

MULTINATIONAL DESIGN EVALUATION PROGRAMME

Annual Report

April 2015-April 2016

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MDEP Policy Group Meeting, Issy-les-Moulineaux (Paris), France, 4 June 2015.



MDEP Steering Technical Committee Meeting, Rockville, MD, United States, 19 January 2016.

FOREWORD FROM THE POLICY GROUP CHAIR



It is once again my privilege to share some thoughts on the Multinational Design Evaluation Programme (MDEP) Annual Report for 2015-2016. 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.

This year marks the 10th anniversary of the creation of MDEP. In the past ten years, MDEP's reputation as an effective organization for leveraging the resources and experiences of multiple nations for 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, 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. In 2015, I was pleased to welcome our fifteenth member, the Hungarian Atomic Energy Authority (HAEA). The HAEA's initial focus will be to participate in the design-specific group for VVER reactor design.

Over the past year, MDEP design-specific working groups have made significant progress towards completing their common positions to address the impact of the Fukushima Daiichi accident on new reactor designs. The EPR Working Group has completed its common position, which is published on MDEP's public website. The other four design-specific working groups have completed their draft common positions, which are expected to be finalized and published in the coming months.

New reactor commissioning activities are a major part of all design-specific working groups. Co-operation among EPR and AP1000 Working Group members are particularly active as these two reactors are addressing commissioning issues related to a first-of-a-kind reactor in both cases. I am also pleased to see the enhanced MDEP collaboration with the NEA Working Group on the Regulation of New Reactors (WGRNR) on generic aspects of commissioning activities. In March of this year, MDEP and WGRNR held their first joint workshop in Korea. During the 2-day workshop, 68 regulators and experts from 15 countries tackled 11 major issues that were identified as being challenging or safety-significant during the commissioning phase.

Finally, I am happy to report that in 2015 the Policy Group made strategic decisions on the future of MDEP to ensure continued, productive and focused engagement for years to come. Based on a thorough evaluation of data collected from member regulators in 2014, the Policy Group made a decision to extend the co-operation period from the end of 2017 to the end of 2022, focusing on its core mission of collaborating on new reactor design-specific activities. Generic issue-specific working groups will be terminated in MDEP with the aim of continuing the work in other NEA committees so as to benefit more NEA member countries.

Overall, MDEP continues to function smoothly, in no small measure as a result of the support of the NEA as the MDEP Secretariat. We owe a great deal of gratitude to Mr Javier Reig who recently retired from his position as the Head of the NEA Division of Nuclear Safety Technology and Regulation, a post he held for over 12 years. I wish him all the best in his well-deserved retirement.

*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, 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 (Rostekhnadzor), 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 and 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 eighth 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 are being appropriately 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, Sweden, 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 been successful in sharing information and experience on the safety design reviews with the purposes of enhancing the safety of the design and enabling regulators to make timely licensing decisions, and of promoting safety and standardization of designs through MDEP co-operation.

The Vendor Inspection Co-operation Working Group (VICWG) continues to achieve its short-term goals with the completion of two technical reports on Multinational Inspection and on Vendor Oversight Good Practices in 2015, completed a major step towards achieving its long-term programme goals. The VICWG continues to focus on maximizing information sharing, joint inspections (multiple regulators inspecting to the regulatory requirements of one country), and witnessing of other regulators' inspections. A total of nine witnessed and joint inspections were conducted through MDEP in 2015. The VICWG is also interfacing with standards development organizations to encourage and explore harmonization of quality standards.

The Digital Instrumentation and Controls (I&C) Working Group (DICWG) has issued 11 common positions based on the existing standards, national regulatory guidance, best practices, and group inputs using an agreed upon process and framework. These common positions describe methods and evidences 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 IEC, 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 organizations 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 harmonization and identify the challenges in harmonizing codes and standards. The group has pushed the industry and the SDOs to move forward and work co-operatively. The working group has finished its work, with its only outstanding mandate of continuing to interact with the industry.

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. The interim results for 2015 include:

- The VICWG conducted nine MDEP-related inspections. This included five joint inspections with participation by the United States, China and Korea, and four witnessed inspections by the United States, Canada, UAE, France, Finland and Korea.
- The VICWG has enhanced its co-operation in the area of risks in supply chain management and vendor activity, specifically Counterfeit, Fraudulent and Suspect Items (CFSIs). The group effectively co-operated on an emerging issue during 2015 associated with fraudulent material certificates supplied from a UK valve manufacturer.
- The ABWR WG drafted a comparison matrix of the key design features with input from the vendors.
- MDEP held a joint workshop with the CNRA WGRNR on commissioning activities in March 2016.
- The AP1000 WG met to discuss co-operation on pre-operational testing and initial test program activities, and the EPR Working Group created a new Commissioning Activities Working Group to begin co-operating on oversight of plant commissioning.
- All five DSWGs have completed draft Common Position papers on post-Fukushima consideration for their specific design and the Steering Technical Committee has begun work on an integrated MDEP Common Position paper.
- The DICWG issued Generic Common Position 9 on Safety Design Principles and Supporting Information for the Overall I&C Architecture.
- The EPR WG issued a draft Common Position paper addressing First Plant Only Tests (FPOT) on the EPR design. The report provides guidance for licensees wishing to credit a FPOT conducted during commissioning of the first EPR unit to characterize the performance and behaviour of a system or component on follow-on units constructed in another country.
- The AP1000 WG 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 VVER WG continued to interact with Russian nuclear industry, as well as invite representatives of Rosatom, Rosenergoatom and design organizations (Atomenergoproekt, Atomproekt, Hidropress) to take part in the meetings of the VVER WG and its subgroups to get additional information about safety-significant design solutions.
- The VVER WG continued to discuss and develop a comparison table of differences in the VVER designs implementing in MDEP countries with input from the industry.

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 retaining the sovereign authority of each regulator to make 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 the 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.

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 2018, in its current form. However, MDEP is considering transferring some specific activities to an NEA committee (CNRA). This report provides a status of the programme after its eighth year of implementation.

2. PROGRAMME GOALS AND OUTCOMES

The main objectives of the MDEP effort are to enable increased co-operation 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 goal of MDEP is not to independently develop new regulatory standards, but to build upon the similarities already existing, and existing harmonization in the form of IAEA and other safety standards. In addition, the common positions developed in MDEP will be shared with IAEA for consideration in the IAEA standards development programme.

MDEP is meeting its goal of enabling increased co-operation through the activities of the working groups. MDEP has been very successful in providing a forum for regulatory bodies to co-operate on design evaluations and inspections. In addition to organizing 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 harmonized, 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. In addition the IAEA takes part in the work of MDEP.

3.2 Organizational structure

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

The Policy Group provides guidance to the Steering Technical Committee on the overall approach; monitors the progress of the programme; and determines participation in the programme. In January 2015, the chairmanship of the Policy Group was transferred to the Director-General of the Finnish nuclear regulator, STUK.

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.

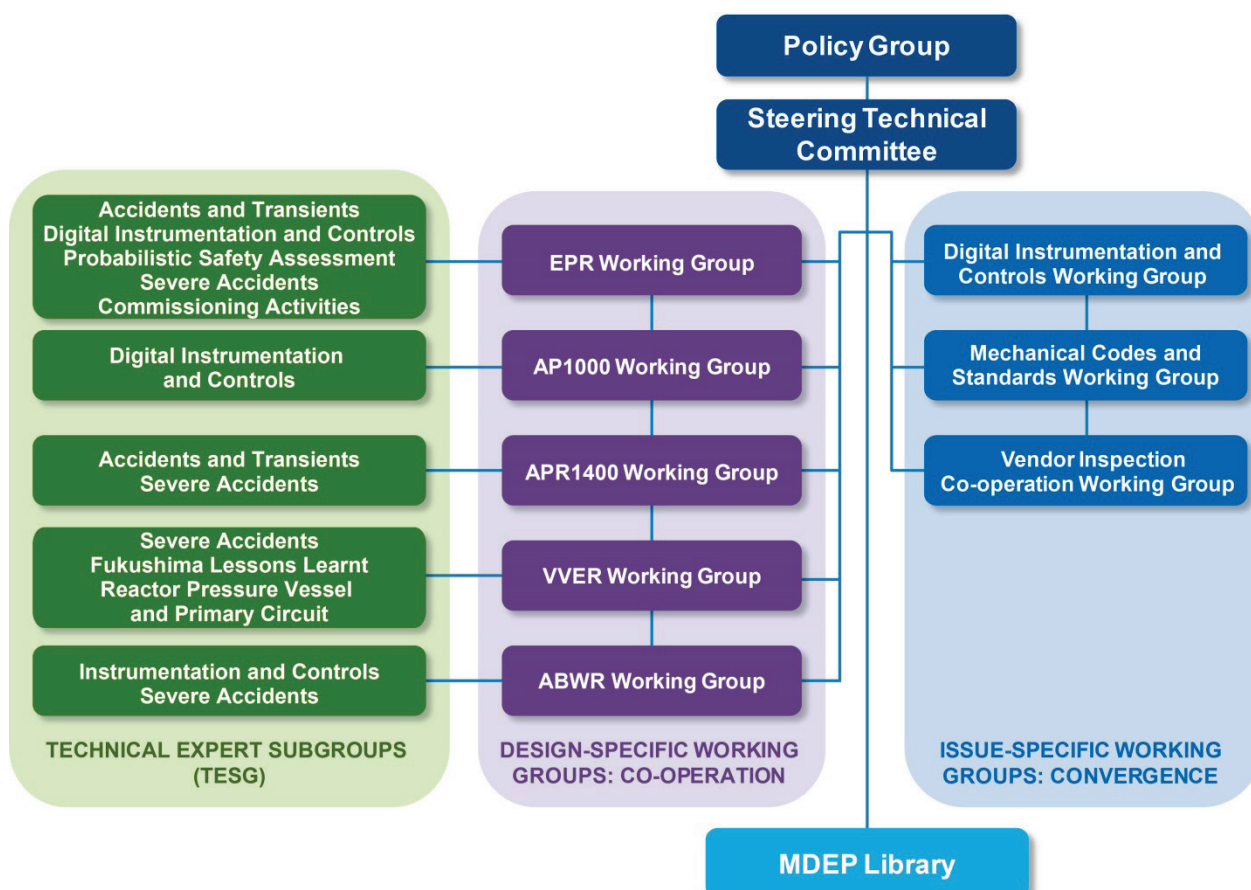
Two lines of activities have been established to carry out the work.

- **Design-specific activities.** Working groups for each new reactor design share information on a timely basis and co-operate on specific reactor design evaluations and construction oversight. Participants in these working groups are the regulatory authorities that are actively reviewing, preparing to review, or constructing the specific reactor design. 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.
- **Issue-specific activities.** Working groups have been organized for specific technical and regulatory process areas within the programme of work. These include vendor inspections, pressure boundary component codes and standards, and digital instrumentation and control standards. 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 approach followed by the MDEP regulators is not completely similar; and successful completion of the activities will likely result in increased harmonization/ convergence in regulatory practices or increased co-operation. At its meeting 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 organization over

the next few years. Any generic topics that are proposed for consideration by MDEP should be addressed through a subgroup of the Steering Technical Committee, transferred to another

organization to address, or addressed within subgroups of the design-specific working groups.

The chart below illustrates how the programme is organized.



3.3 MDEP Library

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 for each DSWG with access to 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-nea.org/mdep/). 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 at fulfilling its goal of leveraging the work of peer regulators in the licensing of new NPP 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 use only by the participating national regulatory authorities. The members of the DSWG 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 which may be 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 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 organizations, 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 for external stakeholder information and comment. Those common positions will become best practices, recommended by the MDEP. There is no obligation on the part of any regulatory body to follow them. If a

regulatory body chooses to adopt a common position, it would be through that country's normal processes.

4. INTERACTIONS WITH OTHER ORGANIZATIONS

MDEP strives to maintain an awareness of, and interactions with, other organizations that are implementing programmes to facilitate international co-operation on new reactors. Interactions are focused on ensuring that MDEP does not duplicate efforts, benefitting from the outputs of these organizations, and communicating MDEP activities and results to other organizations. To ensure that efforts are not duplicated between the groups, MDEP scope is focused on short-term activities related to specific design reviews being conducted by the member countries, and efforts to harmonize specific regulatory practices and standards.

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 siting issues. The WGRNR co-ordinates its work with the work performed by MDEP such that it utilises its outputs and 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 Working Group on Inspection Practices through the NEA staff who also serve 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 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 in which 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 2015, WGRNR undertook an assessment of passive safety systems to compare national approaches to defining and regulating the use of these systems. The MDEP AP1000 Working Group provided input to the assessment specific to that design and the draft survey questionnaire were provided to MDEP for formal feedback.

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.

In accordance with Policy Group direction to close the MDEP issue-specific working groups by 2017, MDEP is interacting with CNRA leadership to propose a transfer of some activities to the WGRNR. Although the MDEP working groups will have completed their current program of work, the benefits of continuing co-ordination among regulators on these topics have been recognized 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 with WGRNR, maintaining the same members, goals and processes during the initial transfer period.

IAEA

IAEA participates in the work of MDEP through participation in the Policy Group and STC meetings, and issue-specific working groups. In addition, the Generic Common Positions developed in MDEP are shared

with IAEA for consideration in the IAEA standards development programme.

Advanced Reactor Forums

Although MDEP is not currently considering the designs of advanced reactors, MDEP has interacted with the Generation IV International Forum to keep informed of multinational co-operative activities in the area of advanced reactors. MDEP also receives updates, through NEA, of the work of the NEA Group on the Safety of Advanced Reactors, 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, there is an understanding that MDEP may form a design-specific working group when three MDEP member countries begin to consider a specific advanced or SMR design.

WENRA

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

Industry

The MDEP working groups are very interested in understanding the perspectives of the design vendors, codes and standards organizations, and component manufacturers, and the challenges they face in dealing with numerous regulators and regulatory systems. The MDEP working groups interact with, and invite industry groups 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 organizations (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 on individual requirements, 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 met with representatives of the licensee for the Barakah NPP, an APR 1400 under construction in the UAE.
- The ABWR Working Group interacts with GE-Hitachi, Hitachi-GE, Toshiba, Tokyo Electric Power Company, Horizon Nuclear Power, Vattenfall AB, and Nuclear Innovation North America.
- The VVER WG continued to interact with Russian nuclear industry, as well as invited representatives of Rosatom, Rosenergoatom and design organizations (Atomenergoproekt, Atomproekt, Gidropress) to take part in the meetings of the VVER WG and its subgroups to get additional information about safety-significant design solutions.
- The Digital Instrumentation and Controls Working Group interacts frequently with applicable standards organizations, IEC and IEEE, 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 met with SDO and WNA representatives to discuss QA/QM standards for manufacturing nuclear components.

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 being addressed 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 harmonization. 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.

CORDEL submitted a letter to MDEP dated 3 February 2015, transmitting a position paper titled "CORDEL View of the Multinational Design Evaluation Programme." That paper provided an overall statement on the future of MDEP, recommendations on MDEP work including collaboration with CORDEL, and several proposals on issues. At its meeting on 4 June 2015, the MDEP Policy Group discussed the paper, including recommendations from the MDEP Steering Technical Committee, and agreed that interactions with industry are beneficial and should continue. MDEP submitted a response on 17 August 2015, responding to seven specific proposals in the report on topics such as sharing of insights with non-MDEP regulatory authorities, a process for formal approval of codes and standards by regulatory authorities, addressing "generic issues" across all designs, and maintaining design standardization throughout the entire plant life cycle. MDEP discussed the responses with CORDEL at a meeting in September 2015.

With effective communications in mind, MDEP holds biennial conferences on New Reactor Design Activities. The most recent conference was held in May 2014. The goal of the conferences is to communicate to a wide spectrum of stakeholders worldwide the program of work and accomplishments

of MDEP, and to solicit feedback and input from these stakeholders regarding recommendations on co-operating more efficiently on new reactor design reviews, and encouraging standardization and harmonization in regulatory requirements and practices. Another key goal of these conferences is to allow the various industry stakeholders to share their activities on new reactor designs and standardization efforts.

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 organized for the technical and regulatory process areas within the programme of work. Each working group has a lead and co-lead country designated, and has developed a programme plan which identifies specific activities, schedules and contacts.

Design-specific working groups

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 to ensure safe designs through:

- exchanging experience on licensing process and design reviews, lessons learnt, and design-related construction and commissioning experience;
- 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;
- looking for opportunities to provide input to issue-specific working groups on potential topics of significant interest;
- identifying and understanding key design differences including those originating from regulatory requirements and then documenting the reasons for differences in regulatory requirements;
- documenting common MDEP positions on aspects of the review;
- documenting their activities with 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 standardization.

While the design-specific working groups typically address issues specific to each design, and that the members find challenging, some topics are addressed by several working groups who share information among themselves. 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 discussions and are presently devoting resources for co-operation on commissioning of first-of-a-kind (FOAK) reactors. 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.

- 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. In October 2015, the WG members from the United States, China and Canada met in China for the third time to discuss co-operation on pre-operational testing and initial test program activities.
- The EPR Working Group has created a new Commissioning Activities Working

Group (CAWG) 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 working group will enable MDEP members to share experience in late-stage construction tests (e.g. hot functional tests) leading to fuel load and operations. The first meeting of the working group on commissioning activities took place in February 2016, in Paris.

MDEP held a joint workshop with the CNRA WGRNR on commissioning activities in March 2016. The purpose of the workshop was to stimulate co-operation and share best practices and recent experience from international regulatory approaches for the commissioning of new reactors. The workshop focused on topics including: regulatory priorities and practices, oversight and regulation of commissioning tests and activities, and commissioning issues which are not design-specific. The outputs of the workshop will be recorded in the form of a report proposing commendable practices to help nuclear regulatory organizations develop their commissioning oversight arrangements, and plan and perform their commissioning oversight activities.

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 recognizes the benefits of continuing the co-operative relationships formed during the design review stage, as well as the benefit to the members of the DSWGs who are still in the licensing phase. At its meeting in June 2016, the MDEP Policy Group agreed that the operational stage should not be included in the scope of MDEP. However, the STC was

requested to provide the PG with the means to ensure that operating experience that may back fit into designs is addressed by the design-specific working groups.

MDEP members agree that operating experience, when it has an impact on designs, should be considered. In particular, information from the first two years 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.

Fukushima Daiichi Nuclear Power Plant Incident Lessons Learnt

Lessons learnt from the Fukushima Daiichi Nuclear Power Plant Incident are discussed by all of DSWGs and has been incorporated in their programme plans. MDEP recognizes that other international initiatives are ongoing that are focused on operating plants. Therefore, it is important for MDEP to address such issues for new reactors. By the end of 2015, the EPR Working Group has completed its evaluation and published its finding in a Common Position paper approved by all member regulators in the working group. The other four MDEP DSWGs have submitted their draft Common Position papers to the STC for review and further direction. The papers identify common approaches to address potential safety improvements as related to lessons learnt from the Fukushima accident.

The MDEP Policy Group directed the Steering Technical Committee and working groups to develop an integrated MDEP Common Position on the lessons learnt from Fukushima Daiichi Nuclear Power Plant Incident. The STC will integrate the common positions from all five DSWGs into a single MDEP position paper. MDEP expects to complete this integrated Common Position paper in 2016. MDEP will also be addressing the Vienna Declaration on Nuclear Safety.

5.1 EPR Working Group (EPRWG)

The EPR Design-specific Working Group 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 exchange information on the reviews being conducted in each country. The following major activities are currently ongoing: Olkiluoto 3, which is under construction in Finland, Flamanville 3 which is under construction in France, the twin unit plant at Taishan which is under 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 first met in February 2016. 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 licensed in each country. This included a meeting in China in June 2015 which included a visit to the Taishan plant under construction.

Accomplishments

The Probabilistic Safety Assessment subgroup is identifying the design differences and modifications affecting risk and the main differences in the modelling of

the PSAs. The PSA subgroup, in co-operation with the EPR Owners and Operators Group (OOG) and other EPRWG subgroups, has focused 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 subgroup held discussions on the use of reflective metallic insulation for the primary circuit, and heterogeneous boron dilution with the aim of trying to reach common positions in these areas.

The EPR I&C technical expert subgroup has continued to focus on the issue of spurious actuations due to software failures although it is recognized that this concern is not specific to EPR, and thus is also being considered in the DICWG. This year the I&C subgroup has also focused on the qualification of I&C systems.

The Severe Accidents subgroup has not met this year, as it has been awaiting the meeting of the French advisory committee on reactors at which the French Institut de Radioprotection et de Sûreté Nucléaire (IRSN) will present its assessment of the severe accident analysis for the Flamanville 3 plant. Future work for this subgroup includes a comparison of source terms and dose evaluations in case of severe accidents for the EPR designs.

An EPR ad-hoc Spent Fuel Pool (SFP) subgroup finalized and issued a Fukushima Daiichi Common Position appendix on long-term cooling of the spent fuel pools. This common position paper discusses the EPR design features credited for the protection of stored spent fuel during normal operation and following an accident scenario. With the completion of this work the TESSG has been disbanded.

In 2015, the EPR Working Group finalized and issued the complete common position paper addressing post-Fukushima consideration. This paper identifies common

approaches to address potential safety improvements for EPR plants as related to lessons learnt from the Fukushima accident or Fukushima-related issues. As the safety reviews of the EPR design applications that are currently in review are completed, the working group plans to update the common position to reflect their safety conclusions regarding the EPR design and how the design could be enhanced to address Fukushima-issues.

The EPR Working Group has created a new Commissioning Activities Working Group (CAWG) 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 working group will enable MDEP members to share experience in late-stage construction tests (e.g. hot functional tests) leading to fuel load and operations. The first meeting of the Working Group on Commissioning Activities took place in February 2016, in Paris. The discussions included the following topics: phasing of the commissioning proposed by the plant vendor and inspection programs; first plant only tests; and lessons learnt during commissioning including any associated regulatory issues.

In a related activity, the EPRWG developed a draft common position on First Plant Only Tests (FPOT). The member countries' requirements have been described in the appendices of the current draft common position. These appendices can give an early insight to the vendors on what requirements they will have to fulfil to make a FPOT acceptable. In November 2015 the EPRWG held a meeting with the EPR Owners and Operators Group (OOG) to discuss their plans for the use of FPOTs within the various EPR projects and to receive their comments on the common position paper. In response to these comments, minor revisions have been made to the common position paper with the intention of providing greater clarity. Member countries have been asked to review the

paper with a view to finalizing it in mid-2016. This common position addresses some specific technical requirements, but primarily addresses national requirements for crediting FPOT, and so is applicable to all designs. Members of the other DSWGs are reviewing the common position to determine relevance to their designs, with the goal of potentially issuing an MDEP generic common position on this topic.



EPRWG Meeting, Beijing, China, June 2015.



EPRWG – Taishan EPR construction site visit, China, June 2015.

5.2 AP1000 Working Group (AP1000WG)

The AP1000 Design-specific Working Group includes the regulatory authorities of Canada (CNSC), China (NNSA), Sweden (SSM), the United Kingdom (ONR), and the United States (NRC). A total of four AP1000 units are under construction in China at the Sanmen and Haiyang sites. Four units are under construction in the United States at the Vogtle and Summer sites. The NRC is reviewing three other combined license applications referencing the AP1000 certified design for the Levy, Lee, and Turkey Point sites (a total of six additional AP1000s).

On completion of a four step Generic Design Assessment (GDA) process, ONR issued an interim Design Acceptance Confirmations (iDAC) of the AP1000 design in 2011, with 51 outstanding GDA issues attached. During 2015, ONR was 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 early engagement with a prospective licensee who has plans to build three AP1000 units in the north-west of England.

In Canada, CNSC has completed a pre-licensing assessment of the AP1000, and in June 2013, issued its Phase 2 evaluation.

Sweden began participation in the working group in 2013 and Vatenfall is the potential licensee in Sweden.

Accomplishments and plan of work

The working group members have shared design information, application documents, evaluations and preliminary findings, and identified the most significant review issues as well as construction and vendor challenges. The result of information exchange is evident by the amount of documents shared in the MDEP Library. As the working group members transitioned to different stages of their design reviews, the

group continues to re-evaluate the scope of the working group topics, and the issues to be addressed. In 2015, the working group continued discussions focused on issues identified with the design of the plants under construction in the United States and China including a change to the condensate return system design, 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 are 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 paper.

The AP1000 WG meet regularly with representatives of Westinghouse to discuss similarities and differences among the designs being licensed in each country and to discuss post-Fukushima safety reviews. In 2015, the working group toured plants under construction in the United States and met with the vendor 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 Generic Design Assessment 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 United States and China continue to

exchange information on a variety of technical topics as a follow-on to a workshop held 3-4 November 2014, in the United States. The two regulators shared information with the other AP1000WG members on the discussion topics including inorganic zinc coating, condensate return, main control room habitability, reactor coolant pumps, squib valves, and equipment qualification, as well as discussions on lessons learnt from the Fukushima Daiichi accident and 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 will make inspectors available 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 2015, the working group members from the United States, China and Canada met in China for the third time to discuss co-operation on pre-operational testing and initial test program activities. The other AP1000WG members were invited to participate and documents were shared in the MDEP Library. Following this meeting, the NRC and NNSA continued discussions and correspondence on this issue since then (including at AP1000WG meetings). A follow-up meeting on pre-operational testing issues is planned for September 2016 in October.

The United States and China have a robust inspector and technical reviewer exchange program 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 Design-specific Working Group (APR1400WG)

The APR1400WG was established in August 2012 and current participants are the regulators of Korea, the United Arab Emirates (UAE), and the US. Korea issued an operating license for the first APR1400 at Shin Kori Unit 3 in 2015. Three additional units are under construction at Shin Kori 4, and Shin Hanul 1 and 2. In January 2014, the government authorised construction of Shin Kori 5 and 6 and construction is expected to start in 2016 and 2017. The United States is reviewing an application for design certification that was submitted in December 2014. Four units are under construction in the UAE at the Barakah site. Finland (STUK) was originally a member of the working group and had completed a preliminary safety assessment of the APR1400 which included information regarding design feasibility, organizational capability, and the plant site. In August 2015, TVO notified the working group that, because TVO had decided not to submit application for a construction license for Olkiluoto Unit 4 (a potential site for an APR1400), STUK would no longer participate in the work of the APR1400WG.

Accomplishments and plan of work

In early 2016, the working group drafted a common position on APR1400 Post-Fukushima Actions. The common position includes appendices on: mitigating long-term loss of electrical power; reliability and qualification of instrumentation; containment pressure management; spent fuel pool long-term cooling; and decay heat removal and subcriticality.

The members have begun to share information on commissioning oversight plans. Working group members participated in the MDEP/WGRNR joint workshop on commissioning. Using the draft First Plant Only Test (FPOT) common position developed by the EPRWG, the members discussed FPOT specific to the APR1400.

In 2015, the working group established a Technical Expert Subgroup on Accidents and Transients. The immediate goal of this group is to cover the regulatory experience associated with Core Long-term Cooling (GSI-191) and the related large break loss of coolant accident long-term cooling analysis. The subgroup plans to issue common positions on genetic safety issue-191 (GSI-191), and specific technical reports describing: national approaches to regulatory evaluations of GSI-191 resolution, Summaries of comparison in various resolutions of the GSI-191, and technical issues and their resolution.

In 2014, the working group established a technical expert subgroup on severe accidents. The Severe Accident Technical Expert Subgroup drafted tables showing differences in: 1) severe accident regulatory positions of participating countries and 2) provisions for prevention and mitigation of severe accidents in APR1400 designs proposed or implemented in participating countries. The working group has prepared a draft report on safety review findings related to Molten Core Concrete Interaction (MCCI) performed to date. The document will be updated as the Barakah NPP operating license analysis is reviewed and the NRC review of the design control document (DCD) information related to this issue is available.



APR1400WG Meeting in Busan, Korea, 12-14 May 2015.



APR1400WG Shin Kori Units 3 and 4 construction site visit.

5.4 VVER Working Group (VVERWG)

The VVER Design-specific Working Group includes the regulatory authorities of Finland, India, Russia, Turkey, China and Hungary. China and Hungary are the newest members of the group, joining in 2015. The working group members are reviewing plants at various stages of design and construction. In Russia, five units are under construction at Rostov, Novovoronezh-II, and Leningrad-II; one unit is under review for an operating license at Novovoronezh-II; siting licenses have been issued for four units at Leningrad-II and Kursk-II; one unit is under review for a construction license at Kursk-II; and one unit at Rostov was put into operation in 2015. In Finland, one unit is under review for a construction license at Hanhikivi. India has one unit in operation and one unit under commissioning at Kudankulam. In Turkey, two units are being considered at the Akkyuy site and a Site Parameter Report is under review. In China, two units are in operation and two units are under construction at Tianwan. Hungary is considering two VVER units at Paks-II and a PSIR is under review based on generic design information.

Accomplishments and plan of work

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

The VVERWG meeting in May 2015, held in Sosnovy Bor (Saint Petersburg) included participation of representatives from Rosenergoatom and AEP (Russian utility and design organizations) to share information on the progress of units

construction at Leningrad-II NPP and Novovoronezh-II NPP and to discuss safety issues related to new VVER designs in Russia, India, Turkey and Finland. The meeting included a visit to Leningrad-II NP Unit 1 which is under construction. The members plan to make a technical visit to Novovoronezh-II NPP Unit 1 (in the final stage of construction) in April 2016.

In 2015, the TESG SA prepared a draft report on regulatory approaches and criteria used in member countries for severe accidents analyses and management. Future TESG SA activity includes discussions with representatives of Russian utility and design organizations on technical issues related to severe accidents such as instrumentation and controls for severe accident conditions, long-term containment heat removal, corium catcher aspects, and reliable methods and systems for primary pressure decrease.

In 2015, the TESG Fuku focused on how lessons learnt from the Fukushima Daiichi NPP accident are implemented in new designs, taking into account regulatory approaches and identifying differences among the VVERWG members. In addition, the members are sharing their experience on technical decisions implemented in new VVER designs. Members developed a first draft 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 detailed development of a common position, and definition and discussion of new safety issues related to Fukushima lessons learnt.

In 2015, the TESG RPV&PC exchanged information on four topics related to regulatory requirements (two more topics were discussed in 2016), and agreed upon the format and time schedule for the TESG RPV&PC technical reports. The topic of the

first draft technical report is members' regulatory approaches and oversight practice related to reactor pressure vessel

and primary circuit components. Draft reports for all discussed topics will be completed by mid-2016.



VVERWG Meeting at Leningrad-II NPP, Sosnovy Bor, Russia, 19-20 May 2015.



VVERWG Meeting at Leningrad-II NPP, Sosnovy Bor, Russia, 19-20 May 2015.

5.5 ABWR Working Group (ABWRWG)

The Advanced Boiling Water Reactor Working Group (ABWRWG) includes the regulatory authorities of Japan, Sweden, the United Kingdom and the United States. The regulator of Finland previously participated but chose to withdraw during 2015 because the anticipated applicant decided not to apply for a construction license for Olkiluoto 4. The formation of this working group was approved in 2013 and the first meeting of the working group was held in January 2014.

Several different ABWR designs, offered by different vendors, are currently under consideration by the working group members: Two US-ABWR designs offered by GE-Hitachi and Toshiba, UK-ABWR offered by Hitachi-GE, J-ABWRs offered by Hitachi-GE and Toshiba and EU-ABWR offered by Toshiba. With the withdrawal of Finland none of the current ABWRWG members has an active EU-ABWR project.

Accomplishments and plan of work

Two technical expert subgroups are co-operating on the topics of severe accident prevention and mitigation, and instrumentation and controls. The subgroups

are in the process of understanding and documenting the similarities and differences among designs to identify specific technical aspects to address in detail. A work plan of each technical expert subgroup will be established during 2016.

The ABWRWG is developing a comparison matrix of the key design features with input from the vendors and substantial progress was made during 2015. The ABWRWG is currently focusing on completing gaps and making the contents and level of detail consistent. The ABWRWG plans to issue a technical report discussing the design similarities and differences during 2016.

ABWRWG completed a final draft common position paper addressing issues related to the Fukushima Daiichi accident in December 2015. It includes the context of the events at Fukushima Daiichi NPP, a discussion on how the various ABWR designs address those aspects and a statement of the common position for different areas. In February 2016 the common position paper was sent to ABWR industry stakeholders for review of factual accuracy and completeness.



ABWRWG Forsmark Unit 2 site visit, Forsmark, Sweden, 24 April 2015.

Issue-specific working groups

5.6 Vendor Inspection Co-operation Working Group (VICWG)

The goals of the VICWG are to:

- maximize 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/Management (QA/QM) Requirements in order to reach a consensus on the potential for harmonization;
- facilitate the adoption of good vendor oversight practices by national regulators;
- harmonize the vendor inspection practices among MDEP regulators for inspections under the MDEP protocol;
- implement joint and witnessed inspections and perform multinational inspections of vendors according to the common QA/QM requirements; and
- focus vendor attention on the risks of Counterfeit, Fraudulent and Suspect Items (CFSI).

The working group enhances the understanding of each regulator's inspection procedures and practices by co-ordinating witnessed inspections of safety-related components and quality assurance inspections. 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. MDEP regulators are using the experience gained during conduct of VICWG witnessed inspections in their inspection planning.

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

Multinational inspections consist of two or more regulators performing an inspection using the common Quality Assurance/Quality Management (QA/QM) requirements developed by the VICWG.

The working group maintains a list of inspections from the member regulators to identify opportunities to witness inspections, and shares inspection results through a database maintained in the MDEP library. This data base includes not only the reports of witnessed and joint inspections, but all inspections that may be of interest to the MDEP members.

The VICWG effectively informs and influences regulatory activities including the adoption of good vendor oversight practices by national regulators. The group has developed into a strong and effective regulatory network focused on high-risk supply chain issues.

Accomplishments and plan of work

The Vendor Inspection Co-operation Working Group (VICWG) continues to achieve its short-term goals with the completion of two technical reports on Multinational Inspection and on Vendor Oversight Good Practices in 2015, completed a major step towards achieving its long-term program goals. As the VICWG moves forward, the group will attempt to increase the number of multinational inspections in addition to continuing joint inspections, witnessing of other regulators' inspections and sharing vendor inspection outcomes and themes. In support of this goal the VICWG published a good practice guide for vendor inspections to support harmonization of regulatory approaches.

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 an emerging issue during 2015 associated with fraudulent material certificates supplied from a UK valve manufacturer. The co-operation facilitated

review of regulatory activity aimed at mitigating the risks of CFSI entering licensee facilities through vendors.

In 2015, the members conducted nine MDEP-related inspections. This included five joint inspections with participation by the US, China and Korea, and four witnessed inspections by the United States, Canada, UAE, France, Finland and Korea.

In October 2015, the group met with a representative from AFCEN, the French standards development organization. The representative highlighted the development of NSQ-100. The VICWG highlighted areas of emerging regulatory concern that the SDO may wish to consider including: CFSI events, reverse engineering of components, commercial grade dedication issues, and nuclear safety culture in high-risk manufacturing organizations.

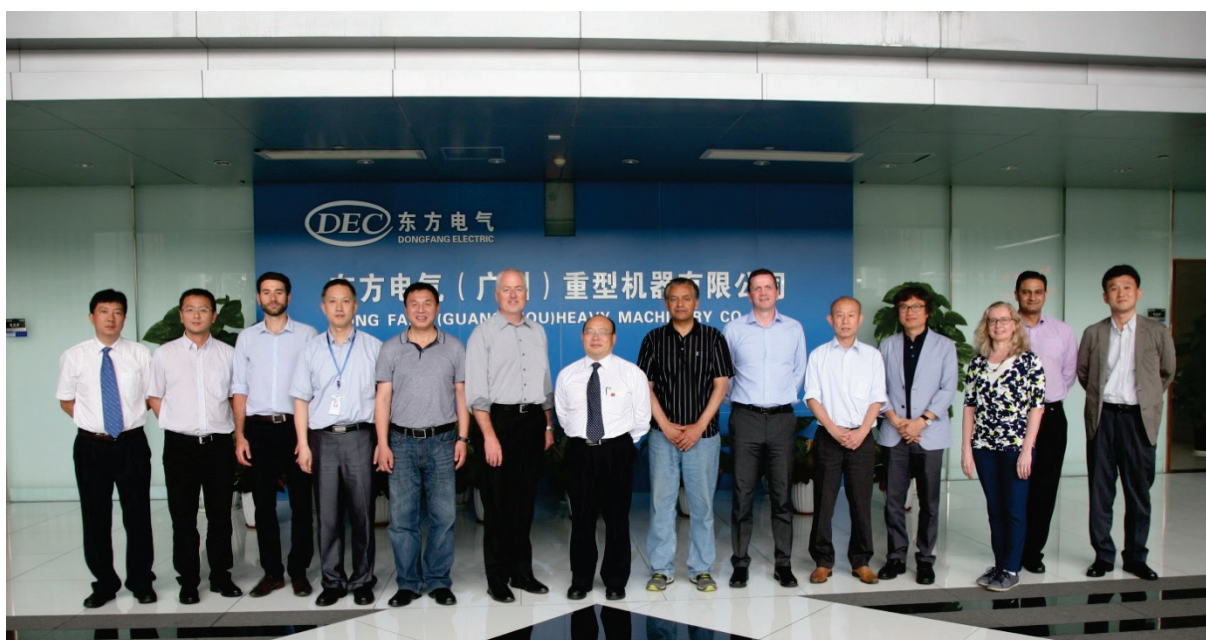
Next steps

In support of its long-term goal of understanding the similarities and differences

between MDEP national regulators' QA/QM Requirements, and to facilitate the adoption of good vendor oversight practices by national regulators, the working group aims to build on the establishment of common arrangements for vendor inspections and to encourage the ongoing co-operation on vendor inspection activities and sharing of results and emerging risks. A key focus of the group remains, to maximize the results obtained from regulators' efforts in inspecting vendors.

The group intends to increase its focus during vendor inspections on addressing areas of emerging risk. This is likely to include CFSI in the short term. The group is in a good position to react to other emerging trends and influence appropriate mitigating methods.

The VICWG will continue to work with the Standards Developing Organizations to encourage and explore harmonization of QA/QM standards.



VICWG Meeting with DFHM staff and tour of the manufacturing facility, Guangdong Province, China, 21 May 2015.



VICWG Site Visit at Le Creusot Fabrication Facility, France, 29 October 2015.

5.7 Codes and Standards Working Group (CSWG)

The goal of the Codes and Standards Working Group (CSWG) is harmonization 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 recognized early on that the first step to achieving harmonization 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 organizations

(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 harmonization. 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 hierarchy structure

for achieving code harmonization. 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 harmonization. At the bottom level, code harmonization is performed, which includes convergence and reconciliation of code differences, and minimization 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 harmonize codes and standards. CSWG interacts with the WNA CORDEL group which has established a 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 harmonize 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 harmonized 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 harmonize 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 SGs, 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 harmonization and identify the challenges in harmonizing codes and standards. The group has established a regular communication process for information exchange and discussion, and has pushed 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 harmonization, 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 harmonization, and provides general guidance on using foreign codes. The common position document proposes a hierarchy structure as a global framework for harmonization, and documents the CSWG common positions on code harmonization.

Despite the challenges of code convergence, with dedicated work and close co-operation among the CSWG, CORDEL's 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. Another 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.

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 minimize 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 minimize 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.

5.8 Digital Instrumentation and Controls Working Group (DICWG)

The 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 organizations 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.

The DICWG has published 11 generic common positions that describe methods and evidence that all 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 Resulting from Software
- Generic Common Position 2 – Software Tools for the Development of Software for Safety Systems
- 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 11 – Digital I&C System Pre-Installation and Initial On-Site Testing
- Generic Common Position 12 – Use of Automatic Testing in Computer Based Systems as part of Surveillance Testing

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

The DICWG continues to develop Common Position 10, hazard identification and control. The working group has developed and agreed upon a final draft of this common position which is expected to be made final in 2016.

The working group has begun discussions on the topic of spurious actuations in I&C systems that are important to safety. The topic of spurious operation was originally raised in the EPR I&C technical expert subgroup. However, considering this topic generally affects multiple I&C design centres, it was transferred to the DICWG so that the topic of spurious operation can be handled generically. Member countries agreed with the potential safety concerns of spurious actuations and the need to address the topic generically. DICWG plans to develop a draft common position on spurious actuations for future work and will collaborate with the MDEP EPR I&C and other design-specific I&C subgroups to address this topic.

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 provide for storing this information in a retrievable database. The DICWG maintains frequent communication with the design-specific working groups, particularly with the EPR digital instrumentation and controls subgroup.

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. As part of their near-term tasks, CORDEL intends to provide white papers on the following topics: Safety I&C classifications, Diversity and Common Cause Failures, and criterion on the use of field-programmable gate arrays (FPGAs) in nuclear applications. CORDEL plans to engage DICWG for comments on these papers.

Next steps

The DICWG has made significant progress in increasing harmonization 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 states. The DICWG will continue to develop one common position that is near completion and another that is in the initial stages. As the planned generic common positions are nearing completion, the working group and steering committee have

considered the DICWG's future. The members desire to continue interaction in some format that provides a forum to share information among the member states, as well as an interface with standards organizations (e.g. IAEA, IEC and IEEE) and industry (CORDEL group) to promote harmonization.



DICWG Meeting in Helsinki, Finland, 25-27 May 2015.

6. INTERIM RESULTS

MDEP is considered a long-term programme with interim results. Interim results are those products that document agreement by the MDEP member countries and are necessary steps in working towards increased co-operation and convergence. The interim results for 2015 include:

- The VICWG conducted nine MDEP-related inspections. This included five joint inspections with participation by the United States, China and Korea,
- and four witnessed inspections by the United States, Canada, UAE, France, Finland and Korea.
- 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 an emerging issue during 2015 associated with fraudulent material certificates supplied from a UK valve manufacturer.

- The ABWRWG drafted a comparison matrix of the key design features with input from the vendors.
- MDEP held a joint workshop with the CNRA WGRNR on commissioning activities in March 2016.
- The AP1000WG met to discuss co-operation on pre-operational testing and initial test program activities, and the EPR Working Group created a new Commissioning Activities Working Group to begin co-operating on oversight of plant commissioning.
- In 2015, the EPRWG has completed its evaluation of the Fukushima Daiichi Nuclear Power Plant Incident and published its finding in a Common Position paper. The other four MDEP DSWGs have submitted their draft common position papers to the STC for review and further direction. The Steering Technical Committee has begun work on an integrated MDEP Common Position paper.
- All five DSWGs have completed draft common position papers addressing post-Fukushima consideration for their specific design and the Steering Technical Committee has begun work on an integrated MDEP Common Position paper.
- 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 NPPs.
- The VVERWG continued to discuss and develop a comparison table of differences in the VVER designs implementing in MDEP countries with input from the industry.
- In 2015, the VVERWG TESSA prepared a draft report on regulatory approaches and criteria used in member countries for severe accidents analyses and management.
- The DICWG issued Generic Common Position 9 on Safety Design Principles and Supporting Information for the Overall I&C Architecture.
- The EPR WG issued a draft common position paper addressing First Plant Only Tests (FPOT) on the EPR design. The report provides guidance for licensees wishing to credit a FPOT conducted during commissioning of the first EPR unit to characterize the performance and behaviour of a system or component on follow-on units constructed in another country.

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 PG 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, 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 which was the end of the current term of the programme. 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 their June 2015 meeting.

At its meeting in June 2015, the MDEP Policy Group determined that MDEP should

continue for at least five years (until the end of 2022) after 2017, in its current form. 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, WGIP), to address the issues 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 PG 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. 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 PG are considering transferring the generic activities to other organizations. The working groups have 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. At its meeting in June 2015, the PG requested information on how current ISWG could terminate their activities within MDEP and either stop or be transferred to another framework by 2018.

Appendix 1
List of abbreviations and acronyms

APPENDIX 1

LIST OF ABBREVIATIONS AND ACRONYMS

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 Electro Nucléaires (French SDO)
ASME	American Society of Mechanical Engineers
ASN	Autorité de Sûreté Nucléaire (Nuclear Safety Authority from France)
CCF	Common cause failure
CNRA	Committee on Nuclear Regulatory Activities (from the NEA)
CNSC	Canadian Nuclear Safety Commission
CORDEL	Cooperation in Reactor Design Evaluation and Licensing
CSA	Canadian Standards Association
CSWG	Codes and Standards Working Group
DICWG	Digital Instrumentation and Controls Working Group
DSWG	Design-specific 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
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
JSME	Japanese Society of Mechanical Engineers
KEPIC	Korean Electric Power Industry Code
KINS	Korea Institute of Nuclear Safety
MDEP	Multinational Design Evaluation Programme
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)
NSSC	Nuclear Safety and Security Commission
OECD	Organisation for Economic Co-operation and Development
ONR	Office for Nuclear Regulation (United Kingdom)
PG	Policy Group
PSA	Probabilistic safety assessment
SDO	Standard development organisation
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
VICWG	Vendor Inspection Co-operation Working Group
WGRNR	Working Group on the Regulation of New Reactors (from the NEA/CNRA)
WNA	World Nuclear Association

Appendix 2
New and revised MDEP documents
[April 2015 – March 2016]
www.oecd-nea.org/mdep/

APPENDIX 2

REVISED DOCUMENTS AND PUBLICATIONS

Revised documents and publications

- Working group programme plans
- Technical Report: MDEP Protocol for Witnessed, Joint and Multinational Vendor Inspections (TR-VICWG-01)
- Technical Report: Survey on Quality Assurance Programme Requirements (TR-VICWG-02)
- Common position addressing Fukushima Daiichi related issues, Version 6 (CP-EPRWG-02)

New documents and publications

- Common Position on Hazard Identification and Controls for Digital Instrumentation and Control Systems (DICWG-10)
- Common position on Safety Design Principles and Supporting Information for the Overall I&C Architecture (DICWG-09)
- Technical Report on the Definition of Primary Coolant Source Terms Used in the Different EPR Designs for Shielding, Radiation Zoning, DBA Consequences (TR-EPRWG-03)
- Technical Report: Common QA/QM Criteria for Multinational Vendor Inspection (TR-VICWG-03)
- Technical Report: Assessment of Multinational Vendor Inspection of Valinox Nuclear (TR-VICWG-04)
- Technical Report: Vendor Oversight Good Practices (TR-VICWG-05)
- Common Position: Establishment of Common QA/QM Criteria for the Multinational Vendor Inspection (CP-VICWG-01)

Appendix 3
Photographs of reactors considered within MDEP

APPENDIX 3

PHOTOGRAPHS OF REACTORS CONSIDERED WITHIN MDEP



Taishan Units 1 and 2 – EPR, China, March 2016 (provided by NNSA).



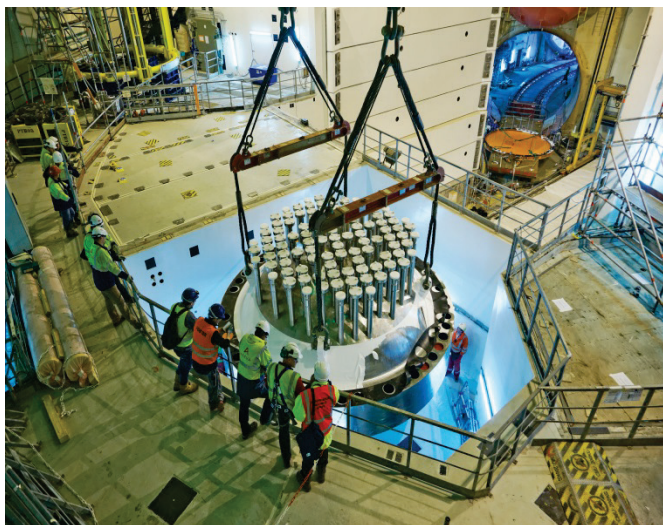
Taishan Unit 1 – EPR, China, March 2016
(provided by NNSA).



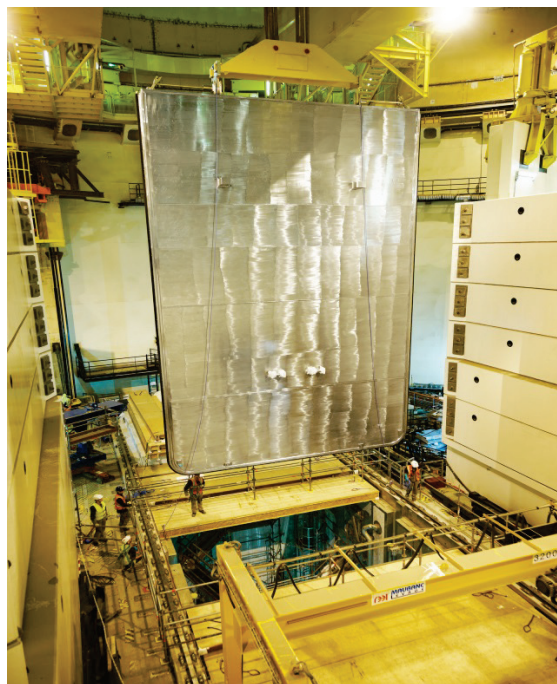
Taishan Unit 2- EPR, China, April 2016
(provided by NNSA).



Flamanville 3 – Construction site aerial view, EPR, France, 24 March 2016 (© EDF All rights reserved. Aménagement Flamanville 3, Communication).



Flamanville 3 - EPR, France, Placement of the reactor vessel head, February 2016 (© EDF All rights reserved. Aménagement Flamanville 3, Communication).



Flamanville 3 - EPR, France, Placement of the cofferdam in the reactor pool, February 2016 (© EDF All rights reserved. Aménagement Flamanville 3, Communication).



Olkiluoto 3 – Construction site, EPR, Finland, 23 September 2015 (Source TVO).



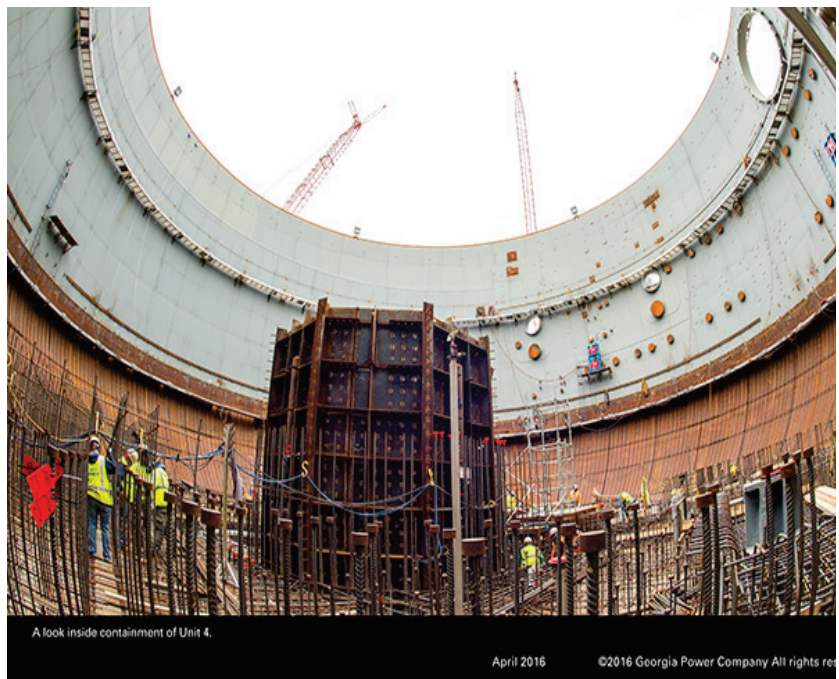
Olkiluoto 3 – Construction site, EPR, Finland, 23 August 2015 (Source TVO).



Vogtle Unit 3 and 4 – Aerial view, AP1000, United States, April 2016 (Georgia Power Company, all rights reserved).



Vogtle Unit 3 – AP1000, United States, April 2016 (Georgia Power Company, all rights reserved).



Vogtle Unit 4 – AP1000, United States, April 2016 (Georgia Power Company, all rights reserved).



V.C. Summer – Units 2 and 3 AP1000 Construction Site Aerial View – United States, September 2015 (SCE&G, all rights reserved).



V.C. Summer Unit 2 – Installation CA01 in containment, AP1000, United States, 23 July 2015 (SCE&G, all rights reserved).

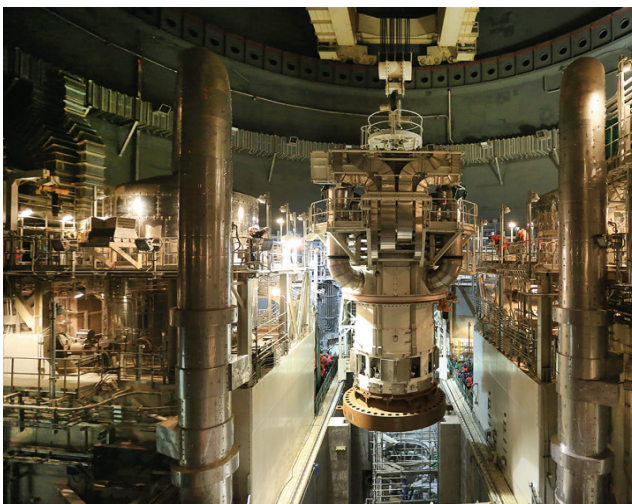


V.C. Summer Unit 2 – CA01 in Containment, AP1000, United States, 23 July 2015 (SCE&G, all rights reserved).



三门一期全景图（2015年12月29日）

Sanmen Units 1 and 2 – Construction site, AP1000, China, 29 December 2015 (provided by NNSA).



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



Sanmen Unit 2 – AP1000, China, December 2015, CB20 Hoisted in Place (provided by NNSA).



Haiyang Units 1 and 2 – Construction site, AP1000, China, 18 December 2015 (provided by NNSA).



Haiyang Unit 2 – AP1000, China, August 2015,
CVTH Installation (provided by NNSA).



Shin Kori Units 3 and 4 – Overview, APR1400, Korea, March 2015 (provided by KINS).



Shin Hanul – Construction site overview, APR1400, Korea, 29 March 2015 (provided by KINS).



Shin Hanul – Factory integrated system test of Shin Hanul nuclear power plant Unit 1 MMIS, APR1400, Korea, 3 April 2015 (provided by KINS).



Shin Hanul Unit 2 – Setting of reactor vessel, APR1400, Korea, 2 April 2015 (provided by KINS).



Barakah Unit 1 and 2 – Overview, APR1400, United Arab Emirates, March 2016 (property of ENEC).



Barakah Unit 2 – Overview, APR1400, United Arab Emirates, March 2016 (property of ENEC).



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



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



Tianwan NPP Unit 3 and 4 – Construction Site VVER, China, 2016
(provided by Rostech nadzor).



Tianwan NPP Unit 4 – RPV lifted in position 17
March 2016, VVER, China (provided by NNSA).



Kashiwazaki-Kariwa 5, 6 and 7 (from far side), ABWR, Japan,
Copyright Tokyo Electric Power Company.



Installation of Iodine filters in Kashiwazaki-Kariwa NPP, ABWR, Japan,
Copyright Tokyo Electric Power Company.

Cover page photo credits: Haiyang Unit 1 and 2 – Construction site, AP1000, China, December 2015 (provided by NNSA); Vogtle Unit 3 and 4 Construction Site AP1000, United States, April 2016 (© Georgia Power Company, all rights reserved).



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