MULTINATIONAL DESIGN EVALUATION PROGRAMME

Phase 1 Summary Report

2006-2021

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The Multinational Design Evaluation Programme (MDEP) was established in 2006 as a multinational initiative to develop innovative approaches to leverage the resources and knowledge of the national regulatory authorities that are currently or will be tasked with the review of new nuclear power reactor designs. MDEP members are the regulatory authorities of Argentina, Canada, China, Finland, France, Hungary, India, Japan, Korea, Russia, South Africa, Sweden (up to 2019), Türkiye, the United Arab Emirates, the United Kingdom and the United States. The Nuclear Energy Agency serves as technical secretariat for MDEP. The International Atomic Energy Agency also takes part in the work of MDEP.

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1 February 1958. Current NEA membership consists of 34 countries: Argentina, Australia, Austria, Belgium, Bulgaria, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Poland, Portugal, Korea, Romania, Russia (suspended), the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, the United Kingdom and the United States. The European Commission and the International Atomic Energy Agency also take part in the work of the Agency.

The mission of the NEA is:

- to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally sound and economical use of nuclear energy for peaceful purposes;
- to provide authoritative assessments and to forge common understandings on key issues as input to government decisions on nuclear energy policy and to broader OECD analyses in areas such as energy and the sustainable development of low-carbon economies.

Specific areas of competence of the NEA include the safety and regulation of nuclear activities, radioactive waste management and decommissioning, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

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List of abbreviations and acronyms

ABWR	Advanced boiling water reactor
ABWRWG	Advanced Boiling Water Reactor Working Group
CNRA	Committee on Nuclear Regulatory Activities (NEA)
CSWG	Codes and Standards Working Group
DI&C	Digital instrumentation and controls
DICWG	Digital Instrumentation and Controls Working Group
FANR	Federal Authority for Nuclear Regulation (United Arab Emirates)
FPOT	First-Plant-Only-Tests
I&C	Instrumentation and controls
IAEA	International Atomic Energy Agency
IRWST	In-containment refuelling water storage tank
KINS	Korea Institute of Nuclear Safety
LOCA	Loss of coolant accident
MB	Management Board
MCCI	Molten Core Concrete Interaction
MDEP	Multinational Design Evaluation Programme
NEA	Nuclear Energy Agency
NNSA	National Nuclear Safety Administration (China)
NRC	Nuclear Regulatory Commission (United States)
ONR	Office for Nuclear Regulation (United Kingdom)
PAR	Passive autocatalytic recombiners
PG	Policy Group
PSA	Probabilistic safety assessment
QA/QM	Quality assurance and quality management
SDO	Standards development organisations
STC	Steering Technical Committee
TESG	Technical expert subgroups
ToR	Terms of reference
UAE	United Arab Emirates
VICWG	Vendor Inspection Co-operation Working Group
VVER	Water-water energetic reactor
WG	Working group

Multinational Design Evaluation Programme
MDEP Phase 1 summary report for the period 2006-2021

1. Purpose

This report presents a summary of the Multinational Design Evaluation Programme (MDEP), undertaken between 2006 and 2021, with the intent to ensure an appropriate transition to a new MDEP framework beyond 2021. This report highlights the key milestones, successes and lessons learnt from the first 15-year period of MDEP, explains the documentation produced during this period and its future storage, and introduces the new MDEP framework from 2022 onwards.

2. MDEP milestones and evolution

Creation

The idea for the programme originated in 2005 when the United States Nuclear Regulatory Commission (NRC), the French Nuclear Safety Authority (ASN) and the Finnish Radiation and Nuclear Safety Authority (STUK) were co-operating on the licensing of the EPR design. In 2006, the initiative was designated as MDEP, a multinational effort to develop innovative approaches to leverage the resources and knowledge of the national regulatory authorities involved in the review of new reactor designs.

Objectives

The main objectives of MDEP have been to enable increased co-operation within existing regulatory frameworks and establish mutually agreed positions, enhancing the safety of new reactor designs. This strengthened co-operation among regulators focused on improving the effectiveness and efficiency of the regulatory design reviews, which are part of each country's licensing process. The programme focused on co-operation on regulatory practices that aim at harmonising regulatory requirements. The International Atomic Energy Agency (IAEA) Safety Standards, which provide a general level of harmonisation, provide input to the work and have been able to benefit from the results.

Scope

MDEP is primarily focused on design evaluation but also includes inspection activities and generic issues. As the designs moved into the construction, commissioning and eventually the operational phases, the scope was expanded to continue co-operation on oversight of construction and commissioning, and to incorporate feedback from operating experience during the initial two-year period of operations. A key concept throughout the programme is that MDEP will better inform the decisions of regulatory authorities through multinational co-operation, while each regulator retains sovereign authority to make licensing and regulatory decisions.

Membership

Since MDEP's inception in 2006, regulators from Canada, the People's Republic of China (hereinafter referred to as China), Finland, France, Japan, Korea, Russia, South Africa, the United Kingdom, and the United States are involved in MDEP activities as members. The membership had grown to 16 national regulators by 2017, with India and the United Arab Emirates joining in

2012, Sweden and Türkiye joining in 2013 (Sweden withdrew in 2019), Hungary joining in 2015, and Argentina joining in 2017. The IAEA also takes part in the work of MDEP, to maximise the benefit of the harmonisation work carried out.

Organisational structure

The programme is governed by a Policy Group (PG), which provides guidance to the Steering Technical Committee (STC) on the overall focus of MDEP, monitors the progress of the programme, and determines participation in the programme. The STC provides oversight of working group activities to ensure consistency in MDEP work and products and to co-ordinate, based on guidance from the PG, communications with external stakeholders. The OECD Nuclear Energy Agency (NEA) performs the technical secretariat function in support of MDEP.

Two streams of activity were established to carry out work under MDEP, covering design-specific activities and issue-specific activities.

The design-specific activities went from strength to strength under the PG and STC guidance, with the portfolio of reactor designs under evaluation reaching six by 2018:

- EPR Working Group (EPRWG) – operating since MDEP's creation in 2006;
- AP1000 Working Group (AP1000WG) – established in 2008;
- APR1400 Working Group (APR1400WG) – established in 2012;
- VVER Working Group (VVERWG) – established in 2013;
- Advanced Boiling Water Reactor Working Group (ABWRWG) – established in 2013;
- HPR1000 Working Group (HPR1000WG) – established in 2017.

Under each of the design-specific working groups, technical expert subgroups (TESG) were formed to address specific technical issues.

For issue-specific activities, three working groups, namely the Codes and Standards Working Group (CSWG), Digital Instrumentation and Controls Working Group (DICWG) and Vendor Inspection Co-operation Working Group (VICWG), were created in 2008. In 2015, the PG determined that MDEP should focus on design-specific activities going forward and the issue-specific working groups should be closed or transferred to another organisation over the next few years.

Between 2017 and 2018, the PG implemented the transfer of two of the issue-specific working groups (CSWG and DICWG) and one design-specific working group (ABWRWG) to the NEA Committee on Nuclear Regulatory Activities (CNRA).

Key decisions leading to close-out of the framework in 2021

MDEP was established as a multinational initiative for a five-year period. It was extended for another five-year period in 2012 by the PG based on the value gained by the members. In 2015, the PG determined that MDEP should continue in its current form for at least five more years beyond 2017.

In 2019, the PG decided to sunset MDEP in its current form by 2022 – the end of the existing terms of reference of MDEP. The decision was taken as the EPRWG, AP1000WG, and APR1400WG were expected to complete all planned activities specified in the programme plan by 2022. However, the PG affirmed that for the MDEP designs that will continue to be active after 2022 (VVER and HPR1000), the work should continue to enable these technologies to gain the full benefit of the MDEP approach. In 2020, the PG formally approved implementing plans for closure of the EPRWG, AP1000WG, and APR1400WG by the end of 2021, as well as agreeing that a new MDEP governance structure should be implemented in 2022 for the two remaining reactor technologies.

The PG also decided to propose transferring the VICWG to the CNRA. VICWG activities will close under the MDEP framework at the end of 2021. During 2022, the VICWG will be working with the CNRA, under the auspices of the NEA, on the process of transition. The official transition is expected in 2023 when CNRA implements a new working group structure.

It has also been confirmed that the EPRWG activities will transfer into the CNRA for 2022, as the EPRWG members have identified additional work related to operating reactors that is beyond the MDEP framework. The status of the outstanding activities will be discussed during the current process of CNRA review.

3. Successes of MDEP

MDEP products

One of the aims of MDEP is to work towards greater harmonisation of regulatory requirements. To achieve this aim, it was necessary to establish a degree of convergence on the safety goals that are required to be met by designers and operators. Consequently, the MDEP STC set up a sub-committee on safety goals to address this and subsequently issued the MDEP Steering Technical Committee Position Paper on Safety Goals. This position paper proposed a hierarchical structure for developing safety goals and targets, that can be applied to different technologies in a consistent and coherent manner. The hierarchical structure for safety goals encompasses the basic defence-in-depth approach, with a top-level safety goal and a set of high-level safety goals, that can be used to integrate the elements of safety desired to protect health and safety during normal operation and accident conditions for the whole plant lifecycle.

Co-operation among national regulators under MDEP has led to harmonisation of regulatory positions and practices through the establishment of common positions, achieved through the activities of different design and issue-specific working groups as well as the STC.

Design-specific common positions document common conclusions that the working group members reached during the design review. Discussions among the members and the sharing of information in these areas helped to strengthen the individual conclusions reached.

Between 2006 and 2021, MDEP published 39 common positions (see Appendix A). The areas addressed in common positions reflect a variety of technical topics that were identified during the design reviews and often required a considered approach to resolution.

Generic common positions apply generically rather than to one specific design. They are intended to provide guidance to the regulators in reviewing new or unique areas, and have been shared with the IAEA and other standards organisations for consideration in standards development programmes.

Issues related to the Fukushima Daiichi Nuclear Power Plant accident and the impact of emerging learning on new reactors, such as hydrogen management systems and the Vienna Declaration on Nuclear Safety, were thoroughly discussed. As a result, a generic Common Position on Fukushima Daiichi Nuclear Power Plant accident lessons learnt was developed, as well as six design-specific working group common positions.

MDEP produced 43 technical reports (see Appendix B) that enable member countries to better appreciate similarities and understand the differences in national requirements and practices. The topics for technical reports were selected based on the issues arising from regulatory activities in member countries, safety implications, or the general need to have a better understanding of the topic. This facilitated sharing experiences and is considered to be the basis of work on harmonisation.

Increased co-operation in design evaluations

The most effective aspect of MDEP is the co-operation and exchange of information it facilitated during design reviews. While the IAEA provides high-level guidance, MDEP addressed more specific issues for new reactors for practical use in licensing considerations and provided opportunities for early dialogue with the industry.

The working groups highlighted areas of difficulty and challenges and allowed participants to explore these in a co-operative and neutral environment, offering insight into how others had worked to resolve specific issues. This was facilitated by sharing advanced copies of review findings, responding to requests for additional information and monitoring the progress of the design reviews within member countries.

Increased communications

National regulatory bodies worked closely together through MDEP. Effective communication paths were established as a result of MDEP activities and it became quick and easy to communicate with colleagues from other countries when issues arose. In addition to organising working groups, MDEP provided the regulators with peer contacts to allow them to share information, discuss issues informally, and disseminate information rapidly. For example, the design-specific working group members have benefitted significantly from the sharing of questions among the regulators, resulting in more informed and harmonised regulatory decisions.

When a regulator hosted a working group meeting in a country where a plant was under construction, a tour was arranged of the site and a meeting held with the licensee. This allowed the working group members to see the status of construction first-hand and discuss issues with the licensees. Working group members were able to see the parts of the plants where issues had been raised that had been discussed during meetings, helping all to better visualise and understand the issues.

Greater quality of national safety assessments

MDEP interactions were useful in aligning views across national regulators on the significance of specific issues. This improved the focus of the design reviews and also helped discover safety issues or expand the scope of a review.

Common position papers have meant that additional assessment work can be avoided and provide additional leverage for safety improvements. Having a harmonised position significantly improves the credibility of national regulatory positions. Moreover, regulatory bodies have contributed to and benefitted enormously from interactions with each other in terms of understanding different approaches and different regulatory systems, and this has helped each regulator look at its approach critically. Some countries considered the interest of updating their own regulation implicitly taking into account the lessons learnt from the design evaluation.

Greater harmonisation of regulatory reviews

MDEP recognised that achieving harmonisation in specific areas was a valuable but challenging long-term activity. It found that to make progress, the goal should not be to make all requirements and practices identical or to produce a single code or standard that would be used by all countries, but increasing harmonisation incrementally in specific areas would be beneficial and achievable.

Consequently, MDEP has facilitated the comparison of regulatory requirements and practices, helped regulators understand the differences, and provided an opportunity to understand their basis and application, as well as reducing the differences in technical requirements, so far as is reasonably practicable.

Effective engagement with stakeholders

Successful interactions with stakeholders via MDEP have built links with regulators, industry, standards development organisations (SDOs) and other international organisations, and have been beneficial in aiding the review of different reactor designs. For example, MDEP has brought together regulators, SDOs and industry, through the World Nuclear Association Co-operation in Reactor Design Evaluation and Licensing (WNA CORDEL) Working Group, to discuss issues and clarify regulatory positions that have significant impacts.

MDEP is recognised as a unique multinational framework where new reactor vendors can participate on a regular basis. Furthermore, MDEP used the opportunities provided by workshops and conferences. Four MDEP conferences were held under the leadership of the STC, with a total of about 600 participants. The topics addressed in the conferences included important common issues at the time, such as new reactor activities related to the Fukushima Daiichi Nuclear Power Plant accident, with more specific technical discussions around:

- common cause failures reassessment;
- multiple units on the same site;
- technical challenges in DI&C;
- commercial off the shelf software;
- nuclear safety culture in the supply chain;
- commissioning activities (first-plant-only-test and construction inspection test plan).

Those activities provided a forum for MDEP stakeholders to share the results of their engagement with the programme, deliver presentations on going activities related to new reactor licensing, and explore options to resolve common issues.

4. Working group summaries

EPRWG

From 2008 to 2021, the EPRWG was a forum of discussion focused on EPR reactor design safety issues between the nuclear safety authorities of Canada (Canadian Nuclear Safety Commission, CNSC), China (National Nuclear Safety Administration, NNSA), Finland (STUK), France (Nuclear Safety Authority, ASN), India (Atomic Energy Regulatory Board, AERB) (from 2012), Sweden (Swedish Radiation Safety Authority, SSM) (from 2013 to 2019), the United Kingdom (Office for Nuclear Regulation, ONR) and the United States (NRC).

The first long-term objective of the EPRWG was to leverage national regulatory resources by sharing information and experience on the regulatory safety design reviews and commissioning of the EPR with the purpose of enhancing the safety of the design and enabling regulators to make timely licensing decisions to ensure safe designs. The second main objective was to promote safety and standardisation of designs through MDEP co-operation (consideration was given to promoting harmonisation of regulatory practices where there may be a safety benefit).

The EPRWG and its TESGs issued many written outcomes, including eight common positions and seven technical reports. In addition to providing a structured information sharing platform, the EPRWG also succeeded in engaging valuable technical exchanges with the licensees and vendors in different countries. The working group provided a means for the regulators to leverage resources and to focus design reviews on safety issues in areas that were critical to making licensing decisions in member countries.

AP1000WG

The AP1000WG includes the regulatory authorities of Canada (CNSC), China (NNSA), India (AERB), the United Kingdom (ONR) and the United States (NRC). The working group developed three common positions and six technical reports addressing some of the more important discussion topics from the AP1000WG meetings. Further, the working group identified a number of recommendations and inputs to other issue-specific working groups and MDEP DSWGs regarding potential generic issues and harmonisation opportunities (including the "Technical Report on Lessons Learnt from Implementation of the Common Position on First-Plant-Only-Tests (FPOT) for AP1000").

Between 2009 and 2021, the NRC, ONR, and NNSA finished their safety assessments for the AP1000 design and drew the conclusion that the AP1000 design was acceptable according to the regulations of the United States, the United Kingdom and China. Sharing the assessments and their outcomes improved understanding between the member regulators and provided significant grounding for AP1000WG discussion and co-operation.

APR1400WG

The APR1400WG was established in August 2012 with four countries, although Finland later opted to leave following the cancellation of the Olkiluoto 4 project in 2015. In 2021, the final participants were the regulatory authorities of Korea, the United Arab Emirates (UAE), and the United States. The UAE was leading the working group.

From 2012 to 2021, the APR1400WG and its TESGs issued many written outcomes, including four common positions and eight technical reports.

The nuclear safety authorities of Korea (Korea Institute of Nuclear Safety, KINS), United Arab Emirates (Federal Authority for Nuclear Regulation, FANR), and the United States (NRC) published their APR1400 safety evaluation reports. They granted construction and operating licences for Shin-Kori Units 3 and 4 and Shin-Hanul Unit 1 in Korea and Barakah Units 1 and 2 in the UAE, as well as the Design Certification Rule for the APR1400 Design (10CFR52 Appendix F) in the United States.

The APR1400WG successfully achieved its main goal of developing co-operation between member regulators on topics of interest and value within the scope of MDEP.

ABWRWG

The ABWRWG was established in January 2014 and included the regulatory authorities of Finland, Japan, Sweden, the United Kingdom and the United States, although Finland later opted to leave following the cancellation of the Olkiluoto 4 project in 2015. The ABWRWG achieved the task of compiling a vendor-informed comparison table of design features between the eight existing and proposed designs for an advanced boiling water reactor (ABWR).

The ABWRWG and its TESGs issued many written outcomes, including one common position and three technical reports.

Seven noteworthy differences were highlighted as relating to the severe accident design features and, as a consequence, the ABWRWG recognised that it is important to document the regulatory basis for severe accident design differences. The basis was developed by the Severe Accident Technical Sub-group and was collated in a technical report. Other achievements include the sharing of the United Kingdom's analysis of the outcomes from the ABWR Generic Design Assessment (GDA), which resulted in the award of a Design Acceptance Certificate for that design, and the outcomes of the Japanese regulator's review of the KK6/KK7 reactor site.

The ABWRWG closed its activities under MDEP in May 2018 and is now operating under the CNRA.

VVERWG

The VVERWG includes the regulatory authorities of China, Finland, Hungary, India, Russia and Türkiye. The working group members are reviewing plants at various stages of design and construction. The VVERWG currently includes four technical expert subgroups that are addressing specific technical issues: Severe Accidents (SA TESG), Fukushima Accident Lessons Learnt (FUKU TESG), Reactor Pressure Vessel and Primary Circuit Components (RPV&PC TESG) and Accidents and Transients (T&A TESG). The members meet regularly to exchange information and experience in their countries' regulatory activities, approaches and legal framework related to new designs.

The VVERWG provided many common positions and technical reports and will continue to document lessons learnt from design reviews and design issues faced during construction and commissioning and the early phases of operation.

HPR1000WG

The HPR1000WG includes the regulatory authorities of Argentina (ARN), China (NNSA), South Africa (National Nuclear Regulator, NNR), and the United Kingdom (ONR). The HPR1000WG completed a common position on Fukushima Daiichi lessons learnt as well as two technical reports on hydrogen control during severe accidents and regulatory requirements and practices for severe accidents.

In light of its discussions on Fukushima Daiichi and severe accidents, FPOTs, unique design features affecting safety, and the treatment of external and internal events, the HPR1000WG has opted to establish two TESGs to further scrutinise the issues: the Severe Accidents (SA) TESG and the Internal and External Hazards TESG. The WG together with TESGs has established a number of objectives to be completed and will continue its efforts on developing common positions on sump strainer performance, the Vienna Declaration on Nuclear Safety, in-vessel retention strategy, etc.

CSWG

The primary goal of the CSWG has been to promote international harmonisation of codes and standards, with an initial focus on pressure boundary components in nuclear power plants that are important to safety. In working towards this goal, the CSWG collaborated with SDOs from various countries to perform comparisons of several pressure boundary codes and standards and collaborated with the WNA CORDEL group to converge selected code requirements. These activities helped some countries consider the interest of updating their own regulation and contributed to the convergence of regulatory requirements. In addition, the CSWG published several documents reporting the results of their efforts. These products and the continuing collaboration with industry organisations span a wide variety of technical topics with applications for both operating and new reactors.

The CSWG fulfilled its original goals and has been transferred to the CNRA.

DICWG

The DICWG worked under MDEP from 2008 to 2018 to facilitate timely and efficient mechanisms for sharing of knowledge and experience among members, thus allowing more effective safety reviews. The second main objective of the DICWG was to work jointly to develop common positions among members on issues of significance, which may be based on a review of the existing standards, national regulatory guidance, best practices and group inputs.

As a key accomplishment, the DICWG identified topics for generic common positions, selected on the basis of their safety implications, and the need to develop a common understanding from the perspectives of regulatory authorities. The DICWG generic common positions are not intended to cover all issues associated with the digital instrumentation and controls (I&C) technical disciplines, but only those of most value to the members.

Under MDEP, the DICWG published 13 common positions that describe the methods and evidence that the DICWG member states find acceptable to support safety justification for digital I&C systems.

The DICWG shared information with key stakeholders such as IAEA, the Institute of Electrical and Electronics Engineers (IEEE) and the International Electrotechnical Commission (IEC). In 2018, the activities led by the DICWG under MDEP were transferred to the CNRA in the Working Group on Digital Instrumentation and Control (WGDIC).

VICWG

The main goals of the VICWG were to maximise use of the results obtained from regulators' work in inspecting vendors and understand the similarities and differences between national regulatory bodies' quality assurance and quality management (QA/QM) requirements within MDEP. The information was then used to improve the regulators' own requirements and approaches.

The VICWG enhanced the understanding of regulatory inspection procedures and practices by co-ordinating witnessed and multinational inspections of QA arrangements of safety related components. Multinational inspections consisted of one regulator conducting an inspection according to its own regulatory framework with the active participation of one or more other national regulators. This allowed the participating members to use the results of the inspection that were applicable to their regulations. Multinational inspections are a tool to gain vendor performance insight with minimal inspection resources from the participating regulators.

As the VICWG matured, the opportunities it provided expanded from co-operation on vendor inspection activities to sharing the outcomes of national vendor inspection programmes. The VICWG programme plan was extended to integrate supply chain nuclear safety culture, enhanced stakeholder engagement and commercial grade dedication & equipment qualification. In 2020, the MDEP PG decided to propose transferring the VICWG to the CNRA and the VICWG activities closed under the MDEP current framework at the end of 2021.

5. Lessons learnt

Maintaining active involvement of members and participants

Good preparation was essential to ensure effective engagement; it was important for participants to take time to understand the aims and objectives of the working groups to maximise their effectiveness in realising benefits. This was done in the first instance by reviewing previous minutes and documents for discussion at forthcoming meetings. In addition, preparation included consideration of the agenda and discussion of the relevant items internally prior to attendance. It has been suggested that in future, new members may benefit from an induction note communicating the scope and aims of each of the working groups and TESGs.

It was observed that the majority of national regulators are content to engage with other participants and provide access to their independent confirmatory analysis, and are willing to share their assessment in a transparent manner. Active participation has been excellent in building relationships between regulators, bringing greater benefits both within and potentially outside of MDEP activities.

By far the biggest impediment to participation in MDEP meetings and to MDEP-related functions has been "other regulatory work of higher priority". This was heightened during the COVID-19 pandemic.

Information sharing

MDEP has made improvements in communicating information regarding member regulatory practices. The development of an MDEP Library has been a major step forward, serving as a central repository for all documents associated with the programme. This library is essential to the sharing of research and confirmatory analysis. It has facilitated access to information and the development of credible common positions.

It was recognised that information sharing may give rise to concern from licensees and vendors of reactor technologies, as the library can be accessed by many members. Access has been restricted to only MDEP participating regulatory bodies and it is important that this be understood by all members and their associated vendors, plant designers, requesting parties and licensees. This should avoid situations in which regulators and owners and operator group members are reluctant to provide sensitive documents.

In addition, it has been observed that the terms and conditions of information sharing are not standard across member countries, and that export licences and commercial issues need to be given due consideration when sharing information with other members.

Communication

It is clear that the various regulatory regimes do not operate in the same environments or with the same legal and regulatory frameworks. It has therefore been important to understand the context within which regulatory regimes operate. This can only be done through honest and transparent communication. Experience has shown that the MDEP working groups provided a safe, secure, and neutral environment for participating members to develop ideas and challenge assumptions in an open, honest and respectful manner.

The adoption of English at the MDEP meetings allowed members and stakeholders to communicate, but did understandably create a limitation for some. When members experienced communication challenges, this resulted in detailed conversations to allow all to understand the issues of concern, making sure all in the group had an opportunity to ask questions and understand.

Realisation of benefits

Effective engagement depended on the level to which the individual member countries contributed. Participation via timely and relevant input to working group planning activities enabled members to realise the greatest benefit from the interactions.

The chair of each working group has a key role in ensuring the effectiveness of co-operation. The chair needs to have knowledge of the reactor technology, the technical issues and their complexities/subtleties. The experience and effectiveness of working group chairs has been variable; in the next phase of MDEP it may be useful to provide guidance for the participants who take on this role.

Careful consideration needs to be given to how industry representatives become involved in working group discussions, as their presence changes the dynamic and environment in which the technical issues are explored and has the potential to stifle discussion between regulators, becoming counter-productive. But involving industry representatives is crucial for the working group to address specific issues and their contribution should be seen as important and beneficial.

6. MDEP Library

MDEP WGs have documented their work and results, including with individual close-out reports for the design-specific working groups that are now closed. All these materials are archived in the MDEP Library for future use. This electronic library is password protected and is restricted to the national regulatory agencies of the member countries that have been or currently are participating in MDEP.

The library is managed by the NEA Secretariat. According to the MDEP Terms of Reference, permission to access the information should be sought through the NEA Secretariat, which handles requests according to an agreed protocol.

In its final meeting, on 14 December 2021, the MDEP PG agreed that the NEA will manage access to the MDEP Library by non-MDEP countries. For requests for access to non-proprietary information held in the library, it was agreed that the NEA Secretariat can use its discretion. For requests for access to proprietary information received from non-MDEP countries, the NEA Secretariat must either request permission from the originating country to allow access or direct the requestor to the originating country. In all instances, the NEA Secretariat will advise the CNRA of requests from non-MDEP members for access to the library and the subsequent provision of information. This will ensure that the benefits of MDEP can be realised by a much wider group of national regulators.

The MDEP Library will continue to be a central repository for MDEP.

7. Conclusion

The MDEP has been and will continue to be a unique multinational initiative leveraging the resources and knowledge of national regulators to review new reactor designs. The programme has successfully operated for 15 years and is recognised as an effective framework for regulatory co-operation and harmonisation.

By November 2021, the EPRWG, AP1000WG, APR1400WG, as well as the STC closed their activities under the current MDEP framework. All relevant documentation – minutes of meetings, common positions, technical reports, etc., have been archived in the MDEP Library, administered by the NEA Secretariat, and are available for future reference. For this reason, the MDEP Policy Group concludes that the MDEP framework 2006-2021 can be closed.

8. MDEP future framework

The regulatory authorities that are members of the VVER and HPR1000 design-specific working groups, as existing MDEP members, have stated their shared desire to continue the successful and mutually beneficial collaboration under a new streamlined MDEP framework.

A special session of the MDEP Policy Group involving members of the future framework, namely Argentina, China, Finland, Hungary, Russia, South Africa, Türkiye, and the United Kingdom, was held in March 2021. The general consensus from the special session is that:

- The programme of MDEP work will be governed and implemented by a new MDEP Management Board (MB), with the NEA serving as the technical secretariat.
- The first priority is to deliver a successful transition to the new MDEP framework.
- Harmonising regulatory practices should be a greater focus of working groups in the future.
- Work on cross-cutting issues could still be part of MDEP but awareness of co-operation in existing NEA working groups on generic topics is necessary.
- The organisation of events and conversations with a broader group of regulators is still of great interest for the members of the new MDEP framework.

Following the successful transition to the revised framework, the MDEP MB will consider options for wider international co-operation as national regulators consider new reactor technologies for assessment.

A transition team that consists of the member countries of the future framework was established to consider the roles and responsibilities of the PG and the STC and to define the roles and responsibilities of the new Management Board of the future framework. The transition team re-structured the MDEP terms of reference (ToR) for the new framework, with the aim of presenting the final proposal during the first meeting of the MB.

The transition team also revised the Design-Specific Working Group’s ToR and Issue-Specific Groups ToR, discussed the transition process, and made preparations for the first MB meeting following the last PG meeting.

Appendix A: MDEP common positions (2006-2021)

- CP-STC-01, "Common Position Addressing FPOT", provides high-level guidance for applicants/licensees wishing to take credit for a test performed during the commissioning of the first unit of a similar type, www.oecd-nea.org/mdep/documents/CP-STC-01-FPOT-rev1_April_2018.pdf.
- CP-STC-02, "Common Position Addressing Fukushima Daiichi Nuclear Power Accident", identifies approaches to address potential safety improvements for several designs as related to lesson learnt from the Fukushima Daiichi nuclear accident or related issues, to ensure adequate safety of new reactor design activities being undertaken pursuant to the MDEP programme of work. This Common Position also includes a statement regarding the Vienna Declaration on Nuclear Safety, www.oecd-nea.org/mdep/common-positions/cp-stc-02-common_position_addressing_fukushima.pdf.
- CP-EPRWG-01, "Common Positions on the EPR Instrumentation and Controls Design", identifies the areas of common agreement between regulatory bodies regarding the EPR I&C design that were identified during digital instrumentation and controls (DI&C) TESG interactions, www.oecd-nea.org/mdep/documents/CPEPRWG01_I&C_2020.pdf.
- CP-EPRWG-02, "Common Position Addressing Fukushima Daiichi-Related Issues", identifies common preliminary approaches to address potential safety improvements for EPR plants, as well as common general expectations for new nuclear power plants, as related to lessons learnt from the Fukushima Daiichi accident or Fukushima Daiichi-related issues, www.oecd-nea.org/mdep/documents/CP-EPRWG-02-addressing-fukushima-related-issues-v6-September2015.pdf.
- CP-EPRWG-03, "Common Position on EPR Containment Mixing", examines the two-room concept in the containment of the EPR, which differs from many typical pressurised water reactor containments, and in particular the use of the CONVECT system in the EPR to promote heat transfer and mixing in accident conditions. The EPR two-room concept allows personal access to the outer room while the reactor is at power, www.oecd-nea.org/mdep/documents/2015-03-16_CP-EPRWG-03-common-position-containment-mixing-March2015.pdf.
- CP-EPRWG-04, "Common Position on EPR Containment Heat Removal System in Accident Conditions", compares and discusses the containment heat removal system across the different EPR reactors, including the regulatory requirements, EPR design and compliance with the regulatory requirements and the safety authorities' positions. It outlines the general expectations regarding containment integrity, and summarises the main EPR design characteristics regarding containment integrity to prevent and mitigate the consequences of severe accidents, www.oecd-nea.org/mdep/documents/2015-03-16_CP-EPRWG-04-common-position-CHRS-SAHRS_March2015.pdf.
- CP-EPRWG-05, "Common Position on In-containment Refuelling Water Storage Tank (IRWST) pH Control in Accident Conditions", compares and discusses the different approaches to control IRWST pH in the EPR plants, and notes the importance of pH control, www.oecd-nea.org/mdep/documents/2015-03-16_CP-EPRWG-05-common-position-IRWST-ph-Control-March2015.pdf.
- CP-EPRWG-06, "Common Position on EPR Boron Dilution During a Small Break Loss of Coolant Accident (SBLOCA)", presents the common position developed by the participating regulators to ensure consistency in the assessment of the relevant aspect of the design, considering that the potential for rapid reactivity insertion due to inherent boron dilution resulting from a SBLOCA is of significant safety importance, www.oecd-nea.org/mdep/documents/CP-EPRWG-06_Boron_dilution.pdf.

- CP-EPRWG-07, "Common Position Addressing the Vienna Declaration on Nuclear Safety", summaries the regulators' views on how the EPR design complies with the Vienna Declaration, www.oecd-nea.org/mdep/documents/CP-EPRWG-07%20Vienna%20Declaration%20on%20Nuclear%20Safety.pdf.
- CP-AP1000WG-01, "Common Position on the Design and Use of Explosive-Actuated (SQUIB) Valves in Nuclear Power Plants", was developed to communicate a common position among regulators reviewing squib valve designs in order to promote and understand each country's regulatory decision and basis and to aid in the assessment of explosive-actuated valves (squib) valves that are used to perform a safety function within a nuclear power plant, www.oecd-nea.org/mdep/common-positions/PUBLIC%20USE%20DCP-AP1000-01-%20Squib%20valves.pdf.
- CP-AP1000WG-02, "Common Position Addressing Fukushima Daiichi NPP Accident-Related Issues", identifies common preliminary approaches to address potential safety improvements for AP1000 plants as related to lessons learnt from the Fukushima Daiichi accident or Fukushima Daiichi-related issues. In seeking a common position, regulators provided input to this paper to reflect their safety conclusions regarding the AP1000 design and how the design could be enhanced to address Fukushima Daiichi issues, www.oecd-nea.org/mdep/common-positions/cp-ap1000wg-02-common_position_fukushima.pdf.
- CP-AP1000WG-03, "Common Position on AP1000 IRWST Condensate Return Modelling", explains how the members of AP1000WG with active regulatory assessments of the AP1000 reactor co-operated and shared information on issues associated with the return of condensate to the IRWST in postulated fault conditions. It also captures common positions reached by the regulators on work done by the Westinghouse Electric Company (Westinghouse or the designer) to address the identified issues that were equally applicable to the AP1000 designs proposed for each country, www.oecd-nea.org/mdep/common-positions/cp-ap1000wg-03.pdf.
- CP-APR1400WG-01, "Common Position Addressing Fukushima-Related Issues", was developed to identify the characteristics of post-Fukushima enhancements put in place by each country and set a common position to achieve balanced and harmonised APR1400 design. The common preliminary approaches are organised into five sections, namely external hazards, reliability of safety functions, accidents with core melt, spent fuel pools, and emergency preparedness in design, supplemented by appendices, www.oecd-nea.org/mdep/common-positions/cp-apr1400wg-01-common_position_fukushima.pdf.
- CP-APR1400WG-02, "Common Positions on the APR1400 Post Loss of Coolant Accident (LOCA) Strainer Performance and Debris In-Vessel Downstream Effects", was developed to promote and understand each country's regulatory decision and basis and to aid in the assessment of ECCS performance considering debris effect and sump strainer, Also, the Common Position discussed the common regulatory position on the Sump Strainer Debris Bypass Testing, Fuel Assembly Head Loss Testing, Reactor Core Long-Term Cooling Thermal-Hydraulic Analysis, and Risk Informed Approach and Margin Assessment Approach, www.oecd-nea.org/mdep/common-positions/cp-apr1400wg-02-debris-common-position.pdf.
- CP-APR1400WG-03, "Common Position on the Fuel Thermal Conductivity Degradation", has a general position that the degradation of the thermal conductivity with fuel burnup should be taken into account in an appropriate manner and the compliance with the acceptance criteria based on the evaluation should be confirmed. A specific position was provided such as that a replacement of old fuel performance code with new codes having a capability to account the burnup effect. As an interim approach, penalty to Peak Cladding Temperature (PCT) and Peak Local Oxidation (PLO) due to the absence of consideration of TCD in the old fuel analysis codes was also discussed, www.oecd-nea.org/mdep/documents/DCP-APR1400-Fuel_Thermal_Conductivity_Degradation.pdf.

- CP-APR1400WG-04, "Common Position on Irradiation Effect on the APR1400 Fuel Bundle Spacer Grid Strength", specifies that an evaluation of the spacer grid strength shall appropriately address the potential degradation of the spacer grid crush strength due to irradiation throughout the lifetime of a fuel bundle. In the common position, the methodology of demonstration approved by regulators in Korea, the United States and the United Arab Emirates was described, including a series of tests on spacer grid and fuel assembly together with a re-analysis of the seismic/LOCA response of the PLUS7 fuel in APR1400 design, www.oecd-nea.org/mdep/common-positions/cp_apr1400wg_01_fuel%20seismic.pdf.
- CP-ABWRWG-01, "Common Position Addressing Issues Related to the Fukushima Daiichi Nuclear Power Plant Accident", identifies common preliminary approaches to address potential safety improvements for ABWR plants, as well as common general expectations for new nuclear power plants, as related to lessons learnt from the Fukushima Daiichi Nuclear Power Plant accident or Fukushima-related issues, www.oecd-nea.org/mdep/common-positions/cp-abwrwg-01-fukushima_daiichi_accident.pdf.
- CP-VVERWG-01, "Common Position Addressing Fukushima-Related Issues", identifies common preliminary approaches to address potential safety improvements for VVER plants, as well as common general expectations for new nuclear power plants. The common preliminary approaches are organised into four sections, namely accounting for external events in the design, reliability of safety functions implementation, design solutions to cover specific beyond design basis accident or design extension conditions or loss of heat removal to ultimate heat sink, emergency preparedness and response, www.oecd-nea.org/mdep/documents/CP-VVERWG-01-fukushima.pdf.
- CP-VVERWG-02, "Common Position Addressing Ex-Vessel Corium Stabilisation in Core Catcher", identifies common positions regarding the criteria/conditions for reliable ex-vessel corium stabilisation in the core catcher of VVER designs. These criteria could be recommendatory in addition to the existing requirements of national regulators. It covers only those issues (phenomena) that can affect corium stabilisation and those that require some specific properties of the corium and corium stabilisation process, www.oecd-nea.org/mdep/documents/CP-VVERWG-02_CoriumStabilization_CoreCatcher_FINAL.pdf.
- CP-VVERWG-03, "Common Position on Reactor Pressure Vessel and Primary Components Reliability for AES-2006 Designs", represents common positions developed by the VVERWG participating regulators to ensure consistency in the assessment of the reactor pressure vessel (including vessel, reactor head, internals and bolt connections) and primary components (main coolant pipelines, reactor coolant pump, pressuriser, pressuriser safety valve, pressurised surge line, steam generator primary side) of the VVER design, www.oecd-nea.org/mdep/documents/CPVVERWG_RPVPC_Final.pdf.
- CP-HPR1000WG-01, "Common Position Addressing Fukushima Daiichi NPP Accident-Related Issues", identifies common preliminary approaches and regulatory expectations to address potential safety improvements for HPR1000 plants, as related to lessons learnt from the Fukushima Daiichi accident or Fukushima Daiichi-related issues. In seeking a common position, regulators provided input to this paper to reflect their regulatory expectations regarding the HPR1000 design and how the design could be enhanced to address Fukushima Daiichi issues. This common position supplements CP-STC-02 and should be read in conjunction with that document, www.oecd-nea.org/mdep/documents/CP-HPR1000WG-01_CP_AddressingFukushimaDaiichiNPPAccident-RelatedIssues.pdf.
- CP-VICWG-01, "Common Position: Establishment of Common QA/QM Criteria for the Multinational Vendor Inspection", provides a set of common positions for harmonising inspection criteria called "Common QA/QM Criteria" which will be used in Multinational Vendor Inspection. The Common QA/QM Criteria provides the basic areas for consideration when performing vendor inspections. The Criteria have been developed in conformity with International Codes and Standards such as IAEA, ISO, etc. that MDEP member countries have adopted, www.oecd-nea.org/mdep/common-positions/cp-vicwg-01.pdf.

- CP-VICWG-02, “Common Position: Witnessed, Joint, and Multinational Vendor Inspection Protocol”, provides guidance to regulators that wish to carry out witness, joint, and multinational vendor inspections or participate in other regulators’ vendor inspections. It also provides guidance for the sponsoring regulator with regard to its interactions with inspecting, witnessing or participating regulators, www.oecd-nea.org/mdep/documents/CP-VICWG-02_RevApproved_28Jan2021_FINAL.pdf.
- CP-VICWG-03, “Common Position: Preparation and Performance of Vendor Inspections”, lists commendable practices in the preparation and performance of vendor inspections and in addressing any findings, www.oecd-nea.org/mdep/common-positions/cp-vicwg-03.pdf.
- CP-VICWG-04, “Common Position on Mitigating the Risks of Counterfeit, Fraudulent, and Suspect Items”, provides high-level guidance for regulators interested in developing a more robust reporting and information sharing system to minimise the threats posed by counterfeit, fraudulent, and suspect items (CFSI) in their country. It also offers guidance on how regulators may reinforce their oversight of nuclear power plant supply chains, www.oecd-nea.org/mdep/documents/VICWG_CFSI_CommonPositions09Jun2021_approved_FINAL.pdf.
- CP-DICWG-01, “Common Position on the Treatment of Common Cause Failure Caused by Software within Digital Safety Systems”, addresses the topic of common cause failures of software-based, safety DI&C systems. The common position directs readers to consider the effects of software common cause failures of plant components within the safety analysis and that diversity can be an effective means to reduce the potential effects of software common cause failure, www.oecd-nea.org/mdep/common-positions/dicwg-01.pdf.
- CP-DICWG-02, “Common Position on Software Tools for the Development of Software for Safety Systems”, addresses software tools used to design and develop DI&C systems based on the ability of software tools to affect the integrity and reliability of DI&C products. The common position establishes guidelines for the usage and limitations of software tools and the applicability of software tools to the overall DI&C system life cycle, www.oecd-nea.org/mdep/common-positions/gcp-dicwg-02-Software_Tools_Ver_C.pdf.
- CP-DICWG-03, “Common Position on Verification and Validation Throughout the Life Cycle of Digital Safety Systems”, sets forth basic guidelines regarding verification and validation (V&V) activities for DI&C safety systems throughout the system’s lifecycle. It addresses a plant’s overall V&V approach, as well as concerns that are specific to digital computers such as pre-developed software V&V, www.oecd-nea.org/mdep/common-positions/gcp-dicwg-03_VV_Ver_H.pdf.
- CP-DICWG-04, “Common Position on Principle on Data Communication Independence”, focuses on data communications independence between safety systems and between systems of differing safety classification. This common position provides guidelines for specific areas of interest such as communications between safety divisions, between systems of differing safety classification and command prioritisation, www.oecd-nea.org/mdep/common-positions/dicwg_4_ver_b.pdf.
- CP-DICWG-05, “Common Position on the Treatment of Hardware Description Language (HDL) Programmed Devices for Use in Nuclear Safety Systems”, focuses on the development life cycle of HDL-based programmable devices (e.g. FPGAs) and comes as a result of the proliferation of HDL-based devices in the nuclear industry and their similarity to traditional software, www.oecd-nea.org/mdep/common-positions/gcp-dicwg-05_hdl_Pro_Dev_Ver_A.pdf.
- CP-DICWG-06, “Common Position on Principle on Simplicity in Design”, addresses the concerns that complexity in DI&C design can lead to more faults in the design, difficulty in detecting and correcting faults, as well as increased licensing uncertainty. This common position outlines how simplicity in DI&C design is defined and alleviates these concerns while making designs more straightforward and easier to understand, www.oecd-nea.org/mdep/common-positions/gcp-dicwg-06_Simplicity_in_Design_Ver_C.pdf.

- CP-DICWG-07, "Common Position on Selection and Use of Industrial Digital Device of Limited Functionality", addresses digital devices of limited functionality that can be found embedded in plant components such as pumps and breaker. These devices are not necessarily designed for use in nuclear applications and this common position provides criteria for their selection and usage, www.oecd-nea.org/mdep/common-positions/DICWG_GCP-DICWG-07.pdf.
- CP-DICWG-08, "Common Position on the Impact of Cyber Security Features on Digital I&C Safety Systems", provides guidelines on aligning cybersecurity measures with DI&C systems of the highest safety classification. The goal of the common position is to ensure that safety measures and cybersecurity measures do not adversely impact each other, www.oecd-nea.org/mdep/common-positions/dicwg_8_rev_f.pdf.
- CP-DICWG-09, "Common Position on Safety Design Principles and Supporting Information for the Overall I&C Architecture", sets guidelines for safety design principles and supporting information that should be demonstrated for the entire DI&C architecture of a plant, as modern DI&C systems become more integrated and perform more functions, and it is critical to implement safety design principles and documentation to ensure safe operation, www.oecd-nea.org/mdep/common-positions/GCP-09_Overall_IC_Architecture_final.pdf.
- CP-DICWG-10, "Common Position on Hazard Identification and Controls for Digital Instrumentation and Control Systems", lays the foundation for addressing hazards both internal and external to DI&C systems. The common position outlines a systematic approach for determining the hazards associated with DI&C system and the controls to address those hazards, www.oecd-nea.org/mdep/common-positions/MDEP_GCP-DICWG-10_HazardIDandControl.pdf.

  CP-DICWG-11, "Common Position on Digital I&C system Pre-Installation and Initial On-Site Testing", sets forth guidelines regarding pre-installation and initial on-site testing for DI&C systems. These types of testing can confirm that DI&C systems comply with their requirements at different phases of a system's life cycle, www.oecd-nea.org/mdep/common-positions/gcp-dicwg-11-ver-e.pdf.
- CP-DICWG-12, "Common Position on the Use of Automatic Testing in Digital I&C Systems as Part of Surveillance Testing", addresses automated testing feature alignment with DI&C system implementation and performance, in consideration of the fact that automated fault detection features are a common aspect of modern DI&C systems and can provide early detection of system issues in advance of surveillance testing, therefore allowing for a reduction in the need for some manual surveillance activities while maintaining safe operation, www.oecd-nea.org/mdep/common-positions/Public_Use_MDEP_GCP-DICWG-12_Ver_A.pdf.
- CP-DICWG-13, "Common Position on Spurious Actuation", continues DICWG's focus on hazard assessment and controls, focusing on a specific hazard referred to as spurious actuation. Spurious actuation of plant equipment (regardless of safety class) can potentially place a plant in an unanalysed state and this common position explores controlling for this hazard from a DI&C perspective, www.oecd-nea.org/mdep/common-positions/cp-dicwg-13.pdf.
- CP-CSWG-01, "Common Position on Findings from Code Comparisons and Establishment of a Global Framework towards Pressure Boundary Code Harmonisation", contains a compilation of common positions identified by the CSWG in its pursuit of harmonising the requirements in codes and standards governing the design, materials, fabrication, examination, testing and over-pressure protection requirements of presser-boundary components such as vessels, piping, pumps and valves typically found in large, water-cooled reactor nuclear power plants, www.oecd-nea.org/mdep/documents/CP-CSWG-01-common-position.pdf.

Appendix B: MDEP technical reports (2006-2021)

- TR-EPRWG-01, "Regulatory Approaches and Criteria Used in the Analysis of Accidents and Transients in MDEP EPRWG Member Countries", summarises key aspects of practices used by the regulatory agencies in evaluation of safety analyses in support of licensing (or certification) of the EPR, www.oecd-nea.org/mdep/documents/EPR-Survey-Regulatory-Approaches.pdf.
- TR-EPRWG-02, "Insights from PSA Comparison in Evaluation of EPR Designs", describes the outcome of a limited probabilistic safety assessment (PSA) comparison on the EPR designs. It was presented by the chairman of the EPR technical experts' subgroup on probabilistic safety assessment at the PSAM 12 meeting in June 2014, www.oecd-nea.org/mdep/documents/PSAM-12-PSA.pdf.
- TR-EPRWG-03, "Technical Report on the Definition of Primary Coolant Source Terms Used in the Different EPR Designs for Shielding, Radiation Zoning, DBA Consequences", considers the way the EPR primary coolant source term was elaborated and used in the different countries at the design stage. It identifies the main discrepancies and their origins. Discrepancies are not really linked to the EPR design but to historical practices, available feedback and the different methods used, www.oecd-nea.org/mdep/documents/TR-EPRWG-03-Source-term-survey_May2015.pdf.
- TR-EPRWG-04, "Limited Comparison of EPR™ PSA", describes the outcome of a limited PSA comparison on the following EPR designs: the Olkiluoto 3 Nuclear Power Plant in Finland, the Flamanville 3 Nuclear Power Plant in France, the United Kingdom's EPR design, and the United States EPR design. The objective of this comparison was to identify differences in the modelling aspects and results of EPR PSAs, as well as to assess the rationale for these differences, www.oecd-nea.org/mdep/documents/2017-11-30%20TR-EPRWG-04%20Limited%20Comparison%20of%20EPR%20PSA.PDF.
- TR-EPRWG-05, "Technical Report on FPOT Considered for EPR", provides background to FPOTs and the development of the generic FPOT common position, and the planned EPR FPOTs. It also describes the Commissioning Activities TESG observation of the Taishan Unit 1 special vibration measurements on the reactor pressure vessel internals (RPVI) FPOTs and the lessons learnt associated with the practical arrangements that should be considered when preparing to observe any future FPOTs, www.oecd-nea.org/mdep/documents/EPRWG-EPR05-EPR-for-FPOT.pdf.
- TR-EPRWG-06, "Technical Report on Hydrogen Management for EPR", identifies what is common and what is different between the EPR designs related to hydrogen management, focusing mainly on hydrogen passive autocatalytic recombiners (PARs), www.oecd-nea.org/mdep/documents/EPRWG06_TechnicalReport_Hydrogen_Management.pdf.
- TR-EPRWG-07, "Technical Report on EPR Assessment of 2A Large Break Loss of Coolant Accident (2A-LOCA) Analysis", presents the work carried out by regulators to demonstrate a common understanding of the response of a generic EPR plant following a double-ended Large Break LOCA referred to as "2A-LOCA" and how this has been addressed within the safety submissions supporting the EPR reactor design, www.oecd-nea.org/mdep/documents/EPRWG07_TechnicalReport_2A%20LOCA_public.pdf.
- TR-EPRWG-08, "Technical Report on EPR I&C", introduces both the general common design features and specific features of the five EPR I&C design variants. The report also discusses the major technical issues or concerns. Finally, it provides recommendations and lessons learnt to support ongoing MDEP activities and future reviews of new reactors.

- TR-EPRWG-09, "Technical Report on EPR Break Preclusion Approach on the Secondary System", provides a comparison of the technical references used for each EPR project regarding the break preclusion approach on the secondary system.

- TR-AP1000WG-01, "Technical Report on Lessons Learnt with AP1000 Reactor Coolant Pumps", describes the design, manufacturing and testing of the reactor coolant pump (RCP) used in the AP1000 nuclear power plants. The testing includes prototype and commissioning test. This report focuses on the regulatory practices, co-operative regulatory experiences, and lessons learnt related to the RCPs, www.oecd-nea.org/mdep/common-positions/tr-ap1000wg-01.pdf.

- TR-AP1000WG-02, "Technical Report on AP1000 Squib Valves Design, Construction, Qualification, and Testing Experience", describes the design, qualification, and application of pyrotechnic-actuated (squib) valves used in the AP1000 nuclear power plant. The objectives of this report are to describe lessons learnt from these activities for consideration in future design, construction, qualification, and testing of AP1000 squib valves, www.oecd-nea.org/mdep/common-positions/tr-ap1000wg-02.pdf.

- TR-AP1000WG-03, "Technical Exchanges between US NRC and NNSA during the Design, Construction, and Commissioning of AP1000 Reactors", provides a compilation of the question and answer exchanges between the US NRC and NNSA. The information exchanges include several documents that are publicly available in the US NRC's Agency wide Documents Access and Management System (ADAMS), as well as other documents provided or exchange during the AP1000WG meetings. It is restricted to AP1000WG members at the request of the members.

- TR-AP1000WG-04, "Technical Report on Common Understanding of the Hydrogen Control System for the AP1000 Design", identifies a common understanding of the regulatory requirements for the AP1000 design. This report also identifies differences between the AP1000 design proposed in China, India, and the United States as it relates to hydrogen management, the rationale for the Hydrogen Recombiner Subsystem, and the use of Hydrogen PARs and any related regulatory differences, www.oecd-nea.org/mdep/documents/Technical_Report_AP1000_Hydrogen_Control_System_Approved_Sept2020_FINAL.pdf.

- TR-AP1000WG-05, "Technical Report on Lessons Learnt from Implementation of the Common Position on FPOT for AP1000", evaluates the implementation of the MDEP Common Position Addressing First-Plant-Only-Tests (FPOT), Version 1, dated April 2018, CP-STC-01, in the crediting of FPOT and First-Three Plant Only Test (F3POT) for the AP1000 design. As described in the common position, a FPOT or F3POT performed at one reactor can be credited to another reactor as long as appropriate preconditions are met, and the common position identifies a series of such preconditions. This report describes how each of the preconditions was considered in crediting FPOTs and F3POTs in implementing the AP1000 design across multiple reactors, www.oecd-nea.org/mdep/documents/AP1000_TR_LessonsLearnt_ImplementationCP_FPOT_FINAL.pdf.

- TR-AP1000WG-06, "Technical Report on Hot Functional and Startup Testing Lessons Learnt", discusses lessons learnt from the AP1000 Hot Functional Testing (HFT) and Startup testing performed at Sanmen Unit 1 and Haiyang Unit 1 in China, www.oecd-nea.org/mdep/documents/AP1000_TR_hotfunctionaltesting_startuplessonslearnt_FINAL.pdf.

- TR-APR1400WG-01, "Technical Report on Design Description and Comparison of Design Differences Between APR1400 Plants", documents differences in the design of APR1400s submitted for licensing applications. With APR1400s in different licensing stages among member countries, APR1400WG members identified design differences in order to better understand the associated rationale, such as design improvements or regulatory requirements which are different for each member countries, www.oecd-nea.org/mdep/documents/TR-APR1400-01%20Design%20Description%20and%20Comparison%20of%20Design%20Differences.pdf.

- TR-APR1400WG-02, "Technical Report on Background Information Relevant to Addressing Severe Accidents in the APR1400 Design", was developed in recognition of differences in the governing legislative requirements of the country in which the APR1400 is to be constructed and operated, that largely influence the design and implementation of measures provided to prevent and/or mitigate the effects of Severe Accidents in nuclear power plants. The report compiled regulatory requirements applicable to Severe Accidents in APR1400WG member countries, Severe Accident prevention and mitigation features of the APR1400 designs, and the summary of codes, methodologies and countermeasures for severe accident analysis adopted for each APR1400WG member country, www.oecd-nea.org/mdep/documents/2017-11-30%20TR-APR1400-02%20on%20the%20comparison%20of%20the%20prevention%20and%20mitigation%20measures%20against%20severe%20accident.pdf.
- TR-APR1400WG-03, "Technical Report on the Findings of the Review of the Molten Core Concrete Interaction (MCCI) Phenomena for the APR1400", documents the technical assessments performed by KINS, FANR, and the US NRC on the MCCI phenomena in their respective APR1400 designs. It also summarises applicable regulatory requirements in each member country relevant to MCCI, www.oecd-nea.org/mdep/documents/TR-APR1400-03%20on%20the%20findings%20of%20the%20review%20of%20the%20MCCI%20phenomena.pdf.
- TR-APR1400WG-04, "Technical Report on Hydrogen Recombiner Survey Results for APR1400 design in place, or proposed, for MDEP Member Countries", presents a common understanding of the regulatory requirements pertaining to hydrogen control for the APR1400 designs of MDEP member countries. The report is based on a survey conducted among the APR1400WG members on specific regulatory requirements applicable in each country on hydrogen control, hydrogen control system design and implementation as well as maintenance and availability, www.oecd-nea.org/mdep/documents/TR-APR1400WG-04_hydrogenrecombiner_surveyreport_FINAL.pdf.
- TR-APR1400WG-05, "Technical Report on the Comparison of the Regulatory Requirements for Probabilistic Risk Assessment (PRA) of the APR1400 Nuclear Power Plants, for the MDEP Member Countries", documents each participating member country's assessment in the form of a survey that compares the contents of the applicable regulations and regulatory guides, probabilistic safety goals, scope of PRA, quality control, technical adequacy, peer review, PRA maintenance and updates as well as the use of PRA for changes in licensing basis between KINS and FANR, www.oecd-nea.org/mdep/documents/TR-APR1400WG-05_ComparisonRegulatoryRequirements_PRA_NPP_Final.pdf.
- TR-ABWRWG-01, "Technical Report on Design Comparisons", accumulates comparative information on ABWRs and similar designs. It is restricted to ABWRWG members at the request of the members.
- TR-ABWRWG-02, "Technical Report on Design Differences Identified from Comparison of International ABWR Designs", explains the noteworthy design differences identified from report TR-ABWRWG-01. This report was important to document the regulatory basis for severe accidents design differences. It is restricted to MDEP members at the request of members.
- TR-ABWRWG-03, "Technical Report on Comparison of Severe Accidents Regulatory Positions for ABWR Reactors (Regulatory Differences)", documents the regulatory basis, where applicable, for differences in the design of severe accident features of reactors considered within the scope of the ABWRWG. It is restricted to ABWRWG members at the request of the members.

- TR-VVERWG-01, “Regulatory Approaches and Criteria used in Severe Accident Analyses and Severe Accident Management”, summarises key aspects of the regulatory requirements and existing practices in the field of severe accident assessment and severe accident management, highlighting the items where approaches of regulators in VVERWG member countries are similar and also identifying the differences. The focus of the information presented in this report is on the events which lead to reactor core or fuel damage, www.oecd-nea.org/mdep/documents/2017-11-30%20TR-VVERWG-01%20Regulatory%20approaches%20and%20criteria%20used%20in%20severe%20accident%20analyses%20and%20severe%20accident%20management.pdf.
- TR-VVERWG-02, “Regulatory Approaches and Oversight Practices Related to Reactor Pressure Vessel and Primary Components”, identifies differences in regulatory approaches and oversight practices used in different countries within the VVERWG related to reactor pressure vessel and primary components. It also identifies commendable practices in this field, www.oecd-nea.org/mdep/documents/vverwg-tr-02-2017.pdf.
- TR-VVERWG-03, “Regulatory Approaches Related to Accidents and Transients Analyses”, summarises the main findings from discussions between VVER Accidents and Transients TESG participants concerning the regulatory requirements and existing practices in the field of accident and transient analyses, highlighting the items where approaches of regulators in VVER member countries are similar and also identifying the differences. The focus of the information presented in this report is on all accident and transient issues, including severe accidents, www.oecd-nea.org/mdep/documents/VVERWG_TR_%20Accident_Transients_0_7_STC%20comm_FINAL.pdf.
- TR-VVERWG-04, “Technical Report on Core Catcher”, creates a basis for a common understanding of features of design, safety limits and conditions of the core catcher of the VVER design, in order to define safety concerns and to discuss the possibility of the common approach for licensing, www.oecd-nea.org/mdep/documents/tr-vverwg-04_CoreCatcher_Final.pdf.
- TR-VVERWG-05, “Technical Report on Hydrogen Recombiners”, identifies similarities and differences in regulatory requirements and practices related to PARs in the new VVER design. This report covers the rationale for PARs and for the location and number of PARs, the justification of performance, and the safety classification, www.oecd-nea.org/mdep/documents/TR-VVERWG-05_HydrogenRecombiners_FINAL.pdf.
- TR-HPR1000WG-01, “Hydrogen Control During Severe Accidents”, identifies common features of the HPR1000 design and develops a common understanding of the regulatory requirements of the regulators that make up the HPR1000WG. A survey was produced and sent to all the regulators regarding various aspects of the HPR1000 Containment Combustible Gas Control System (CCGCS). This document compiles the information provided within the responses to the survey and summarises the information presented by the regulators, www.oecd-nea.org/mdep/documents/TR-HPR1000WG-01%20Hydrogen%20Control%20During%20Severe%20Accidents_clean%20copy_FINAL.pdf.
- TR-HPR1000WG-02, “Technical Report on Regulatory Requirements and Practices for Severe Accidents”, summarises the regulatory requirements and expectations of the regulators that make up the HPR1000WG, and highlights where consensus or differences exist. A survey was produced and sent to all regulators regarding various aspects of the regulation, analysis, and management of severe accidents. This report compiles the information provided within the responses to the survey and summarises the information presented by the regulators, www.oecd-nea.org/mdep/documents/TR-HPR1000WG-02_TR_RegulatoryRequirements_Practices_Severe%20Accidents.pdf.
- TR-VICWG-01, “MDEP Protocol: Witnessed, Joint, and Multinational Vendor Inspection Protocol”, provides guidance to regulators that wish to carry out vendor inspections or participate in or witness other regulators’ vendor inspections. It also provides guidance for the sponsoring regulator with regard to its interactions with inspecting, witnessing or participating regulators. CP-VICWG-02 replaces this technical report, www.oecd-nea.org/mdep/documents/VICWG-01-V2-vendor-inspection-protocol.pdf.

- TR-VICWG-02, "Technical Report: Survey on Quality Assurance Program Requirements", presents a survey that was prepared using the requirements of Appendix B to 10CFR Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." These requirements form the basis upon which the U.S. NRC oversees the activities of vendors providing parts and services to the commercial U.S. nuclear power industry. The member regulators' responses to the survey are also provided, www.oecd-nea.org/mdep/common-positions/tr-vicwg-02.pdf.
- TR-VICWG-03, "Technical Report on Common QA/QM Criteria for Multinational Vendor Inspection", provides the "Common QA/QM Criteria" which will be used in the Multinational Vendor Inspection. The Common QA/QM Criteria provides the basic areas for consideration when performing vendor inspections. The Criteria have been developed in conformity with International Codes and Standards such as those of the IAEA, ISO, etc., that MDEP member countries have adopted.
- TR-VICWG-04, "Technical Report: Assessment of Multinational Vendor Inspection of Valinox Nuclear", describes the first MDEP Multinational Vendor Inspection at Valinox Nuclear in France, specifically, the inspection team, inspection scope and findings, and VICWG assessment of the multinational inspection effort, www.oecd-nea.org/mdep/common-positions/tr-vicwg-04.pdf.
- TR-VICWG-05, "Technical Report: Assessment of Multinational Vendor Inspections of AREVA NP Creusot Forge (ACF)", describes the second MDEP Multinational Vendor Inspection AREVA NP in its Creusot Forge plant (ACF) in France. It is restricted to VICWG members at the request of the members.
- TR-VICWG-06, "Technical Report on Assessment of Multinational Vendor Inspection of ENSA" (Spain). It is restricted to VICWG members at the request of the members.
- TR-VICWG-07, "Technical Report on Safety Culture in the Nuclear Supply Chain", provides a high-level summary of how each member country encourages or regulates safety in the nuclear supply chain based on the responses to a survey. This report also identifies commonalities and differences between regulatory practices of the member countries in encouraging or regulating safety culture in the nuclear supply chain, www.oecd-nea.org/mdep/documents/TR-VICWG-07_TR_SafetyCulture_NuclearSupplyChainFinal_Rev29Jan2021_FINAL.pdf.
- TR-DICWG-01, "Technical Report on the Relational Structure of the DICWG Common Positions", describes the relational structure between the DICWG common positions, as well as addressing their scope, content and how they relate to the mission of DICWG, www.oecd-nea.org/mdep/common-positions/tr-dicwg-01-relational_structure_cp.pdf.
- TR-CSWG-01, "Technical Report: Regulatory Frameworks for the Use of Nuclear Pressure Boundary Codes and Standards in MDEP Countries", documents how each MDEP regulator utilises national or regional mechanical codes and standards in its safety reviews and licensing of new reactors, www.oecd-nea.org/mdep/documents/cswg-technical-report-tr-cswg-01.pdf.
- TR-CSWG-02, "Technical Report on Lessons Learnt on Achieving Harmonisation of Codes and Standards for Press for Pressure Boundary Components in Nuclear Power Plants", documents the findings and overall conclusions of the CSWG pertaining to the adequacy and sufficiency of several MDEP member countries' pressure boundary codes and standards, and the potential for harmonisation of those pressure boundary codes and standards based on the code-comparison work performed by the SDOs from April 2008 to December 2012. It also documents a strategy and process proposed by the SDOs for achieving code harmonisation, www.oecd-nea.org/mdep/documents/TR-CSWG-02-technical-report.pdf.

- TR-CSWG-03, "Technical Report: Fundamental Attributes for the Design and Construction of Reactor Coolant Pressure-Boundary Components", provides the fundamental attributes which have been developed for the codes and standards used in the design and construction of reactor coolant pressure boundary components in nuclear power plants. The fundamental attributes are the basic concepts to be considered in the design, materials, fabrication, installation, examination, testing and over-pressure protection requirements for pressure boundary components, www.oecd-nea.org/mdep/documents/TR-CSWG-03-fundamental_attributes.pdf.
- TR-CSWG-04, "Technical Report: The Essential Performance Guidelines for the Design and Construction of Pressure Boundary Components", provides the essential performance guidelines for the codes and standards used in the design and construction of reactor coolant pressure boundary components in nuclear power plants. These guidelines are qualitative descriptions of the rules and practices derived from the codes and standards of MDEP member countries, which can be considered as essential, www.oecd-nea.org/mdep/documents/2015-03-16_TR-CSWG-04-Essential-Performance-Guidelines-March2015.pdf.
- TR-CSWG-05, "Technical report on CSWG Past, Current and Future Activities", expresses CSWG members' thoughts on their participation and hopes for future codes and standards harmonisation potential howsoever that would be supported by international bodies. It also summarises the results of a survey of CNRA members concerning their views of codes and standards, and the potential for an entity such as the CSWG to continue within the CNRA, www.oecd-nea.org/mdep/documents/TR-CSWG-05%20Past%20Current%20Future%20Activities%20May%202018.pdf.

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