2 Central Street
Saxonville, MA 01701
Tele. 508-788-6260; Fax 508-788-6233
www.mtechnology.net

**Yoonik Kim**
PRA Analyst
kim@mtechnology.net

## Expertise

Experienced nuclear engineer with Ph.D. and proven work history in analysis research and special achievements in:

System Dynamics
Organizational factor analysis
Human reliability analysis
Decision analysis
Expert system analysis
Statistical analysis
Safety culture analysis
Probabilistic safety assessment
Plant configuration control analysis

## Education

**Seoul National University, Seoul, Korea** **2004 Ph.D.**
Doctor of Philosophy (Ph.D.) degree in nuclear engineering, February 2004. Thesis under professor Chang-Hyun Chung entitled **"A Study on the Assessment Method of Organizational Impacts on Risk of Nuclear Power Plants."** Work included: Quantification and modeling of organizational impacts, trip event analysis of Korean nuclear power plants in view of organizational factors, influence diagram utilization, and statistical independence test of organizational factors. Teaching assistant.

**Seoul National University, Seoul, Korea** **1998 M.S.**
Master of Science (M.S.) degree in nuclear engineering, February 1998. Thesis under professor Chang-Hyun Chung entitled **"Development of a Human Error Evaluation Methodology for Low Power and Shutdown Operation Tasks."** Work included: Modeling and analysis of human activities during low power and shutdown operations, reliability engineering, human factor engineering, and nuclear systems. Teaching assistant.

**Seoul National University, Seoul, Korea** **1996 B.S.**
Bachelor of Science (B.S.) degree in nuclear engineering, February 1996. This included a broad curriculum in nuclear engineering, mechanical engineering, computer programming, physics and mathematics.

**Professional Experience**

**MTechnology: PRA Analyst:** Dec. 2006 - Present

**Massachusetts Institute of Technology:**

Postdoctoral Fellow, Nuclear Science and Engineering Department: Nov. 2004 – Oct. 2005

Postdoctoral Associate, Nuclear Science and Engineering Department: Nov. 2005 – Nov. 2006

- **Idaho National Laboratory** **In progress**
  **Development of a Bayesian Method for the Detection of Nuclear Proliferation**
  - The objective of this research was to design, develop, and demonstrate a Bayesian-based decision support system for identification of situations where the operator of a nuclear fuel cycle facility may plausibly said to be either preparing for or participating in nuclear proliferation.
  - My work used Bayesian estimation techniques for quantifying the probability that proliferation is occurring, given the available information concerning how the facility is operated. This Bayesian approach should clarify the relative value of different diagnostic steps in reducing the uncertainty associated with interpretation of operator action.
  - Published a 'Fiscal Year 2006 Status Report,' in October 2006.

- **U.S. Department of Energy (DOE): Evaluation Methodology** **September 2006**
  **Proliferation Resistance and Physical Protection (PR&PP) Demonstration Study**
  - Project evaluated the proliferation resistance measures for a portion of the nuclear fuel pyrochemical reprocessing facility by applying a methodology that is being developed by the Proliferation Resistance and Physical Protection (PR & PP) Expert Group. Three different implementations of the pathway analysis methodology were used for the assessment of the Proliferation Resistance (PR) measures: the qualitative approach; the logic tree approach; and the Markov approach.
  - My contribution is part of the logic tree approach. Mass balance around a control volume was modeled by using System Dynamics and the success tree technique was used in pathway analysis. The System Dynamics model of mass flow showed the balance between the inflows to, outflows from and stored quantity in a control volume, and let the analysts have information on the significant amount of weapons material to be diverted.
  - The success tree analysis method was used to complement the event tree/fault tree analysis that is another part of the logic tree approach. Plausible scenarios of diversion were assumed and modeled by building success trees. The results were compared with those of event tree/fault tree analysis and sensitivity analysis was performed to obtain more reasonable probabilities of diversion attempts.
  - This event tree/fault tree and success tree analysis method has been used in the risk and reliability analysis area, esp. in the field requiring ultra high reliability. This pathway analysis could be used to identify and evaluate vulnerabilities of any kind of system.
  - Demonstration Study Results presented in the Interim Report, draft 7: Sept. 25, 2006

  Implementation Guide of Proliferation Resistance In progress
  - The Implementation Guide complements and refers to the Proliferation Resistance (PR) methodology report. It will be used for methodology training and will eventually become the training tool for the methodology after the PR Expert Group is disbanded.

- My contribution is to review this initial working document and suggest refinements and modifications through the application of the Implementation Guide to the DUPIC (Direct Use of Pressurized Water Reactor spent fuel in CANDU reactors) facility. This review application is performed in a stepwise manner with frequent feedback from domain experts.

- **Electric Power Research Institute, Inc. (EPRI) March 2006**
  **The Operational Risk Simulation Model (ORSIM): A project on improving nuclear power plant operations using system dynamics.**
  - Most significant part of the work: Developed a model that illustrated plant performance especially in terms of management/maintenance over time and, also, performed a simulation of a pilot nuclear power plant. This simulation fitted well to the real result. The time dependent characteristics were modeled by using System Dynamics.
  - Direct benefit to the project and contribution to the field: The model can help managers to maintain resource utilization while avoiding unnecessary vulnerabilities. This can simulate competing policies for facility management and, therefore, assists managers to make policy decisions.
  - Potential applications outside of nuclear power plant operations: The model can be applied to estimation of the reliability of any equipment and facilities over time. This method can be used to solve problems regarding the probability of systems being operational at any given time.

- **Safety Culture Evaluation Model In progress**
  **Model for nuclear power plants using System Dynamics & ORSIM**
  - Developing a safety culture evaluation model for nuclear power plants by using System Dynamics. Currently building this evaluation model in consultation with a safety culture evaluation expert in the Millstone Nuclear Power Plant in Waterford, CT where Units 2 and 3 were shut down between 1996 and 1998 due to safety problems. The model focuses on the leaders' role in an organization and will be integrated with ORSIM to show plant performance in terms of corrective work backlogs.
  - Results of this safety culture modeling work can be used in the management of nuclear power plants and can be applied to organizations in which leadership should be considered to be important.

**Systemix Co. Ltd., Seoul, Korea May 2004 – Oct. 2005**

**Researcher**

- A study on people recognition on energy policy in Korea
- A study on high-level waste management facility using System Dynamics algorithm.
- Development of safety culture indicators in Korean nuclear power plants. Used a System Dynamics model and the organizational factors suggested in preceding research.

**Seoul National University, Seoul, Korea March 2004 -**

**Post-Doctoral Researcher, Research Institute of Engineering Science**

- Statistical study in development of high brightness plasma ion source for focused ion beam.
- Development of a quantitative model of organizational impacts on nuclear power plant risk. Used a ratio model and the core damage frequency as a measure of risk.

- Statistical study on dependencies between organizational factors. Analyzed trip events of Korean nuclear power plants and used the results of the event analysis to identify dependency relationships between organizational factors.

**Seoul National University, Seoul, Korea** **1998-2004**

**Ph.D. Candidate, Nuclear Engineering Department**

- Development of a quantitative model of organizational impacts on nuclear power plant risk. Used a ratio model and the core damage frequency as a measure of risk.
- Statistical study on dependencies between organizational factors. Analyzed trip events of Korean nuclear power plants and used the results of the event analysis to identify dependency relationships between organizational factors.
- Development of a conceptual organization model for nuclear power plants, SPOOM (Self Poly-Oriented Organization Model) and an evaluation model of organizational impacts on NPP performance, EDM (Evaluation Diamond Model). Suggested an organization would be oriented to a specific direction.
- A study on human reliability analysis method using influence diagrams. Classified performance shaping factors according to their effects on human actions, and used fuzzy theory to quantify vague states of the effects.
- Cause analysis of human errors considering risk significance of trip events in nuclear power plants. Evaluation of risk significance using the conditional core damage probability as a risk measure.
- Development of a model to reflect censoring information in estimating reliability. Improved the redistribution method and using the Monte-Carlo method simulated to show the efficiency of the method developed.
- A study on the estimation of surveillance test interval for reactor protection system and engineered safety features actuation system (RPS/ESFAS) in nuclear power plants considering human reliability. Evaluated the probabilities of human error related to the surveillance test of RPS/ESFAS, which caused the adverse effects of the surveillance test.
- Lectured graduate students as a teaching assistant

**Seoul National University, Seoul, Korea** **1996-1998**

**M.S. Candidate, Nuclear Engineering Department**

- Development of a human error evaluation methodology for low power and shutdown operation tasks in nuclear power plants. Modeling and analysis of human activities during low power and shutdown operations.
- A study on the human reliability analysis methods. Used influence diagrams to identify the relationships between the performance shaping factors.
- Lectured undergraduate students as a teaching assistant.

**Korea Atomic Energy Research Institute (KAERI), Daejeon, Korea** **2001-2002**

**Entrusted Researcher, Integrated Safety Assessment Team**

- Development of a framework to identify organizational influences on component maintenance and identification of the organizational factors related to component maintenance in Korean nuclear power plants.

**Korea Atomic Energy Research Institute, Daejeon, Korea** **2000-2001**

**Research Student, Integrated Safety Assessment Team**

- A study on organizational factors in nuclear power plants.
- Development of a framework to identify organizational influences on component maintenance and a study on the organizational factors related to component maintenance in nuclear power plants.

**Korea Institute of Nuclear Safety, Daejeon, Korea** **1998-2000**

**Research Student, Reactor & Safety Evaluation Department**

- A study on risk informed regulation and application.
- A study on organizational factors including the intermediate results of COOPRA (The International Cooperative Probabilistic Risk Assessment Research Program).

**Training**

- IAEA Training Workshop on Optimization of Resource Allocation Effectiveness in Controlling Risk in the Operation of Nuclear Power Plants
- Compact Nuclear Simulator (CNS) training in KAERI
- Programming knowledge of FORTRAN and C language
- Extensive use of system dynamics code VENSIM
- Extensive use of decision making code HUGIN
- Extensive use of probabilistic safety assessment and reliability analysis code KIRAP
- Experience on reliability and risk analysis code SAPHIRE/IRRAS and plant risk monitoring code EOOS

**Professional Society Membership**

**Korean Nuclear Society: Member** **2003-Present**

## PUBLICATIONS

### Paper in progress

Yoonik Kim, Bobby M. Middleton, Michael W. Golay, "Use of system dynamics to aid in determining a management policy in a nuclear power plant," *International Journal of Electrical Power and Energy Systems*, In progress. Abstract:

> System dynamics can be a useful tool for plant managers to determine policy in a nuclear power plant in which complex feedback effects are engaged. The nonlinear nature of these complex feedbacks makes it difficult to predict the outcome of the system when subjected to a given impulse even in cases where experience has been gathered in similar situations. Unlike a linear system, the response of a nonlinear system to a given impulse is not proportional to the magnitude of the impulse. System dynamics can be very useful in these situations, because it allows managers to see the results of applying an impulse to the system without the organization actually having to bear the cost of the outcome. As systems become more complex, the impact of feedbacks become much more difficult to foresee without a quantitative means of modeling the system -- System Dynamics provides this means of analysis.
>
> For this study, system dynamics technique was applied to a construction project and to management of human resources in a nuclear power plant in order to improve solutions for workforce management problems. Analysis focused on the relative amount of time it takes to complete a given project under various conditions and simulated plant operations in terms of work priorities, resources and corrective work backlogs. This system dynamics examination provided results to facilitate management analysis and decision-making to determine appropriate levels of staffing; evaluate risks associated with implementing changes; and manage litigation for change-related contract costs. Beyond revealing the effects of controlling the workforce, the results illustrate the potential of the system dynamics technique to model complex, mutual feedback relationships in a wide range of plant operations and organizations.

### Journal Papers

Yong Suk Lee, Yoonik Kim et al., "Analysis of Human Error and Organizational Deficiency in Events Considering Risk Significance," *Nuclear Engineering and Design*, 230, pp. 61-67, 2004

Yoonik Kim et al., "A Study on Human Reliability Analysis Method Using Influence Diagrams," *Annals of Nuclear Energy* (under review), 2003

### International Conference Papers

Yoonik Kim et al., "A Method to Identify Dependencies between Organizational Factors using Statistical Independence Test," ICONE12, Arlington, USA, 2004

Yong Suk Lee, Yoonik Kim et al., "Analysis of Human Error in Trip Event Considering Risk Significance of Events in Korean NPPs," Trans. ANS, Vol. 88, pp. 877-878, 2003

Yong Suk Lee, Yoonik Kim et al., “Cause Analysis of Human Error Considering Risk Significance of Events,” ICONE11, Tokyo, Japan, 2003

S. H. Kim, Yoonik Kim et al., “The SPOOM-EDM Method for Assessing Organizational Factors,” ICONE11, Tokyo, Japan, 2003

Yoonik Kim et al., “Use of Influence Diagrams and Fuzzy Theory to Develop Assessment Method of Organizational Influences on Component Maintenance,” ICONE10, Arlington, USA, 2002

Kwang-Won Ahn, Yoonik Kim et al., “Development of Reliability Function and Failure Rate Considering Information of Censored Data,” ICONE10, Arlington, USA, 2002

Yoonik Kim et al., “Organizational Influences on Human Performance,” KJPSA-7, Jeju, Korea, 2002

Huichang Yang, Yoonik Kim et al., “A Study on the Estimation of Surveillance Interval for RPS/ESFAS Considering Human Reliability,” KJPSA-7, Jeju, Korea, 2002

Yoonik Kim et al., “Incorporation of organizational factors into human error probabilities using influence diagrams and fuzzy theory,” ESReDA2001, pp. 112-121, Rome, Italy, 2001

Kwang-Won Ahn, Yoonik Kim et al., “The non-parametric method estimating the survival or the reliability function considering the information of censored data,” ESReDA2001, pp. 13-22, Rome, Italy, 2001

Yoonik Kim et al., “Use of Influence Diagrams and Fuzzy for Evaluating Human Reliability,” KJPSA-5, Seoul, Korea, 1999
Yoonik Kim et al., “Use of Fuzzy for Assessing Human Factors during Low Power and Shutdown Operations,” PSAM4, pp. 1125-1130, New York, USA, 1998

**Research Reports**

Curtis Smith, Michael Golay, Man-Sung Yim, Kurt Vedros, Jerry Phillips, Yoonik Kim, “Development of a Bayesian Method for the Detection of Nuclear Proliferation”, FY 2006 Status Report, Idaho National Laboratory, 2006

M.W. Golay, Yoonik Kim et al., “PR & PP Evaluation Methodology Demonstration Study Interim Report,” Department of Energy, 2006

Ike Therios, Bob Bari, Eric Pujol, Trond A Bjornard, Dennis Bley, Cheng, Lap-Yan, Jor Shan Choi, Giacomo Cojazzi, Michael Golay, Richard Nishimura, Per Peterson, SEVINI FILIPPO, Yue, Meng, Michael Zentner, Joseph Pilat, Guido Renda, Mike Ehinger, Yoonik Kim, Eckhard Haas, Ike Therios, Brian W Smith, Garill A. Coles, “The Operational Risk Simulation Model (ORSIM),” EPRI Report-1011911, 2006
http://www.epri.com/OrderableitemDesc.asp?product_id=1011911

Sangman Kwak, Yoonik Kim et al., “Study on HLW management facility using System Dynamics algorithm,” KAERI/CM-XXX/2004, 2004

Chang-Hyun Chung, Yoonik Kim et al., “Development of Assessment Technology for Effects of Organizational Factors on Human Performance,” KAERI/CM-721/2002, 2004

Chang-Hyun Chung, Huichang Yang, Yoonik Kim et al., “Development of Configuration Risk Management Plant for PHWR Shutdown/Low Power Operation,” TM.02NE04.P2003.091, 2003

Chang-Hyun Chung, Yoonik Kim et al., “Development of Organizational Concept Model in Nuclear Power Plants,” KAERI/CM-516/2001, 2002

Chang-Hyun Chung, Huichang Yang, Yoonik Kim et al., “Development of Regulatory Technical Rationale for Risk Monitoring Program,” KINS/HR-458, 2002

Chang-Hyun Chung, Young Woo You, Huichang Yang, Yoonik Kim et al., “Development of Assessment Methodology for Plant Configuration Control,” KINS/HR-358, 2001

Chang-Hyun Chung, Yoonik Kim et al., “A Basic Study for Development of Environmental Standard Review Plan of Nuclear Power Plant,” KINS/HR-279, 1999

Chang-Hyun Chung, Young Woo You, Huichang Yang, Yoonik Kim et al., “A Study on Assessment Methodology of Surveillance Test Interval and Allowed Outage Time,” KINS/HR-213, 1998

Chang-Hyun Chung, Moosung Jae, Yoonik Kim et al., “Development of Human Reliability Analysis Methodology and Its Computer Code during Low Power/Shutdown Operations,” KAERI/CM