

MULTINATIONAL DESIGN EVALUATION PROGRAMME

Annual Report

April 2016-April 2017

August 2017



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Policy Group – Olkiluoto 3 EPR construction site visit, Finland, 24 May 2016.



Steering Technical Committee – 31st meeting, Vienna, Austria, 7-8 June 2017.

Cover page photo credits: Barakah Nuclear Energy Plant, United Arab Emirates, May 2017 (provided by Emirates Nuclear Energy Corporation – ENEC); Three reactors of Olkiluoto Nuclear Power Plant in Eurajoki, Finland, May 2016 (provided by the Finnish Radiation and Nuclear Safety Authority – STUK).

Foreword from the Policy Group Chair



It is my renewed pleasure to share my thoughts on the Multinational Design Evaluation Programme (MDEP) Annual Report for 2016-2017. The Annual Report provides an opportunity to reflect on the achievements of collaboration under this unique programme for regulatory activities related to new reactors. The contents of this report demonstrate another successful year for MDEP.

MDEP was launched in 2006. In the past ten years, MDEP's reputation as an effective organisation for leveraging the resources and experiences of multiple nations in the regulatory review of new reactors has grown significantly. As a result, the portfolio of new reactor designs that are being addressed have increased from two in 2006 to five in 2017, with a possibility of adding more new reactor designs in the coming years. MDEP's membership has grown from the original 10 national regulators to 15.

Over the past year, MDEP design specific working groups have all completed their common positions to address the impact of the Fukushima Daiichi nuclear power plant accident on new reactor designs. New reactor commissioning activities are a major part of all design specific working groups. The EPR and AP1000 Working Groups are particularly active in this area, as together they are overseeing 12 new reactor constructions worldwide. The design specific working groups have finalised a common position to provide high-level guidance to applicants and licensees that wish to take credit for a first plant only test (FPOT). This common position was first implemented in March 2017 at the Taishan 1 plant in China, where regulators and licensees from the United Kingdom, France and Finland witnessed reactor pressure vessel internals vibration tests. The FPOT marked a significant milestone for MDEP since it provided a unique opportunity for regulators involved to demonstrate the efficiency of using common positions to effectively collaborate and share information on test results. This model should be followed as much as possible in other MDEP co-operation areas. Another significant step in multinational regulatory co-operation was the successful completion of the second multinational vendor inspection at the AREVA NP Creusot Forge facility in December 2016. This multinational inspection constituted an excellent example of regulatory co-operation using MDEP vendor inspection protocol for an area of high risk that could potentially impact several nations' nuclear programmes. In addition, it has proven to be a valuable tool to gain vendor performance insights with minimal inspection resources from the participating regulators. I am also content to see the fruitful MDEP collaboration with the Nuclear Energy Agency (NEA) Working Group on the Regulation of New Reactors (WGRNR) on generic aspects of commissioning activities.

I am pleased to report that, in line with the MDEP Policy Group's decision to focus on design specific activities, MDEP and the NEA have taken steps to consider transferring MDEP generic activities to the NEA. Towards this end, one of three generic issue specific working groups, the Digital Instrumentation and Controls working group, will conclude its programme of work under MDEP and start its new mandate under the NEA Committee on Nuclear Regulatory Activities with the aim of broadening its scope to include operating reactors, as well as its membership.

Moving forward, we will continue to build on our achievements to further improve the effectiveness of new reactors regulation and collaboration under MDEP. Overall, MDEP continues to function smoothly, in no small measure as a result of the support of the NEA as the MDEP Secretariat.

*Petteri Tiippana,
MDEP Policy Group Chairman*

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Executive summary

The Multinational Design Evaluation Programme (MDEP) is a multinational initiative to leverage the resources and knowledge of national regulatory authorities that are currently, or will shortly be, undertaking the review of new reactor power plant designs. MDEP members are the regulatory authorities of Canada (CNSC), China (NNSA), Finland (STUK), France (ASN), Hungary (HAEA), India (AERB), Japan (NRA), Korea (NSSC), the Russian Federation (Rostechнадзор), South Africa (NNR), Sweden (SSM), Turkey (TAEK), the United Arab Emirates (FANR), the United Kingdom (ONR) and the United States (NRC). The International Atomic Energy Agency (IAEA) also takes part in the work of MDEP. The Nuclear Energy Agency (NEA) performs the Technical Secretariat function in support of MDEP. MDEP incorporates a broad range of activities including enhancing multilateral co-operation within existing regulatory frameworks and increasing multinational convergence of codes, standards, guides and safety goals. A key concept throughout the work of MDEP is that national regulators retain sovereign authority for all licensing and regulatory decisions.

Working groups are implementing the activities in accordance with programme plans with specific activities and goals, and have established the necessary interfaces both within and outside of MDEP. This report provides a status of the programme after its ninth year of implementation.

Significant progress is being made on the overall MDEP goals of increased co-operation and enhanced convergence of requirements and practices. In addition, the lessons learnt from the 11 March 2011 events at the Fukushima Daiichi nuclear power plant (NPP) have appropriately been incorporated into MDEP activities in the Design Specific Working Group (DSWG) programme plans.

Five DSWGs are facilitating the MDEP goal of enhanced co-operation. The EPR Working Group (EPRWG) consists of the regulatory authorities of China, Finland, France, India, Sweden, the United Kingdom and the United States. The AP1000 Working Group (AP1000WG) consists of the regulatory authorities of Canada, China, India, the United Kingdom and the United States. The APR1400 Working Group (APR1400WG) includes the regulatory authorities of Korea, the United Arab Emirates and the United States. The VVER Working Group (VVERWG) includes the regulatory authorities of China, Finland, Hungary, India, Russia and Turkey. The ABWR Working

Group (ABWRWG) includes the regulatory authorities of Japan, Sweden, the United Kingdom and the United States. The DSWGs have continued to share information and experience successfully on the safety design reviews with the purpose of enhancing the safety of the design and enabling regulators to make timely licensing decisions. Additionally, promoting safety and standardisation of designs is made possible through MDEP co-operation.

The Vendor Inspection Co-operation Working Group (VICWG) continues to implement its programme successfully; reaching another key milestone in December 2016 with the completion of the second multinational inspection. This accomplishment represents a significant step in multinational regulatory co-operation and it clearly demonstrates the benefits of regulatory co-operation in vendor inspection. The inspection team consisted of eleven inspectors from France, Canada, China, Finland, the United States and the United Kingdom.

The VICWG continues to focus on maximising information sharing, conducting joint inspections (multiple regulators inspecting to the regulatory requirements of one country) and witnessing other regulators' inspections. In 2016, in addition to the multinational inspection, two witnessed inspections were completed. The French and United States regulators also collaborated on inspections results from separately conducted vendor inspections. In total, 15 opportunities were identified to co-operate on vendor inspection related information. The VICWG is also interfacing with standards development organisations to encourage and explore harmonisation of quality standards.

The Digital Instrumentation and Controls (I&C) Working Group (DICWG) has issued 13 common positions (CP) based on the existing standards, national regulatory guidance, best practices and working group inputs. These common positions describe methods and evidence that all DICWG member countries find acceptable to support safety justification for digital I&C systems. In addition, the DICWG members jointly research and comment on proposed International Electrotechnical Commission (IEC), Institute of Electrical and Electronics Engineers (IEEE) and IAEA standards that are relevant to the regulatory review of digital instrumentation and control systems.

The Codes and Standards Working Group (CSWG) is working closely with standards development organisations to converge code

requirements related to pressure boundary components and to reconcile code differences. The working group has successfully completed its goal and mandate to achieve some harmonisation and to identify the challenges in harmonising codes and standards. The group works closely with industry and standard development organisations (SDOs) to continue to advance its goals and seek further progress co-operatively.

Accomplishments to date provide confidence that the MDEP membership, structure and processes offer an effective method of accomplishing increased co-operation in regulatory design reviews. The interim results and key accomplishments for 2016-2017 include the publication of the two first generic common positions from the Steering Technical Committee (STC). The first one provides high-level guidance to applicants and licensees that wish to take credit for a first plant only test (FPOT) performed during the commissioning of the first unit of a similar type, if accepted by the applicants, licensees and regulators. This common position is based on the draft that was developed by the EPRWG, recognised to be applicable to all designs. The second generic common position addresses the Fukushima Daiichi nuclear power plant accident for all MDEP reactor designs, based on the work of the design specific working groups. At the level of the working groups, the key accomplishments for 2016-2017 include:

- All five DSWG have completed common positions on post-Fukushima consideration for their specific design and the Steering Technical Committee has issued an integrated MDEP common position.
- As the ABWR has multiple vendors with differing designs, the ABWRWG drafted a comparison matrix of the key features of each design. This comparison matrix was sent to member country vendors to voluntarily populate in order for the ABWRWG to compile and review the responses. It is intended that a technical note discussing the outcomes of the review will be drafted towards the end of 2017.
- The APR1400WG completed a technical report on design differences between APR1400 plants, the Technical Report TR APR1400WG-01: Design Description and Comparison of Design Differences between APR1400 Plants was approved by the STC in June 2017.
- The APR1400WG Accident and Transients TESC finalised the Common Position CP-APR1400-02: Common Position on the APR1400 Post Loss-of-Coolant Accident (LOCA) Strainer Performance and Debris In-Vessel

Downstream Effects, that was approved by the STC in June 2017.

- The FPOT was conducted during the first semester 2017 at the Taishan 1 plant in China. This test provided the opportunity to implement the MDEP common position on FPOT. The attendees to the FPOT in March 2017 included ONR, ASN, STUK, NEA representing the MDEP CATESG (Commissioning Activities Technical Expert Subgroup) and EDF, NNB, and TVO representing the EPR Owners and Operators Group (OOG).
 - The AP1000WG continued to exchange information about important design changes, construction issues and vendor issues associated with the AP1000 design, especially among the regulators of China, the United Kingdom and the United States.
 - The VVERWG continued to interact with the Russian nuclear industry, as well as invite representatives of Rosatom, Rosenergoatom and design organisations (Atomenergoproekt, Atomproekt, Hidroproekt) to take part in the meetings of the VVERWG and its subgroups to get additional information about safety-significant design solutions.
 - The VVERWG completed two technical reports – TR-VVERWG-01 on regulatory approaches and criteria used in severe accident analyses and severe accident management and TR-VVERWG-02 on regulatory approaches and oversight practices related to reactor pressure vessel and primary components. These technical reports were presented to the STC in June 2017.
 - The VICWG completed the second multinational inspection at AREVA NP, Creusot Forge facility in December 2016.
 - The DICWG issued the CP-DICWG-13: Common Position on Spurious Actuations.
 - The CSWG has reviewed three SDOs and CORDEL code harmonisation reports and provided comments to the SDOs and CORDEL.
- MDEP held a joint workshop with the Committee on Nuclear Regulatory Activities (CNRA) Working Group on the Regulation of New Reactors (WGRNR) on commissioning activities in March 2016. The report on the workshop results focused on proposed commendable practices to help nuclear regulatory organisations (NROs) develop their commissioning oversight arrangements in addition to planning and performing their oversight activities. This report will be submitted for CNRA approval in December 2017.

1. Introduction

The Multinational Design Evaluation Programme (MDEP) is a multinational initiative that develops innovative approaches to leverage the resources and knowledge of national regulatory authorities who are, or will shortly be, undertaking the review of new reactor power plant designs. MDEP is primarily focused on design evaluation, but also includes inspection activities and generic issues. A key concept throughout the programme is that MDEP will better inform the decisions of regulatory authorities through multinational co-operation, while each regulator retains the sovereign authority to make licensing and regulatory decisions.

Working groups are implementing the activities in accordance with their programme plans with specific activities and goals, and the working groups have established the necessary interfaces both within and outside MDEP members. Significant progress has been made over the past year on the overall MDEP goals of increased

co-operation and enhanced convergence of requirements and practices. Accomplishments to date provide confidence that the MDEP membership, structure and processes provide an effective method of accomplishing increased co-operation in regulatory design reviews for new reactors.

MDEP was established in 2006 as a multinational initiative for a five-year period. It was extended for another five-year period in 2012 by the Policy Group based on the value gained by the members. At its meeting in June 2015, the MDEP Policy Group determined that MDEP should continue at least for five years following 2017, in its current form. Since MDEP is a temporary organisation, the Policy Group has approved the transfer of two of the issue specific working groups to an NEA committee. This report provides a status of the programme after its ninth year of implementation.

2. Programme goals and outcomes

The main objectives of the MDEP effort are to enable increased co-operation within existing regulatory frameworks and establish mutually agreed upon practices to enhance the safety of new reactor designs. The enhanced co-operation among regulators will improve the effectiveness and efficiency of the regulatory design reviews, which are part of each country's licensing process. The programme focuses on co-operation on regulatory practices that aim at harmonising regulatory requirements. The IAEA safety standards, which provide a general level of harmonisation, provide input to the work and can benefit from the final results.

MDEP is meeting its goal of enabling increased co-operation through the activities of the working groups. MDEP has been successful in providing a forum for regulatory bodies to co-operate on

design evaluations and inspections. In addition to organising working groups, MDEP has provided each regulator with peer contacts who share information, discuss issues informally and disseminate information rapidly. For example, the design specific working group members have benefitted significantly from the sharing of questions among the regulators, resulting in more informed and harmonised regulatory decisions. MDEP members have also been highly successful in co-ordinating vendor inspections in which the regulators share observations and insights. MDEP has made improvements in communicating information regarding the members' regulatory practices through development of an MDEP library which serves as a central repository for all documents associated with the programme.

3. Programme implementation

3.1 Membership

Participation in the Policy Group and Steering Technical Committee is intended for national safety authorities of interested countries that already have commitments for new build or firm plans to have commitments in the near future for new reactor designs. MDEP members are: Canada, China, Finland, France, Hungary, India, Japan, Korea, Russia, South Africa, Sweden, Turkey, the United Arab Emirates, the United Kingdom and the United States. The IAEA also takes part in the work of MDEP.

3.2 Organisational structure

The programme is governed by a Policy Group (PG), made up of the heads of the participating organisations, and implemented by a Steering Technical Committee (STC) and its working groups. The Steering Technical Committee consists of senior staff representatives from each of the participating national safety authorities in addition to a representative from the International Atomic Energy Agency (IAEA).

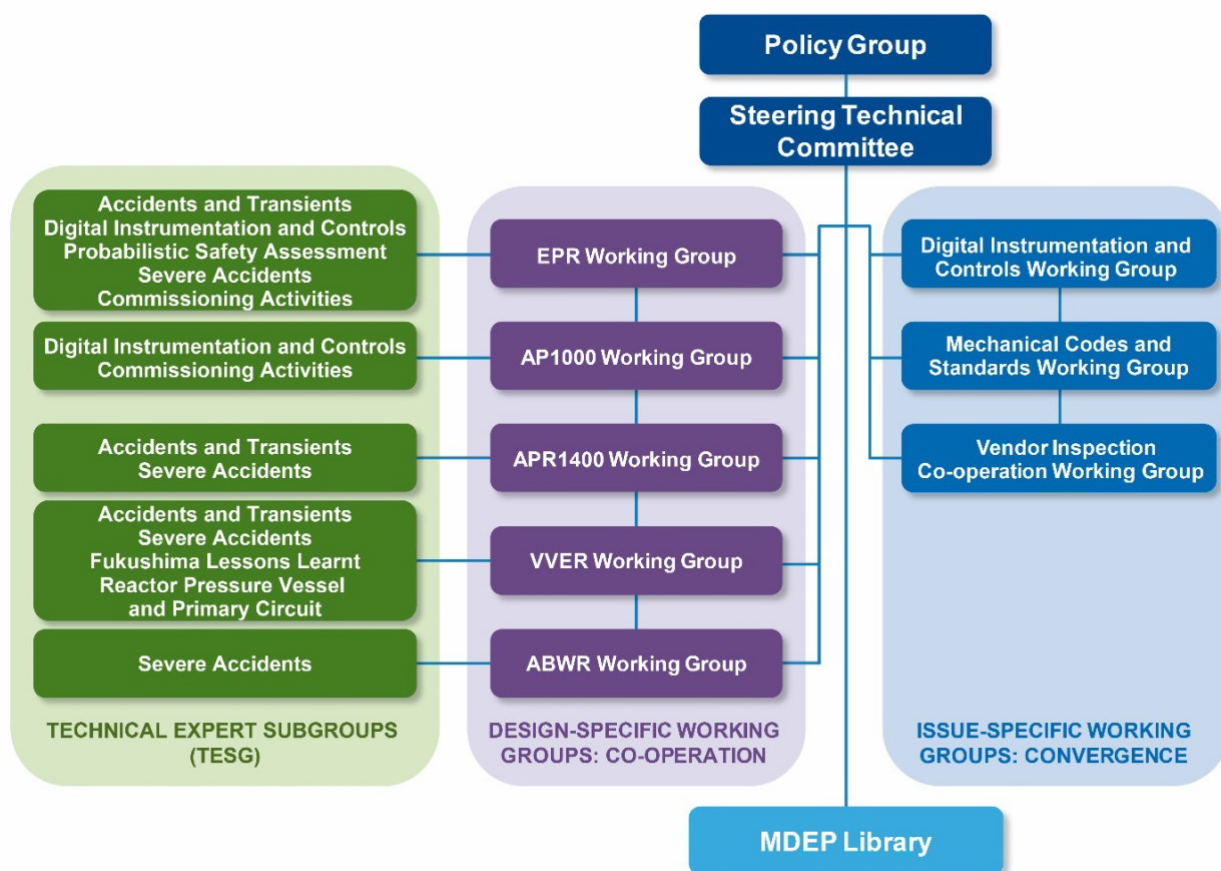
The Policy Group provides guidance to the Steering Technical Committee on the overall focus of MDEP; monitors the progress of the programme; and determines participation in the programme.

The Steering Technical Committee manages and approves the detailed programme of work including: defining topics and working methods; establishing technical working groups and nomination of experts; approving procedures and technical papers developed by the working groups; establishing interfaces with other international efforts to benefit from available work and avoid duplication; developing procedures for the handling of information to be shared in the project; reporting to the Policy Group; identifying new topics for the programme to address; and establishing subcommittees of the STC to study specific topics.

The OECD Nuclear Energy Agency (NEA) performs the Technical Secretariat function in support of MDEP.

Two lines of activities have been established to carry out the work of MDEP:

- **Design specific activities.** Design specific working groups share information on a timely basis and co-operate on the areas of specific reactor design evaluations, construction oversight and the commissioning and early-phase operation of new reactor type plant. Participants in these working groups are the regulatory authorities that are actively reviewing, preparing to review, or regulating the construction of the specific new reactor designs. A design specific working group is formed when three or more MDEP member countries express interest in working together. Under the design specific working groups, expert subgroups have been formed to address specific technical issues. Non-MDEP regulators could request MDEP membership in order to join a design specific working group.
- **Issue specific activities.** Working groups have been organised for specific technical and regulatory process areas within the programme of work. These include vendor inspections, codes and standards, and digital instrumentation and controls. Membership in issue specific working groups is open to all MDEP participating countries and the IAEA representatives. These topics were chosen because the activities are of generic interest and of safety significance to the licensing of new reactors in MDEP member countries. The approaches followed by the MDEP regulators are not completely alike, and successful completion of the activities related to the issue specific working groups will likely result in increased harmonisation and convergence in regulatory practices or increased co-operation. In June 2015, the MDEP Policy Group determined that the programme should focus on design specific activities going forward and the issue specific working groups should be closed or transferred to another organisation over the next few years. The STC is currently working with the NEA to transfer two of the three issue specific working groups under NEA's CNRA within the next two years. The DICWG will transition to the CNRA in December 2017. The CSWG may be transferred in the future, if approved by the CNRA. The following chart illustrates how the programme is currently organised.



MDEP organisational structure

3.3 MDEP Library

In part, MDEP information is communicated among the members through the MDEP library which serves as a central repository for all documents associated with the programme. The NEA provides the technical support for development and maintenance of the MDEP library on a secured password-protected website. The website provides two levels of access which are: 1) general access open to every member, and 2) restricted area access for each MDEP working groups' member regulators participating in that specific group. Publicly available documents related to MDEP are available on the MDEP page of the NEA website (www.oecd-neo.org/mddep/). The STC, through the secretariat, manages the maintenance of the library and makes enhancements to improve the effectiveness of the library.

In order for MDEP to be successful in fulfilling its goal of leveraging the work of peer regulators in the evaluation of new nuclear power plant designs, a framework was developed to facilitate

the sharing of technical information among MDEP participants which at times may include the sharing of proprietary and other types of sensitive information. As a general rule, the information exchanged as part of the MDEP in meetings and the MDEP library is for the sole use of the participating national regulatory authorities. The members of the working groups also have a communication protocol to share new information related to new reactors with other members in advance of its release to the public. A large portion of the information shared may not be proprietary or sensitive; however, all participating members must protect and properly handle the information that an originator claims to be proprietary or sensitive.

3.4 Common positions

MDEP has developed a process for identifying and documenting common positions on specific issues among the member regulators based on existing standards, national regulatory guidance,

best practices and group member inputs. Design specific common positions document common conclusions that each of the working group members have reached during design reviews. Discussions among the members and sharing of information in these areas help to strengthen the individual conclusions reached.

Generic common positions apply generically rather than only to one specific design. Generic common positions document practices and positions that each of the working group members find acceptable. The common positions are intended to provide guidance to the regulators in reviewing new or unique areas, and will be shared with the IAEA, and other standards organisations, for consideration in standards development programmes. After a common

position is agreed to by a working group, it is presented to the STC for endorsement. Upon endorsement by the STC, the proposed common positions are made publicly available on the NEA MDEP website in order to keep external stakeholders informed of the work completed within MDEP. Those common positions will become commendable practices, recommended by the MDEP. There is no obligation on the part of any regulatory body to follow them. A key concept throughout the work of MDEP is that national regulators retain sovereign authority for all licensing and regulatory decisions. If a regulatory body chooses to formally adopt a common position, it would be through that country's normal processes.

4. Interactions with other organisations

MDEP strives to maintain an awareness of, and interactions with, other organisations that are implementing programmes to facilitate international co-operation on new reactors. Interactions focused on ensuring that MDEP does not duplicate efforts, benefits from the outputs of these organisations. Continued communication of MDEP activities and results to other organisations assists these interactions. In order to ensure that efforts are not duplicated between the groups, MDEP's scope is focused on short-term activities related to specific design reviews being conducted by the member countries and efforts to harmonise specific regulatory practices and standards.

4.1. CNRA WGRNR

The CNRA Working Group on the Regulation of New Reactors (WGRNR) examines the regulatory issues of siting, licensing, and regulatory oversight of generation III+ and generation IV nuclear reactors. The current focus areas of the WGRNR are construction experience and construction inspection issues. The WGRNR co-ordinates its work with the work performed by MDEP such that it utilises its outputs, does not duplicate its efforts, and extends the results of MDEP to other CNRA members. To avoid overlap of activities between the groups, WGRNR focuses on procedures and guidance, while MDEP focuses on design specific issues.

MDEP interacts with the CNRA WGRNR and the Working Group on Inspection Practices (WGIP) through the NEA who also serves as the Technical Secretariat for the CNRA. WGRNR is the focal point of interactions between MDEP and the CNRA and its working groups, and will assist in

co-ordinating communications and requests between the two activities in order to ensure that the MDEP's efforts take full advantage of the work already being done by the CNRA.

In 2014, MDEP and CNRA agreed to a proposed framework in which MDEP addresses commissioning activities (hot functional and start-up testing) specific to a design and WGRNR addresses generic commissioning activities. Lessons learnt from MDEP commissioning activities will be transferred to WGRNR for it to pursue the work on a generic basis with participation open to a wider range of regulators.

In March 2016, MDEP and WGRNR held a joint commissioning workshop in Korea with well-balanced WGRNR-MDEP participation. The workshop consisted of three parallel sessions on commissioning management, commissioning oversight and cross-cutting issues. The report on the workshop results will focus on the 11 topics discussed at the workshop and propose commendable practices to help nuclear regulatory organisations (NROs) develop their commissioning oversight arrangements in addition to planning and performing their oversight activities. This report will be submitted for CNRA approval in December 2017.

In accordance with the Policy Group direction to transfer the MDEP issue specific working group activities to another structure, MDEP is interacting with CNRA leadership to propose a transfer of some the activities to CNRA. Although the MDEP working groups will have completed their current programme of work, the benefits of continuing co-ordination among regulators on these topics have been recognised both within and outside of the MDEP members. Therefore,

MDEP has proposed that the working group activities, in full or a limited scope, be transferred as a new task under CNRA, maintaining the same goals and processes during the initial transfer period. The first issue specific working group to be transferred to CNRA in December 2017 is the DICWG.

4.2. IAEA

The IAEA takes part in the work of MDEP through participation in the Policy Group meetings, STC meetings and issue specific working groups. In addition, the generic common positions developed in MDEP are shared with the IAEA for consideration in the IAEA standards development programme.

4.3. Advanced Reactor Forums

Although MDEP is not currently considering the designs of advanced reactors, MDEP interacts with the Generation IV International Forum (GIF) to stay informed of multinational co-operative activities in the area of advanced reactors. MDEP also receives updates, through NEA, of the work of the Joint CNRA/CSNI Ad hoc Group on the Safety of Advanced Reactors (GSAR), and maintains an awareness of the efforts of the IAEA Small Modular Reactor Forum. While these groups co-operate on the generic issues related to advanced and small modular reactors (SMR), there is an understanding that MDEP may form a design specific working group if three MDEP member countries begin to consider a specific advanced or SMR design.

4.4. WENRA

The MDEP Steering Technical Committee meets periodically with a representative of the Western Europe Nuclear Regulators Association (WENRA) to discuss the development of WENRA safety objectives and reports. The WENRA Reactor Safety Working Group has welcomed MDEP input when developing its documents.

4.5. Industry

The MDEP working groups are very interested in understanding the perspectives of the design vendors, codes and standards organisations, component manufacturers and the challenges they face in dealing with numerous regulators and regulatory systems. The MDEP working groups interact with industry groups, and invite

them to participate in selective portions of meetings and other activities. For example:

- The Codes and Standards Working Group interacted with a committee of standards development organisations (SDOs) (ASME, JSME, KEPIC, AFCEN, NIKIET and CSA) in a code comparison project. After issuing the code comparison report, the SDOs formed a Code Convergence Board to limit divergence and achieve convergence on individual requirements, where realistic and practical. Members of the MDEP CSWG participate in meetings of the Code Convergence Board.
- The EPR Working Group meets regularly with representatives of AREVA, EDF and other EPR-licensees, applicants and potential applicants to discuss similarities and differences among the EPR designs being licensed in each country.
- The AP1000 Working Group meets with Westinghouse and the AP1000 applicants and licensees.
- The APR1400 Working Group meets with KHNP and representatives of the licensee for the Barakah NPP, an APR1400 under construction in the United Arab Emirates (UAE).
- The ABWR Working Group interacts with a number of industry representatives including GE-Hitachi, Hitachi-GE, Toshiba, Tokyo Electric Power Company, Horizon Nuclear Power, Vattenfall AB and Nuclear Innovation North America.
- The VVER Working Group continues to interact with Russian nuclear industry, as well as invited representatives of Rosatom, Rosenergoatom and design organisations (Atomenergoproekt, Atomproekt, and Gidropress) to take part in the meetings of the VVERWG and its subgroups to acquire additional information about safety-significant design solutions.
- The Digital Instrumentation and Controls Working Group (DICWG) interacts frequently with applicable SDOs, the Institute of Electrical and Electronics Engineers (IEEE) and the International Electrotechnical Commission (IEC), by including representatives of IEC and IEEE in MDEP meetings, attending IEC and IEEE meetings, and involving them in the development of common positions.
- The Vendor Inspection Co-operation Working Group (VICWG) met with SDO and World Nuclear Association (WNA) representatives to discuss Quality Assurance and Quality Management (QA/QM) standards for manufacturing nuclear components.

4.6. World Nuclear Association

The World Nuclear Association CORDEL group acts as the industry counterpart to MDEP. CORDEL has initiated task forces to address many issues, including those currently being worked on by the MDEP issue specific working groups. Members of the MDEP STC meet with CORDEL periodically, and CORDEL has participated in meetings of the MDEP Codes and Standards and Digital I&C Working Groups. CORDEL plays an important role in code harmonisation. They have established a Codes and Standards Task Force (CSTF) to converge code requirements and technical experts from over ten companies worldwide are working in the CSTF.

Since both MDEP and CORDEL have expressed interest in and have established a goal of furthering harmonisation of reactor designs, regulatory practices, and industry and international standards, the MDEP Policy Group has agreed that co-ordination of efforts with CORDEL is appropriate in some cases. While co-ordinating efforts in areas of mutual interest, MDEP members will always retain their individual and independent regulatory roles and positions.

While MDEP is a regulatory forum and CORDEL is an industry organisation, both parties agree they can benefit from communications and co-operation where the organisations share common goals. Two areas in which CORDEL and MDEP both have programmes of work to increase harmonisation are digital instrumentation and controls and codes and standards.

Both MDEP and CORDEL maintain strong interests in the harmonisation of new reactor designs and design reviews, regulatory safety standards and practices, and related industry and IAEA standards. MDEP values continued interaction to assist in achieving these goals while each organisation functions in a manner consistent with its appropriate roles and responsibilities.

With effective communications in mind, MDEP has regular interactions with CORDEL. The most recent meeting was held in March 2017, in Maryland, USA. During this meeting, MDEP STC members and CORDEL discussed current activities being undertaken at CORDEL and their role in MDEP. Collectively, the group discussed the potential for industry and SDO work on the area of carbon segregation. The next interaction with CORDEL will be in September 2017.

To celebrate its 10 year anniversary, MDEP will host a 2-day conference in September 2017 in London, United Kingdom. The conference will include sessions on: codes and standards harmonisation; digital instrumentation and controls: current and emerging technical challenges; supply chain regulatory issues and vendor inspection co-operation; influence of MDEP interaction on reactor designs safety; commissioning activities; and perspectives for MDEP. Each session will be led by a Policy Group member and organised by a working group chair. CORDEL will participate throughout the conference.

5. Current activities

The current activities of MDEP are being implemented through design specific and issue specific working groups. The members of the design specific working groups share information and co-operate on specific reactor design evaluations and construction oversight. Issue specific working groups are organised for the technical and regulatory process areas within the programme of work. Each working group has a lead and co-lead regulator designated, and has developed a programme plan which identifies specific activities, schedules and contacts.

The design specific working groups leverage national regulatory resources by sharing information and experience on the regulatory safety design reviews with the purposes of enhancing the safety of the design and enabling regulators to make timely licensing decisions.

Design specific working groups achieve this goal through:

- Exchanging experiences and lessons learnt on licensing process implementation, design reviews, and design-related construction and commissioning activities;
- Working to understand the differences in regulatory safety review approaches in each country to support potential use of other regulators safety design evaluations, where appropriate;
- Identifying and understanding key design differences including those originating from regulatory requirements and then documenting the reasons for differences in regulatory requirements;

- Looking for opportunities to provide input to issue specific working groups on potential topics of significant interest;
- Documenting common MDEP positions on aspects of a review;
- Documenting the group's activities in technical reports to ensure knowledge transfer;
- Communicating and co-ordinating communications on MDEP views and common positions to vendors and operators regarding the basis of safety evaluations and standardisation.

While the design specific working groups typically address issues that the members find challenging, specific to each design, some topics are addressed by several working groups. Two such topics are commissioning activities and Fukushima Daiichi lessons learnt.

Commissioning activities

Members of design specific working groups, especially EPRWG and AP1000WG, have started activities and are presently devoting resources for co-operation on commissioning of first-of-a-kind (FOAK) reactor testing. Lessons learnt by MDEP will be transferred to WGRNR for it to pursue the work on a generic basis, with participation open to a wider range of regulators.

Early 2016, the EPRWG issued a draft common position addressing first plant only tests (FPOT) on the EPR design. During 2016, the other design specific working groups recognised the paper to be applicable to their own design. As a consequence, the draft EPR common position on FPOT was published as a generic one at the STC level in May 2016. The MDEP generic common position on FPOT provides high-level guidance to applicants and licensees that wish to take credit for a FPOT performed during the commissioning of the first unit of a similar type, if accepted by the applicants, licensees and regulators. An FPOT allows a test performed on the very first reactor of a specific design to be credited for the subsequent units of similar design.

- As the United States and China progress in construction of AP1000s and move into the commissioning phase, they have begun to share information on commissioning tests and activities. The Commissioning Activities Technical Expert Subgroup (TESG) future activities include increasing co-operation on pre-operational and start-up testing as more reactors start going through these phases.
- The EPR Working Group has created a new Commissioning Activities TESG in order to

begin co-operating on oversight of plant commissioning, pre-operational and start-up testing. As several of the member countries get closer to the late stages of construction and preparations for operation, the new subgroup will enable MDEP members to share experience in late-stage construction tests (e.g. hot functional tests) leading to fuel load and operations. The commissioning activities focused mainly on preparing for the joint witnessing of the reactor pressure vessel internals vibration first plant only test at the Taishan 1 nuclear power plant conducted in March 2017.

The 2016 MDEP joint workshop with the CNRA WGRNR on commissioning activities aimed to share best practices and recent experience from international regulatory approaches for the commissioning of new reactors. Topics discussed included: regulatory priorities and practices, oversight and regulation of commissioning tests and activities, and commissioning issues not tied to a specific design. The outputs of the workshop will be recorded in the form of a report proposing commendable practices to help nuclear regulatory organisations develop their commissioning oversight arrangements, and plan and perform their commissioning oversight activities. The final draft report of the joint WGRNR-MDEP workshop on commissioning is to be submitted to the STC for approval by October 2017. WGRNR aims to have the report approved at the CNRA meeting in December 2017.

MDEP co-operation in operational phases

MDEP was established primarily as a forum to co-operate on design reviews. As the designs are moving into the commissioning and eventually the operational phases, the Policy Group and Steering Technical Committee have discussed the benefits and challenges of continuing co-operation after construction is complete and into the operational stages. MDEP recognises the benefits of continuing the co-operative relationships formed during the design review stage, as well as the benefit to the members of the Design Specific Working Groups (DSWG) who are still in the licensing phase. The Policy Group has determined that the operational stage should not be included in the scope of MDEP. However, they stated there should be a means to ensure that operating experience related to design issues is addressed by DSWGs. With this in mind, MDEP will continue to share information on construction and commissioning of new reactors, and incorporate feedback from operating experience as it pertains to design.

MDEP members agree that operating experience, when it has an impact on designs, should be considered. In particular, information from the first year of operation may be directly related to commissioning. MDEP members are encouraged to stay and participate in a group after the considered reactor begins to operate in their country to share operating experience.

This issue was raised once more at the STC meeting in June 2017. After an extensive discussion, it was clear that the members value the forum that MDEP provides. The discussion revolved mostly around the transition of a DSWG from MDEP to another area because there is a real value in the structured co-operation and dialogue that MDEP promotes. The STC discussed this challenge extensively and will be looking for the Policy Group's guidance following their September 2017 meeting.

Fukushima Daiichi Nuclear Power Plant Accident Lessons Learnt

Lessons learnt from the Fukushima Daiichi nuclear power plant accident are discussed by all of the DSWGs and have been incorporated in their programme plans. MDEP recognises that other international initiatives are ongoing that are focused on operating plants. Therefore, it is important for MDEP to address such issues for new reactor designs. All of the MDEP design specific working groups conduct discussions on Fukushima Daiichi lessons learnt and each working group has developed a common position that identifies common approaches to address potential safety improvements, as well as common general expectations for new NPPs. As directed by the MDEP Policy Group, the STC and working groups developed an integrated MDEP common position on the lessons learnt from the Fukushima Daiichi NPP accident. The STC finalised this document in 2016 and placed it on the MDEP public webpage.

5.1 EPR Working Group (EPRWG)

The EPR design specific Working Group (EPRWG) includes the regulatory authorities of China (NNSA), Finland (STUK), France (ASN), India (AERB), Sweden (SSM), the United Kingdom (ONR) and the United States (NRC). Numerous meetings and technical exchanges have taken place to share information on the reviews being conducted in each country. The following major construction activities are currently ongoing: Olkiluoto 3, which is in the final stage of construction in Finland, Flamanville 3 which is under construction in France, the twin unit plant at Taishan which is in the final stage of construction in China, and the

twin unit plant at Hinkley Point C which is in the early construction phase in the United Kingdom.

The working group currently includes five technical expert subgroups that are addressing information on specific technical issues: Accidents and Transients, Digital Instrumentation and Controls, Probabilistic Safety Assessment, Severe Accidents and Commissioning Activities. The latter is a new subgroup which was created in early 2016 and has actively met during this year. Each of these subgroups meet regularly to exchange information on relevant aspects of the design review status, share relevant evaluations when they become available, produce technical reports to identify and document similarities and differences among designs, regulatory safety review approaches and resulting evaluations.

The EPRWG meets regularly with representatives of AREVA, EDF and other EPR-licensees, applicants, and potential applicants to discuss similarities and differences among the EPR designs being reviewed and licensed in each country. In June 2016, the EPRWG held a meeting in France with a visit to the Flamanville 3 plant under construction. In November 2016, the EPRWG held a meeting in China which included a visit to the Taishan plant under construction.

Accomplishments and plan of work

In 2016, the EPR Working Group commenced work on a draft common position stating how the EPR design addresses the objectives of the Vienna Declaration, especially with regards to avoiding large and early releases and long-term contamination. This common position addresses design basis, design extension and severe accidents.

The Probabilistic Safety Assessment (PSA) TESG is incorporating the EPR Owners and Operators Group (OOG) feedback in a technical report identifying the main differences in the modelling of the PSAs used on the modelling of internal hazards in the various EPR designs. Similar studies will now focus on the modelling of the heating, ventilation and air conditioning (HVAC) systems and the instrumentation and control systems in various EPR designs.

The Accidents and Transients TESG held discussions on the use of reflective metallic insulation for the primary circuit, and boron dilution issues with the aim of trying to reach common positions in these areas. In addition, the subgroup contributed to the EPRWG common draft position on the Vienna Declaration. The subgroup plans to work on LOCA status in the safety assessment report.

The EPR I&C TESG continues to focus on the issue of spurious actuations due to software failures. It is recognised that this concern is not specific to EPR, and thus it is also being considered in the DICWG. This year the subgroup has also focused on the qualification of I&C systems and the updating of the technical report on the EPR I&C designs.

The Severe Accidents TESG shared the final assessment of the severe accident analysis for the Flamanville 3 plant. The subgroup also provided input to the EPRWG draft common position on the Vienna Declaration.

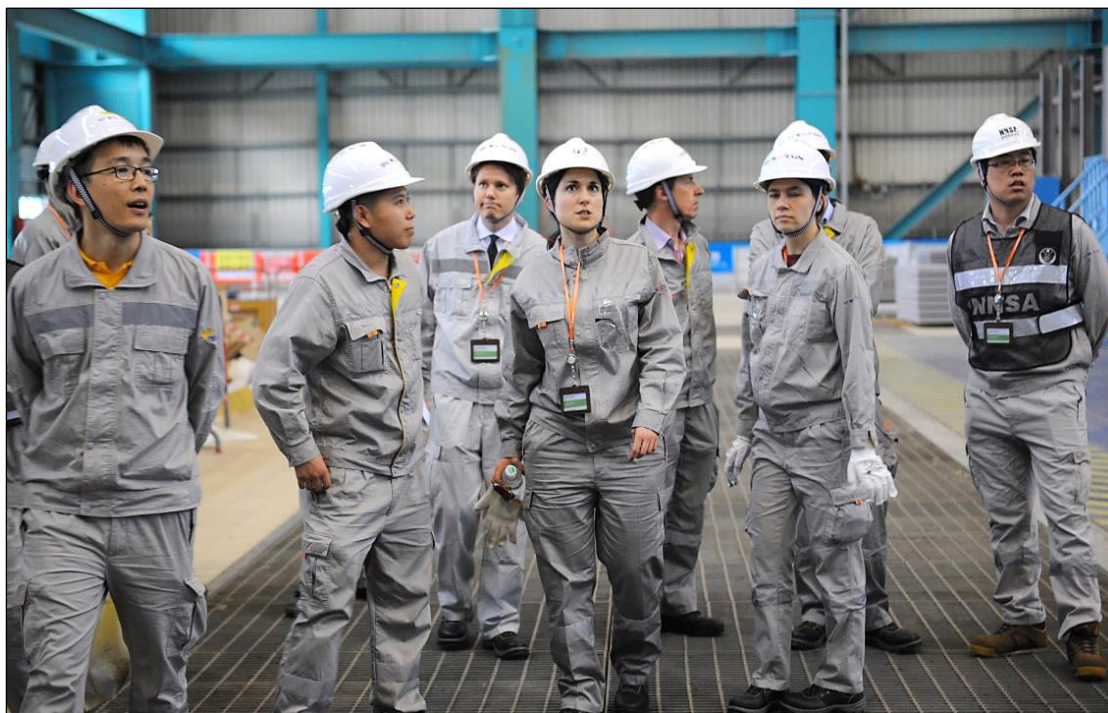
The EPR Commissioning Activities TESG (CATESG) met four times during 2016. The discussions included the following topics: phasing of the commissioning proposed by the plant vendor and inspection programmes; first plant only tests (FPOT); and lessons learnt during commissioning including any associated regulatory issues.

The CATESG prepared for the joint witnessing of the reactor pressure vessel internals vibration FPOT by sharing technical documentations and agreeing on the conditions to witness the test. Preparatory meetings for the FPOT were held in June, October and December 2016. The FPOT was conducted during the first semester 2017 at the Taishan 1 plant in China. This test provided the

opportunity to implement for the first time the MDEP common position on FPOT. The CATESG organised in March 2017 a common witnessing of the FPOT, in order to gain confidence in the manner in which the FPOTs are undertaken and observe the quality assurance and quality control arrangements. The objective was not to review the technical adequacy of the tests nor the resulting data.

In this aim, the Chinese regulatory authority, NNSA, shared with its counterparts, in a very open manner, its inspection process and results. The attendees to the FPOT included ONR, ASN and STUK, supported by NEA. One of the preconditions set by MDEP for crediting FPOT is for regulator and licensee to be provided with possibility to witness the FPOT. In this aim, the Taishan Nuclear Power Joint Venture Co., Ltd kindly welcomed EDF (France) and NNB GenCo (UK) to witness the FPOT alongside the regulators. While planning to also perform the test at Olkiluoto 3, TVO (Finland) also attended the event.

The general observations of the EPR CATESG included that there was evidence of adequate quality control arrangements for preparation and performance of FPOT; no fundamental reasons identified for not crediting TSN1 FPOT results; and that this was a positive example of MDEP supporting regulators to work together to benefit the EPR family.



EPR CATESG – Witnessing of the reactor pressure vessel internals vibration FPOT, Taishan 1 EPR construction site, China, March 2017.

In the coming year, the EPRWG plans to:

- Continue to communicate timelines for sharing regulatory evaluations of the EPR among all EPRWG member countries.
- Continue to share information among EPRWG members in the areas in which technical experts subgroups (TESGs) have been formed including Digital Instrumentation and Controls – DI&C (Lead: Finland), Probabilistic Safety Assessment – PSA (Lead: Finland), Severe Accidents – SA (Lead: France), Accidents and Transients – A&T (Lead: UK) and Commissioning Activities – CA (Lead: UK). These groups plan to perform the following:
 - the technical expert subgroups will provide a work plan including description and scope of issues to be addressed to the EPRWG and report on the status at every EPRWG meeting;
 - continue to meet regularly and exchange information on relevant aspects of the design review status;
 - share relevant evaluations when they become available;
 - produce technical expert subgroup technical reports on subject that the subgroup deems important to safety to identify and document similarities and differences among designs, regulatory safety review approaches and resulting evaluations;
 - produce MDEP EPRWG common positions, especially on important safety evaluation findings, such as how EPR design meets the expectations of the Vienna Declaration;
 - post evaluations, positions, reports, etc. in the MDEP library.
- Follow up on EPR specific commissioning activities regarding:
 - follow-on licensees to submit case to retrospective regulators for crediting TSN1 RPVI FPOT results as appropriate;
 - sharing the first results of the commissioning tests with a NEA press release reporting CATESG visit and present RPVI FPOT at the fourth MDEP Conference in September 2017;
 - preservation and maintenance of equipment during the commissioning phase to ensure its qualification is not invalidated;
 - provide feedback to WGRNR on potential generic issues for their consideration.
- Address important ad hoc topic areas to support design safety review decision making:
 - exchange of information on specific technical issues (carbon properties of nuclear pressure equipment);
 - NPP accident-related issues within the EPRWG and with the vendors and licensees/operators/applicants to ensure follow up on safety issues.
- When necessary, plan and conduct design-related inspections to ensure adequate design configuration control, quality assurance and acceptability of structures, systems, and components of the EPR (with appropriate coordination with VICWG).
- Provide recommendations, when appropriate, to the STC for considering possible items as topics to address generically.



EPRWG – Flamanville 3 EPR construction site visit, France, 15 December 2016.



EPRWG – Olkiluoto 3 EPR construction site visit, Finland, 15 June 2017.

5.2 AP1000 Working Group (AP1000WG)

The AP1000 design specific Working Group (AP1000WG) includes the regulatory authorities of Canada (CNSC), China (NNSA), the United Kingdom (ONR), and the United States (NRC). In 2017, India (AERB) joined the AP1000 WG. A total of four AP1000 units are under construction in China at the Sanmen and Haiyang sites. As of 30 July 2017, four units were under construction in the United States at the Vogtle and Summer sites. On 31 July 2017, South Carolina Electric & Gas (SCE&G) ceased construction on VC Summer Units 2 and 3. The NRC has issued combined (construction and operating) licenses for four other AP1000 units, two each at the Levy and Lee sites. The NRC is also nearing completion of its review of combined licenses for two other AP1000 units at the Turkey Point site.

In 2016 and 2017, ONR continued its review of the AP1000 as part of the four step Generic Design Assessment (GDA) process. In 2011, ONR issued an interim Design Acceptance Confirmations (iDAC) of the AP1000 design, with 51 outstanding GDA issues attached. Since restarting the Step 4 review in 2015, ONR has been engaged in detailed technical discussions with Westinghouse to address these issues and to re-establish the generic AP1000 design proposed for the United Kingdom, cognisant of changes to the AP1000 design (and supporting analyses) introduced in the United States and China since 2011. ONR is also in engagement with a prospective licensee who has plans to build three AP1000 units in the north west of England. Westinghouse addressed the 51 issues raised by ONR as part of their GDA process. In March 2017, a Design Acceptance Certification was awarded with a number of GDA “assessment findings” attached that will need to be addressed by future licensees at the site specific design stage.

In Canada, since CNSC completed a pre-licensing assessment of the AP1000 in June 2013 as part of its Phase 2 evaluation, there has been no activity with Westinghouse on further review efforts. The Phase 2 vendor design review is now complete.

In April 2017, India joined the AP1000WG. The Atomic Energy Regulatory Board (AERB) provided an overview of their organisational structure, new reactor construction and licensing status in India. India is planning to build six AP1000 units at Kovvada site (Andhra Pradesh state).

Accomplishments and plan of work

The working group members have shared design information, application documents, evaluations and preliminary findings, and identified the most

significant design review issues as well as construction and vendor challenges. As the working group members transitioned to different stages of their design reviews, the group continued to re-evaluate the scope of the working group topics, and the issues to be addressed. In 2016, the working group continued discussions focused on issues identified with the design of the plants under construction in the United States and China including changes to the containment condensate return system design, hydrogen venting inside containment, and main control room dose and heat up. An additional focus of co-operation was in support of exchanging information with the United Kingdom on a variety of topics that were the focus of the continued GDA review by ONR. The working group also shared information and experience on vendor issues such as squib valve design and testing, reactor coolant pump design and testing, and digital instrumentation and controls. The working group has also exchanged information on how the AP1000 design addresses the findings from the Fukushima Daiichi nuclear power plant accident and drafted a common position.

As the AP1000s in China moved closer to completion and the first units there started system hot and cold functional testing, the working group began to focus its discussion on the results of these tests through their official communication channels (e.g. working meetings, teleconferences, e-mail exchanges). The group will also discuss how the initial test programme is implemented. The AP1000 Working Group meets regularly with representatives of Westinghouse to discuss similarities and differences among the designs being licensed and constructed in each country and to discuss post-Fukushima safety reviews. In 2016, the working group toured plants under construction in China and met with China and US licensees.

The United States and ONR held several bi-lateral discussions to support information exchange associated with closing out issues identified in the GDA Step 4 for the AP1000. These discussions focused on the topics of squib valve design and testing, human factors engineering, spent fuel pool and Fukushima lessons learnt.

The United States and China exchanged several letters containing questions and responses related to design and construction issues in each country. The documents were shared with the other working group members through the MDEP library. This exchange of information was the result of engagement of upper managements of the two regulators. The two regulators shared information with the other AP1000WG members on the discussion topics including condensate return, main control room

dose and habitability, reactor coolant pumps, squib valves and equipment qualification, as well as discussions on lessons learnt from the Fukushima Daiichi accident and the prevention and mitigation of severe accidents.

As the United States and China progress in construction and move into the commissioning phase, they have begun to share information on commissioning tests and activities. The US NRC provided NNSA inspection procedures and has sent inspectors to AP1000 sites in China to observe the commissioning activities. In addition, NNSA has assembled experts in NPP design and commissioning to plan a strategic approach for the commissioning inspections. In October 2016, the working group members from the United

States, the United Kingdom, China and Canada met in China for the fourth time to discuss co-operation on pre-operational testing and initial test programme activities. Following this meeting, the NRC and NNSA continued discussions and correspondence on this issue (including at AP1000WG meetings). A follow-up meeting on pre-operational testing issues is planned for October 2017 in the United States.

The United States and China have a robust inspector and technical reviewer exchange programme ongoing with a goal of sharing information about regulatory activities such as commissioning, initial test program and other regulatory responsibilities and roles in each country.



AP1000WG – 12th meeting, Rockville, MD, United States, 22-25 September 2015.

5.3 APR1400 Working Group (APR1400WG)

The APR1400 design specific Working Group (APR1400WG) started in August 2012 with four countries, but Finland decided to leave the APR1400WG in 2015 due to the cancellation of the Olkiluto 4 project. The current participants are the regulatory authorities of the Republic of Korea, the United Arab Emirates (UAE), and the United States. The Republic of Korea leads this working group.

Korea issued an operating license for the first APR1400 at Shin-Kori Unit 3 in 2015, and currently Shin-Kori Unit 3 is in full power operation. Five additional units, Shin-Kori 4, Shin-Hanul 1&2, Shin-Kori 5&6, are under construction. Four APR1400 units are under construction at the Barakah site in the UAE. The construction licenses for Barakah Units 1&2 and Barakah Units 3&4 were granted in July 2012 and September 2014, respectively. The operating licensing application for Barakah NPP Unit 1 was submitted in March 2015 and new fuel import license, fresh

fuel transportation license and fresh fuel storage license were granted in 2016. The United States is reviewing an application for design certification that was submitted in December 2014 by KHNP and KEPCO and docketed in March 2015. The contents of the application include design control documents, environmental report, technical reports, Inspection, Tests, Analyses, and Acceptance Criteria (ITAAC) and topical reports. The Phase 1 safety evaluation was completed in February 2016 and Phase 2 review was completed in May 2017. Safety evaluation reports with open items were issued in 2016 and the NRC's Advisory Committee on Reactor Safeguards completed its review in July 2017.

Accomplishments and plan of work

The APR1400WG had two meetings in 2016. In addition, in 2016, the Accident and Transient technical experts subgroup met twice and the Severe Accident subgroup met once. In February 2017, the ninth APR1400WG meeting, the fourth Accident & Transient technical experts subgroup meeting, and the fourth Severe Accident technical experts subgroup meeting convened at FANR, UAE.

The participating regulatory agencies from USA, Korea, and UAE continued to exchange information related to several significant regulatory review issues identified during the March and October meetings in 2016. These issues included the testing approach related to APR1400 strainer debris by-pass fraction measurement, boron precipitation evaluation during long-term cooling of a LOCA, boron dilution during SBLOCA and Mode 3-5 operation and loop seal reformation. In addition, the TESP members reviewed the Common Position CP-APR1400WG-01: Common Position addressing the Fukushima Daiichi NPP accident and developed a revised version to be considered by each participating organisation. This common position was approved by the STC in June 2017.

In February 2017, a representative from KINS observed the NRC's audit on the APR1400 testing programme related to the fuel seismic evaluation of APR1400 PLUS-7 fuel design, currently used in Korea and the UAE.

In February 2017, the member countries completed their common position on debris strainer performance and in-vessel downstream effects and decided to launch the effort of initiating a new common position on fuel pellet thermal conductivity degradation issue. The Accident and Transients TESP reviewed,

discussed and finalised the in-vessel downstream effects CP at their fourth meeting. The margin assessment approach was added to the common position and finalised. The Common Position CP-APR1400-02: Common Position on the APR1400 Post Loss-of-Coolant Accident (LOCA) Strainer Performance and Debris In-Vessel Downstream Effects was approved by the STC in June 2017, noting that if more information becomes available that the CP should be updated if necessary.

The APR1400 working group also completed the following activities in 2016:

- Compilation of a Severe Accident Regulatory Requirements and Criteria table which documents the regulatory requirements considered relevant to the review of severe accident considerations in the participating countries;
- Preparation of a table reflecting differences in provisions for prevention and mitigation of Severe Accidents in the APR1400 designs proposed and/or implemented in participating countries;
- Development of a table summarising the methodologies and countermeasures associated with the different severe accident phenomena considered in the severe accident assessment provided by the participating countries.

Additionally, the safety evaluation report of Shin-Kori Unit 3 operating license from KINS and the APR1400 design certification from NRC were shared between members using the MDEP library.

The APR1400WG completed the Technical Report TR-APR1400WG-01: Design Description and Comparison of Design Differences between APR1400 Plants. This report was approved by the STC in June 2017.

The working group is continuing the development of a report on the safety review findings related to the Molten Core Concrete Interaction (MCCI) phenomena performed to date. The interim technical report was completed in April 2017. The severe accident TESP reviewed and discussed the APR1400 MCCI technical report at their fourth meeting, and the interim version was finalised with KINS and FANR's input. The technical report was presented at the STG meeting in June 2017. The approval of the APR1400 MCCI technical report is expected during the November 2017 meeting after NRC completes their review of the document.



APR1400WG – 9th meeting, Abu Dhabi, UAE, 28 February-2 March 2017.

5.4 VVER Working Group (VVERWG)

The VVER design specific Working Group (VVERWG) includes the regulatory authorities of China, Finland, Hungary, India, Russia and Turkey. The working group members are reviewing plants at various stages of design and construction. In Russia, Rostov NPP: Unit 3 is in operation and Unit 4 is under construction (review for an operating license started); Leningrad-II NPP: Unit 1 is under construction (review for an operating license ongoing), Unit 2 is under construction, and siting licenses have been issued for Units 3 and 4; Novovoronezh-II NPP: Unit 1 is in operation, and Unit 2 is under construction (review for an operating license ongoing); Kursk-II NPP: Units 1 and 2 are under construction (construction licences issued); Smolensk-II NPP, siting licenses have been issued for Units 1 and 2. While in Finland, one unit is under review for a construction license at Hanhikivi NPP. India has two units in operation and two units at the early stage of construction at Kudankulam NPP, and two more units are planned. In Turkey, four units are being considered at the Akkyuy site and a Revised Site Parameter Report was approved by TAEK in February 2017. In China, two units are in operation and two units are under commissioning and construction at Tianwan NPP. Hungary is considering two VVER units at Paks-II NPP, a review was completed based on generic design information and a site license granted.

Accomplishments and plan of work

The VVERWG continues to discuss a comparison table of differences in the VVER designs. The VVERWG currently includes four technical expert subgroups that are addressing specific technical issues: Severe Accidents (SA TSEG), Fukushima accident Lessons Learnt (Fuku TSEG), Reactor Pressure Vessel and Primary Circuit Components (RPV&PC TSEG). The VVERWG recently added a new TSEG on Accidents and Transients. The members meet regularly to exchange information and experience in their countries' regulatory activities, approaches and legal framework related to new design NPPs.

The sixth VVERWG meeting in April 2016, held in Novovoronezh, included participation of representatives from Rosenergoatom, Gidropress, Atomproekt, NIAEP and AtomTechEnergio (Russian utility and design organisations). The participants shared information on the progress of construction at Leningrad-II NPP and Novovoronezh-II NPP and discussed safety issues related to new VVER designs in Russia, India, China, Turkey, Finland and Hungary. The meeting included a visit to Novovoronezh-II NPP Unit 1 which was in the final stages of construction.

The seventh VVERWG meeting in November 2016 held in Beijing, China, included participation of representatives from JSC AtomStroyExport and Jiangsu Nuclear Power Corporation. The participants shared information on the progress of units under construction at Tianwan NPP and discussed

safety issues related to new VVER designs in Russia, India, China, Turkey, Finland and Hungary. The meeting concluded with a visit to Tianwan NPP Unit 1 under operation and Unit 3 under commissioning; where participants discussed nuclear safety and commissioning oversight issues with representatives of the operating organisation.

The eighth VVERWG meeting was held in May 2017 in Paris. At this meeting, the final version of the technical report on regulatory approaches and criteria used in severe accident analyses and severe accident management was discussed, agreed upon and submitted to the STC for review. Also, the Technical Report TR-VVERWG-02: Regulatory Approaches and Oversight Practices Related to Reactor Pressure Vessel and Primary Components was discussed, agreed upon and approved by the STC in June 2017. The report covers the following seven topics:

- Regulatory requirements related to application of the leak before break concept;
- Requirements and regulatory oversight on manufacturing of primary components;
- Radiation embrittlement of RPV regarding use of new base materials including influence of Ni and Mn;
- Regulatory requirements related to pre- and in-service inspection of primary components (including hydrostatic pressure test);
- Regulatory requirements related to design basis of primary components (loadings and their combinations);
- Regulatory requirements related to cladding of primary circuit;
- Regulatory requirements related to protection against overpressure of primary circuit.

The new TEGS on Accidents and Transients plans to have a kick-off meeting at the end of September 2017.

In addition, in 2017, the SA TEGS, initiated the development of a draft common position addressing ex-vessel corium cooling and containment integrity strategy and discussed a questionnaire on passive autocatalytic recombiners and another one on extended station blackout.

In 2016 and 2017, the Fuku TEGS refined the common position addressing Fukushima-related issues that includes four topics: accounting for external events in the design; reliability of safety functions implementation; design solutions to cover specific beyond design basis accidents (station blackout and loss of ultimate heat sink); and emergency preparedness and response. Future work of the subgroup includes the definition and discussion of new safety issues related to Fukushima Daiichi NPP accident lessons learnt or other problems highlighted by the accident; one of possible paths is to develop a new common position to address the Vienna Declaration issues.

During 2016-2017, the RPV&PC TEGS focused on the preparation of the technical reports on regulatory approaches and criteria used in severe accident analyses and severe accident management and on regulatory approaches and oversight practices related to RPV and PC. The RPV&PC TEGS activities also included exchange of information on topics related to regulatory requirements and design basis of primary components (loadings and their combinations), cladding of primary circuit and protection against overpressure of primary circuit. Future subgroup's activity includes the definition and discussion of possible issues for development of a common position related to RPV and primary components.



VVERWG – Tianwan NPP, China, 25 November 2016.



VVERWG – 7th meeting, Beijing, China, 22-24 November 2016.

5.5 ABWR Working Group (ABWRWG)

The Advanced Boiling Water Reactor design specific Working Group (ABWRWG) includes the regulatory authorities of Japan, Sweden, the United Kingdom and the United States. The first meeting of the working group was held in January 2014 and May 2017 marked the date of the seventh meeting. The eighth meeting is scheduled for October 2017 in the UK.

Several different ABWR designs, offered by different vendors, are currently under consideration by the working group members. These are two US-ABWR designs offered by GE-Hitachi and Toshiba, UK-ABWR offered by Hitachi-GE and J-ABWRs offered by Hitachi-GE and Toshiba.

Accomplishments and plan of work

ABWRWG published its common position addressing issues related to the Fukushima Daiichi NPP accident in June 2016. The paper presents the overall position that “the ABWR today represents an evolution in safety compared with earlier generation BWR designs. Following the Fukushima Daiichi NPP accident, further safety enhancements are being considered, and/or designed and implemented, by the ABWR vendors and licensees to respond to national regulatory requirements and international expectations”. These enhancements will be monitored by the group as new ABWRs are constructed and commissioned.

Utilising the efforts of the technical expert subgroups, the group is considering the development of additional common positions as annexes to this report, in areas such as hydrogen management.

The group worked on the development of a comparison matrix identifying variations in key design features of the reactor. They identified a number of challenges regarding the details to be asked of the vendors. Following some extended discussions throughout 2016, a completed matrix has now been issued for reactor vendors to populate. The ABWRWG focused the meeting in May 2017 on reviewing the responses from the vendors. The responses should assist the group in developing a sustainable plan for collaborative

work. The working group intends to develop a technical note discussing the outcomes of the review by the end of 2017.

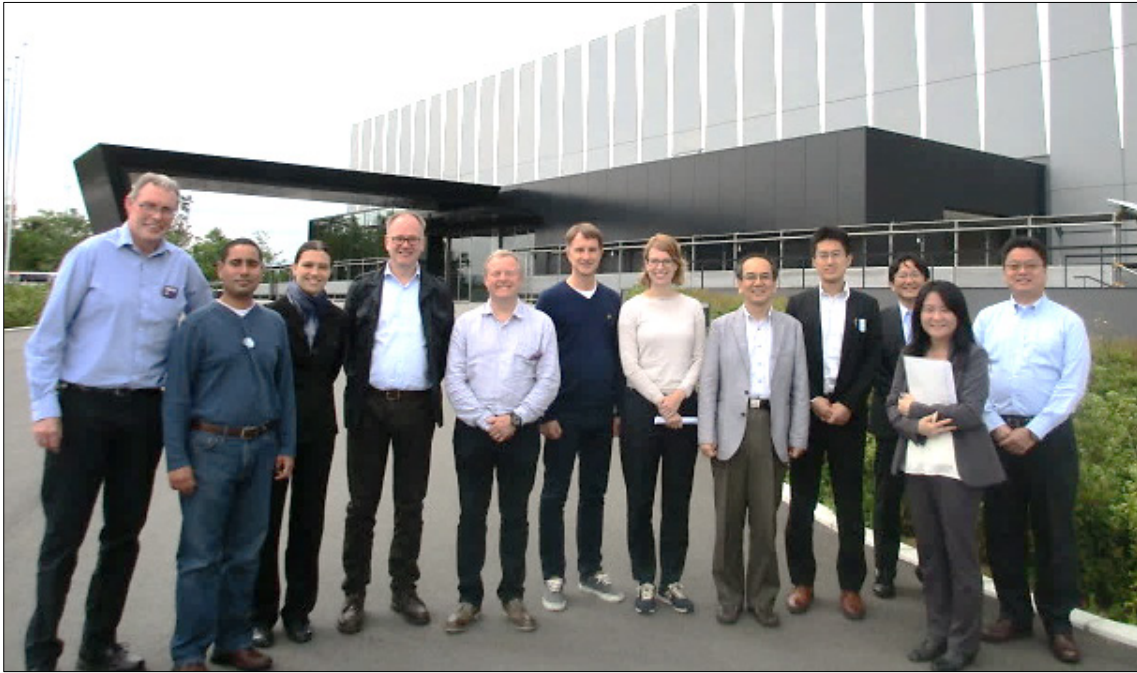
Two technical expert subgroups continued to co-operate during 2016 on the topics of severe accident prevention and mitigation, and instrumentation and controls.

The severe accident subgroup worked on defining a comparison table of key severe accident design features and established a work plan for 2017 and beyond. The next deliverable will be to document differences in the provision of severe accident measures in key categories including reactor building hydrogen control and instrumentation for use in a severe accident.

The instrumentation and controls subgroup also worked on defining a similar table. However, no consensus could be drawn from the work for either a comparison table or a future plan. Thus the instrumentation and controls subgroup has been disbanded. The long-term goals of ABWRWG remain unchanged; however, the intermediate goals have been modified to address the disbanding of the I&C TESSG. Other achievements include the completion of the ABWR key features design comparison table, identification of areas of significant difference, and further sharing of the UK regulatory observations (ROs) and regulatory issues (RIs) from the ABWR GDA assessments.

The major activities planned for 2017 and 2018 include:

- An MDEP paper on the differences identified between vendor designs;
- An ABWRWG internal paper on design comparisons (including strictly confidential material);
- Confirming and detailing potential activities of common interest that are related to the ABWR designs (e.g. suppression of pool suction strainer, diversity of liquid level measurement within Reactor Pressure Vessel, plus others);
- The SA TESSG to deliver a draft technical report on regulatory differences in Severe Accidents;
- The UK regularly sharing of the ROs and RIs from the ABWR GDA assessments and how they are being used.



ABWRWG – Fukushima Daiichi NPP site visit, Japan, 18 May 2017.



ABWRWG – Fukushima Daiichi NPP site visit, Japan, 18 May 2017.

5.6 Vendor Inspection Co-operation Working Group (VICWG)

The goals of the VICWG are to:

- Support MDEP design specific working groups;
- Maximise the use of the results obtained from other regulator's efforts in inspecting vendors;
- Understand the similarities and differences between MDEP national regulators' Quality Assurance and Quality Management (QA/QM) Requirements in order to utilise the information to improve regulators own requirements;
- Facilitate the adoption of good vendor oversight practices by national regulators;
- Harmonise the vendor inspection practices among MDEP regulators for inspections under the MDEP protocol;
- Continue joint and witnessed inspections and perform multinational inspections of vendors according to the common QA/QM requirements;
- Focus vendor attention on areas of emerging risks;
- Focus licensee and vendor oversight on effective supply chain performance;
- Focus licensee and vendor attention on positive nuclear safety culture expected within the supply chain;
- Continue to engage with CNRA to consider how to maximise the use of information gathered through VICWG activities;
- Consider the establishment of an NEA working group for vendor oversight at the closure of MDEP activities.

The working group enhances the understanding of each regulator's inspection procedures and practices by co-ordinating witnessed, joint and multinational inspections of quality assurance arrangements and safety related components.

Witnessed inspections consist of one regulator performing an inspection to its criteria, observed by representatives of other MDEP countries. The benefits to the observing countries include additional information and added confidence in the inspection results.

Joint inspections consist of one regulator conducting an inspection according to its own regulatory framework with the active participation of one or more regulators. This allows the participating members to use the results of the inspection that are applicable to their regulations.

Multinational inspections involve two or more regulators conducting an inspection of a vendor based on the MDEP common requirements. Multinational inspections are a tool to gain vendor performance insights with minimal inspection resource from the participating regulators.

The working group maintains a list of planned inspections providing the opportunity to co-operate and fully maximise the results from vendor inspection activity. The inspection results can be shared through the MDEP library. This database includes not only the reports of witnessed, joint and multinational inspections, but all inspections that may be of interest to the MDEP members.

Accomplishments and plan of work

The MDEP VICWG continues to achieve its goals. The completion of the second multinational inspection in December 2016 represented a significant step in multinational regulatory co-operation and demonstrated the benefit of regulatory co-operation in vendor inspection. The inspection incorporated eleven inspectors from France, Canada, China, Finland, United States and the United Kingdom.

The multinational inspection conducted at AREVA's Creusot Forge facility was led by France's ASN and has led to ASN issuing a number of improvement demands. The inspection represented a good example of regulatory co-operation identifying areas of risk potentially impacting several nations' civil nuclear programmes.

In 2016, in addition to the multinational inspection, two witnessed inspections were completed involving regulators from the United States, China and Canada. The French and United States regulators also collaborated on inspection results from separately conducted vendor inspections. In total, 15 opportunities were identified to co-operate on vendor inspection related information.

The VICWG routinely engages with standard development organisations (SDOs) to exchange regulatory experience, encourage forward co-operation and influence the future activity of the SDOs. During 2016, the working group met with representatives from the IAEA and the World Nuclear Organisation. The VICWG welcomed the publication of related IAEA guidance on procurement and supply chain oversight, including Counterfeit, Fraudulent and Suspect Items (CFSIs) mitigation, and the World Nuclear Association's Supply Chain Report.

The VICWG has enhanced its co-operation on areas of emerging risk in supply chain management and vendor activity, specifically CFSIs. The group effectively co-operated on an emerging issue during

2015 associated with fraudulent material certificates supplied from a UK valve manufacturer and continued this approach into 2016 with the sharing of related experience from French civil nuclear industry vendors. The ongoing co-operation has enabled participating regulators to consider the adequacy of their activities aimed at mitigating the risks of CFSIs entering licensee facilities through vendors. Forward activities will continue to consider co-operation on areas of emerging risk.

Next steps

The VICWG will continue to examine opportunities to co-operate on vendor inspection activity considering the potential for witnessed, joint or multinational inspections. The team will learn from the similarities and differences between MDEP national regulators' QA/QM requirements in order to utilise the information to improve individual regulators' own arrangements. The VICWG considers it an appropriate time to review its Technical Report TR-VICWG-03: Common QA/QM Criteria for Multinational Vendor Inspection, following experience gained in the first two multinational inspections and changes in international quality standards.

As the VICWG has matured and national vendor inspection programmes have developed, the opportunities from VICWG participation have

increased from co-operation on vendor inspection activities to sharing the outcomes from national vendor inspection programmes. The Programme Plan has been amended to emphasise this additional objective of the VICWG.

Following completion of the second multinational inspection, the VICWG will produce a learning report to influence the organisation of future multinational inspections and ensure its programme documents and inspection protocols are effectively maintained.

The VICWG will continue to co-operate on areas of emerging risk and share inspection programme outcomes among regulators and with SDOs to influence appropriate mitigating methods including the development of associated international standards and guidance.

To ensure continued alignment with MDEP goals, the VICWG will engage with the Design Specific Working Groups (DSWG) during 2017 and 2018 to assess if it continues to provide effective support for DSWG issues and identify any opportunities for enhancement. The VICWG has been supporting the DICWG in considering how existing vendor inspection process could be applied to support Digital I&C Vendor Inspections. Currently, VICWG is considering a proposal for co-operation with DICWG to develop a common position on Digital I&C vendor inspection subject to the STC approval.



VICWG – 19th meeting, Rockville, MD, United States, 4-6 April 2017.



VICWG – Curtiss-Wright Electro-Mechanical Corporation site visit, USA, 7 April 2017.

5.7 Codes and Standards Working Group (CSWG)

The goal of the Codes and Standards issue specific Working Group (CSWG) is to achieve harmonisation of code requirements for 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 CSWG recognised early on that the first step to achieving harmonisation is to understand the extent of similarities and differences among the pressure boundary codes and standards used in various countries. The CSWG encouraged standards development organisations (SDOs) to compare the requirements in JSME's S-NC1 Code (Japan), AFCEN's RCC-M Code (France), KEA's KEPIC Code (Korea), CSA's N285.0 standard (Canada) and NIKIET's PNAE G-7 Code (Russia) against the requirements of Section III of the ASME Boiler and Pressure Vessel Code (United States) for Class 1 vessels, piping, pumps and valves. The results identified the extent of similarities and differences among the national codes, provided insight into background, history,

and philosophy of each code, and provided a basis for developing general approach for code harmonisation. The report on code comparison was published in December 2012.

Based on the CSWG findings and the code comparison results, the CSWG established a global framework of a hierarchical structure for achieving code harmonisation. At the top of the hierarchy, the Fundamental Attributes provides overarching requirements for NPP design and construction. At the middle level, the Essential Performance Guidelines recommends basic design and construction rules to be included in codes, and provides guidance for code harmonisation. At the bottom level, code harmonisation is performed which includes convergence and reconciliation of code differences as well as the minimisation of further code divergence. The CSWG proposed a stepwise approach for code convergence and established a regular communication process for information exchange and discussion.

The CSWG plays an important role as an interface between the regulators and industry efforts to harmonise codes and standards. CSWG interacts with the WNA CORDEL group Codes and Standards Task Force (CSTF), consisting of technical experts from over ten companies

worldwide (AREVA, Bentley, Rolls-Royce, EDF, EPRI, Westinghouse, TVO, et al.) working to converge code requirements. They proposed a pilot project plan, which is consistent with CSWG stepwise approach, to harmonise code requirements. CORDEL CSTF has achieved significant accomplishments in the areas of non-destructive examination (NDE) personnel certification and non-linear analysis. They have compared requirements in the major nuclear design codes, compared the current international industrial certification practices, and recommended a harmonised international alternative for the certification of NDE personnel. They have also thoroughly reviewed the existing non-linear rules in different codes, and compared the scope, methods and availability of material data needed to perform analysis in very technical detail; they are developing universal new rules for non-linear analysis.

After issuing the code comparison report, the SDOs formed a Code Convergence Board to limit divergence on individual requirements, and achieve convergence on individual requirements where realistic and practical. SDOs and CORDEL are working jointly on code convergence of weld qualification. They extensively review worldwide practices in performance qualification, procedure qualification, and quality assurance of welding; and explore strategy to harmonise code requirements on weld qualification. The SDOs are also considering including other significant technical issues with international interest; that are not currently addressed in the working scope and jointly developing universal code requirements. These include corrosion fatigue, RPV indications, flow-induced vibration in steam generators, small modular reactors, margin under high-seismic loadings and the use of high-density polyethylene piping.

Accomplishments

The CSWG has successfully completed its goal and mandate to achieve some harmonisation and identify the challenges in harmonising codes and standards. The group has established a regular communication process for information exchange and discussion, and has encouraged the industry and the SDOs to move forward and work co-operatively. Five documents have been formally issued by the working group. The Fundamental Attributes document and Essential Performance Guidelines document provide high-level and middle-level guidance for code harmonisation, respectively. The Regulatory Frameworks for Use of Codes document describes the regulatory practices in each country in using codes and provides insight on the flexibility of the regulatory framework of MDEP countries in using

foreign codes. The Lessons Learnt document provides CSWG's preliminary findings on achieving code harmonisation and provides general guidance on using foreign codes. The common position proposes a hierarchy structure as a global framework for harmonisation and documents the CSWG common positions on code harmonisation. Despite the challenges of code convergence, with dedicated work and close co-operation among the CSWG, CORDEL CSTF and SDOs, code convergence is happening in several technical areas. For example, one SDO is developing its code based on the SDOs' Code Comparison Report, and introducing new code areas. A regulatory authority is using the CORDEL/SDO Weld Qualification report to draft proposals for modifying regulatory requirements. An SDO that requires company-based certification has started to modify its code and to accept the international alternative proposed in the NDE personnel certification report.

With the continuation of the close co-operation from the three parties, more achievements are expected in the near future, which will increase the efficiency of design and construction of nuclear power plants, and will enhance the safety of nuclear power plants that may be licensed in multiple countries.

Next steps

The working group will continue to interact with the CORDEL CSTF, and SDOs on: 1) preventing further code divergence; 2) converging code differences; and 3) reconciling code differences.

The CSWG has reviewed three SDO and CORDEL code harmonisation reports and provided comments to the SDOs and CORDEL. The three reports are titled *Comparison Report on Welding Qualification and Welding Quality Assurance*, STP-NU-078, *Non-Linear Analysis Design Rules, Part 1 Code Comparison*, and *Non-Linear Analysis Design Rules, Part 3 Benchmark on Nozzles under Pressure, Thermal and Piping Loads*. The CSWG is currently conducting a survey to identify potential topics for future code harmonisation.

A code is a living document that is continuously being updated to incorporate emerging technologies, improved understanding and accumulated operational experience. Therefore, the CSWG will continue to encourage SDOs to communicate with each other to minimise divergence of code during code updates. Some countries are considering developing their own codes. The CSWG will encourage these countries to study the existing codes carefully and minimise the potential differences between new codes and the existing codes.

The CSWG will continue to encourage CORDEL and the SDOs to converge code requirements using two methods: 1) modify existing code requirements that are identified as urgent and practical for code convergence; 2) jointly develop universal new code requirements on significant technical issues with international interest that are not currently addressed in codes.

Code convergence is a very challenging work. Even if the effort does not result in change of code

requirements, the work is still very valuable for code reconciliation. The CSWG will also continue exploring strategies for reconciling code differences. The CSWG is currently working with NEA to develop a document that highlights the working groups' scope of work and the benefit(s) the group can provide to CNRA members in case the CSWG is transferred under CNRA.



CSWG – 16th meeting with the SDO Board and CORDEL CSTF, Saint Louis, 8-9 November 2016.

5.8 Digital Instrumentation and Controls Working Group (DICWG)

The Digital Instrumentation and Controls issue specific Working Group (DICWG) works to increase collaboration, co-operation, and knowledge transfer among members and with other stakeholders to achieve the following primary goals: 1) facilitate timely and efficient mechanisms for sharing of knowledge and experience among members, thus allowing knowledge transfer and more effective safety reviews; and 2) work jointly to develop common positions among members for issues of significance, which may be based on a review of the existing standards, national regulatory guidance, best practices and group inputs.

The IAEA, the Institute of Electrical and Electronics Engineers (IEEE) and the International Electrotechnical Commission (IEC) representatives are invited to participate in working group meetings and activities. Industry is represented via the IEC and IEEE standards organisations and through specific invitations by the DICWG to share information and give presentations on topics of interest.

Accomplishments

The DICWG identified topics for generic common positions which were selected based on the safety implications of the issue, and the need to develop a common understanding from the perspectives of regulatory authorities. DICWG generic common positions are not intended to cover all issues

associated with the digital I&C technical disciplines, but only those of most value to the members.

Since its creation, the DICWG has published 13 common positions that describe methods and evidence that the DICWG member states find acceptable to support safety justification for digital I&C systems. The published common positions include:

- Generic Common Position 1 – Treatment of Common Cause Failures Caused by Software within Digital Safety Systems
- Generic Common Position 2 – Software Tools
- Generic Common Position 3 – Verification and Validation Throughout the Life Cycle of Digital Safety Systems
- Generic Common Position 4 – Data Communications Independence
- Generic Common Position 5 – Treatment of Hardware Description Language (HDL) Programmed Devices for Use in Nuclear Safety Systems
- Generic Common Position 6 – Simplicity in Design
- Generic Common Position 7 – Selection and Use of Industrial Digital Devices of Limited Functionality
- Generic Common Position 8 – Impact of Cyber Security Features on Digital I&C Safety Systems
- Generic Common Position 9 – Safety Design Principles and Supporting Information for the Overall I&C Architecture
- Generic Common Position 10 – Hazard Identification and Control for Digital I&C Systems
- Generic Common Position 11 – Digital I&C System Pre-Installation and Initial On-Site Testing
- Generic Common Position 12 – Use of Automatic Testing in Digital I&C Systems as part of Surveillance Testing
- Generic Common Position 13 – Spurious Actuations

These common positions have been made publicly available on the MDEP website.

The STC approved the scope of work of a new common position 14, on qualification of I&C platforms for use in important to safety applications. The new common position is intended to provide guidance on the qualification process of the hardware and software of I&C platforms for systems important-to-safety at nuclear power plants. Many I&C platforms and other digital equipment readily available in the marketplace were not designed

specifically for use in nuclear facilities and have not been subject to the quality assurance criteria established by national regulators. In order for this equipment to be used in important-to-safety digital equipment (those whose adverse performance could challenge the assumptions in safety analyses), they must undergo qualification in order to demonstrate their suitability for their intended applications. The DICWG has agreed that a common position on this topic is warranted given its growing applications to new and operating reactors, its safety implications, and the need to develop a common understanding from the perspectives of regulatory authorities.

The working group also developed a plan approved by the STC for updating Common Position 4, on data communications independence, which was last revised in December 2012. An evaluation performed by the working group revealed that the issued text in the common position needs to be revised to address, among other issues, recent technical developments in the field of data communications.

The working group continues to implement a formal “Quick Inquiry” process to generate and process inquiries from member countries to promote an efficient and structured information exchange and provides for storing this information in a retrievable database. The DICWG maintains frequent communication with the design specific working groups, particularly with the AP1000 digital instrumentation and controls technical expert subgroup, and with the VICWG and the NEA/CNRA working group on inspection practices in regards to the topic of vendor inspections of digital I&C equipment.

The industry counterpart to MDEP DICWG is CORDEL’s Digital I&C Task Force. CORDEL’s stated objectives for the task force include 1) management of design changes for digital I&C, 2) develop a common understanding of what is expected by industry and regulators and 3) promote the development of international standards. In 2016, the DICWG reviewed and provided comments on the CORDEL report *Safety Classification for I&C Systems in Nuclear Power Plants – Current Status & Difficulties*. The purpose of the report is to address the current status in classification of I&C systems and identify key causes for inconsistencies and difficulties across international standards as well as potential solutions for harmonising these standards. As part of their future tasks, CORDEL intends to provide draft position papers on I&C safety classification: comparison of I&C keywords definition provided by MDEP member states, and defence in depth & diversity – challenges related to the I&C architecture. CORDEL plans to continue to engage with the DICWG for comments on these and related documents.

Next steps

The DICWG has made significant progress in increasing harmonisation of digital I&C standards by developing generic common positions that have been or are planned for incorporation into regulations and regulatory guidance of many member regulators. The DICWG will continue to develop common position 14 that is in the initial stages. The working group and steering committee have considered the DICWG's future including the transition to NEA. The members desire to continue interaction in some format that provides a forum to share information among the member regulators, as well as an interface with standards organisations (e.g. IAEA, IEC and IEEE) and industry (CORDEL group) to promote harmonisation.

A draft mandate for the transition of the DICWG to CNRA has been finalised. The draft mandate is a joint effort with the NEA and it addresses some potential challenges that the working group will face throughout its transition to CNRA. DICWG's draft mandate and activities were presented to CNRA for review during the May 2017 meeting. The draft mandate was also discussed at the STC meeting in June 2017. NEA will provide the final mandate to CNRA prior to the December 2017 meeting where the committee will be asked to approve the integrated plan and the mandate, formalising the transition of DICWG to CNRA. The STC highlighted the importance of continuing the work of the DICWG with minimal disruption during the transition period.



DICWG – 24th meeting, Boulogne-Billancourt, France, 22-24 March 2016.



DICWG – Flamanville 3 EPR construction site visit, France, 15 December 2016.

6. Interim results

MDEP is considered a long-term programme with interim results. Interim results are those products that document agreement by the MDEP members and are necessary steps in working towards increased co-operation and convergence. The interim results for this reporting period include:

- The VICWG has enhanced its co-operation on an area of risk in supply chain management and vendor activity, specifically Counterfeit, Fraudulent and Suspect Items (CFSIs). The group effectively co-operated on issues associated with fraudulent material certificates supplied from a UK valve manufacturer and continued collaboration in 2016 with the sharing of related experience from French civil nuclear industry vendors.
- The ABWRWG drafted a comparison matrix of the key design features with input from the vendors.
- The AP1000WG formed a Commissioning Activities technical experts subgroup and met to discuss co-operation on pre-operational testing and initial test programme activities, and the EPRWG created a new Commissioning Activities technical experts subgroup to begin co-operating on oversight of plant commissioning.
- The EPRWG started developing a common position on how the EPR design addresses the objectives of the Vienna Declaration.
- The Commissioning Activities TESSG of the EPRWG witnessed the reactor pressure vessel internals vibration first plant only test conducted in Taishan 1, in March 2017. This test constituted the first implementation of the MDEP Common Position on FPOT. The general observations from the group concluded that there was evidence of adequate quality control arrangements for preparation and performance of FPOT. No fundamental reasons were identified for not crediting TSN1 FPOT results.
- The APR1400WG compiled a severe accident regulatory requirements and criteria table that documents the regulatory requirements considered relevant to the review of severe accident considerations in the participating countries; prepared a table reflecting differences in provisions for prevention and mitigation of severe accidents in the APR1400 designs proposed and/or implemented in participating countries; and developed a table summarising the methodologies and countermeasures associated with the different severe accident phenomena considered in the severe accident assessment provided by the participating countries.
- The VVERWG continued to exchange information and experience on regulatory activities, approaches and legal framework related to new design NPPs and important-to-safety design differences, especially Leningrad-II, Novovoronezh-II, Hanhikivi, Paks-II and Akkuyu NPPs.
- The VVERWG, with input from the industry, continues to develop a comparison table of VVER designs differences implemented in the member countries.
- The CSWG has issued several documents related to code harmonisation and general guidance on how to use foreign codes.
- The DICWG issued Generic Common Position 10 on Hazard Identification and Control for Digital I&C Systems as well as Common Position 13 on spurious actuation.
- All five DSWGs have completed their common position addressing post-Fukushima accident consideration for their specific design and the Steering Technical Committee issued an integrated MDEP common position in September 2016.

7. Next Steps – Future of the Programme

MDEP was established in 2006 as a multinational initiative for a five-year period. It was extended for another five-year period in 2012 by the Policy Group based on the value gained by the members. At its May 2014 meeting, the MDEP Policy Group requested a data collection to be conducted among the members to prepare for a discussion on MDEP's mid and long-term strategy. The questions focused on MDEP's mission and expected deliverables, the use of MDEP products, and the future of MDEP. The results of the data collection indicated that the members continue to receive significant benefits from participation in MDEP and it should continue beyond 2017. The members confirmed that the core activity should be the design specific working groups and identified some recommended improvements in development of the programmes of work, defining the products and ensuring knowledge transfer as reactors begin the operational phase. These findings were shared with the Policy Group at its June 2015 meeting. At this meeting, the Policy Group determined that MDEP should continue in its current form for at least five years after 2017; until the end of 2022. The PG stressed that going forward, MDEP should focus on design specific activities.

As new cross-cutting issues are identified in the future, the STC will consider setting up specific arrangements, such as ad hoc groups, subcommittees or arrangements with other working groups (e.g. the NEA's WGRNR and WGIP) to address the issues without duplication rather than creating new issue specific working groups. The design specific working groups will continue

co-operation and exchanging feedback on design issues through the construction phase. The Policy Group has determined that the operational stage should not be included in the scope of MDEP. However, there should be a means to ensure that operating experience related to design issues is addressed by DSWGs. With this in mind, MDEP will continue to share information on construction and commissioning of new reactors, and incorporate feedback from operating experience as it pertains to design.

As the current issue specific working groups are completing the goals and activities specified in their programme plans, the STC and Policy Group have considered transferring the generic activities to other organisations. In this regard, the NEA CNRA has initiated the process to transfer the DICWG activities from MDEP to the CNRA as a new working group. The DICWG has identified completion strategies that include products, schedules and recommendations for ensuring the continuation of the interactions among the regulators, and between regulators and external stakeholders when these activities are transferred.

MDEP participating countries have also expressed the need and benefits of continuing the ongoing co-operation among members even after a specific design review has concluded. To that end, the STC has begun to explore different options that can be utilised to transition existing co-operation within a design specific working group outside of the MDEP once the working group has achieved its mandate under MDEP.

Appendix 1: List of abbreviations and acronyms

ABWR	Advanced boiling water reactor
ABWRWG	Advanced Boiling Water Reactor Working Group
AERB	Atomic Energy Regulatory Board (India)
AFCEN	Association Française pour les règles de conception, de construction et de surveillance en exploitation des matériels des chaudières électro nucléaires (French SDO)
ASME	American Society of Mechanical Engineers
ASN	Autorité de sûreté nucléaire (Nuclear Safety Authority of France)
BWR	Boiling water reactor
CATESG	Commissioning Activities Technical Experts Subgroup
CCF	Common cause failure
CNRA	Committee on Nuclear Regulatory Activities (NEA)
CNSC	Canadian Nuclear Safety Commission
CORDEL	Co-Operation in Reactor Design Evaluation and Licensing
CP	Common position
CSA	Canadian Standards Association
CSTF	Codes and Standards Task Force
CSWG	Codes and Standards Working Group
DICWG	Digital Instrumentation and Controls Working Group
DSWG	Design Specific Working Group
EDF	Electricité de France
ENEC	Emirates Nuclear Energy Corporation
EPRWG	EPR Working Group
FANR	Federal Authority for Nuclear Regulation (United Arab Emirates)
FOAK	First-of-a-kind
FPGA	Field-programmable gate arrays
FPOT	First plant only tests
GDA	Generic design assessment
GIF	Generation IV International Forum
GSAR	Group on the Safety of Advanced Reactors
HVAC	Heating, ventilation and air conditioning

HAEA	Hungarian Atomic Energy Authority
HDL	Hardware description language
I&C	Instrumentation and controls
IAEA	International Atomic Energy Agency
IEC	International Electro Technical Commission
IEEE	Institute of Electrical and Electronics Engineers
IRWST	In-containment refuelling water storage tank
ISWG	Issue Specific Working Group
ITAAC	Inspection, Tests, Analyses, and Acceptance Criteria
JSC	Joint Stock Company (AtomStroyExport, Russia)
JSME	Japanese Society of Mechanical Engineers
KEPCO	Korea Electric Power Corporation
KEPIC	Korean Electric Power Industry Code
KHNP	Korea Hydro and Nuclear Power
KINS	Korea Institute of Nuclear Safety
LOCA	Loss-of-coolant accident
MCCI	Molten core concrete interaction
MDEP	Multinational Design Evaluation Programme
MHI	Mitsubishi Heavy Industries
NDE	Non-destructive examination
NEA	Nuclear Energy Agency
NIKIET	Scientific Research and Design Institute of Energy Technologies (Russian SDO)
NNSA	National Nuclear Safety Administration (China)
NPP	Nuclear power plant
NRA	Nuclear Regulation Authority (Japan)
NRC	Nuclear Regulatory Commission (United States)
NRO	Nuclear regulatory organisation
NSSC	Nuclear Safety and Security Commission (Korea)
OECD	Organisation for Economic Co-operation and Development
ONR	Office for Nuclear Regulation (United Kingdom)
OOG	Owners and Operators Group
PC	Primary circuit components
PG	Policy Group
PSA	Probabilistic safety assessment
QA	Quality Assurance

QM	Quality Management
RI	Regulatory issue
RO	Regulatory observation
RPV	Reactor pressure vessel
SBLOCA	Small-break loss-of-coolant accident
SDO	Standard development organisation
SMR	Small modular reactor
SSM	Strålsäkerhetsmyndigheten (Swedish Radiation Safety Authority)
STC	Steering Technical Committee
STUK	Säteilyturvakeskus (Radiation and Nuclear Safety Authority of Finland)
TAEK	Türkiye Atom Enerjisi Kurumu (Turkish Atomic Energy Authority)
TESG	Technical Experts Subgroup
TR	Technical report
TVO	Teollisuuden Voima Oyj (Finnish Nuclear Power Company)
UAE	United Arab Emirates
VICWG	Vendor Inspection Co-operation Working Group
VVER	Water-water energetic reactor
VVERWG	VVER Working Group
WENRA	Western Europe Nuclear Regulators Association
WGIP	Working Group on Inspection Practices (NEA/CNRA)
WGRNR	Working Group on the Regulation of New Reactors (NEA/CNRA)
WNA	World Nuclear Association

Appendix 2: Revised or new documents and publications

- Working group programme plans
- Terms of References (TOR) – Multinational Design Evaluation Programme (MDEP)
- Common Position on Spurious Actuation (CP-DICWG-13)
- Common Position addressing First-Plant-Only-Tests (FPOT) (CP-STC-01)
- Common Position addressing Fukushima Daiichi Nuclear Power Accident (CP-STC-02)
- Common Position addressing Fukushima Daiichi NPP Accident-related Issues (CP-AP1000WG-02)
- Common Position addressing Fukushima related issues, Version 2 (CP-VVERWG-01)
- Common Position addressing Issues Related to the Fukushima Daiichi Nuclear Power Plant Accident (CP-ABWRWG-01)
- Common Position addressing Fukushima-related issues, Revision 1, 2017 (CP-APR1400WG-01)
- Common Position on the APR1400 Post Loss-of-Coolant Accident (LOCA) Strainer Performance and Debris In-Vessel Downstream Effects (CP-APR1400WG-02)
- Technical Report: Design Description and Comparison of Design Differences between APR1400 Plants (TR-APR1400WG-01)
- Technical Report: Regulatory Approaches and Oversight Practices Related to Reactor Pressure Vessel and Primary Components (TR-VVERWG-02)

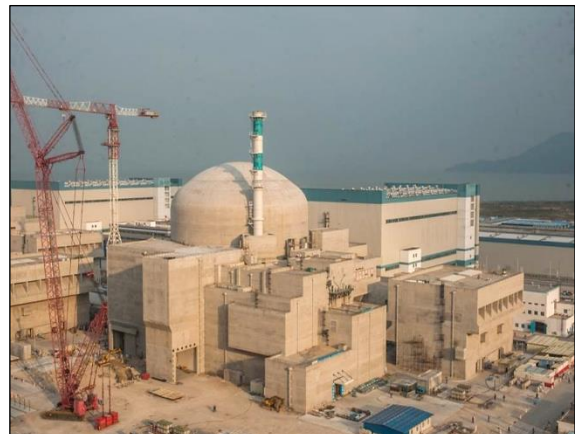
Appendix 3: Photographs of reactors considered within MDEP



Taishan Units 1 and 2 – EPR, China, April 2017 (Provided by NNSA).



Taishan Unit 1 – EPR, China, March 2017
(Provided by NNSA).



Taishan Unit 2 – EPR, China, March 2017
(Provided by NNSA).



Flamanville 3 – Construction site aerial view, EPR, France, 31 May 2017 (© EDF All rights reserved. Aménagement Flamanville 3, Communication).



Flamanville 3 – EPR, France, Commissioning supervision in the control room, June 2017 (© EDF All rights reserved. Aménagement Flamanville 3, Communication).



Flamanville 3 – EPR, France, Equipment yard of the vessel head completed: CRDM, June 2017 (© EDF All rights reserved. Aménagement Flamanville 3, Communication).



Olkiluoto 3 – EPR, Finland, May 2016 (Provided by STUK).



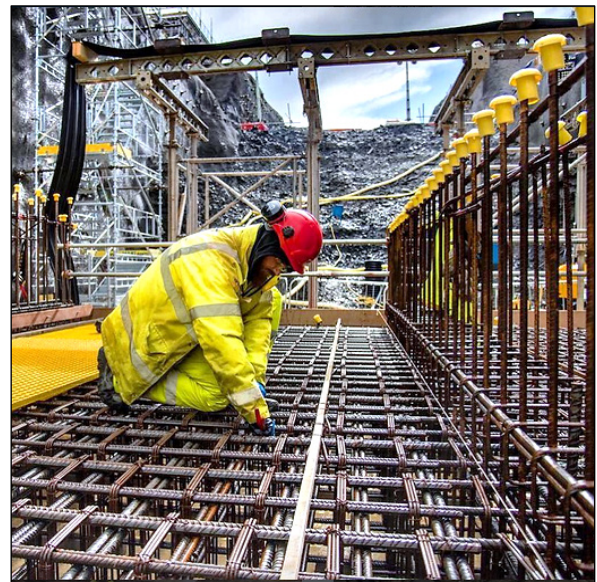
Olkiluoto 3 – EPR, Finland, Turbine island being prepared for hot functional tests May 2017(Provided by STUK).



Hinkley Point C – View from the Batching Plants, showing the Bylor fabrication area, tower cranes, and Kier BAM JV spray concrete batch plant, EPR, UK. May 2017 (Provided by EDF).



Hinkley Point C – North West Area of Construction Site, EPR, UK, May 2017(Provided by EDF).



Hinkley Point C – A Bylor team member checks the reinforcement ties prior to the start of the first nuclear safety concrete pour, EPR, UK, March 2017 (Provided by EDF).



Vogtle Unit 3 and 4 – Aerial view, AP1000, United States, April 2017 (Georgia Power Company, all rights reserved).



Vogtle Unit 3 – AP1000, United States, December 2016 Middle Ring placed in nuclear island (Georgia Power Company, all rights reserved).



Vogtle Unit 4 – AP1000, United States, August 2016 CA20 module placed (Georgia Power Company, all rights reserved).



V.C. Summer – Units 2 and 3 AP1000 Construction Site Aerial View – United States, January 2017.
(SCE&G, all rights reserved).



V.C. Summer Unit 2 – Placed final Unit 2 containment vessel ring, AP1000, United States, 9 June 2017.
(SCE&G, all rights reserved).



V.C. Summer Unit 3 – CA01 in Containment, AP1000, United States, 23 July 2015.
(SCE&G, all rights reserved).



Sanmen Units 1 and 2 – Construction site, AP1000, China, 2016 (Provided by NNSA).



Sanmen Unit 1 – AP1000 China, April 2016 Installation of HFT.
(Provided by NNSA).



Sanmen Unit 2 – AP1000, China, RCP
installation (Provided by NNSA).



Haiyang Unit 1 – Construction site, AP1000, China, 27 September 2017 (Provided by NNSA).



Haiyang Unit 2 – AP1000, China, September 2017, CVTH Installation (Provided by NNSA).



Shin-Kori Unit 3 – Inside Control Room, APR1400, Korea, 2017 (Provided by KINS).



Shin-Kori Units – Overview, APR1400, Korea, 2016 (Provided by KINS).



Shin-Hanul Overview, APR1400, Korea, 2016 (Provided by KINS).



Barakah Units 1,2,3, 4 – Overview, APR1400, United Arab Emirates, February 2017 (Property of ENEC).



Barakah Units 3 and 4 – Overview, APR1400, United Arab Emirates, September 2016 (Property of ENEC).



Leningrad 2 – Overview of the construction site, VVER, Russia, 2016 (Provided by Rostekhnadzor).



Leningrad 2 – Application of voltage for in-house needs, VVER, Russia, 2017 (Provided by Rostekhnadzor).



Novovoronezh NPP-2 Unit 2 – Overview of construction site, VVER, Russia, 2016 (Provided by Rostekhnadzor).



Baltic NPP-2 Unit 1 – Overview of construction site, VVER, Russia, 2016 (Provided by Rostekhnadzor).



Novovoronezh NPP-2 Unit 1 – Overview, VVER, Russia, 2016 (Provided by Rostekhnadzor).



Novovoronezh NPP-2 Unit 1 – Overview, VVER, Russia, 2016 (Provided by Rostekhnadzor).



Kudankulam Units 1 and 2 – Overview, VVER, India, 2017 (Provided by AERB).



Tianwan NPP Unit 3 and 4 – Construction Site VVER, China, 2016 (Provided by NNSA).



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