Report on the 18th international workshop on nuclear safety and simulation technology

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Abstract: The 18th International Workshop on Nuclear Safety & Simulation Technology (IWNSST18) was held in December 8-9, 2014 at Harbin Engineering University, in Harbin, China. The major topics of this international workshop are related with recent advances in theory, methods, and systems on risk monitor technology and its application for nuclear power plants. There were eleven invited presentations at the IWNSST18, and the subject of the 11 presentations are classified into three categories: (i) Online real time risk monitor technology, (ii) Trends of PSA activities in individual countries, and (iii) Various risk monitor relevant researches from new aspects. This article provides the overview of the IWNSST18 with giving condensed summaries of all invited presentations given by international experts.

Keyword: risk monitor; online real time risk monitor; living PSA; wireless technology

1 Introduction[1]

The 18th International Workshop on Nuclear Safety and Simulation Technology (IWNSST2014) was held on December 8-9, 2014, at Meeting Room 370, No. 31 Bldg, Harbin Engineering University. The major topics of this international workshop are related with recent advances in theory, methods, and systems on risk monitor technology and its application for nuclear power plants. This report will give readers of this journal (IJNS) a comprehensive summary of the two-days' workshop.

2 Workshop program and organization of this report

2.1 Workshop program and participants

The 18th International Workshop on Nuclear Safety and Simulation Technology (IWNSST2014) was organized by the College of Nuclear Science and Technology of Harbin Engineering University (HEU). The time table of the two-days is as shown in **Table 1**. There were totally ca. 40 participants which include eleven speakers and HEU organizers, senior master course students, Ph.D. students and young teachers at College of Nuclear Science and Technology (CNST), HEU, and many experts from Chinese nuclear industries. The list of 11 speakers is given in **Table 2**. **Photo 1** shows the group photo of all attendants while **Photo 2** a snap of the workshop room.

Table 1 Time table of the 18th International Workshop on Nuclear Safety and Simulation Technology, December 8 and 9, 2014

Date	Time	Presentations
	09:00-09:20	Opening Address by Prof. Zhijian Zhang (HEU)
	09:20-09:30	Photo Time
	09:30-10:00	Lecture 1: General Introduction of HEU'S Project on Online Real Time Risk Monitor Development Speaker: He Wang Chair: Ming Yang
	10:00-10:20	Coffee break
	10:20-11:10	Lecture 2: Living PSA Updating Method Speaker: Min Zhang Chair: Richard T. Wood

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Date	Time	Presentations
	11:10-12:00	Lecture 3: Development of Reliability Data Online Acquisition, Analysis and Storage System in Nuclear Power Plant Speaker: Yingfei Ma Chair: Richard T. Wood
	12:30	Lunch
	14:00-15:00	Technical Tour to Visit labs in College of Nuclear Science and Technology
	15:00-16:00	Lecture 4 Review of Korean activities on PSA and its application for NPP Speaker: Kang Hyun Gook Chair: Hidekazu Yoshikawa
	16:00-16:20	Coffee break
	16:20-17:20	Lecture 5: Recent Advancements of Probabilistic Risk Assessment Methodologies and Risk Monitoring Usages in Japan Speaker: Takahiro Kuramoto Chair: Hidekazu Yoshikawa
December 9	08:40-9:40	Lecture 6: Synergy Effects of PSA and Information Technologies Speaker: Gyunyoung Heo Chair: Jing Jiang
	9:40-10:40	Lecture 7: Prognostics health management technologies and risk management Speaker: Pradeep Ramuhalli Chair: Jing Jiang
	10:40-11:00	Coffee break
	11:00-12:00	Lecture 8: Risk-Informed Decision Making for Automated Operation of Advanced Nuclear Power Plants Speaker: Richard T. Wood Chair: Jing Jiang
	12:00	Lunch
	14:00-15:00	Lecture 9:Wireless Technologies for NPP Applications Speaker: Jing Jiang Chair: Kang Hyun Gook
	15:00-15:20	Coffee break
	15:20-16:20	Lecture 10: Simulation, Digital System Validation and Reliability Speaker: Wong, Kin Wah Chair: Kang Hyun Gook
	16:20-17:20	Lecture 11: Nuclear Risk Management Speaker: Ernie Kee Chair: Hidekazu Yoshikawa
	17:20-17:40	Wrap up by Hidekazu Yoshikawa

Table 2 List of speakers

No.	Speaker	Title/Affiliation
1	Richard T. Wood	Oak Ridge National Laboratory （ORNL） Senior Research Engineer
2	Pradeep Ramuhalli	Pacific Northwest National Laboratory (PNNL) Senior Research Scientist
3	Kang Hyun Gook	Korea Advanced Institute of Science and Technology Dept. of Nuclear & Quantum Engineering Professor
4	Takahiro Kuramoto	Nuclear Engineering, Ltd. Design Service Department Deputy General Manager
5	Jing Jiang	University of Western Ontario Department of Electrical and Computer Engineering Senior Industrial Research Chair Professor

No.	Speaker	Title/Affiliation
6	Gyunyoung Heo	Kyung Hee University Center for Convergence Education, Director Department of Nuclear Engineering, Mainformatics Lab, Associate Professor
7	Wong Kin Wah	A-D Technology, Inc. President
8	Ernie Kee	Texas A&M University Associate Professor of Practice
9	He Wang	Harbin Engineering University College of Nuclear Science and Technology Associate Professor
10	Min Zhang	Harbin Engineering University College of Nuclear Science and Technology Lecturer
11	Yingfei Ma	Harbin Engineering University College of Nuclear Science and Technology PhD Graduate

Photo 1 Group photo of all attendants.

Photo 2 Snapshot of the workshop room.

2.2 Organization of this report

The contents of all the eleven papers presented at the workshop and the related discussion are summarized in the subsequent chapters by classifying into three categories: (i) Online real time risk monitor technology, (ii) Trends of PSA activities in individual countries, and (iii) Various risk monitor relevant researches from new aspects. According to Prof. Zhang Zhijian's saying in his opening address of IWNSST2014, the first subject of online real time risk monitor technology is in fact the HEU's on-going three-year R&D project with the corporation of several companies in China .

3 Online real time risk monitor technology

3.1 General introduction of HEU project on online real time risk monitor development

Prof. He Wang presented the overall summary of HEU project on online real time risk monitor development. The synopsis of his presentation and the subsequent discussions are given in the following.

Photo 3 Prof. He Wang.

3.1.1 Summary

The online real time risk monitor system (OLRMS) development is the National High-tech R&D Program and PWR Major Program for science & technological development plan in China. This program is headed by HEU, collaborating with CNPE, SNERDI and CNPI. The salient feature of this risk monitor is that it can conduct on-line accessing to I&C system through hardware, which is different from existing risk monitor. At the same time, this risk monitor can automatically operate and update the risk models and the reliability data of the equipment by online manner in time. So this online real time risk monitor is in the stage 4 of living PSA according to the Freeman's definition of risk monitor. When the plant configuration changes, the risk monitor will obtain the results about instantaneous risk and component importance in two minutes.

There are five key parts of OLRMS, including (1) on-line acquisition, analysis and storage of reliability data, (2)on-line risk model updating, (3)on-line risk model calculation, (4)operation recommendations and (5)human machine interface. The five parts are simply introduced by the structure diagram. The details of the first two parts were separately introduced by Ms. Min Zhang in the next presentation. The method of on-line risk model calculation is based on Binary Decision Diagram (BDD). The operation of the prototype software for component cooling water system when status changes occur among the pumps was demonstrated by using video.

3.1.2 Record of discussion

Q1: For the Texas Project in US, the operator is easy to see which one of subsystems is available. But in your example, the operator firstly sees the unavailable equipment.

A1: According to the technical specification in US, when one pump is unavailable while the redundant pump is normal in one subsystem, then the operator think that the subsystem is normal. But the operator in Chinese plants thinks that the same situation is abnormal. The operator in US concerns the system layer, whereas the operator in China concerns the equipment layer.

Comment: In US, the STP plant prequalifies the impact of unavailable equipment or subsystem for a higher level motion in the off-line risk monitor.

Q2: Do you think the on-line real time risk monitor will help the maintenance?

A2: We provide the equipment importance ranking. But the maintenance information is manually input by the maintainers.

The details of his presentation is described in his paper [1] in this issue.

3.2 Living PSA updating method

Following Prof. He Wang's presentation, Ms. Min Zhang presented the development of living PSA updating method now conducted by the HEU's project. The synopsis of her presentation and the subsequent discussions are given in the following.

Photo 4 Ms. Min Zhang.

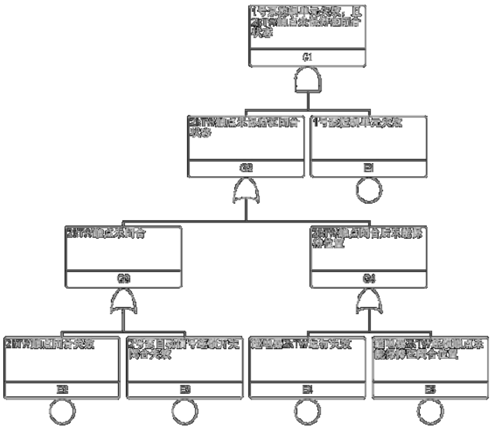
3.2.1 Summary

Living PSA modeling and updating is a part of online real time risk monitor development program which includes (i)independent failure modeling and updating, (ii)CCF modeling and updating and (iii)sequence dependent failure modeling and updating. The target of this research is to develop the method of automatic updating the living PSA models by considering conditional and time-dependent component failure probability. The updating manner could be to change the event Logic to be "True" or to change the event Probability to be "1" when there is a component unavailable.

The mathematical models are introduced for both non-repairable and repairable independent failure modeling and updating. For CCF modeling & updating, mapping down process is proposed to be used to measure the change trends of the CCF parameters when there is a decrease of CCF train/order caused by a random independent causes. The recursive rules are deduced for Alpha Factor model and MGL model to update CCF parameters. For sequence dependent failure, priority-And Gate is induced to describe this kind of dependent property, and enumerating modeling and House Event are recommended by considering the difficulty to judge the sequential relation automatically.

3.2.2 Record of discussion

Q1: What happened in the E1 component in your slide 28 below?



A1: E1 is the control unit failure.

Q2: For the preventive maintenance, there is a conditional probability for the component to bring back. Do you consider such situation in your recovery process?

A2: I put value "True" for the prevent maintenance because I am not sure whether the worker can recover the components immediately or by what probability it can be recovered during the preventive maintenance when there is a demand of the component. If they can do it, the formula or model for the component is to be updated according to the real situation. And the way to put the event to be true when it is in preventive maintenance will lead to a conservative assessment.

Q3: According to the IAEA report, the living PSA process includes living PSA model and living PSA document. How do you update the maintenance document?

A3: That is the work for the next year. So I cannot answer your question.

The details of her presentation is described in her paper [2] in this issue.

3.3 Development of reliability data online acquisition, analysis and storage system in nuclear power plant

Mr. Yingfei Ma presented the developmental work of reliability database management method within the HEU project. The synopsis of his presentation and the subsequent discussions are given in the following.

Photo 5 Mr. Yingfei Ma.

3.3.1 Summary

This system can realize the function of reliability data and parameter acquisition, calculation and storage in the real environment of nuclear power plant. It has three functions and the most important function is providing reliability parameters for online risk monitor. The way of acquisition has two ways, off-line and on-line.

Data analysis and conceptual design for the system is introduced by dividing into four parts: data acquisition, data pre-processing, parameter calculation and interface. Since this system has to work continuously for 18 months, a redundancy backup hardware is provided for the safety of data. Modular design method has been employed to construct the system and the primary design has been finished. But there are some technical problems to solve in the next phase.

3.3.2 Record of discussion

Comment: The changes of maintenance policy may also change the failure rate. So I think the database should consider the changes of policy. For the zero-failure reliability data analysis, you can collect the data from many ways such as manufacturer, appropriate modeling method and so on. Maybe you can consider it from the data of similar equipment. Pulling data is a way to solve the problem for no failure data.

Q1: The database is good information for the

maintenance policy because the maintenance is conducted when the condition of component becomes close to the failure.
A1: The main task of the system is providing the data for the risk assessment. Other application will be considered in the next phase.

Q2: How do you distinguish the data between safety system and non-safety system?
A2: The two different kinds of data are separated by the different device class. The device class is determined by the professional users.

Q3: What is the purpose of the Mann-Whitney U test?
A3: The test is used to determine the distribution of parameters. If the result is non-NHPP test, the Weibull distribution is used to measure the parameter.

The details of his presentation is described in his paper [3] in this issue.

4 Trends of PSA activities in individual countries

4.1 Review of Korean activities on PSA and its application for NPP

Prof. Hyun Gook Kang made a review of Korean activities on PSA and its application for NPP. The synopsis of his presentation and the subsequent discussions are given in the following.

Photo 6 Prof. Hyun Gook Kang.

4.1.1 Summary

His presentation provides an overview of Korean activities on the utilization of probabilistic safety assessment (PSA) for various applications in nuclear field. Korea is one of the most active countries which utilize the risk information for balancing safety and economy. In 1994, the policy statement on the nuclear safety was promulgated, requiring that the utility should perform integrated safety assessments for NPPs by using the PSA and that the regulator should implement a risk-informed and reasonable regulation by considering the balance between cost benefit. Typically Risk Monitoring System (RIMS) was deployed in nuclear power plants (NPP) in 2007. Outage Risk Indicator of NPPs (ORION) and Plant Reliability data Information System (PRINS) were also implemented in NPPs. Risk information plays very important role in the improvement of plant designs and operation procedure development.

In addition to the utilization of PSA for a construction permit and an operating license, many risk-informed applications including surveillance test intervals extension and allowed outage time extension were performed. Now periodic risk quantification is required for every NPP by regulatory body in its Periodic Safety Review (PSR) that assesses the cumulative effects of plant aging, modifications, operating experience, technical developments, and site characteristics.

Active utilization of risk information implies that the PSA must have a credible and defensible basis since it is to be used to support decision making at NPPs. Since the concept of ‘living PSA’ means continuous efforts to update or modify the risk models and data when it is necessary, it would be critical to keep the credible basis.

4.1.2 Record of discussion

Q1: Is there any specific method to combine PSA and dynamic risk information in your work?
A1: We just proposed it, and it is still under development.

The details of his presentation is described in his paper[4] in this issue.

4.2 Recent advancements of probabilistic risk assessment methodologies and risk monitoring usages in Japan

Dr. Takahiro Kuramoto gave a comprehensive overview on Japanese activities of PSA researchers and practitioners after Fukushima Daiichi accident. The synopsis of his presentation and the subsequent discussions are given in the following.

Photo 7 Dr. Takahiro Kuramoto.

4.2.1 Summary

The first part of his presentation describes the recent advancements of PRA methodologies especially on developing the PRA standards by the Standards Committee of Atomic Energy Society of Japan (AESJ).

The importance of Probabilistic Risk Assessment (PRA) not only for internal events but also external events has been highlighted following the Fukushima Daiichi NPP accident in Japan. The Standards Committee of AESJ is currently working on the development of the PRA implementation standards concerning the individual external events. At the same time, the Committee is studying how to assess the combinations of external events, and it has started the development of PRA implementation standards for combinations of external hazards. Besides the implementation of PRA as the quantitative risk assessment, the committee is studying the risk assessment procedures for various types of potential external hazards.

The Japanese utilities also recognize that the risk information should be used to enhance the rationality and accountability of safety-related activities in order to realize efficient management of NPPs. "Risk Monitoring" is the essential item for PRA usage and safety-related activities. The latter part of his presentation describes the current status of "Risk Monitoring" usages in Japan especially on "Shut down risk evaluation for every outage".

4.2.2 Record of discussion

Q1: How to convert the effect of external events to that of internal events in your slide which explains various external events to the plant?

A1: The blue line of converting Tsunami into the internal events is one of the issues to be considered further, where how the external events would affect the plant as the internal events are the important points to study.

The details of his presentation on the standardization of PRA practice by AESJ is described in his paper [5] in this issue, while the introduction of "Risk Monitoring" usages in Japan was already published in this journal (See Ref.[6]).

4.3 Nuclear risk management

Prof. Ernie Kee reflected on the past activities in USA where the PSA had first emerged in 1975 and then expanded not only in USA and but also around the world. The synopsis of his presentation and the subsequent discussions are given in the following.

Photo 8 Prof. Ernie Kee.

4.3.1 Summary

Practical application of risk assessment in nuclear power operation and maintenance is described. Historical experiences with risk assessment of example major projects are described. A current example of an incremental step of risk assessment where UQ of statistical and physical models is incorporated in event tree quantification is summarized. The current state of interactions (license amendment process) with the US regulator is summarized. The possible improvements that could be made with equipment data collection and analysis are explored based on experience with use of US database.

4.3.2 Record of discussion

Q1: How do you choose the limitation value in your slides of illustration of the risk accumulation process with threshold crossing?

A1: We consider it from the guideline RG1. 174 to keep track the risk accumulation.

Q2: Do you think the guideline is completely right?
A2: I am not sure. Perhaps you could figure it out by yourself and determine it as what you believe. But this guideline was approved by regulatory, so we have to use it as limitation value.

Q3: Whether do you think your assessment is subjective?
A3: Yes, all the assessment is subjective, and I am sure we have missed a lot of possibilities, but it is very hard to take all factors into consideration. And we do not know if we are right. It is harder to "unknown unknown" than "know unknown". Human beings want to take risk, and the operators may not be really careful. So we still need much work need to do to improve performance.

Q4: Why do you choose operators are more careful and reliable than equipment?
A4: This is my option, for operators have work order to follow to do what they need to do, but what you said is also a possible factor, as sometimes they just focus on specific equipment but not all systems.

5 Various risk monitor relevant researches from new aspects

5.1 Synergy effects of PSA and information technologies

Prof. Gyunyoung Heo made a critical review on the PSA from the aspect of Information, Communication and Technology (ICT). The synopsis of his presentation and the subsequent discussions are given in the following.

Photo 9 Prof. Gyunyoung Heo.

5.1.1 Summary

Probabilistic Safety Assessment (PSA) is getting strengthened not only to support Risk-Informed Applications (RIAs) but also to meet regulatory requirements. Meanwhile, the design of Man-Machine Interface System (MMIS) is implemented upon the functional requirement assigned in top-down manner after determining hardware designs. The role and opportunity of nuclear MMIS should be worthwhile to be highlighted. The current PSA models have factors which can significantly reduce risk if advanced MMIS technologies are applied. The enabling techniques for initiating event frequency update, diagnosis enhancement, and severe accident management with resilient capability can be proposed.

5.1.2 Record of discussion

Q1: Why do you use the model of forecast information in your slide No. 20 of the comparison between reliability-based distribution and condition-based distribution?
A1: This figure can answer the question why the characteristic of the model is the more information we got, the more accuracy it can get. So we use this model to present information to the operator.

Q2: What the index of "anomaly early warning" with the value of 99.89 % means in No.16 of your PPT and what type of NPP is your work based on?
A2: The index is just an example without any specific meaning and I just offer an NPP to explain my model.

5.2 Prognostics health management technologies and risk management

Dr. Pradeep Ramuhalli made a comprehensive overview on Prognostics health management technologies with its significant role for effective risk management. The synopsis of his presentation and the subsequent discussions are given in the following.

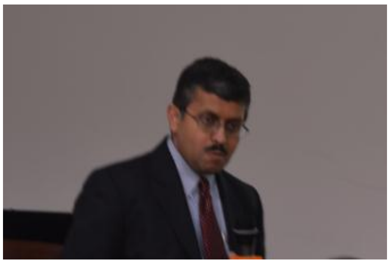


Photo 10 Dr. Pradeep Ramuhalli.

5.2.1 Summary

Current operations and maintenance (O&M) practices in nuclear power plants essentially use periodic inspections of safety-critical active and passive components to ensure safety. These practices, while effective, can have a negative impact on the cost of operation of these reactors. Approaches that help manage and/or mitigate O&M costs are likely to help improve the economics of operation of nuclear power while maintaining adequate safety margins.

One requirement to improving O&M costs while not compromising safety in nuclear power reactors is the ability to monitor for component degradation. Information on component degradation may be applied to estimate the remaining service life of the component (*i.e.*, prognostics), and integrated with operational risk monitors to assess the risk to continued operation of the nuclear power plant. The assessment of remaining life is important in proactive- or prognostic-based health management of these facilities because such “condition-based maintenance” strategies can potentially improve safety and reduce costs by detecting damage and scheduling appropriate mitigation strategies early in the component life cycle. Systems for prognostics health management (PHM) in nuclear power plants have several requirements, including appropriate sensors and instrumentation for monitoring degradation, analysis methods that extract metrics of degradation level, and algorithms for prognostics that account for uncertainty in various parameters. The resulting prognostic output needs to be integrated into operational risk monitors to provide a robust estimate of changing risk in the power plant. His presentation provides an overview of current research in the area of prognostics health management and its integration with risk monitors to achieve these goals.

5.2.2 Record of discussion

No specific questions were given from the audience.

5.3 Risk-informed decision making for automated operation of advanced nuclear power plants

Dr. Richard T. Wood proposed a new methodology for risk-informed decision making for automated operation of advanced nuclear power plants such as small modular reactor. The synopsis of his presentation and the subsequent discussions are given in the following.

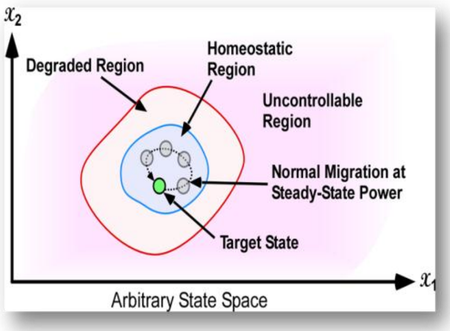
Photo 11 Dr. Richard T. Wood.

5.3.1 Summary

Advanced reactors, especially small modular reactors, can benefit greatly from highly automated operations. Innovative operational approaches embedded in a supervisory control structure can facilitate nearly autonomous operation of multi-unit plants, which can greatly reduce demands on operational staff, lower operations and maintenance costs, and promote efficient power generation. Current supervisory control research is investigating the use of probabilistic risk assessment (PRA) tools to support operational decision-making. By doing so, the risk of operational strategies can be determined online given a specific plant configuration and condition knowledge for key plant components. Consequently, automated decision-making can be incorporated based on probabilistic methods to minimize risk and enhance efficiency. In association with this research, development of enhanced risk monitors is underway to update reliability data for components based on equipment condition assessment results to ensure that risk determination is based on the actual plant condition. His presentation gave the current research on supervisory control decision techniques and the incorporation of condition monitoring assessment data into dynamic risk monitors.

5.3.2 Record of discussion

Q1: What does the red line and the axis means in Page 27 of the PPT?



A1: The red line illustrates a safety boundary corresponding to safe states (inside the boundary) and unsafe states (outside the boundary). Safety systems act to prevent plant conditions from violating the safety boundary. The axes represent arbitrary state variable. Specific examples include power and flow, temperature and pressure, *etc.*

Q2: How to address high-impact technologies?
A2: The supervisory control framework provides a means of incorporating high-impact technologies into the operational control of plants. An example of the integration of control, diagnostic and decision capabilities for supervisory control is the development of real-time predictive risk monitors to inform operational decisions.

5.4 Wireless technologies for NPP applications

Prof. Jin Jiang introduced the merit of introducing wireless technologies for NPP applications both for improving safety and reduction of cost. The synopsis of his presentation and the subsequent discussions are given in the following.

Photo 12 Prof. Jin Jiang.

5.4.1 Summary

Wireless technology has matured to a level where it can reliably be deployed in several industries for the purposes of measurement, condition monitoring and process control. It has been proved that they are beneficial in terms of reducing cable costs and installation time as well as increased flexibility through temporary sensor network deployment. The nuclear industry could also benefit from the adoption of wireless technologies, provided certain specific issues are resolved. These issues include, but not limited to, relevant codes and standards, resistance to radiation in a nuclear environments, cyber security and wireless technological issues.

In his presentation, a preliminary review of several industrial wireless sensor standards was covered first and technical issues specific to nuclear industries were then described. Lastly, initial results of the research and demonstration of wireless technologies for nuclear power plant applications will be summarized with the details of key issues to support and to facilitate adoption of wireless sensor technologies within nuclear power plants and other nuclear facilities.

5.4.2 Record of discussion

Q1: Is there any international criteria for wireless sensor utilization?
A1: Before there is a committee focused on this but now dismissed. Because different companies has different technology. They cannot combine.

Q2: If the wireless sensor signal can penetrate into the containment, how was about your test results in the air chamber in containment?
A2: We have tested in the air chamber and there has no impact to our results. Now our method is to use wireless signal inside and outside the containment then use a cable to transmit the signals. As electric magnetic wave cannot penetrate into the concrete. Besides, a new project proposed by IAEA is using ultrasound to transmit the wireless signals between inside and outside concrete.

Q3: What are the advantages and disadvantages between cables and wireless transmitting?
A3: Cables are inexpensive, with high quality, stability but hard to change. For example if you build a new NPP, cables would be the best choice. In contrast, if you need repair and maintain a NPP, then wireless would be better.

The extensive research activities of his group for wireless technology are introduced in Refs. [7] and [8] in this issue.

5.5 Simulation, digital system validation and reliability

Dr. Wong Kin Wah introduced the interrelationship between simulation, digital system validation and reliability and how to cope with the related problems comprehensively. The synopsis of his presentation and the subsequent discussions are given in the following.

Photo 13 Dr. Wong Kin Wah.

5.5.1 Summary

In the past nuclear power plant (NPP) instrumentation and control (I&C) systems are mostly based on analog technology. With the advancement of commercially available digital systems such as Programmable Logic Controllers (PLC) and Distributed Control Systems (DCS), digital technology will be widely used in new installations and in replacement of existing installations.

Validation and reliability assessment of digital systems in nuclear power plant applications are both important and challenging, where the challenging issue will be on how to perform dynamics, integrated and interactive testing of digital systems and how to quantify reliability assessment. An engineering simulator can play important role in validation testing and reliability assessment, where the engineering simulator must satisfy the following criteria; (i)The reactor core modeling should be based on advanced best estimate core modeling codes, and (ii)The simulator should be a full scope simulator, that is, it should include all the plant systems and the process and logic modeling should be the same way as the actual plant. The V&V program should be implemented to assure that the implementation of both the plant process and logic model are correct.

In his presentation a methodology on how to use simulation to perform validation and quantify assessment of digital systems were discussed and preliminary results for a specific application were also presented.

5.5.2 Record of discussion

Q1: We are suspecting if our computers are completely reliable. What do you think about it?

A1: According to our experience, we met problems. That is why NRC requires us all NPP must have backup systems which include equipment, persons, all kinds of back up.

Q2: In simulation, how do you deal with the time delay between real situation and simulation?

A2: We have cooperation with GE Company and they give us codes to do the simulation, but we cannot handle the real time simulation.

Q3: Is there any method to combine PSA in your work?

A3: We just proposed this issue. Thus far, all things including validation have not been performed yet.

The details of his presentation at the IWNSST2014 was published in IJNS, Vol.5, No.4. Please see his paper in Ref. [9].

6 Conclusion

The 18th International Workshop on Nuclear Safety & Simulation Technology (IWNSST18) was held in December 8-9, 2014 at Harbin Engineering University, in Harbin, China. The major topics of this international workshop are related with recent advances in theory, methods, and systems on risk monitor technology and its application for nuclear power plants. There were eleven invited presentations at the IWNSST18, and the subject of the 11 presentations are classified into three categories: (i) Online real time risk monitor technology, (ii) Trends of PSA activities in individual countries, and (iii) Various risk monitor relevant researches from new aspects. This article provides the overview of the IWNSST18 with giving condensed summaries of all invited presentations given by international experts.

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