



MULTINATIONAL DESIGN EVALUATION PROGRAMME

4th Conference on New Reactor Design Activities

**12-13 September
2017**

Queen Elizabeth II Centre
London, United Kingdom

PROCEEDINGS



Background and objectives

The MDEP is a unique multinational initiative, leveraging the resources and knowledge of national regulators to review new reactor designs. The programme celebrated its 10th anniversary in 2016 and is recognised as an effective framework for regulatory co-operation and harmonisation.

Over the first 10 years of its existence, MDEP has published 24 common positions and 13 technical reports. In 2015, the MDEP members extended the co-operation period from the end of 2017 to the end of 2022, focusing on its core mission of collaborating on new reactor design-specific activities. The scope of MDEP was extended in 2016 to incorporate commissioning and early phase operation as additional MDEP areas of co-operation.

At this important first decade milestone, MDEP was willing to gather feedback on its current activities and discuss its future. To this end, MDEP organised its fourth MDEP conference. The event provided a forum for MDEP stakeholders (including industry representatives, standard development organisations and other international organisations) to share the results of their engagement with the programme and to deliver presentations on ongoing activities related to new reactor licensing. The two-day conference included sessions on codes and standards harmonisation, digital instrumentation and controls, supply chain regulatory issues and vendor inspection co-operation, influence of MDEP interactions on reactor designs safety, commissioning activities and perspectives for MDEP.

Organisation and participation

Participation

To maintain focus, participation was by invitation only to:

- industry representatives;
- international organisations and associations;
- countries' nuclear regulatory organisations and their technical support organisations.

Language

All presentations and discussions were held in English.

Organising committee

The members of the organising committee were:

- Mr Julien Collet, ASN, France, STC Chair, Chair of the organising committee
- Mr Christian Carrier, CNSC, Canada, STC member
- Mr Tapani Virolainen, STUK, Finland, STC member
- Mr Gary Holahan, US NRC, USA, STC member
- Ms Donna Williams, US NRC, USA, STC member
- Ms Anne-Cécile Rigail, ASN, France, EPRWG Chair
- Mr Lawrence Burkhart, US NRC, USA, AP1000WG Chair
- Dr Sweng Woong Woo, KINS, Korea, APR1400WG Chair
- Mr Sergei Bogdan, SEC-NRS, Russia, VVERWG Chair
- Mr Neil Blundell, ONR, UK, ABWRWG Chair
- Mr Xuejun Wei, CNSC, Canada, CSWG Chair
- Mr Ismael Garcia, US NRC, USA, DICWG Chair
- Mr Stuart Allen, ONR, UK, VICWG Chair

with the support of Aurélie Lorin, MDEP Technical Secretariat.

Venue and contact

The conference took place at

[Queen Elizabeth II Centre](#)

Saint James room

Broad Sanctuary

Westminster, London

SW1P 3EE, United Kingdom

For any additional information, please contact mdepconference2017@oecd-nea.org.

OPENING SESSION

The Conference opened with an overview of the MDEP creation and development, its achievements for the 10 years period, and the co-operation between MDEP and the World Nuclear Association (WNA)'s Working Group on Cooperation in Reactor Design Evaluation and Licensing (CORDEL).

Mr Lacoste, former ASN Chairman, co-founder and first MDEP Chairman (2006-2013), shared the context, motivations and ambitions of the MDEP foundation. He noted that after a lot of frank and open discussions between USNRC, ASN, STUK and other European regulators the MDAP (Multinational Design Assessment Programme) had been created in 2005. The MDAP, after a one-year pilot project conducted in 2006-2007 and specific recommendations approved in 2008, was converted into a long-term programme (MDEP) in 2009. He said that the initial goal of MDEP was to set up an enhanced co-operation among regulators in order to improve the effectiveness and efficiency of regulatory design reviews, to raise the safety assessment quality and the safety level, and to facilitate convergence of regulatory requirements. He went on to say that, with years, the ambitions of MDEP evolved to "go as far as possible on co-operation, sharing, harmonisation and convergence of the reactor design review".

Mr Holahan, MDEP Steering Technical Committee (STC) member, provided an overview of MDEP achievements during the 10 years of its activities including the STC accomplishments, design-specific and issue-specific working groups benefits and past successes. Among others, mention was made of the Generic Common Positions (Fukushima-Daiichi Accident, First-Plant-Only-Tests), working group's Common Positions and Technical Reports, increased communications and co-operation in design evaluations as well as greater degree of harmonisation in review practices. He also noted that STC identifies ways to work with and influence other programmes and organisations such as the International Atomic Energy Agency (IAEA), standards development organisations – American Society of Mechanical Engineers (ASME), (French Association for design, construction and surveillance rules of nuclear power plant components (AFCEN), Canadian Standards Association (CSA), Japan Society of Mechanical Engineers (JSME), Korea Energy Agency (KEA), N.A. Dollezhal Scientific Research and Design Institute of Energy Technologies (NIKIET), International Electrotechnical Commission (IEC) and the Institute of Electrical and Electronics Engineers (IEEE) –, WNA's CORDEL, Western European Nuclear Regulators' Association (WENRA) and the Generation IV International Forum (GIF). The continuing evolution of MDEP includes transition of existing issue-specific working groups to NEA committees, creation of new design-specific working groups, as needed, increasing regulators membership and increased co-ordination and interaction.

Ms Rising, Director General of WNA, noted in her presentation the close co-operation between MDEP and CORDEL at different levels – CORDEL and MDEP Policy Group, MDEP Steering Technical Committee and CORDEL Steering Committee, CORDEL task forces and MDEP issue-specific working groups. She also highlighted that international harmonisation of regulatory requirements and standardisation of reactor design is crucial to derive safety benefits alongside efficient delivery of nuclear energy.

In the presentations and the discussions that followed, a number of key points, commonalities and challenges were identified by the participants. These are:

Key points

The purpose of MDEP is to:

- Increase co-operation between member-countries in new designs evaluation;
- Enhance convergence (harmonisation) of requirements and practices.

Commonalities identified

- The MDEP is a very important and useful tool for regulators;
- The observation of commissioning activities is very important for regulators;

- Interactions with external organisations developed very effectively in MDEP;
- The MDEP future is very important for the nuclear community.

Challenges identified

- Maintaining active involvement of regulators, vendors and operators;
- The need to provide innovative approaches with limited ability to define routine work;
- Need a higher level of international harmonisation for digital Instrumentation and Controls (I&C) systems.

SESSION 1

Codes and standards harmonisation

The goal of the Codes and Standards issue specific Working Group (CSWG) is to achieve harmonisation of code requirements for the design and construction of pressure-retaining (pressure boundary) components in order to improve the effectiveness and efficiency of the regulatory design reviews, increase quality of safety assessments, and to make each regulator stronger in its ability to make safety decisions.

The session opened with the commentary that the standard development organisations (SDOs) and national regulatory bodies have been working together for code development and harmonisation for a number of years and reemphasised the need for an international view on the relevant codes and standards. It was stated that harmonisation can be achieved through convergence and reconciliation by which it is meant that the areas of difference are identified and, for those differences, the impacts are understood and accepted.

There are a number of challenges ahead of any code or standard harmonisation, namely:

- Codes and standards are comprehensive and are typically self-contained which means it is not feasible to select certain aspects over another;
- Codes and standards consider all safety aspects and balance all safety requirements;
- Codes or standards often reference other codes or standards which vary from country to country;
- Regulatory requirements can result in code variations and also supplement code requirements. Each country has a unique regulatory regime.

The chair of the CORDEL Mechanical Codes & Standards Task Force (MCSTF) and the representative of the SDO board presented CORDEL work and SDOs work on code harmonisation, respectively. They also presented some of the results on code comparison and code convergence.

The MCSTF chair stated that the aim of the MCSTF was to promote the convergence of nuclear mechanical codes and standards in order to facilitate the international standardization of reactor designs. To date, the MCSTF has reviewed the different approaches to the certification of Non-Destructive Examination (NDE) personnel and proposed a harmonised international alternative for the certification of NDE personnel; the MCSTF has also compared the international practices in welding qualification and quality assurance. At the present time, the MCSTF is working on the harmonisation of non-linear analysis design rules. The next phase of work is to consider the possible harmonisation of fatigue life analysis methods.

The representative from the SDOs stated that the objectives for the Nuclear Power Plant Codes and Standards group were to limit divergence on individual code requirements and to achieve convergence on individual code requirements, where realistic and practical. It was noted that code harmonisation was difficult where different national regulators had different regulations in force. The primary benefit of the code comparisons is to identify the impact of differences in the codes and provide improvements that can be made to each code or standard. The future areas of investigation for the SDOs are Fatigue, Nozzle design

and the treatment of Finite Element Analysis (FEA). It was postulated that future topics could also include material, fabrication and quality assurance.

In terms of the national regulatory requirements, representatives from the UK's Office for Nuclear Regulation (ONR), VO Safety, the provider of technical services to Rostechnadzor, and China's Institute for Standardisation of Nuclear Industry (INSI) gave presentations. In these presentations, each representative gave a view on how code harmonisation may influence a regulatory view of codes and standards at a national level.

Within the UK, the ONR's role is to ensure that licensees reduce risk so far as is reasonably practical (SFAIRP). ONR uses the principal of relevant good practice (RGP) and expects the licensee to justify why those codes and standards represent RGP. In line with this approach, ONR does not specify nuclear codes or standards to be used. ONR is cognisant of all factors which might affect RGP specifically guidance from the IAEA and WENRA Safety Reference Levels. The ONR representative noted that as codes and standards evolve so does RGP and hence it is important to be aware of international codes and standards to ensure that an appropriate definition of RGP is maintained. The final point that the ONR representative made was that codes and standards are not applied in isolation and components are subject to specific national regulatory requirements. These supplement the codes and standards and hence it is important to understand the impact of these additional regulatory requirements.

The representative from VO safety gave a presentation on how the work of the CSWG had influenced the code development activities in Russia. It was stated that the common positions had been used in development of Russian internal procedures. The most significant benefit of the codes and standards group was the clarification of general requirements and the identification of differences. It was stated that, in the VO representatives' view, full harmonisation was unlikely but that a move to increase harmonisation would be beneficial. Specific areas where a benefit could be realised would be areas such as non-destructive testing, manufacturing, conformity assessment and strength analysis.

The representative from China's Institute for Standardisation of Nuclear Industry (INSI) gave an overview of how different codes are used within China. It was noted that there is significant new nuclear construction activity within China using different reactor technologies developed using different international codes and standards (e.g. EPR, AP1000, VVER) as well as Chinese developed reactor design (M310 and HPR1000). This has presented a need to have a consistent view on the different international standards. It is the intent within the Chinese system to develop integrated and comprehensive Nuclear Safety Standards. The development of these Chinese standards has encountered problems due to the technology diversity. The INSI representative stated that the work of the MDEP CSWG has helped inform the development of these Chinese standards when these issues have arisen.

During the following panel discussion, the following points were noted:

Key points

The activities of the codes and standards working group have highlighted the difficulties of the harmonisation process. Despite these difficulties, the group has established a general approach for code harmonisation, studied the regulatory practices in using codes, explored strategies for code reconciliation, helped SDO's talk to each other for preventing further code divergence, and encouraged the SDO's and the WNA's CORDEL to working on code comparison and code convergence including NDE certification and Non-linear analysis.

Commonalities identified

It is the majority view that the purpose of code harmonisation is not to make all codes and standards identical or to produce a single code or standard which would be used by all countries. However, with the rise of international new nuclear build, there is a desire to understand the differences between the different national codes and standards, and to reduce code differences in technical areas as much as possible. MDEP has facilitated the comparison of codes and standards, helped regulators in understanding code differences, and provided a basis for accepting or conditionally accepting their use.

Challenges identified

Code harmonisation is a very valuable but very challenging long-term work. This is primarily due to the factors that:

- Codes are highly integrated; a provision usually is related to, or conditioned on, many other provisions. Code needs to be considered as a whole package;
- Human performance and industry culture may be different from country to country; and codes embed these differences;
- Codes reference many other industry standards which are different from country to country;
- Regulatory requirements can result in code variation, and also supplement code requirements. Each country has a unique regulatory system;
- The industry is deeply invested in current practice.

The success of code harmonisation is strongly dependent on global co-operation among the regulatory authorities, nuclear industry (CORDEL) and SDOs.

SESSION 2

Digital instrumentation and controls: Current and emerging technical challenges

This session was devoted to the MDEP current activities and technical challenges related to digital instrumentation and controls (DI&C) systems in member-countries, requirements harmonisation and safety assurance in software systems.

Mr Garcia, chair of DICWG, presented an overview of on-going DICWG activities as well as the plans on its transition to a permanent organisation within the NEA. He discussed the I&C technical expert subgroup activities in the different design specific working groups, their outcomes and near-term plans. It was noted that such issues as continual evolution in the DI&C technology implementation/use, differences in regulations, regulatory practices and national standards, and reaching agreement on common terminology are the challenges for I&C going forward.

Mr Wardle, ONR's principal inspector, discussed the current and emerging technical challenges in the UK related to DI&C such as I&C architecture design, use of Commercial Off-The-Shelf (COTS) software, justification of smart devices and development of coherent safety cases which are affected on the safety justification. Aspects of the I&C architecture design important to the safety justification of nuclear power plants include categorisation of safety functions, classification of systems, interconnection between systems of different safety classes, fault propagation through the architecture and security by design. It was noted that use of COTS software and smart devices in DI&C systems important to safety, which are typically not developed for nuclear application, greatly complicates the safety justification. He also underlined that the aforementioned challenges are not isolated to the UK, but applicable worldwide.

Mr Bouard provided information on activities of the oldest international standard body, the IEC, and its Sub-Committee SC45A (Instrumentation, control and electrical power systems of nuclear facilities). He outlined the structure of SC45A and described how the Sub-Committee works in relation with the IAEA in I&C safety and security domains. Other successful collaboration efforts with the European standards organisation, IEEE, MDEP DICWG and WNA's CORDEL on requirements harmonisation were discussed.

Mr Pickelmann provided an update and outlook on the WNA's CORDEL DI&C Task Force (DICTF) activities. He discussed the WNA's CORDEL mission and its role in the international co-operation framework as a promoter of nuclear energy as well as supporting of nuclear industries' companies. It was noted that DICTF has identified a number of key issues that needs to be tackled by a series of papers including safety classification of I&C systems, defence-in-depth and diversity, modernisation of existing I&C systems, structures & components. The challenges and conclusions identified in these papers were presented.

Dr Cofer from Rockwell Collins shared some experience from the aircraft industry on safety assurance in software systems. He mentioned that the nuclear industry has similar concerns and challenges as the civil aviation industry with regard to DI&C systems. It was noted that the nuclear industry can benefit from aerospace software development and verification practices, for example, from the certification process used in civil aviation. He discussed how the aerospace industry addresses software complexity and underlined that the use of formal methods such as complete exploration of the design can help to cope with this challenge and reduce costs while increasing confidence through early detection and elimination of errors. He also shared the experience of using formal methods for achieving cybersecurity in real aerospace systems. It was stated that the use of formal methods can also address cybersecurity concerns for high-assurance systems.

Mr Ma from Sanmen Nuclear Power Company shared the company's experience on I&C commissioning for the first AP1000 unit in China. He informed that due to the delay of design finalisation and deficiencies found during the commissioning of Sanmen NPP unit 1, several baseline design updates were required, causing an increase of workload and a delay in the commissioning schedule. It was also mentioned that design changes could result in needing to change the test methods and procedures accordingly, which in turn can generate additional delay. He stated that Plant Monitoring System (PMS) is more complex and has more functions than before, which requires higher knowledge/skill from the commissioning personnel. Finally, he noted that the DI&C systems require better control of their operating environment during commissioning activities to deal with temperature, humidity, dust, etc. that would be outside the normal operational design conditions.

In the presentations and the discussions that followed, a number of key points, commonalities, and challenges were identified by the participants:

Key points

- Collaboration between regulators and industry with the objective of convergence/harmonisation of requirements is valuable;
- MDEP provides the possibility for interaction between regulators and vendors; and
- The problem of regulations/standards convergence is not just a technical problem, it is largely a human/culture problem.

Commonalities identified

- The nuclear industry could benefit from development and verification practices applied in other industries, e.g. aerospace;
- The use of formal methods may help to cope with software complexity (providing evidence for validation);
- Formal methods may also address cybersecurity concerns for high-assurance systems; and
- DI&C systems require better control of operating environment during commissioning activities (temperature, humidity, dust, etc.).

Challenges identified

- Differences in regulatory practices and national standards;
- DI&C architecture design including aspects such as safety classification and defence-in-depth;
- Use of COTS software and smart devices in DI&C systems;
- Modernisation of existing DI&C systems; and
- Continuous development in the implementation and use of DI&C systems, which creates a need for continuous development of assessment methodologies and certification processes.

SESSION 3

Supply chain regulatory issues and vendor inspection co-operation

Mr Chevet, France PG Member, ASN Chairman, provided opening remarks including an introduction of the issues at Creusot Forge. Mr Chevet observed that oversight of the supply chain is not just a concern for new reactors but also to operating reactors.

Mr Allen, VICWG chair (ONR, UK), stated that the speakers in Session 3 would be quite diverse and would provide their own unique regulatory perspective. In his presentation, Mr Allen provided a background of the VICWG, the key objectives, achievements and challenges going forward.

Mr Wang, project officer, NNSA, China, discussed nuclear safety culture (NSC) for equipment vendors in China. NNSA utilises the IAEA concept of nuclear safety culture. Mr Wang stated that human factors are a major problem in China, particularly regarding fraudulent behaviour. NNSA has taken several actions to inspect and promote nuclear safety culture at vendor facilities. NNSA uses four evaluation methods to review safety culture. It divided vendors based on NSC review scores and issued its own policy guidance on NSC. NNSA also took enforcement action against vendors who did not abide by the laws and will be developing an NSC inspection procedure in the near future.

Mr Emond, Component Manufacturing Business Unit Senior Executive Vice President, AREVA NP, France, presented the quality audit and quality improvement plan at Areva NP Le Creusot (ACF) forging facility. Mr Emond discussed the overall values at Areva NP and vision – high performing people and technologies for safe and competitive nuclear plants worldwide. Mr Emond acknowledged that ACF had an NSC issue that did not promote employees reporting issues to management. He also acknowledged that there are deficiencies and non-conformances at ACF that need to be addressed. Mr Emond described the two issues: carbon segregation and marked files. Based on inspection of a sample of records associated with these issues, Areva NP decided to check all the manufacturing records activities to identify any additional marked files. There are approximately 9 000 files generated since 1965. He described the process that they are using to review the files noting that issues identified so far have been minor deviations. Mr Emond provided a schedule for completion of the review which includes the update of manufacturing files and development of a plan to improve NSC. Mr Emond commented on the usefulness of the MDEP inspection, i.e. multiple regulators at once versus multiple inspections, and safety culture focus training.

Mr Ivey, Supplier Quality Oversight Director, Westinghouse Electric Company (WEC), USA, presented the AP1000 Nuclear Power Plant Squib Valve Design Challenges and Regulatory Interface. Squib valve design is innovative and first of a kind. Mr Ivey provided the key design requirements and commented on some challenges during design qualification and testing. Mr Ivey discussed WEC decision to modify design to operate when submerged and identified that the shear cap design was the engineer “weak link”. NRC raised very good questions regarding margin. As a result, WEC needed to develop a testing and surveillance programme for the actuators which did not previously exist. Based on this experience, Mr Ivey stated that WEC encourages regulatory engagement early in the design process.

Mr Kaser, Senior Project Manager, WNA, provided an update on World Nuclear Association activities associated with the nuclear supply chain. Mr Kaser stated that the supply chain working group was set up in 2010 to share information and leading practices, and to address common issues such as supply chain conformity, lack of consistency in regulatory oversight and customer requirements. Mr Kaser described why communications are important such that suppliers understand why certain requirements are important for a similar component, and recognition of the importance of interface management and flow down of requirements. WNA recommends better communication between customer and supplier (i.e. more than inspections, hold points and surveillance) but understands the expense. Mr Kaser stated that better integration of the management system at the top tier levels and vendor oversight is critical. Other challenges include counterfeit, fraudulent and suspect items (CFSI), export controls, and safety culture controls.

Mr Chevet asked where the VICWG would be in 10 years (i.e. what is the vision). AREVA was asked how it would prevent the issue at ACF again. AREVA was asked whether lessons learnt have been shared with

other suppliers and whether the end has been reached or whether something new and bigger will hit. AREVA was asked to share the wider root causes of the issues at ACF (there was not one single cause – there were other contributory factors across the whole plant). The session presenters were asked if NSC needs to be an issue evaluated in the supply chain. WNA suggested that you would need to educate the supply chain on NSC and vulnerabilities.

Key points

- Nuclear safety culture in the supply chain is difficult to cultivate both by the regulator and the suppliers;
- MDEP multinational inspections are useful, i.e. multiple regulators at once versus multiple inspections;
- Vendor oversight is critical, especially in the areas of CFSI, export control and nuclear safety culture.

Commonalities identified

- A strong nuclear safety culture is important for safe nuclear plants worldwide;
- Communication between parties is the key to success.

Challenges identified

- Challenges in cultivating a nuclear safety culture in the supply chain by the regulatory body and by the suppliers;
- Development of nuclear safety culture policies;
- Early engagement with the regulator during first of a kind design;
- Importance of supplier oversight and communication in order to develop a high-quality supply chain.

SESSION 4

Influence of MDEP interactions on reactor design safety

Dr Tyobeka, South Africa PG Member, NNR CEO, introduced the topic of reactor design safety by summarising some of the key points from the previous day's sessions. He remarked that interactions at MDEP may result in some regulators changing the way they provide oversight.

Ms Rigail, EPRWG chair, ASN, France, provided a brief background on one of the original design working groups, the EPRWG. Ms Rigail stated that there are five TESSG under the EPRWG which interact with the industry at the request of the regulators on particular detailed technical issues, comments on the draft common positions and technical reports. Ms Rigail presented high-level industry initiatives that were presented to the EPRWG to review, i.e. FOAK and FPOT.

Dr Woo, APR1400WG chair, KINS, Korea, provided a brief background on the APR1400WG. The APR1400WG focusses on discussing safety issues and exchange of experiences. Two TESSG exist under the APR1400WG. Commissioning issues have been shared among members.

Mr Nicaise, Nuclear Safety and Licensing Manager, AREVA NP, France (EPR), provided a status of the EPR design and construction. There are four EPR under construction and in the last commissioning phase worldwide. Hinkley Point 1 pre-construction report has been issued. Future plants include six EPRs in India and four ATMEA-1 (3 loop EPR developed by MHI and AREVA) in Turkey. Mr Nicaise provided two examples of successful interaction with MDEP (i.e. impact of the Fukushima Daiichi NPP accident on EPR design and FPOT). MDEP organisation has been efficient to support regulators to work together to permit effective review of issues. Mr Nicaise stated that the communication between MDEP and the EPR Owner Operator Group (OOG) is highly successful and supports the overall MDEP goal to increase multinational co-operation. Mr Nicaise provided areas that can be improved, such as actively promoting the harmonisation

between countries.

Mr Easterling, Vice President of Technical Services and Licensing, Westinghouse Electric Company (WEC), USA (AP1000), stated that MDEP brings an effective review of designs. Mr Easterling provided a status on Sanmen and Haiyang. He complimented NNSA and NRC on their interactions and the solution of the review of issues. Mr Easterling indicated that WEC was in negotiations with India for six AP1000 and Turkey for AP1000 and CAP1000. Mr Easterling noted wide differences in regulatory approach and difference in timing and stage in the review. AP1000WG provides means to discuss the difference in regulatory philosophy and approach. Mr Easterling stated that AP1000WG promotes design standardisation and plant safety.

Mr Kim, Deputy Project Manager, KHNP, Korea (APR1400), provided background on the APR1400 design and the status construction of APR1400. Mr Kim stated that the APR1400 design was currently in phase 4 under the NRC review process. Mr Kim provided an overview of the APR1400 design. Mr Kim stated that the APR1400 is more and more mature.

Mr Svetlov, Chief Expert for Design, JSC "ATOMPROEKT", Russia (VVER), provided the background on the development of the VVER design and a description of the VVER 1200 design. Mr Svetlov described the MDEP activities related to the new design.

Mr Watson, senior regulatory advisor, Nuclear Power Project, Hitachi Europe Ltd, UK (ABWR), provided a description of the features of the ABWR design. Mr Watson stated that the ABWR was in the Generic Design Assessment (GDA) review process by the UK nuclear regulator (ONR). The GDA is a challenging review which examines safety, environmental protection and security, and takes significant effort. Mr Watson stated that a nuclear license application has been made for four units at two sites in the UK. The ABWR has undergone regulatory assessments in four countries, which has contributed to design development and safety improvement. It has been Hitachi's experience that MDEP has influenced the UK regulator and their assessment under the GDA. Mr Watson stated the MDEP has been positive for getting international regulators to work more closely together, ultimately encouraging international harmonisation of approaches for new reactor reviews.

Dr Tyobeka asked whether the MDEP review group would be helpful for the review of Small Modular Reactors (SMRs). In this area, are the industry representatives receiving feedback from the design working groups and are there areas for improvement?

Key points

- Successful interactions with the industry via MDEP has been beneficial in reviewing different reactor designs;
- There are wide differences in regulatory approach including differences in timing and phased review;
- MDEP design specific working groups have focused on common safety and technical issues among regulators, promoting design standardisation and plant safety.

Commonalities identified

- MDEP common positions and technical reports are successfully encouraging international harmonisation of approaches for new reactor assessments;
- MDEP has been positive for getting international regulators to work more closely together;
- Reactor designs have benefitted from multiple regulator reviews.

Challenges identified

- Further work on international regulatory review harmonisation is needed.

SESSION 5

Commissioning activities

This session was devoted to the MDEP current activities and challenges in commissioning activities as well as commissioning experience in member-countries.

Mr Yates, chair of EPR Commissioning Activities Technical Expert Sub-Group, presented an overview of on-going commissioning activities in support of new designs reactor. He mentioned that MDEP provides a framework for working groups to adopt common approaches to the more challenging design specific commissioning issues, share the more significant design specific lessons, and complement WGRNR work on generic commissioning issues. He discussed generic and working group activities related to the commissioning of new reactors. Among generic activities, it was noted the Common Position CP-STC-01 addressing first plant only test (FPOT) which sets out regulators pre-conditions for accepting FPOT results. He informed that a number of working groups have a regular discussion on commissioning issues at their meetings and EPRWG focused on regulators observing the FPOT vibrations tests which have been performed at Taishan NPP unit 1 in March 2017. He stated that FPOT in Taishan NPP is a positive example of MDEP supporting regulators to work together.

Mr Viktorsson, Director General of FANR, shared the commissioning experience in the United Arab Emirates. He provided general information on the establishment of regulatory authority in the UAE, development of the regulatory framework, licensing steps for Barakah NPP and establishment of the inspection programme. Commissioning challenges were noted including the need to establish nuclear infrastructure and to understand the established regulatory control by licensee and contractors. The construction inspection test plan (CITP) was discussed including construction license condition, requirements for testing of key safety-related structures, systems and components, reporting on the results of completion of CITP items, etc. It was also stated that FANR has now reached a transition point from construction oversight to nuclear commissioning and operation.

Ms Zhang from NNSA presented an overview of AP1000 commissioning inspection in China. She informed of the current status of AP1000 projects at Sanmen NPP units 1 & 2, and Haiyang NPP units 1 & 2. She discussed the inspection issues of AP1000 commissioning paying attention to its preparation, inspection items, inspection activities and challenges identified. It was noted the significant number of design changes in safety case, test documents and configuration control require test impact evaluation which is a big challenge for the regulator. She also mentioned a challenge that some tests do not have acceptance criteria and some acceptance criteria were revised after the test has been performed. Another identified challenge was that several pieces of equipment experienced significant deficiencies during testing.

Mr Lambert from EDF gave a presentation on Reactor Pressure Vessel Internals (RPVI) vibratory behavior test implementation. He provided an overview of the exchanges between MDEP and the EPR OOG on EPR commissioning. He mentioned that the EPR OOG identified 4 FPOT test sequences and RPVI vibration measurement test was selected by licensees for the transposition to next of a kind (NOAK) units. The description of RPVI FPOT context and a brief scheme of this test have been discussed. It was noted that all site preparation works, sensors installation/calibration and a visual inspection of vessel internals were done prior hot functional tests (HFT) at Taishan NPP unit 1. During an NNSA inspection scheduled at the beginning of HFT, an observation was carried out by the overseas regulators (STUK/ASN/ONR) with the presence of overseas licensees (TVO/EDF/NNB) of part of the RPVI test performed by AREVA/TNPJVC. He informed that RPVI test results analysis is on-going and that the test report is under preparation by AREVA. The regulators did not identify any fundamental reasons for not crediting Taishan NPP unit 1 FPOT results at this stage.

Mr Lee from KHNP provided a brief overview of the APR1400 commissioning. He gave general information on nuclear power plants in Korea, construction terms of each NPP as well as major construction schedule of Shin-Kori unit 3 (SKN 3) which was put into commercial operation in December 2016. The pre-core hot functional test and post-core test, their objectives, acceptance criteria and results have been presented. He shared the experience of SKN 3 commissioning and discussed background, root causes and mitigation

options for two events – leakage of pilot operated safety relief valve and power discrepancy in SKN 3.

Mr Bezzubtsev from JSC «Concern Rosenergoatom» shared the commissioning experience of new nuclear power units in Russia. He informed the conference that 6 units are currently under construction in Russia: 1 unit with VVER-1000, 3 units with VVER-1200 and 2 units with VVER-TOI. The generic commissioning schedule for a VVER nuclear power unit includes four stages – pre-commissioning activities, physical start-up, power start-up and pilot operation. It was mentioned that the use of commissioning experience allowed reducing commissioning period for VVER-1000 from 649 days (Rostov NPP unit 2) till 483 days (Rostov NPP unit 4). He also discussed commissioning experience of Novovoronezh NPP-II unit 1 and the main causes which resulted in an increase of commissioning period. He noted the key issues arising during commissioning of nuclear power units including organisation and planning of the activities, documentation management, control of equipment quality and inconsistency management, as well as personnel management.

In the presentations and the related discussions, a number of key points, commonalities and challenges were identified by the participants:

Key points

MDEP working groups are increasing their focus on commissioning activities:

- EPRWG observing the first EPR First Plant Only Test (FPOT) in Taishan NPP;
- FPOT in Taishan NPP is a positive example of MDEP supporting regulators to work together.

Commonalities identified

- Use of resident on-site inspectors;
- Use of Technical Support Organisations to support inspectors (special skills, additional resource);
- Regulatory review of commissioning controls and processes prior to fuel load;
- Shortening of commissioning period for next of a kind NPP.

Challenges identified

- The number of design changes in safety case, test documents and configuration control;
- Dealing with commissioning non-compliances;
- Managing handover between construction and commissioning phases.

SESSION 6

Perspectives for MDEP

Mr Nieh, Head of the Division of Nuclear Safety Technology and Regulation, NEA, opened the session and asked the panellists to address five key questions relating to the role and the future of MDEP:

- What role, if any, should MDEP have for Design Specific Working Groups with operational units?
- What role could MDEP have for new technologies (e.g. SMRs, ...)?
- What should be MDEP's role in cross-cutting issues for new NPPs and what should be the associated ambitions be regarding harmonisation?
- Is there a need to further develop the co-operation with MDEP stakeholders?
- Where do you see MDEP in 10 years from now?

The PG chair, Mr Tiippana, opened the discussion. He said that the framework of MDEP has been very effective during the design phase and it could be useful to get a couple of years of operating experience after commissioning of the plant. He said that the MDEP model could be useful for NEA committee's or

other international organisations as they consider managing their future tasks, for instance SMRs and other new technologies. Mr Tiippana observed that despite MDEP is now transferring the work of the issue specific groups to other organisations, in the future, it could consider starting new ad-hoc groups when necessary.

The STC chair, Mr Collet, provided his perspectives by underlining that MDEP is at the end of a cycle, for example, EPRs and AP1000s under construction in China, France and Finland are scheduled to be commissioned in 2019 and the role of the regulators in MDEP will change at that point. Additionally, it should be recognised that existing members need to pass the knowledge acquired to date to the new comers. Mr Collet said that harmonisation can only happen if there is a real political will to make it happen – making the impossible become possible. Sharing practices and experience and trying to create opportunities for harmonisation has been very effective and beneficial for MDEP regulators. He believes that there should be more collaboration between the NEA WGs and MDEP WGs to integrate theory and practice and that way improve harmonisation. Cross-cutting issues, like station blackout, hydrogen issues in containment, and how each regulator addresses these issues is very beneficial to MDEP harmonisation goal.

China PG member, Mr Hua, said that MDEP is a good platform for regulators to exchange views on safety issues on new reactor designs and information exchange. China hopes that MDEP can continue beyond 2020 and that the members could better share tools, test facilities and results of their safety review. Publishing technical reports for public understanding of nuclear issues could also be a worthwhile effort for MDEP as well as creating a new design specific working group for the new HPR1000 design.

India PG member, Mr Bhardwaj, noted that MDEP has made the regulatory review process more effective, but not necessarily more efficient. By sharing the real review work regulators can benefit more. In addition to nuclear safety, also security could be a good topic to co-operate. From India's perspective, MDEP is needed for the next 10 years to support new reactor regulatory activities.

Russia PG member, Mr Ferapontov, said that there are soon several new designs, including VVERs, that are in operation and it should be discussed as to how MDEP can support this operational phase in the longer term. For a few years now, Russia has also tried to find a way to share SMRs design experience – what new approaches do we need to regulate the safety of SMRs? A new group concentrating on SMRs could be useful. Mr Ferapontov sees that MDEP has a leading role in maintaining a dialogue with CORDEL. MDEP and CORDEL should continue collaboration and harmonisation of technical standards and regulatory requirements.

UK PG member, Mr Finnerty, provided the UK perspective. He said there is some benefit on the operating feedback and getting that perspective while currently reviewing the designs. In terms of organisation, each regulator in MDEP has to make their individual decisions, but having the reassurance that the regulators from other countries have approved the technology is very positive.

General Manager Sato from Nuclear Power Project in Hitachi Europe Ltd, CORDEL's representative, underlined that operating feedback is important for the international community and MDEP maybe the right approach. Related to MDEP collaboration for new technology, there are needs to clarify high-level safety objectives for SMRs. If this is accomplished in MDEP, it could be beneficial. In 10 years, it would be great to see MDEP be able to deliver standard design approvals for new reactor designs, Mr Sato said.

Ms Cornelia Spitzer, Head of the IAEA Safety Assessment Section, said that, in the context of the new IAEA design safety principles, systematic design evaluations are needed for new builds and safety reassessments for NPPs in operation. MDEP has supported such assessments for new designs as well, and existing NPPs may benefit from such experience. The principles for the implementation of the objective of the Convention on Nuclear Safety to prevent accidents and mitigate radiological consequences, the so-called Vienna Declaration, addresses these topics too. Ms Spitzer understands well how difficult harmonisation is because of the IAEA experience with the safety standards development in consent with member states, but sees that MDEP also offers a forum for open and frank discussion on safety requirements. Related to SMRs and medium size reactors, Ms Spitzer sees that MDEP has a well-established framework, but is confronted with the large number of very diverse technologies. In this regard, perhaps MDEP in the future is not a Multinational Design Evaluation Programme but a Multi-Design Evaluation Programme, she said.

The audience asked how MDEP manages the situation with new comer countries that are performing their safety reviews after the active phase of the working group is ended and the group is perhaps not working anymore at all. MDEP STC chair answered that the groups have documented their work and results in common positions and technical reports and all these material is available on the MDEP library. It is not the same as having an active WG on the design but it provides a basis for the decisions made to help new comers. Mr Collet mentioned that going back and looking at all the lessons learnt that have been identified during these 10 years, could be a green booklet for NEA to publish. The audience answered that there is no final evaluation report for each design that summarises all the evaluations in a single report.

The audience commented that the codes and standards working groups cannot achieve harmonisation because the industry is not pushing the SDOs to harmonise codes and standards. There are now many countries developing their own codes and standards, for instance, Russia and China are now writing and updating their own codes. The industry goal should be to avoid more divergence. PG Chair Mr Tiippana responded that there will be a workshop in spring 2018 with CNRA, SDOs and industry to determine the best way to proceed with the co-operation.

CLOSING SESSION

The PG Chair, Mr Petteri Tiippana concluded what he considered to be a successful conference. He noted, in particular, the views of CORDEL for the MDEP future and would include them at the PG meeting agenda. He recognised that harmonisation of codes and standards was not discussed only in session 1 but in several places and concluded that regulators should play a more important role in the development of codes and standards to make sure that the regulatory requirements are met at the end of the process. Mr Tiippana qualified the DI&C activities as a flagship of the MDEP issue-specific activities with several technical issues tackled and many common positions produced that have been beneficial to regulators. These activities will soon be transferred to CNRA and serve a wider group of regulators. A lot of discussions happened about safety culture in the supply chain and how to manage multiple interfaces. Mr Tiippana recognised that suppliers are the users of codes and standards so these two topics are connected. He appreciated a quite positive feedback from the industry that identified in session 4 a lot of work achieved. He highlighted that all results cannot be wrapped up in common positions or technical documents, nor the benefit of regulators pools of experts brought together by MDEP in different areas. The success story of the FPOT in Taishan illustrates very well the goal of the MDEP. Timing plays a role in the success of the initiatives too. The PG chair considered that one of the coming tasks for MDEP is to determine how to tackle challenges related to commissioning activities. He warmly thanked the conference participants, speakers, NEA staff and the organising committee for a very good support. He was pleased with everyone's active participation and good discussions. He appreciated the positive atmosphere of the conference that proves MDEP is on the right track and will keep that spirit.

Mr William Magwood the Director General of NEA concluded that if the will to co-operate exists, it is possible. The question is to determine what we exactly want to achieve as there are divergences in the member's views who not all participate in the MDEP activities with the same objective. Some of the existing MDEP activities need to migrate to a slightly different format with the momentum kept. The success of MDEP is to have brought regulators, SDOs and industry, through CORDEL, together and produced some results that have significant impacts. He considered communication of feedback to the industry should be improved. Mr Magwood suggested capturing lessons learnt and wisdom from commissioning and testing nuclear facilities in a strong technical document that could be a reference for the future. He guaranteed that there is a willingness to see codes and standards activities and relations built to go forward. Some new work should be engaged on supply chain issues. On top of evaluating DI&C systems, Mr Magwood considered that regulators expectations should be determined precisely and this could be done in the form of some guidance or a green book. Regarding comments that were made that MDEP did not bring as much harmonisation as expected but more proliferation of questions from the regulators, he explained that regulators, by nature, cannot ignore questions but should go further and prioritise the questions within MDEP. Mr Magwood also considered the emerging need to create regulatory fora for operating designs. He was pleased to be part of this very interesting and substantive conference and had been very impressed

with the level of dialogue that took place. He suggested the PG to consider organising conferences more often as they allow capturing nuances. Mr Magwood thanked the organising committee, NEA staff and Mr Tiippana for organising this event. He concluded the ten year-MDEP effort allowed to accomplish very good things and that there are still very good things to be done in the future. He congratulated everybody involved in this effort and stated it is NEA mission to take it forward in a sustainable and productive way.

Programme

Day 1 – Tuesday 12 September

9.00-9.30: Registration and welcoming coffee

9.30-10.50: Welcome and opening of the conference

Chair: Mr Petteri Tiippana, MDEP Policy Group (PG) Chair and Finland PG member, STUK Chairman

Welcome and introductory remarks

Mr Petteri Tiippana, PG Chair

Mr William D. Magwood, Director General, NEA

10 years of MDEP achievements

Mr André-Claude Lacoste, MDEP co-founder, Former ASN Chairman, France – *The creation and development of MDEP*

Mr Gary Holahan, MDEP STC member, Chief Technical Advisor to the Executive Director for Operations, NRC, USA – *10 years of MDEP achievements*

Ms Agneta Rising, Director General, World Nuclear Association – *10 years of cooperation between MDEP and CORDEL*

10:50-12:35: Session 1 – Codes and standards harmonisation

Chair: Mr Peter Elder, Canada PG member, Acting Vice-President Technical Services Branch, CNSC

Introduction of the session

Panellists presentations

Mr Xuejun Wei, Chair of CSWG, CNSC, Canada – *MDEP activities, achievements and challenges in codes harmonisation*

Mr Shane Turner, Principal inspector, ONR, UK – *Approach to codes and standards in the UK*

Mr Andrey Obushev, Deputy Director for Development, VO Safety, Russia – *The use of MDEP products for Russian national standards development*

Dr Nawal Prinja, Chairman of the Codes and Standards Task Force, CORDEL – *Harmonising nuclear codes and standards for mechanical components*

Mr Philippe Malouines, Standard Development Organisations (SDO) board member – *SDO mechanical codes Convergence Board: achievements and perspectives*

Mr Hongwei Zhang, Engineer, Institution for Standardization of Nuclear Industry, China – *Application of nuclear codes and standards in China*

Panel discussion

Closing remarks of the session

12:35-14:00: Lunch

14:00-15:45: Session 2 – Digital instrumentation and controls: Current and emerging technical challenges

Chair: Mr Michael Knochenhauer, Sweden STC member, Director of Department of NPPs Safety

Introduction of the session

Panellists presentations

Mr Ismael Garcia, DICWG Chair, NRC, USA – *Digital instrumentation and controls activities and challenges*

Mr Stephen Wardle, DICWG Member, ONR, UK – *Digital instrumentation and controls: current and emerging technical challenges in the UK*

Mr Jean-Paul Bouard, IEC/SC45A Secretary, International Electrotechnical Commission – *IEC/SC45A, standards for instrumentation, control and electrical power systems for nuclear facilities*

Mr Johannes Pickelmann, Chairman of the CORDEL Digital I&C Task Force – *Current status and outlook of WNA CORDEL DICTF workload on digital instrumentation and controls topics*

Dr Darren Cofer, Fellow at the Rockwell Collins Advanced Technology Center, Aircraft Industry – *Safety assurance in software systems: from airplanes to atoms*

Mr Ma Shihong, I&C Manager of Commissioning Department, Sanmen Nuclear Power Co., Ltd., China National Nuclear Cooperation – *Challenges of I&C commissioning to first AP1000 unit*

Panel discussion

Closing remarks of the session

15:45-16:15: Break

16:15-18:00: Session 3 – Supply chain regulatory issues and vendor inspection co-operation

Chair: Mr Pierre-Franck Chevet, France PG Member, ASN Chairman

Introduction of the session

Panellists presentations

- Mr Stuart Allen, VICWG Chair, ONR, UK – *MDEP current activities and challenges in vendor inspection*
- Mr Dejun Wang, Project Officer, NNSA, China – *The construction of nuclear safety culture for equipment vendors in China*
- Mr David Emond, Component Manufacturing Business Unit Senior Executive Vice President, AREVA NP, France – *Quality audit and quality improvement plan at AREVA NP Le Creusot forging facility*
- Mr Randy C. Ivey, Supplier Quality Oversight Director, Westinghouse Electric Company, USA – *AP1000® nuclear power plant squib valve design challenges and regulatory interface*
- Mr Greg Kaser, Senior Project Manager, WNA – *The nuclear supply chain: an update on World Nuclear Association activities*

Panel discussion

Closing remarks of the session

18:00: Cocktail reception and dinner platters (Westminster room, 4th floor)

Day 2 – Wednesday 13 September

9:00-10:45: Session 4 – Influence of MDEP interactions on reactor designs safety

Chair: Dr Mzubanzi Bismark Tyobeka, South Africa PG Member, NNR CEO

Introduction of the session

Panellists presentations

- Ms Anne-Cécile Rigail, EPRWG Chair, ASN, France – *EPRWG: organisation and interaction with the industry*
- Dr Sweng Woong Woo, APR1400WG Chair, KINS, Korea – *APR1400WG activities and accomplishments*
- Mr Norbert Nicaise, Nuclear Safety and Licensing Manager, AREVA NP, France (EPR) – *MDEP and EPR design/licensing*
- Mr Richard J. Easterling, Vice President of Technical Services and Licensing, Westinghouse Electric Company, USA (AP1000) – *Multinational regulatory influence on new nuclear construction projects*
- Mr Yun Ho Kim, Deputy Project Manager, KHNP, Korea (APR1400) – *APR1400 safety design features and the influence of MDEP interaction*
- Mr Sergey Svetlov, Chief Expert for Design, JSC «ATOMPROEKT», Russia (VVER) – *New VVERs in Russia and abroad*
- Mr Dave Watson, Senior Regulatory Advisor, Nuclear Power Project, Hitachi Europe Ltd, UK (ABWR) – *Licensing of UK ABWR in an international environment*

Panel discussion

Closing remarks of the session

10:45-11:15: Break

11:15-13:00: Session 5 – Commissioning activities

Chair: Mr Christer Viktorsson, UAE PG Member, FANR Director General

Introduction of the session

Panellists presentations

- Mr Simon Yates, EPR CATESG Chair, ONR, UK – *MDEP current activities and challenges in commissioning activities*
- Mr Christer Viktorsson, Director General, FANR, UAE – *Commissioning experience in the UAE*
- Ms Lin Zhang, Deputy Director of the Department of Nuclear Power Safety Regulation, NNSA, China – *Overview of AP1000 commissioning inspection in P.R. China*
- Mr Didier Lambert, Commissioning Expert, EDF Group, France and Mr Ke Zhang, FPOT manager, TNPJVC, China – *Reactor pressure vessel internals vibratory behaviour test implementation*
- Mr Sang Won Lee, Principal Technical Manager, KHNP, Korea – *A brief overview of the APR1400 commissioning*
- Mr Valery S. Bezzubtsev, Director for Technological Development, JSC «Concern Rosenergoatom», Russia – *Commissioning of new nuclear power units in Russia*

Panel discussion

Closing remarks of the session

13:00-14:30: Lunch

14:30-16:15: Session 6 – Perspectives for MDEP

Chair: Mr Ho Nieh, NEA, Head of the Division of Nuclear Safety Technology and Regulation

Introduction of the session

Panel discussion

Mr Petteri Tiippana, MDEP PG Chair and Finland PG Member, STUK Director General
Mr Julien Collet, MDEP STC Chair and France STC Member, ASN Deputy Director General
Mr Liu Hua, China PG Member, NNSA Administrator
Mr S.A. Bhardwaj, India PG Member, AERB Chairman
Mr Alexey Ferapontov, Russia PG Member, Rostekhnadzor Deputy Chairman
Mr Michael Finnerty, UK PG Member, ONR New Reactors Programme Director
Mr Kenichi Sato, Representative of WNA CORDEL
Ms Cornelia Spitzer, Head of the IAEA Safety Assessment Section

Closing remarks of the session

16:15-16:30: Closing Session – Conclusion and closing of the conference

Mr Petteri Tiippana, PG Chair
Mr William D. Magwood, Director General, NEA

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