

7th International Topical Meeting on Nuclear Plant Instrumentation, Control, and Human-Machine Interface Technologies 2010

(NPIC&HMIT'4232)

**Las Vegas, Nevada
7 – 11 November 2010**

Volume 1 of 3

ISBN: 978-1-61782-266-7

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2010) by the American Nuclear Society
All rights reserved.

Printed by Curran Associates, Inc. (2011)

For permission requests, please contact the American Nuclear Society
at the address below.

American Nuclear Society
555 North Kensington Avenue
LaGrange Park, Illinois 60526

Phone: (800) 323-3044
(708) 352-6611
Fax: (708) 352-0499

www.ans.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

DIGITAL I&C ISSUES – I

Managed Complexity: an Architectural Paradigm for the Integration of Digital Systems in Nuclear Power Plants.....	1
<i>Paul J. Rebstock</i>	
Terrible "T"s of Technology - Ensuring an Effective Knowledge Management Program Exists in Future Nuclear Power Plants.....	11
<i>William Roggenbrodt</i>	
Development of a Computer Aided Licensing Support System (CALS) for Digital I&C System Review Process	25
<i>Swu Yih, Chin-Feng Fan, Yu-Shu Hu</i>	
Communication Issues of Nuclear Digital I&C Systems for Tainics Design.....	39
<i>Ting-Chia Ou, Chung-Lin Lee, Po-Ju Chen, Victor S. S. Shyu, Tzu-Chen Hung</i>	
Performance Evaluation of Token-pass Based Computer Network Protocol for Nuclear Instrument and Control Environment	50
<i>Chih-Ta Chiu, Yung-Chung Wang, Men-Shen Tsai, Tsung-Hsun Wu, Po-Ju Chen, Ting-Chia Ou, Chung-Lin Lee</i>	
The Conceptual Design of a Nuclear Safety Controller for Tainics Project	59
<i>Ting-Chia Ou, Chun-Lin Lee, Chang-Kuo Chen, Tsung-Hsun Wu, Si-Fu Hsieh</i>	
Effects of In-the-loop Interface Fidelity on the Simulation of Npp Processes.....	69
<i>Drew J. Rankin, Jin Jiang</i>	

REGULATORY ASPECTS OF I&C IN THE U.S. AND OTHER COUNTRIES – I

Revision of Branch Technical Position 7-19 Regarding D3 Evaluation of Digital I&C	81
<i>Eugene O. Eagle</i>	
Digital I&C DAC (Design Acceptance Criteria) /ITAAC (Inspections, Tests, Analyses, and Acceptance Criteria) Inspections.....	91
<i>Dinesh Taneja</i>	
Classification of I&C Systems: A Practical Approach	99
<i>Bruce M. Cook</i>	
Assessment of Digital Instrumentation and Control at Irsn: Principles and Application to EPR Flamanville 3	110
<i>Jean Gassino, Pascal Regnier</i>	
10CFR50.59 Evaluation of a Control System Digital Upgrade at Catawba and Mcguire Nuclear Stations	122
<i>Frederick J. Twogood</i>	

I&C NEEDS OF SMALL AND MEDIUM MODULAR REACTORS

Applicability of an In-core Instrument to the Smart (system-integrated Modular Advanced Reactor)	132
<i>Jin-Young Jung, Jin Seok Park, Won Jae Lee</i>	
The Role of Instrumentation and Control Technology in Enabling Deployment of Small Modular Reactors	140
<i>Dwight Clayton, Richard Wood</i>	
Development of an Optimal Sensor Placement Strategy for Nuclear Power Systems	153
<i>F. Li, B. R. Upadhyaya</i>	
Fast Valving for Small and Medium Sized Nuclear Reactors	166
<i>Alan S. Rominger, J. Michael Doster</i>	
Potential Application of Electrical Signature Analysis Methods for Monitoring Small Modular Reactor Components	179
<i>Brian Damiano, Howard D. Haynes, Raymond W. Tucker</i>	
Dynamic Modeling and Control Strategy for Multimodular Integral Pressurized Water Reactors	190
<i>S. R. P. Perillo, B. R. Upadhyaya</i>	

State Observer Design for Iris Nuclear Reactor Based on Dissipation Based High Gain Filter	200
<i>Yin Guo, Xin Jin, Robert M. Edwards</i>	

ADVANCED SURVEILLANCE, DIAGNOSTICS AND PROGNOSTIC TECHNOLOGIES AND APPLICATIONS I

Application of Failure Prognostics to the Iris Plant.....	213
<i>Jamie Coble, J. Wesley Hines, Belle R. Upadhyaya</i>	
Signal Grouping for Condition Monitoring of Nuclear Power Plant Components	226
<i>Piero Baraldi, Roberto Canesi, Enrico Zio, Redouane Seraoui, Roger Chevalier</i>	
Mimir - Continued Work on a Modular Framework for Condition Monitoring and Diagnostics	242
<i>Harald P.J. Thunem, Mario Hoffmann, Terje Bodal</i>	
Control Rod Monitoring of Advanced Gas-cooled Reactors.....	254
<i>C. J. Wallace, G. M. West, G. J. Jahn, S. D. J. McArthur, D. Towle, G. Buckley</i>	
Redundant Continuous Wavelet Transform for Fault Detection and Diagnosis.....	264
<i>S. Seker, B. R. Upadhyaya, T. Senguler, A. H. Kayran</i>	
General Class of Data Fusion Methods for the Plant Components Faults Detection.....	273
<i>Sergey S. Anikanov, Nicholas J. Marangoni, Igor V. Stolyetniy</i>	
A Method for Estimating the Confidence in the Identification of Nuclear Transients by a Bagged Ensemble of Fcm Classifiers	283
<i>Piero Baraldi, Roozbeh Razavi-Far, Enrico Zio</i>	

CURRENT CONCEPTS IN ADVANCED CONTROL ROOMS

Advanced Alarm Systems: a Survey of Industry Guidelines	294
<i>Garry T. Simmons</i>	
US-APWR Human System Interface System Verification & Validation Program for Digital I&C Design	310
<i>Satoshi Hanada, Kenji Mashio, Masashi Hirahatake, Koichi Takahashi</i>	
The Use of Test Facilities in the Design of the AP1000TM Nuclear Power Plant Control Room	316
<i>Steven P. Dobos, George Guzik, Julie I. Reed</i>	
Guidance on Identifying and Implementing Supplemental Human-system Interfaces (HSIS): an Update.....	326
<i>Robert T. Fink, Charles D. Killian, Joseph A. Naser</i>	
Development of the Advanced Candu Reactor Control Centre.....	337
<i>G. Raikums, S. Anam, R. Leger</i>	
Developing the Human System Interface (HSI) and the Supporting Instrumentation & Control (I&C) Architecture for a Multi-module Control Room.....	348
<i>Charles Weaver, Kenneth Harris, Steve Blomgren</i>	
The Influence of Working Postures and Physical Demands on the Operational Performance in the Advanced Control Room.....	357
<i>Chih-Wei Yang, Yuan-Chang Yu, Tzu-Chung Yenn, Tsung-Chieh Cheng, Ming-Huei Chen, Tung-Ming Wu</i>	

USE OF SIMULATION FOR DESIGN, ENGINEERING, MAINTENANCE AND VERIFICATION ACTIVITIES

The Development and Design of Human Machine Interface of the Monitor& Control System for Nuclear Power Plants	368
<i>Shou-yu Cheng, Zhong-kun Liu, Cheng Gong, Qiang Zhao, Min-jun Peng</i>	
A Deterministic Assessment of Lungmen DI&C System Using the Engineering Simulator.....	378
<i>Tze-Chieh Horng, H. P. Chou, Kin Wah Wong</i>	
Real-time Engineering Simulator Application for Plant Design, V&V, and Human Factors	390
<i>Steven Freel</i>	
Modern Nuclear Dcs Hardware Testing Verification Using Simulation.....	391
<i>Jody Ryan, Pascal Gain</i>	
The Development of a Human Systems Simulation Laboratory at Idaho National Laboratory: Progress, Requirements, and Lessons Learned.....	401
<i>Katya L. Le Blanc, David I. Gertman, Alan Mecham, William Phoenix</i>	

HFE DESIGN AND ANALYSIS TOOLS

Review of Methods Related to Assessing Human Performance in Nuclear Power Plant Control Room Simulations.....	411
<i>Katya Le Blanc, David Gertman, Ronald Boring</i>	
Operational Sequence Analysis for the Design of the AM1000TM Nuclear Power Plant	423
<i>Zhonghai Li, Julie I. Reed</i>	
Displays and Controls Sequential Ordering Optimization Based on Ant Colony Algorithm.....	434
<i>Yan Shengyuan, Chen Yu, Wang Shuaiqi, Zhang Zhijian, Peng Minjun, Yang Ming</i>	
A Study on the Evaluation Method for Human Factor Engineering of Nuclear Power Plant Main Control Room Layout.....	442
<i>Huixian Fan, Yuan Liu, Yanxiong Yang</i>	
Operating High Level Displays for Advanced Main Control Rooms.....	449
<i>Luis Rejas</i>	
Multi-layered Hsi Design: Part-plant Overview Displays	459
<i>Christer Nihlwing</i>	
Technical Improvements for Human System Interface in the Digital Control System of Lingao 3&4	472
<i>Shi Ji, Jiang Guojin, Xu Xiaomei</i>	

DIGITAL I&C ISSUES – II

Diablo Canyon Power Plant Digital Process Protection System Replacement Update	480
<i>Scott B. Patterson, John W. Hefler, Edward L. Quinn</i>	
Design Considerations of Analog to Digital Conversion for Digital In-core Wide Range Neutron Monitoring Applications	490
<i>Hsun-Hua Tseng, Hwai-Pwu Chou, Mon-Hwan Hsieh</i>	
Assessment and Qualification of Smart Sensors	499
<i>Sofia Guerra, Peter Bishop, Robin Bloomfield, Daniel Sheridan</i>	
Survey on Techniques for Modeling of Dependencies in the Digital I&C Design Phase	511
<i>Sizarta Sarshar, Monica Kristiansen</i>	
Digital Controls Upgrade Experience Lessons Learned, Key Issues and Recommendations	523
<i>Roy Raychaudhuri</i>	

REGULATORY ASPECTS OF I&C IN THE U.S. AND OTHER COUNTRIES – II

Development of a Harmonized Approach to Qualification of Electrical Equipment for Nuclear Power Plants Around the World.....	524
<i>Richard Wood, James Gleason, Edward L. Quinn</i>	
Guidance to Consistent Compliance of Licensing Digital I&C Systems and Equipment in Nuclear Power Plants.....	532
<i>Clayton Scott, Oszvald Glockler, Edward L. Quinn</i>	
NRC Digital I&C Software Regulation Application Experiences: Issues, Resolutions and Recommendations.....	536
<i>Jiin-Ming Lin, Jeen-Yee Lee, Swu Yih</i>	
Ukrainian NPP I&C Standard Base: Elaboration and Application	553
<i>Mykhaylo Yastrebenetsky, Yuri Rozen, Alexander Siora, Vladimir Bezsaly</i>	
Development and Harmonization of International Standards.....	560
<i>Leroy Hardin</i>	

ADVANCED SURVEILLANCE, DIAGNOSTICS AND PROGNOSTIC TECHNOLOGIES AND APPLICATIONS – II

Development of a New IEC Standard - Requirements for Security Programmes for Computer-based Systems	561
<i>Leroy Hardin, Edward L. Quinn</i>	
Practical Cyber-security Guidance for New Digital Plant Systems.....	562
<i>Robert E. Austin, B. E. Martin, David N. Woodard</i>	

Wireless Network Security in Nuclear Facilities	567
<i>J. Dion, M. K. Howlader, P. D. Ewing</i>	
Introduction of Cyber Security Assessment Methodology for the I&C Systems in Nuclear Facilities.....	579
<i>Youngdoo Kang, Dai. I. Kim, Hagtae Kim, Kil To Chong</i>	
On-line Monitoring Techniques for Improved Reliability and Maintenance of Research Reactors	590
<i>R. D. O'Hagan, H. M. Hashemian, J. P. McConkey</i>	
Experiences with Residual Approach to Validation of In-core Sensors by Peano Neuro-fuzzy System.....	605
<i>Stefan Figedy</i>	
Study of the Precision of the Mtc Estimate by Noise Analysis	617
<i>Griet Monteyne, Peter Baeten, Johan Schoukens</i>	
Elimination and Similarity Fault Diagnostics	626
<i>M. Humberstone, J. W. Hines</i>	
Knowledge-based Accident Diagnostics for APR1400 Nuclear Plants	638
<i>Sung Han Lee, Young Gyu No, Man Gyun Na, Kwang-Il Ahn, Soo Yong Park</i>	
Prediction of Axial DNBR Distribution Using Artificial Intelligence.....	650
<i>Dong Su Kim, Sim Won Lee, Man Gyun Na</i>	
Influence of Feedback on the MTC Estimate by Noise Analysis	662
<i>Griet Monteyne, Peter Baeten, Johan Schoukens</i>	

I&C KNOWLEDGE MANAGEMENT AND TRAINING

I&C Knowledge Management for Regulatory and Expert Activity	670
<i>Oleksandr Klevtsov, Mykhaylo Yastrebenetsky</i>	
Continuous Training to Excell in Products and Services for Nuclear Industry	683
<i>I. Bakhmach, A. Siora, O. Baranova</i>	
Partnerships in Managing NPP I&C Knowledge - a Win-win Strategy for All	690
<i>Andrey Kosilov, Oszvald Glöckler</i>	
Testing Digital Instrumentation and Control Systems Within the Distributed Test Facility (DTF)	692
<i>Qingti Guo, Carol Smidts, Tunc Aldemir, Don Miller, Edward L. Quinn</i>	
A Course on Software Engineering for Safety-related Systems.....	696
<i>Thomas Swain, Jason Carter, Carmen Trammell, Lan Lin</i>	
Development of Iaea Programs on Instrumentation and Control for Nuclear Power Plants.....	708
<i>Oszvald Glöckler, János Eiler, Richard Wood, Eddward L. Quinn</i>	

VOLUME 2

ADVANCED SENSORS AND MEASUREMENT TECHNIQUES – I: IN-PILE INSTRUMENTATION FOR MATERIALS AND TEST REACTORS

Development of an In-situ Creep Testing Capability for Advanced Test Reactor	716
<i>Bong Goo Kim, Joy L. Rempe, Darrell L. Knudson, Keith G. Condie, Bulent H. Spencer</i>	
Hot Wire Needle Probe for In-pile Thermal Conductivity Detection.....	728
<i>Joshua Daw, Joy Rempe, Keith Condie, Darrell Knudson, S. Curtis Wilkins, Brandon S. Fox, Heng Ban</i>	
Flux Sensor Evaluations at the Atr Critical Facility.....	740
<i>Troy Unruh, Joy Rempe, David Nigg, Paul Hart, George Imel, Jason Harris, Eric Bonebrake</i>	
Recommendations for Use of LVDTs in ATR High Temperature Irradiation Testing.....	753
<i>D L. Knudson, J. L. Rempe</i>	
Ultrasonic Thermometry for In-pile Temperature Detection	764
<i>Joshua Daw, Joy Rempe, Steven Taylor, John Crepeau, S. Curtis Wilkins</i>	

HFE STANDARDS AND GUIDELINES

IEEE and Iec Nuclear Power Instrumentation and Control Standardization - Opportunities and Challenges	775
<i>J. Scott Malcolm, James F. Gleason</i>	
Reviewing Consensus Hfe Standards for Nrc Use: a Case Study Using the Ieee Standard for Computerized Operating Procedure Systems	784
<i>John O'Hara, James Higgins, Jing Xing, Stephen Fleger</i>	

Updating the NRC's Human Factors Engineering Design Review Guidance	793
<i>Stephen Fleger, John O'Hara</i>	
Evaluation of Usability of "the Guideline for the Human Reliability Analysis Data Collection and Evaluation" to the Software Failure Scenario of Digital Instrumentation and Control Systems	801
<i>Takaya Hata, Ryuji Kubota</i>	
An Overview of the Ieee Human Factors Standard Development Activities	811
<i>Stephen Fleger</i>	
A Suggestion for the Improvement of Hmi Design Review Guidelines Based on the Design Review Experiences of Digital Devices for Nuclear Power Plants	817
<i>Tong-Il Jang, Yong-Hee Lee, Seong-Hwan Hwang, Jaekyu Park</i>	
A Method to Implement the Request Ofminimum Inventory of Human System Interfaces in Advanced Main Control Roomaccording to ISG05.	825
<i>Chuang Chun-Yu, Peng Cheng-Chun, Cheng Tsung-Chieh, Chen Ming-Huei</i>	

ADVANCED SURVEILLANCE, DIAGNOSTICS AND PROGNOSTIC TECHNOLOGIES AND APPLICATIONS – III

Diagnostics of Core Barrel and Fuel Assembly Vibrations in the Swedish Ringhals PWRS.	833
<i>I. Pázsit, C. Montalvo-Martín, A. Hernandes-Soís, P. Bernitt Cartemo, H. Nylen</i>	
Predicting the Ageing of Advanced Gas-cooled Reactor (AGR) Graphite Bricks	845
<i>G. M. West, C. J. Wallace, G. J. Jahn, S. D. J. McArthur, D. Towle</i>	
Use of On-line Monitoring to Support Condition Based Maintenance of Safety Category Sensors at Sizewell 'B' Nuclear Power Plant	856
<i>David J. Lillis</i>	
A Bayesian Prognostic Algorithm for Assessing Remaining Useful Life of Nuclear Power Components	875
<i>Pradeep Ramuhalli, Leonard J. Bond, Jeffrey W. Griffin, Mukul Dixit, Charles H. Henager</i>	
An Antineutrino Detector for Monitoring a Candu Reactor	887
<i>C. Jewett, R. Didsbury, G. Jonkmans, B. Sur</i>	
Design and Implementation of Advanced Nsss Integrity Monitoring System for Apr1400.	896
<i>Soo-Young Choi, Hyung-Hyun Byun, Soo-Am Kim</i>	
Leakage Diagnostics in Pressure Sensing Lines for Nuclear Power Plants.	906
<i>Keith E. Holbert, Kang Lin</i>	

FIELD PROGRAMMABLE GATE ARRAY (FPGA) FOR I&C APPLICATIONS – I

Design and Qualification of I&C Systems on the Basis of FPGA Technologies	916
<i>Ievgenii Bakhmach, Vyacheslav Kharchenko, Alexander Siora, Volodymyr Sklyar, Victor Tokarev</i>	
Using TMR to Mitigate Seus for Digital Instrumentation and Control in Nuclear Power Plants	925
<i>Xin Wang, Keith E. Holbert, Lawrence T. Clark</i>	
Qualification of Toshiba's FPGA-Based Safety-Related Systems	935
<i>Atsushi Kojima, Mamoru Kato, Masayoshi Tahira, Miyazaki Tadashi, Naotaka Oda, Yasushi Goto, Toshifumi Hayashi, Toshifumi Sato, Shinji Igawa</i>	
Conceptual Design of FPGA-based RPS for Lungmen Nuclear Power Plant	944
<i>Jun-Jen Lu, Hwai-Pwu Chou, Kin-Wah Wong</i>	
Issues on Validation of Programmable Logic Design for Digital Instrumentation and Control System	954
<i>G. Y. Park, Dai I. Kim, C. H. Jung</i>	
Using FPGA Technology As an Obsolescence Tolerant Replacement I&C Solution in the Nuclear Industry	964
<i>Martin Harrison</i>	

LICENSING CRITERIA AND LESSONS LEARNED IN LICENSING DIGITAL SAFETY SYSTEMS (NRC SPECIAL SESSION)

Licensing Field-programmable Gate Arrays in Safety Systems	966
<i>Bernard F. Dittman</i>	
Oconee Digital Safety System Licensing Experience	977
<i>Richard Stattel</i>	
Security of Digital Safety Systems	992
<i>Tim Mossman</i>	

Licensing Process for Digital Safety Systems	1001
<i>Norbert N. Carte, Derek Halverson</i>	
Licensing of the Oconee Nuclear Station Digital Protection System	1009
<i>Michael E. Bailey</i>	

OPERATOR TRAINING

Operator Tracking System Using Particle Filter for Operation Skill Evaluation in Plant Control Room.....	1011
<i>Shigeru Kanamoto, Aiguo He, Takenobu Kazuma, Shiyang Wang, Yo-ichi Kawai</i>	
Evaluation of Support System for Characterization of Training Scenarios for Bwr	1021
<i>Soshi Suzuki, Makoto Takahashi, Toshio Wakabayashi, Kouji Iwatare</i>	
Physical Fidelity Considerations for NRC Advanced Reactor Control Room Training Simulators Used for Inspector/examiner Training.....	1030
<i>Kristi Branch, Mark Mitchell, Mark Miller, Steven Cochrum</i>	
Human Factors Engineering As an Influence on Design Process for Overall Plant Design	1052
<i>Jeffrey M. Jones</i>	
Lessons Learned from the Challenger Disaster	1054
<i>Robert E. Austin</i>	

DIVERSITY AND DEFENSE IN DEPTH (D3) FOR NUCLEAR PLANT I&C SYSTEMS

Diversity Strategies to Mitigate Postulated Common Cause Failure Vulnerabilities	1071
<i>Richard T. Wood</i>	
Multi-diversity Versus Common Cause Failures: FPGA-based Multi-version Npp I&C Systems.....	1081
<i>Vyacheslav Kharchenko, Alexander Siora, Volodymyr Sklar, Andriy Volkovly, Volodymyr Bezsaliv</i>	
Development of a Diversity and Defense-in-depth Strategy for the CNNC Fuqing and Fangjiashan Nuclear Plants	1093
<i>John DiBartolomeo , Jerry Mauck, Mike Howard Edward L. Quinn</i>	
Homogenous Or Diversity-based Digital I&C Systems Using Diverse Elements in Reactor Protection Systems - Approaches Taken in Germany	1099
<i>Alfred Weich, Stefen Heinz, Reinhard Schildheuer</i>	
Development of a Diverse Actuation System for Four New Nuclear Plants in China.....	1108
<i>Eric Bernard, Chen Rigang, Liu Hongchun, Jerry Mauck, Edward L. Quinn</i>	

HUMAN INTERACTION WITH AUTOMATION

The Need for Improving Nuclear Plant Productivity	1113
<i>Robert E. Austin</i>	
The Improvement of Displayand Control Interface in the Digital Systems.....	1122
<i>Yi Chen Yang, Sheue Ling Hwang, Chang-Fu Chuang</i>	
Human-system Interfaces for Automatic Systems	1131
<i>John O'Hara, James Higgins, Stephen Fleger, Valerie Barnes</i>	
The Alarm System Design in Automation Systems	1143
<i>Tzu-Yi Yeh Liu, Sheue-Ling Hwang, Sheau-Farn Max Liang, Chang-Fu Chuang</i>	
Applying Design Principles of User Interfaces on the Screen Display in the Lungmen Nuclear Power Plant	1150
<i>Sheau-Farn Max Liang, Po-Yi Chen</i>	
Guidelines for Design and Implementation of Computerized Procedure Systems: an Update	1157
<i>Robert T. Fink, Charles D. Killian, Lewis F. Hanes, Joseph A. Naser</i>	
Coping with Automation in Future Plants.....	1169
<i>Gyrd Skraaning, Jr., Maren H. R. Eitheim, Nathan Lau</i>	

ADVANCED SURVEILLANCE, DIAGNOSTICS AND PROGNOSTIC TECHNOLOGIES AND APPLICATIONS - IV

A Method for Detection and Estimation of the Drift in Measurements	1178
<i>Sungwhan Cho, Jin Jiang</i>	

An Integrated System for Static and Dynamic On-line Monitoring of Nuclear Power Plant Systems and Components	1195
<i>B. D. Shumaker, G. W. Morton, R. J. Wunderlich, S. D. Caylor, H. M. Hashemian</i>	
Equipment Monitoring Via Transient Methods EPRJ Technology Innovation Program.....	1207
<i>Michael E. Sharp, J. W. Hines, Robert Austin</i>	
Thermal Performance Monitoring for Balance of Plant - Pliska.....	1220
<i>J. Pliska, Z. Machat, V. Horky, P. Sury, L. Havlat</i>	
Advanced Digital Rod Position Indication System For Existing and Next Generation Nuclear Reactors	1231
<i>G. W. Morton, S. D. Caylor, B. D. Shumaker, H. M. Hashemian</i>	

MODELING DIGITAL I&C SYSTEMS IN PRA/PSA

A Potential Methodology for Developing Software Common Cause Failure Parametric Model Parameters	1242
<i>Steven A. Arndt</i>	
Risk Analysis for Digital Reactor Protection System with Consideration of Human Errors in Maintenance Tasks	1244
<i>M. Khalaquzzaman, Hyun Gook Kang, Man Cheol Kim, Poong Hyun Seong</i>	
Development of a Quantitative Analysis Method for Dynamic Reactor Trip Signal Generation Failure in Nuclear Power Plants	1256
<i>Seung Ki Shin, Poong Hyun Seong</i>	
Two Insights and Their Implications in Fault Detection Coverage of Digital I&C Systems	1266
<i>Man Cheol Kim</i>	
Reliability Assessment of Diversity in Digital I&C Systems at Nuclear Power Plants.....	1272
<i>Jiri Sedlak</i>	
A Theoretical and Empirical Investigation of the Validity of the Current Software Reliability Measurement Practice.....	1282
<i>Swu Yih, Chin-Feng Fan, Wan-Hui Tseng</i>	
Quantitative Safety Analysis of Nuclear Safety Software.....	1297
<i>Gee-Yong Park, Heung-Seop Eom, Se-Woo Cheon, Seung-Cheol Jang, Dong-Hoon Kim</i>	

FIELD PROGRAMMABLE GATE ARRAY (FPGA) FOR I&C APPLICATIONS – II

Guidelines and a Primer on Application of Fieldprogrammable Gate Arrays (FPGAs) in Nuclear Plant I&C Systems.....	1305
<i>Robert T. Fink, Charles D. Killian, Thuy Nguyen, Antoine Druilhe, Frederic Daumas, Joseph A. Naser</i>	
Formal Verification of an FPGA Emulation of the Motorola 6800 Microprocessor.....	1316
<i>Antoine Druilhe, Frederic Daumas, Thuy Nguyen</i>	
Use of FPGA Technology in Implementation of the Logic of the Modernized Rod Control System (RCS) of the 900 MW EDF Fleet	1326
<i>Julien Bach, Ivan Tavolara</i>	
FPGA-Based Controller in CANDU® Nuclear Safety-Related Applications	1337
<i>Anqing Xing, John de Grosbois, Paul Archer, Anika Awwal, Vladimir Sklyar</i>	

I&C MODERNIZATION EXPERIENCE – I

Experience of I&C Systems Modernization Using FPGA Technology.....	1345
<i>Ievgenii Bakhmach, Vyacheclav Kharchenko, Alexander Siora, Volodymyr Sklyar, Anton And rashov</i>	
Impact of Data Processing and Monitoring System (DPMS) on Plant Operations	1353
<i>Sergey S. Anikanov</i>	
The Main Control Board Upgrade Project at the Ikata Power Station for Units 1 and 2	1362
<i>Hiroshi Morikawa, Hiroshi Watanabe</i>	
Implementation of Control Rod Control System to eliminate potential for SPV in PWR.....	1373
<i>Chae-Ho Nam, Soo-Am Kim, Kook-Hum Kim</i>	
Replacement of Plant Monitoring System (pms) for Ulchin Unit 1&2 Plants	1376
<i>Jeong-Kweon Lee, Yong-Chul Shin, Hang-Bae Kim, Cheol-Ha An, O-Mo Sung , Ji-Hun Lee</i>	
Manufacture and Function Test of Qualified Indication and Alarm System - Non Safety	1387
<i>Hyung-soo Lee, Jung-jin Park, Dae-jae Kim, Deok-in Kim, Seung-yeob Baeg</i>	

HUMAN PERFORMANCE MODELING IN THE NUCLEAR ENVIRONMENT

Information Foraging in Control Rooms	1395
<i>Ronald Laurids Boring</i>	
Inferring Operator's Thought with Eye Movement Data.....	1396
<i>Jun Su Ha, Poong Hyun Seong</i>	
Operationalizing Human Performance Models Using a Federation of Models Approach.....	1406
<i>Shelly Scott-Nash, Chris Plott</i>	
Extension of Functional Capabilities of NPP Information Computing System.....	1416
<i>A. Terekhov, K. Butkus, A. Voevodin</i>	
Evolution of the Human Client.....	1428
<i>Brian K. S. Smith, Jude Alexander</i>	

SAFETY CULTURE AND HUMAN RELIABILITY ISSUES

Comparing Safe Vs. At-risk Behavioral Data to Predict Accidents	1439
<i>Jeffrey C. Joe</i>	

VOLUME 3

Integration of Human Reliability Analysis with Human Factors Engineering Design	1446
<i>He Jiandong, Qiu Yongping, Hu Juntao</i>	
Systematic Evaluation of Human-machine Reliability	1452
<i>Victor Mihaylov, Rolf Wichman</i>	
Development of a HRA Method based on Human Factor Issues for Advanced NPP	1462
<i>Seung Woo Lee, Jun Su Ha, Poong Hyun Seong</i>	
Scrutinizing Cultural Factors in the Course of Events.....	1475
<i>Atoosa P.J. Thunem</i>	
Human Reliability Analysis for Design: Using Reliability Methods for Human Factors Issues	1488
<i>Ronald Laurids Boring</i>	

WIRELESS TECHNOLOGY APPLICATIONS IN NUCLEAR POWER PLANTS

The Emerging Role of Wireless Technologies in Nuclear Power Plants	1498
<i>Chad Kiger</i>	
Issues Associated with Deploying Wireless Systems in Nuclear Facilities	1510
<i>M. K. Howlader, P. D. Ewing, Jeanne Dion</i>	
Prototype of a Wireless Padlock for Administrative Clearances Monitoring.....	1522
<i>Francois Dionis</i>	
Analysis of High Luminance LED Beam Degradation for Visible Light Communication	1530
<i>Jai-Wan Cho, Seok-Boong Hong, In Soo Koo</i>	

ADVANCED SENSORS AND MEASUREMENT TECHNIQUES – II

Ultrasonic Waveguide Transducer for Under-sodium Viewing.....	1543
<i>H.-T. Chien, K. Wang, W. P. Lawrence, D. Engel, D. Miranda, S.-H. Sheen</i>	
3D Measurement and As-built Modeling by Photogrammetry and Laser Scanning in Nuclear Environments	1555
<i>Arnauld Dumont</i>	
Measurement of True Process Temperatures and Pressures in Nuclear Power Plants	1565
<i>H. M. Hashemian</i>	
A Detector System for Non-contact Imaging of Contamination Patterns	1575
<i>A. Das, B. Sur, S. Yue, M. Gaudet, P. Tonner, G. Jonkmans, N. Munir</i>	
Data-driven Fault Detection in Nuclear Power Plants Under Sensor Degradation	1586
<i>Xin Jin, Yin Guo, Robert M. Edwards, Asok Ray</i>	
Design of High-temperature Ultrasonic Linear Arrays for Under-sodium Viewing.....	1600
<i>J. W. Griffin, L. J. Bond, A. M. Jones, T. J. Peters</i>	

I&C MODERNIZATION EXPERIENCE – II

Manufacture and Function Test of Engineered Safety Features-component Control System for Supply New Nuclear Power Plant	1615
<i>Jeyoung Ryu, Seongtae Kim, Seungyeob Baeg, Kookhun Kim</i>	
The Challenges of Replacing the Saftey System in an Operating Nuclear Plane	1624
<i>Stephen Fowler, Jan-Erik Thomander</i>	
DRPI Upgrade: a Case Study	1633
<i>Joseph M. Maurio, Chris McClure</i>	
The Twice Lifecycle Engineering System	1635
<i>Caj E. Svensson</i>	
Digital Upgrade of the UFTR Protection and Control Systems.....	1646
<i>Alireza Haghighat, Gabriel Ghita, Lionel Bates, Eric Wallace</i>	

FAILURE AND FAULT ANALYSIS OF DIGITAL SYSTEMS

Installation Phase Software Safety Analysis.....	1647
<i>Hui-Wen Huang, Ming-Huel Chen, Shian-Shing Shyu, Tsung-Chieh Cheng, Tseng Mao-Sheng, Jui-Ming Lin</i>	
An Investigation of Digital Instrumentation and Control System Failure Modes.....	1659
<i>Kofi Korsah, Sacit Cetiner, Michael Muhlheim, W. P. Poore</i>	
New Fault Injection Methods for Safety Critical Digital I&C Systems: Application to Commercial Safety Grade I&C Platforms.	1672
<i>Carl R. Elks, Barry W. Johnson, Michael Reynolds, Nishant George, Nishant George, Marko Miklo, Michael Waterman, Jeanne Dion</i>	
Digital System Failure Analysis Methodologies	1690
<i>Bruce J. Geddes, Raymond C. Torok</i>	

SOFTWARE VERIFICATION & VALIDATION (V&V) METHODOLOGIES, ISSUES AND PRACTICES

Formal Validation of Safety I&C Systems.....	1697
<i>Robert R. Moniri</i>	
Experience of NPP with Vver I&C Software V&V with the Use of Computer Codes Applied for Nuclear Steam Supply System Designs Substantiation.....	1707
<i>M. A. Podshibyakin</i>	
Verification of Automated Changeover Swithcing Unit by Model Checking	1719
<i>Kim Björkman, Janne Valkonen, Jukka Ranta</i>	
Integrating Model Checking with Safety-critical I&C Software Design.....	1729
<i>Victor Mihaylov, Rolf Wichman</i>	
Analyzing Quality Aspects in Safety-related Standards.....	1741
<i>Isabella Biscoglio, Mario Fusani</i>	
Relap 5 Water-hammer Benchmarking Via a Theta-implicit Finite-element Algorithm	1749
<i>Stuart A. Walker, Arthur E. Ruggles</i>	

GENERAL HMIT – I

Mmotion Project, the European Project for Defining the EU Research Roadmap on HF, I&C and HSI for NPPS.....	1758
<i>victor Mihaylov, Rolf Wichman, F. Dionis</i>	
The Effects of Degraded Digital Instrumentation and Control Systems on Human-system Interfaces and Operator Performance	1768
<i>John O'Hara, Bill Gunther, Gerardo Martinez-Guridi, Jing Xing, Valerie Barnes</i>	
Human Factors Aspects of Operating Small Modular Reactors	1780
<i>John O'Hara, James Higgins, Richard Deem, Jing Xing, Amy D'Agostino</i>	
Human Error Modes According to the Design of Soft Controls I Advanced Mal Control Rooms	1792
<i>Seung Jun Lee, Jaewhan Kim, Seung-Cheol Jang</i>	

Development of Areva's Human Factors Engineering Strategy for German Modernization Projects	1802
<i>Gwendolin Holzner, Tobias Koeber</i>	
HFE Design Review: The U.S. NRC's Perspective and Lessons Learned	1811
<i>Paul Pieringer</i>	

GENERAL HMIT – II

The Control Room Upgrade in Oskarshamn 2 Modernization Project, Lesson Learned from on Going Human Factor Design Process.....	1812
<i>Thomas Gunnarsson, Magnus Eliasson</i>	
Licensing Issues of Human Factors Engineering for Digital Control Room in China	1822
<i>Shuhui Zhang, Fei Song, Danying Gu, Zhonghe Ning</i>	
Human Factors Engineering Review of a Digital Upgrade at McGuire Nuclear Station	1831
<i>Frederick J. Twogood</i>	
Some Advanced Alarm Functions	1842
<i>François Chériaux, Patrick Salaün, Joseph Naser</i>	
Improving Alarm Vizualization and Consistency for a BWR Large Screen Display Using the Information Rich Concept	1852
<i>Alf Ove Braseth ,Tommy Karlsson, Håkon Jokstad</i>	
Assuring Mmis Integration for Shin-kori 3&4.....	1862
<i>Daryl L. Harmon, Nancy Jo Roseberry</i>	
Hybrid Control Room Design: Challenges and Solutions	1871
<i>Alberto Foronda</i>	

GENERAL I&C – I

Application Prospect Analysis of the H1 Fieldbus in Nuclear Power Plant.....	1878
<i>Zhou Kun, Lin Jie, Sang Ming</i>	
A New Type of the Technological Flow Designing Method of the Nuclear Power Station	1890
<i>Zhi Pang , Yuan Liu, Yang Zhang</i>	
Current Status of Instrumentation for a Fluoride-salt Heat Transport Demonstration Loop0f	1897
<i>Roger Kisner, David Holcomb</i>	
Effect of Drywell Temperature Variations on Boiling Water Reactor Level Instrumentation Readings	1907
<i>Miguel F. Ceceñas, Rosember C. Ovando, Moisés A. G. Cruz, Miguel A. G. Castañeda, Andrés A. Vargas, Jorge J. Cárdenas</i>	
Model-based Condition Monitoring Techniques for Balance of Plant Analysis Using Tempo	1920
<i>William Beere, Steven Mullet, Emil Wingstedt, Oivind Berg, Samuli Savoainen, Tero Lahti</i>	
An Inverse Control-based Set-point Function for the Reduction of Water Level Fluctuations in a U-tube Steam Generator for Nuclear Power Plants.....	1925
<i>Mahmood Akkawi, Jin Jiang</i>	

VIRTUAL REALITY: APPLICATIONS AND ISSUES

Application of Virtual Models to Support Control Room Upgrades.....	1937
<i>Lewis F. Hanes, Christopher J. Sterba , Risa Larsen, Joseph Naser</i>	
Optimized Power Reactor from Drawing Board to Virtual Reality.....	1946
<i>Kune Y. Suh, Young M. You</i>	
A Comparative Study of Radiation Visualization Techniques for Interactive 3D Software Applications.....	1952
<i>Michael N. Louka, Grete Rindahl</i>	
Laser Scanning Technology in Support of Nuclear Plant Lifecycle Prepared for Hmit Conference	1967
<i>Amadeus Burger</i>	

GENERAL I&C – II

Solid State Protection System Refurbishment Using the RPC303 Automatic Test System.....	1980
<i>Michael J. Kmata , Joseph G. Kapusta</i>	

Regulatory Activities on Digital I&C Systems for Compliance with Electromagnetic Compatibility Requirements at Korean Nuclear Power Plants.....	1984
<i>Hong-Seok Jang, Bok-Ryul Kim, Sang-Keun Lee, Dae-Sik Kim</i>	
Requirements and Test Methods for EMC Qualification Testing of Nuclear Power Plant Equipment to Support Digital Upgrades	1996
<i>Chad Kiger</i>	
Going from Analog to Digital: Radiated Emissions Performance of a Nuclear Plant Control System Upgrade from 100 Hz To 6 Ghz.....	2008
<i>Philip F. Keebler, Stephen Berger</i>	

MANAGEMENT OF I&C AGING AND OBSOLESCENCE

Advanced Environmental Qualification Test and Condition-based Environmental Qualification for Cables	2020
<i>Toshio Yamamoto, Takefumi Minakawa</i>	
Applications of Joint Time-Frequency Domain Reflectometry for Health Assessment of Cable Insulation Integrity in Nuclear Power Plants	2032
<i>David Coats, JingJiang Wang, Yong-June Shin, Roger A. Dougal, Thomas Koshy</i>	
Benefits of Failure Analysis and Destructive Physical Analysis in Ageing Management of Electronic Boards.....	2039
<i>Laurent Cretinon, Dominique Talbourdet</i>	

APPLICATIONS OF TECHNOLOGY TO ENHANCE MAINTENANCE AND OPERATIONS

An Integrated Tool for Developing Operator Support System of Nuclear Power Plant.....	2051
<i>Yangping Zhou, Yujie Dong, Hidekazu Yoshikawa</i>	
Development of Semiotic Framework of Proactive Trouble Prevention Knowledge Base System and Its Application for FBR Prototype Plant "Monju"	2060
<i>Hidekazu Yoshikawa, Ming Yang, Morten Lind, Kiyoshi Tamayama, Kyoichi Okusa</i>	
On-line Maintenance Support Technology Based on MFM and Go-flow	2074
<i>Zhang Xu, Yang Ming</i>	
Toward the Preparation of Operating Procedures and Clearances Using 2d Interactive Drawings.....	2086
<i>Renaud Aubin</i>	
Knowledge Representation for Integrated Plant Operation and Maintenance	2092
<i>Morten Lind</i>	
Data Storage and Analysis Techniques for Monitoring Advanced Gas-cooled Reactor Structural Integrity	2104
<i>G. Jahn, S. D. J. McAuthur, D. Towle</i>	

INFORMATION PRESENTATION TECHNIQUES TO IMPROVE HUMAN DECISION MAKING

Knowledge Capture for the Utilities.....	2115
<i>Robert R. Hoffman, Brian Moon</i>	
Application of Knowledge Extraction Method for Ageing Management in Nuclear Power Plant.....	2125
<i>Natsuki Shiraishi, Makoto Takahashi, Toshio Wakabayashi</i>	
Performance Ahead: Innovative Digital, Information and Communication Technologies for Safer and More Efficient Outages in Nuclear Power Plants	2139
<i>Laurent Coudert, Fabrice Saintamon, Samuel Parfouru, Pierre Salom, Stéphanie Rey</i>	
Lessons Learned in Knowledge Elicitation with Nuclear Experts	2160
<i>Brian M. Moon, Matthew H. Kelley</i>	
Methods Applied at Comanche Peak NPP for Eliciting and Presenting Valuable Knowledge.....	2168
<i>Lewis F. Hanes, James Gallman, Joseph Naser</i>	

GENERAL I&C – III

R&D Projects in the NPIC&HMIT Area Sponsored by DOE Under the SBIR Program.....	2175
<i>Madeline Anne Feltus, H. M. Hashemian</i>	

Review of Passive Safety Control Systems in Nuclear Power Plants	2177
<i>Baosheng Wang, Dongqing Wang, Jianmin Zhang, Jin Jiang</i>	
Formal Verification of Freedom from Intrinsic Software Faults in Digital Control Systems	2191
<i>Sébastien Labb�, Nguyen Thuy</i>	
Modeling for the Nuclear Reactor Power Control System Based on T-S Fuzzy Model	2202
<i>Gong Cheng, Peng Minjun, Cheng Shouyu</i>	
Development of a New Working Group on Advanced Instrumentation, Control and Information System Technology for the LWR Sustainability Program	2209
<i>Ken D. Thomas, Frank P. Lipinski, Edward L. Quinn, Bruce P. Hallbert, Joseph Naser</i>	
Author Index	