licensing applications
- Train safety and licensing professionals

How to Apply Results

Members apply results through use of the GOTHIC software, which conducts containment thermal hydraulics analyses. Members apply the codes to various thermal hydraulic issues at their particular site by building plant-specific input decks or plant models and then developing plant-specific calculations. These software codes have been in existence for many years, and current efforts are primarily associated with calculation development as opposed to input deck or model development.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
GOTHIC 8.0: Gothic 8.0 will update current version Gothic 7.2a, and will include expanded modeling capabilities and options for operating systems.	12/31/2009	Software

MAAP4 and MAAP5 UG and Development (052468)

Issue

The MAAP (Modular Accident Analysis Program) code supports investigation of severe accident phenomena involving core melting and relocation. On several occasions, the NRC has requested the use of an alternate code to MAAP, which is the preferred nuclear plant thermal hydraulic code for justifying risk-informed submittals.

Description

This project provides the technical basis to ensure the viability of the MAAP software for supporting NRC safety-related applications, developing new methods to support new license applications, and ensuring that MAAP can address the success criteria for various uses such as PRAs. Two user groups have been formed: one to support, improve, validate, and develop MAAP4; and a second to advance MAAP5, including modules for international users and new plant designs.

Value

- Improve communication between NRC and the MAAP user community
- Demonstrate the technical adequacy of the MAAP code
- Develop an applications guide to assist new users and to ensure a uniform use of the code to specific licensing problems

How to Apply Results

Members typically apply the software by building a plant-specific input deck and then assessing thermal hydraulic or severe accident scenarios of interest. These activities are usually performed in support of plant-specific PRAs or severe accident management programs.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
MAAP 5.1 (beta): Upgrade versions of the current MAAP 5.0 software to support new operating systems and applications	12/31/2009	Software
MAAP 4.0.8: Upgraded version of MAAP 4.0.7 with additional modeling capability and options for operating systems	12/31/2009	Software

ORAM-SENTINEL (052487)

Issue

Nuclear plants need a forum for exchanging lessons learned and technical information on configuration risk management during plant shutdowns and outages. The Outage Risk Assessment and Management/SENTINEL (ORAM-SENTINEL) User Group currently meets at the Configuration Risk Management Forum (CRMF). Continued engagement is required to drive improvements in outage risk management.

Description

Since ORAM-SENTINEL focuses specifically on nuclear safety risk during plant shutdown conditions, this user group is actively involved with supporting the development of the American Nuclear Society (ANS) Low-Power/Shutdown Probabilistic Risk Assessment (LPSD PRA) Standard. Currently, this effort focuses

on applying qualitative methods (defense-in-depth and diversity) to manage nuclear safety risk during plant shutdown conditions.

Value

- Conduct defense-in-depth and diversity evaluations of nuclear safety risk
- Support compliance with 10CFR50.65 (a)(4) requirements
- Support compliance with Regulatory Guide 1.200 and upcoming ANS LPSD PRA standard requirements.

How to Apply Results

Members apply the ORAM-SENTINEL software to support defense-in-depth and diversity evaluations of both plant shutdown and operating risk. Once approved by ANS and endorsed by NRC, these approaches will be required to meet direction provided in the ANS LPSD PRA standard. Beginning January 1, 2008, plants also must comply with Regulatory Guide 1.200 for at-power PRA applications. Continued engagement through the ORAM-SENTINEL User Group and CRMF will permit members to effectively evaluate and manage nuclear safety risk and to ensure regulatory compliance.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
TBD – Project / deliverable to be determined based on RSM Advisor input at 1/08 and 7/08 Nuclear Advisory Meetings: TBD – Project/product to be determined based on advisor input at 1/08 and 7/08 Nuclear Advisory Meetings	12/31/2009	Technical Update

SQUG and SEQUAL (052489)

Issue

Unresolved Safety Issue (USI) A-46 required seismic re-evaluation of the equipment in older operating plants to render plant seismic ruggedness comparable to newer plants in which the equipment was qualified to newer standards.

Description

EPRI instituted the Seismic Qualification Utility Group (SQUG) to resolve NRC Unresolved Safety Issue A-46, "Seismic Qualification of Equipment in Older Nuclear Power Plants." EPRI and the nuclear plant community successfully resolved the issue through development and implementation of an experience-based method that uses equipment performance data from power and industrial facilities that have undergone actual earthquakes. The SQUG/SEQUAL program continues to investigate earthquakes to add to the database, add new equipment classes, and develop and implement methods for experience-based seismic qualification of replacement equipment and parts. SQUG/SEQUAL also promotes the use of the experience-based methodology to its international members and to organizations beyond the nuclear community.

Value

- Provide an innovative and cost-effective methodology for evaluating the seismic ruggedness of nuclear plant equipment without costly seismic shake table testing or analysis

How to Apply Results

Member engineers apply the SQUG methods to assess the seismic ruggedness of plant equipment; perform seismic evaluations of plant changes for heating, ventilating, and air conditioning (HVAC) and piping; and qualify new and replacement equipment and parts.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Data on Kashiwazaki Earthquake: Report documenting efforts to interpret time histories, spectra, and equipment performance data for the Kashiwazaki-Kariwa plant	10/23/2009	Technical Resource
Report on Hawaii Earthquake: Internal SQUG report on the 2005 Hawaii earthquake	7/30/2009	Technical Resource

PRA Applications Users Groups (061652)

Issue

Software tools to aid in risk management and safety need continuous updating and improving as new computer operating systems evolve and new plant application are developed. These tools must be developed under strict quality programs to secure regulatory confidence in validity and methodology. Additionally, software is increasingly expensive to develop and maintain.

Description

EPRI provides full life-cycle support for its software products through various code user groups. Project activities include the following: 1) maintain and upgrade existing EPRI software products to new utility software requirements communicated through the EPRI Software Engineering Team; 2) support the PRA scope and quality needs identified through other EPRI work with NEI and NRC; 3) expand existing applications as needed to support risk-informed regulations; and 4) provide a means to dialogue with NRC research staff to ensure new PRA approaches are well understood. The PRA Applications Group address software for performing Level 1, 2, and 3 PRAs, configuration risk management, external events and human reliability, as well as supporting applications for environmental and offsite accident initiators. The program group also provides tools to help nuclear plants document compliance with various ANS and ASME standards.

Value

- Ensure the viability of EPRI software to support risk-informed applications and operations
- Develop new methodologies to support new applications
- Encourage members to work together to develop a common approach to PRA issues

How to Apply Results

Members of the various software user groups set priorities for code development and testing of new software to ensure products meet customer needs and are fully tested to nuclear quality standards. Members implement these products through two processes: updating of existing software to newer versions and automating analysis through new tools.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
DEMO Version of CAFTA: CAFTA version that can be used to develop new applications and expand use in related EPRI sectors	10/15/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
R&R Tools Applications Package: Updated version of risk-related and licensing software, each software code being released on a roughly 18- to 24-month cycle as new operating systems, models, or data become available	2010	Software

Security Vulnerability Assessment (057871)

Issue

Nuclear plant security must be assessed for all types of threats, including the deliberate crashing of a commercial aircraft into a nuclear plant and armed attack. Nuclear plants must be prepared to respond to public opinion and to potential new regulatory requirements.

Description

This project addresses the range of security threats to nuclear plants and designs mitigation strategies. Project activities establish the relative risks of security vulnerabilities at nuclear plants compared to other energy options (for generation decisions) and compared to other infrastructure threats (for security decisions). Past projects have included structural integrity studies in response to various external attack scenarios and an analysis of risk-informed defensive strategies to lessen or thwart the effectiveness of an imminent attack. In addition, a methodology has been developed under which nuclear plant vendors can investigate the effects of aircraft impact on new designs. Project results are made available to plant owners, NRC, and other security authorities.

Value

- Evaluate the effects of aircraft impact on existing nuclear plant designs and assess inherent defensive capabilities of existing plant structures
- Evaluate the effects of aircraft impact on new nuclear plant designs and assess inherent defensive capabilities of existing plant structures.
- Simplify vulnerability assessments compared to past efforts

How to Apply Results

Members apply the guidelines for evaluating plant vulnerability to assess whether there is a significant risk to the plant given an aircraft impact and to adopt or develop contingency plans for a variety of attack scenarios. For new plants, aircraft impact must be considered as a beyond-design basis condition. EPRI results are routinely cited by industry user groups and owner groups to respond to vulnerability inquiries.

Security Probabilistic Risk Assessment (061653)

Issue

The nuclear industry has performed many analyses in response to September 11, 2001. These analyses have been largely deterministic. There is growing desire to risk-inform future security decisions by industry, Department of Homeland Security (DHS), and other stakeholders.

Description

EPRI is adapting and applying PRA methods for security applications. This research is being performed in close association with the NEI Security Working Group and Nuclear Sector Coordinating Council, whose members constitute all of the industry and government organizations involved in nuclear security issues. EPRI is the contractor for development and trial applications of the DHS Risk Assessment and Management for Critical Asset Protection (RAMCAP).

Value

- Develop a risk-informed approach for evaluating terrorist threats against nuclear plants
- Improve capability to cost-effectively implement security strategies to counteract potential terrorist threats

How to Apply Results

Members will apply methods developed through this research to evaluate plant vulnerabilities to potential terrorist attacks. Results and insights obtained will be integrated into plant security programs.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
RAMCAP Services: Provide services to update or maintain RAMCAP	12/31/2009	Technical Resource

Emergency Planning Protective Action Strategies (061655)

Issue

The NEI Emergency Planning Working Group (EPWG) has recognized the need to update the Emergency Planning (EP) technical basis, which is currently rooted in analysis technology 30 years old. An updated EP technical basis would be risk-informed and would account for the great increase in knowledge built from 30 years of experience.

Description

This project will evaluate the potential to apply risk-informed methods to emergency planning, including improved modeling of plume radionuclide concentrations, dose rate tracking, evacuation modeling, and health effects assessment. The research also will evaluate the effectiveness of enhanced protective action strategies, including shelter-in-place, away from reactor evacuation, away from plume evacuation, and keyhole evacuation.

Value

- Provide the basis for a risk-informed methodology for quantifying the relative effectiveness of various offsite protective action strategies. These strategies could then be considered for use in the EP process for nuclear plants.

- Provide an updated technical basis for EP, including consideration of a risk-informed approach and quantification of the margin in the required 10-mile emergency planning zone.
- Permit industry engagement with NRC to improve EP effectiveness and reduce unnecessary licensee burden.

How to Apply Results

Members will apply research results in developing advanced EP protective action strategies, coordinated through the NEI Emergency Planning Working Group.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
NEI Emergency Planning Working Group Support: Provide support to NEI Emergency Planning Working Group	12/31/2009	Technical Resource
NEI Emergency Planning Working Group Support: Provide support to NEI Emergency Planning Working Group	12/31/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
NEI Emergency Planning Working Group Support: Provide support to NEI Emergency Planning Working Group	2010	Technical Resource

Security Probabilistic Risk Assessment-Supplemental (061654)

Issue

The nuclear industry has performed many analyses in response to September 11, 2001. These analyses have been largely deterministic. There is growing desire to risk-inform future security decisions by industry, Department of Homeland Security (DHS), and other stakeholders.

Description

EPRI is adapting and applying PRA methods for security applications. This research is being performed in close association with the NEI Security Working Group and Nuclear Sector Coordinating Council, whose members constitute all of the industry and government organizations involved in nuclear security issues. EPRI is the contractor for development and trial applications of the DHS Risk Assessment and Management for Critical Asset Protection (RAMCAP).

Value

- Develop a risk-informed approach to evaluating terrorist threats against nuclear plants
- Improve capability to cost-effectively implement security strategies to counteract potential terrorist threats

How to Apply Results

Members will apply methods developed through this research to evaluate plant vulnerabilities to potential terrorist attacks. Results and insights obtained will be integrated into plant security programs.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
TBD – Project / deliverable to be determined based on RSM Advisor input at 1/08 and 8/08 Nuclear Advisory Meetings: TBD – Project/product to be determined based advisor input at 1/08 and 8/08 Nuclear Advisory Meetings	12/31/2009	Technical Report
