

December 17, 2008

MEMORANDUM TO: Patrick L. Hiland, Director  
Division of Engineering  
Office of Nuclear Reactor Regulation

FROM: Steven A. Arndt /RA/  
Division of Engineering  
Office of Nuclear Reactor Regulation

SUBJECT: REPORT OF FOREIGN TRAVEL TO THE INTERNATIONAL  
ATOMIC ENERGY AGENCY TECHNICAL MEETING ON THE  
IMPACT OF DIGITAL INSTRUMENTATION AND CONTROL  
TECHNOLOGIES ON THE OPERATION AND LICENSING OF  
NUCLEAR POWER PLANTS IN BEIJING, CHINA FROM  
NOVEMBER 2-8, 2008.

Attached is a summary trip report of my participation in the technical meeting of the International Atomic Energy Agency (IAEA) on the Impact of Digital Instrumentation and Control (I&C) Technologies on the Operation and Licensing of Nuclear Power Plants in Beijing, China, November 3 – 6, 2008. As part of this trip I also visited the Tianwan nuclear power plant in Jiangsu, China on November 7, 2008.

The purpose of this meeting was to discuss international lessons learned in the planning, design, licensing and implementation of both digital I&C modernization projects and new reactor digital I&C designs. The presentations included I&C upgrade projects and designs for new reactor digital I&C systems, and control room simulator projects for new reactors. At the Tianwan nuclear power plant, a group of international I&C experts were briefed on the development of the digital I&C design for the plant and toured the plant simulator.

This report is for internal NRC use only. The content of this report is not likely to be of interest to the Commission. If there are any questions concerning this report, please contact me at (301) 415-6502.

Enclosure:  
As stated

CONTACT: Steven Arndt, NRR/DE  
(301) 415-6502

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cc: W. E. Kemper, NRR  
T. Jackson, NRO  
I. Jung, NRO  
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OFFICE	NRR/DE
NAME	SArndt
DATE	12/ 17 /08

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**FOREIGN TRIP REPORT**

**Subject**

International Atomic Energy Agency (IAEA) Technical Meeting on the Impact of Digital Instrumentation and Control (I&C) Technologies on the Operation and Licensing of Nuclear Power and visit to the Tianwan 1&2 Nuclear Power Plants

**Dates of Travel, Countries and Organizations Visited**

November 1 - 8, 2008, China, China Nuclear Power Engineering Corporation, Tianwan 1&2 Nuclear Power Plants, and the International Atomic Energy Agency

**Author/Title/Agency Affiliation**

Steven A. Arndt  
Senior Technical Advisor for Digital Instrumentation and Control  
Division of Engineering  
Office of Nuclear Reactor Regulations

**Sensitivity**

Not applicable.

**Background/Purpose:**

The objective of the travel was to participate in the IAEA Technical Meeting on the Impact of Digital Instrumentation and Control Technologies on the Operation and Licensing of Nuclear Power Plants. The purpose of NRC participation in this meeting was to develop an understanding of the current design and regulatory practices in the international community associated with digital I&C for nuclear power plants and to gather information to support the on-going work of the NRC Digital I&C Steering Committee and the Task Working Groups.

**Abstract: Summary of Pertinent Points/Issues**

The technical meeting on the impact of digital I&C technologies on the operation and licensing of nuclear power plants was held at the Xiyuan Hotel in Beijing China from November 3 – 6, 2008. More than sixty persons from fourteen IAEA countries including the USA, Canada, China, France, Finland, Hungary, India, Japan, and Korea attended and participated in the meeting. The meeting was sponsored by the International Atomic Energy Agency and hosted by the China Atomic Energy Authority and the China Nuclear Power Engineering Corporation.

The meeting included twenty nine presentations as well as several discussion sessions and exhibits all focused on digital upgrades and new plant control room designs at

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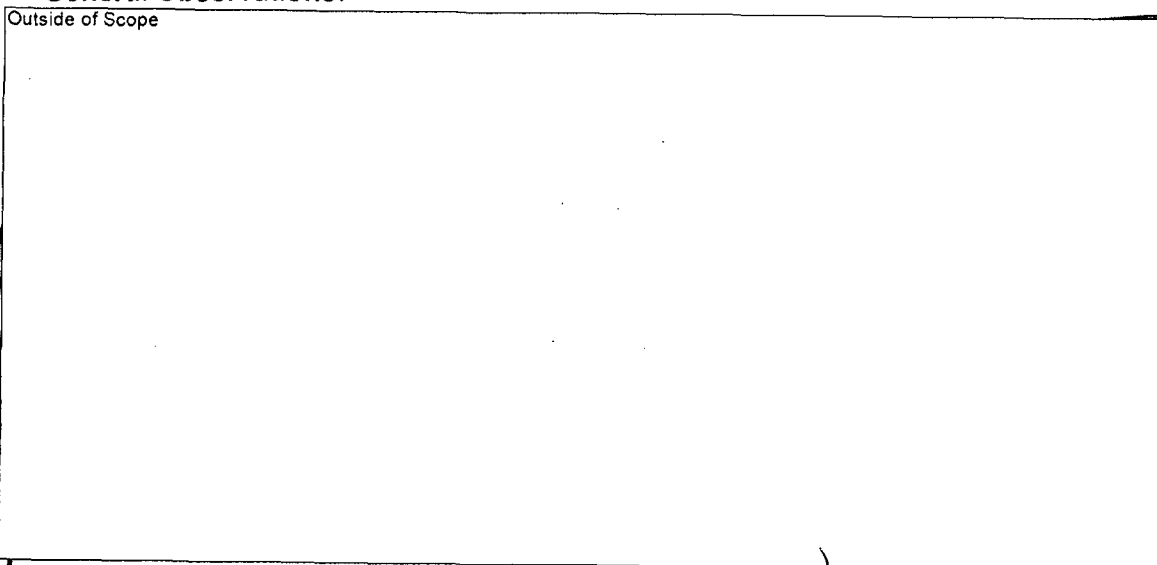
various nuclear utilities worldwide. Other related topics, such as development of control room simulators for new plants and challenges to going forward with modernization projects were also discussed. The opening remarks were provided by Mr. Oszvald Glockler of IAEA, and senior representatives of the host organizations, including Joseph Naser of EPRI, the chair of the meeting. Technical presentations were made by regulators, design organizations, and plant staff regarding the lessons learned during the preparation and design implementation phase of the modernization projects. At the end of the meeting some of the participants traveled to Jiangsu, China to visit the Tianwan 1&2 Nuclear Power Plants on November 7, 2008. The visit to Tianwan included discussions with the plant staff on their fully digital I&C systems and tour of the plant control room. The Tianwan plants use AREVA TELEPERM XS (TXS) and AV-42 modules as part of their digital safety systems and the AREVA TELEPERM XP (TXP) for non safety systems. NRC participation in the meeting and site visit provided the opportunity to better understand the international experience in I&C design for current plant retrofits and new reactor applications.

**Discussion**

This meeting brought together leading practitioners, researchers, and regulators from a number of different countries to discuss the benefits and challenges of using digital technologies in the instrumentation, control and information systems of nuclear power plants and to develop an international consensus on important issues in this area. The primary purpose of the meeting was to present and share the lessons learned in the design, licensing and implementation of digital I&C modernization projects and new reactor digital I&C designs. The projects presented mostly included large scope (all safety and non-safety systems) upgrades from the analog to the digital I&C systems, digital to digital upgrades and large scope new reactor designs. The subject matter of presentations and the actual lessons learned varied with the various stages of implementation of the projects. Some of the presenters were more open and shared their actual lessons learned while others presented a higher level overview of the project without specific reference to the lessons learned. A brief summary of some of the observations associated with these projects is presented below.

**General Observations:**

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Outside of Scope

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**Future Reactor Simulators:**

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**Tianwan 1&2:**

- The Tianwan 1&2 plants are modern VVER-1000/428 (AEC-91 version) Russian PWRs. The plants were "commissioned" in May and August 2007.
- The Taiwan 1&2 plants have fully digital control rooms designed and constructed by AREVA NP. Each plant has 133 I&C cabins. The digital I&C safety systems use the TSX platform and the AV-42 priority logic modules for safety functions and the TXP for non-safety systems. (69 TXS cabins and 64 TXP cabins, 2700 digital and 6100 analog outputs, numerous AV-42 modules actuating 627 outputs.)
- The official language of the site is English; however the "working" language is Russian.
- The control room displays and controls are all in English, however the control room procedures are in Russian and Chinese. I was told by the plant manager that being fluent in all three languages was a requirement for all of the control room staff. And that, over time, they plan to phase out the Russian procedures.
- The three party agreement between AREVA (then Siemens), the Russian vendor and the Chinese government was written and monitored in English and was not without significant problems, mostly to do with schedule slippage. The cost was approximately \$80 million per plant.

- The very first post start up operational period was a "breaker to breaker" run, that the plant staff said was in large part due to the fully digital I&C systems.

The general discussion highlighted the fact that effective regulatory reviews, continues to be a significant challenge to most vendors, utilities and regulatory agencies throughout the world. There were several discussions of how to best consolidate or integrate the various national and international standards and regulations associated with digital I&C in nuclear power plant applications. Although progress is being made, at this time there is still a concern in the international community that the interpretation of the requirements, as well as, the level of review needs to be more consistent between countries.

**Pending Actions/Planned Next Steps for NRC**

There are no specific pending actions or next steps for NRC stemming from this meeting.

**Points for Commission Consideration/Items of Interest**

There are no specific points for Commission consideration.

**On the Margins**

Representatives of several countries discussed with me there interest in our new interm staff guidance (ISG) for Digital I&C. Representatives from both the China Atomic Energy Authority and the China Nuclear Power Engineering Corporation told me that they were actively using ISG-2 and ISG-4.

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