



# MULTINATIONAL DESIGN EVALUATION PROGRAMME

## Annual Report

**Covering Activities  
from July 2021 to June 2023**





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## Foreword from the Management Board Chair



I am very pleased to have been entrusted to serve the Multinational Design Evaluation Programme (MDEP) as elected Chair of the Management Board (former Policy Group), according to the new governance structure implemented for MDEP in 2022.

The results and achievements of MDEP's previous phase were comprehensively recorded and summarised in the *MDEP Phase 1 Summary Report 2006-2021*, while current and former MDEP members' joint work was carefully saved in the MDEP Library and is available for study.

MDEP remains a unique multinational initiative that leverages the resources and knowledge of national regulators in order to review new reactor designs, and it is widely recognised as an effective framework for regulatory co-operation and harmonisation.

We were able to overcome the impact of the COVID-19 pandemic on member interaction within the Programme and actively used all available and appropriate tools to support MDEP activities. Our working groups continued to co-operate in person and remotely to develop, approve and publish Technical Reports and Common Positions, and to discuss practical and organisational details such as the arrangements of the much-expected 5<sup>th</sup> MDEP Conference.

Postponed multiple times, the 5<sup>th</sup> MDEP Conference was finally held in Antalya, Türkiye on 24-25 April 2023, and gathered an impressive number of participants, including MDEP members and stakeholders from 28 countries. The Conference reflected the wealth of knowledge the programme has accumulated, as well as the valuable information and joint documents produced regarding various aspects of safety assessment of new nuclear power plant designs. Moreover, we were able to effectively assess ways to expand the boundaries of MDEP to include small reactor designs within its scope.

While continuing the activities of the working groups and moving towards the finalisation of the tasks they face, we are also actively considering new areas within the Programme. These are, namely, designs of new small modular reactors (SMRs) and initiatives to promote and transfer MDEP knowledge. These new areas are also closely related to MDEP membership and possible new members, including embarking countries within the nuclear sector. We encourage regulators who can contribute to the joint effort and benefit from our work to take part in our initiatives.

As part of our work, we maintain an open dialogue with the industry. It helps us avoid misunderstandings around specific technical requirements and differences of views on safety culture. Similarly, MDEP should remain in touch with international initiatives such as the International Atomic Energy Agency's Nuclear Harmonization and Standardization Initiative (IAEA NHSI) and the World Nuclear Association's (WNA) activities on harmonisation. It continues to be an integral part of the MDEP work.

There should not be any national boundaries for either nuclear safety or regulator co-operation on this matter. It is important to simplify the process of information sharing between all stakeholders and to promote MDEP products, key achievements and major events and activities.

I wish you all success and prosperity despite the challenges you may face.

**Alexey Ferapontov**  
MDEP Management Board Chair



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## Executive summary

The Multinational Design Evaluation Programme (MDEP) is a multinational initiative whose purpose is to leverage the resources and knowledge of national regulatory authorities that are currently, or will shortly be, undertaking the review of new reactor power plant designs. Current MDEP members are the regulatory authorities of Argentina (ARN), the People's Republic of China (NNSA), Hungary (HAEA), the Russian Federation (Rostekhnadzor), South Africa (NNR) and Türkiye (NDK). The Nuclear Energy Agency (NEA) performs the Technical Secretariat function in support of MDEP. The International Atomic Energy Agency (IAEA) also takes part in the work of MDEP. This programme incorporates a broad range of activities including enhancing multilateral co-operation within existing regulatory frameworks and increasing multinational convergence of 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.

This report encompasses all MDEP activities from July 2021 to June 2023, a period during which MDEP underwent an organisational and governmental transition in response to the members' needs and demands and in order to better fulfil its objectives in a changing context in the nuclear sector. In addition, the report presents MDEP's organisation, goals, history, working groups, initiatives, results and future perspectives. Appendix 1 and 2, finally, offer a list of abbreviations and acronyms as well as a list of new and revised publications.

Substantial progress has been 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 accident at the Fukushima Daiichi Nuclear Power Plant have been appropriately addressed by all designs under MDEP and incorporated into MDEP activities in the Design Specific Working Group (DSWG) programme plans. The accomplishments to date provide confidence that the MDEP membership, structure and processes offer an efficient method of co-operating effectively in regulatory reviews for new designs. At the level of the working groups, the key accomplishments for the July 2021 to June 2023 period are the following:

- The VVER Working Group (VVERWG) published in October 2021 a Common Position on reactor pressure vessel and primary component reliability for AES-2006 designs (CP-VVERWG-03). In addition, the VVERWG developed a technical report on Preliminary Analyses and Comparison of Design differences between VVER-1000 Reactors and a technical report on Regulatory Requirements and Practices for Uncertainty Evaluations of Deterministic Safety Analysis.
- The HPR1000 Working Group (HPR1000WG) finalised a Common Position on the Vienna Declaration on Nuclear Safety and developed three documents: a Common Position (CP) on the IRWST Strainer Performance and Downstream Effects of HPR1000 after LOCA; a Common Position addressing In-Vessel Retention strategy for HPR1000; and a technical report (TR) on Internal and External Hazards. The working group is now developing a Common Position on Sump Strainer Performance.

At the inter-organisational level, MDEP interacts and works closely with the NEA Committee on Nuclear Regulatory Activities (CNRA), with the IAEA, with the World Nuclear Association (WNA) via its Working Group on Co-operation in Reactor Design Evaluation and Licensing (CORDEL) and with various industry groups through a number of initiatives such as Working Group Industry Workshops.



# 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 that are, or will shortly be, undertaking the review of new reactor power plant designs. The programme aims to better inform the decisions of regulatory authorities through multinational co-operation, while each regulator retains the sovereign authority to make licensing and regulatory decisions.

Working groups are implementing their programme plans with specific activities and goals, and the working groups have established the necessary interfaces both within and outside MDEP members. Considering MDEP has transitioned to a new framework, significant progress has been made over the past two years on the overall MDEP goals of increased co-operation and enhanced convergence of requirements and practices. Accomplishments to date provide confidence that the MDEP membership, structure and processes provide an effective method of accomplishing increased co-operation in regulatory design reviews for new reactors.

MDEP was established in 2006 as a multinational initiative for a five-year period. It was extended for another five-year period in 2012 by the Policy Group based on the value gained by the members. In 2015, the Policy Group determined that MDEP should continue in its current form for at least five more years following 2017. In December 2021, the Policy Group approved the sunsetting of three MDEP designs that completed their Programme of Work (EPR, AP1000 and APR1400), and to transfer the Vendor Inspection Cooperation Working Group (VICWG) to the NEA Committee on Nuclear Regulatory Activities (CNRA). It also determined that a new MDEP governance structure would be implemented in 2022. A new MDEP governance structure was successfully implemented in 2022. Regardless of this period of transition, working groups focusing on the active MDEP designs (VVER and HPR1000) continued to share information and experience on the safety design reviews with the purpose of enhancing the safety of the design and enabling regulators to make timely licensing decisions.

This annual report encompasses all MDEP activities from July 2021 to June 2023.



## 2. Programme goals and outcomes

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

MDEP is meeting its goal of enabling increased co-operation through the activities of the working groups. MDEP has been successful in providing a forum for regulatory bodies to co-operate on design evaluations and inspections. In addition to organising working groups, MDEP has provided each regulator with peer contacts who share information, discuss issues informally and disseminate information rapidly. For example, the DSWG members have benefitted significantly from the questions shared among the regulators, resulting in more informed and harmonised regulatory decisions. MDEP interactions are useful in confirming findings that had been previously made. It has also improved the safety focus of the design review and helped identify previously undiscovered safety issues as well as expanding the scope of the review. MDEP members have 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 the development of an MDEP Library which serves as a central repository for all documents associated with the programme. Moreover, successful interactions with stakeholders through MDEP have built links with regulators, industry, standard development organisations (SDOs) and other international organisations, and have been beneficial to the reviews of reactor designs.



## 3. Programme implementation

### 3.1 Membership

Participation in MDEP 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's members are Argentina, China, Hungary, Russia, South Africa and Türkiye. The IAEA also takes part in the work of MDEP. Finland withdrew from the Programme on 15 June 2022 due to the cancellation of the Hanhikivi-1 project and the United Kingdom followed at the end of 2022 due to the cancellation of its HPR construction project.

### 3.2 Organisational structure

At its October 2020 meeting, the Policy Group (PG) approved moving forward with plans for the closure of the EPR Working Group (EPRWG), AP1000 Working Group (AP1000WG), and APR1400 Working Group (APR1400WG) by the end of 2021. However, the Policy Group affirmed that for the MDEP designs that would continue to be active after 2022 (VVER and HPR1000), the work should continue.

The Policy Group also decided to transfer the VICWG to the CNRA. During 2022, the VICWG worked with the CNRA under the NEA auspices on the process of transition and the official transition took place in 2023. The EPRWG members have identified additional work related to operating reactors that is beyond the MDEP framework and have established an information sharing forum under the CNRA.

The Policy Group also established a new governance structure for MDEP, which was later implemented in 2022. This new structure involves the formation of an MDEP Management Board (MB), as a main governance body, with the NEA assuming the role of its Technical Secretariat.

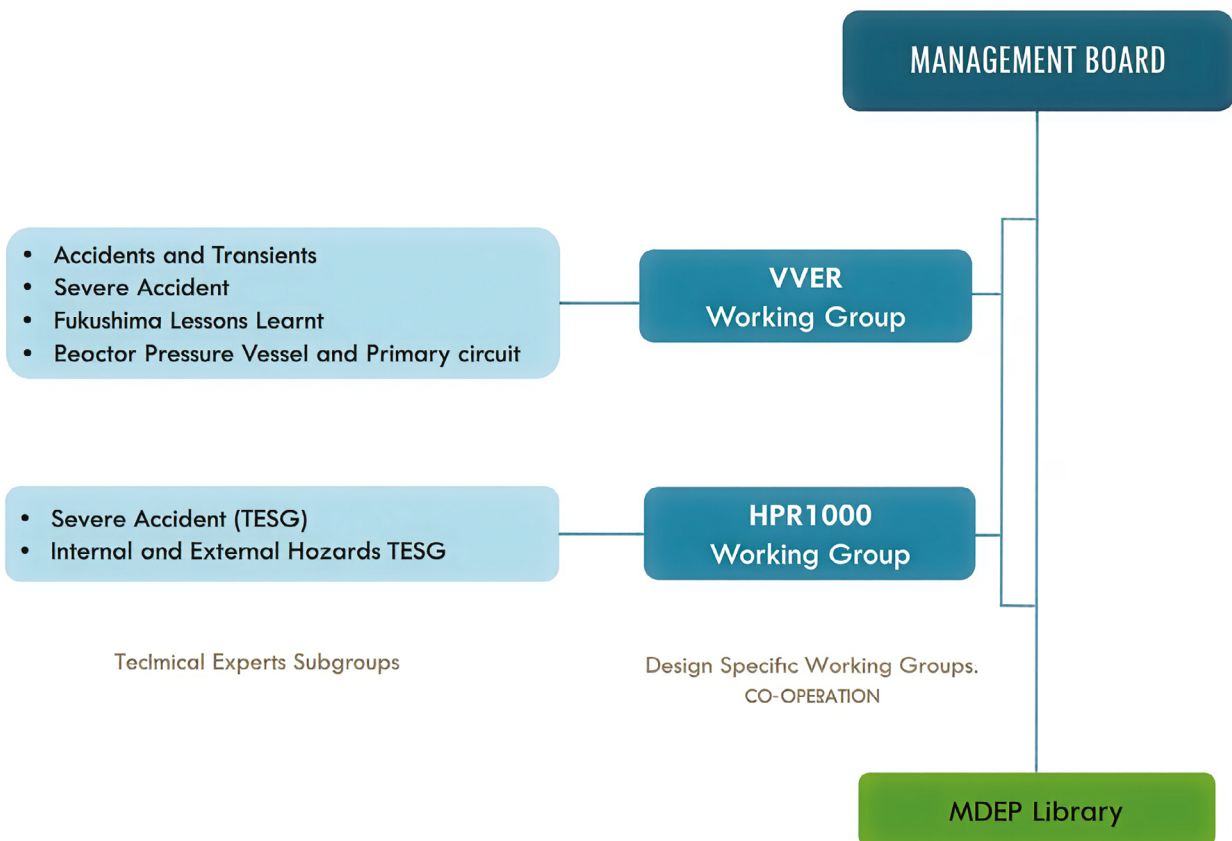
A transition team that consisted of all member countries of the future framework was established to consider the current roles and responsibilities for the Policy Group and the STC in order to propose the roles and responsibilities of the new Management Board of the future framework. Mr Tapani Virolainen (STUK), Finland, was elected Transition Team leader during the MDEP transition to the future framework. Additionally, the Transition Team was composed of: Mr Serhat Alten (NDK), Türkiye; Mr Chai Guohan, Nuclear and Radiation Safety Center of the National Nuclear Safety Administration of the Ministry of Ecology and Environment, China; Mr Abel Julio GONZÁLEZ (ARN), Argentina; Ms Barbara Baller (HAEA), Hungary; Mr Shane Turner (ONR), United Kingdom; Mr Valery Kolobov (Rostekhnadzor), Russia; Mr Orion PHILLIPS (NNR), South Africa.

Three meetings of the MDEP Transition Team (TT) were held in 2021: on 25 May, 23 August and 9 November. It was decided to keep the same MDEP membership criteria, including the need for new members to be committed to participation in the WG (through information sharing and financial support), and that the new framework would start without new Issue Specific Working Groups (ISWGs) while being open to the initiation of new ISWGs and DSWGs. The Transition Team also updated the MDEP and Working Groups' terms of reference. The work performed by the TT made possible a smooth transition to the new MDEP Framework with the Management Board as its sole governance body.

The Management Board held four meetings: on 13 December 2022, 27 June 2022, 30 September 2022 and 26 April 2023. Two ad-hoc meetings were also held on 19 December 2022 and 12 April 2023. Mr Alexey Ferapontov was unanimously elected Chair during the first meeting and the current MB Vice-Chair, Mr Abel González, was elected unanimously during the second MB meeting due to STUK's withdrawal from MDEP. By the end of the 3<sup>rd</sup> meeting, the MB had approved the 2022-2023 budget estimation, as well

as new MDEP and working groups’ Terms of References, versions of communication plans and MDEP Procedures, with which the transition period was formally finalised. It also decided to hold the 5<sup>th</sup> MDEP Conference in Antalya, Türkiye in 2023 and reviewed its Programme. During the 4<sup>th</sup> meeting, the MB supported the Secretariat’s proposal to launch the MDEP training school based at Khalifa University and, finally, discussed and agreed on the preliminary steps for the launch of new SMR-related working group. The following chart illustrates how the programme is currently organised.

Figure 3.1: **MDEP organisational structure as of June 2023**



### 3.3 MDEP Library

MDEP information is communicated among the members in part 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: i) general access open to every member, and ii) restricted area access for each MDEP working group’s 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/mddep](http://www.oecd-nea.org/mddep)). As a general rule, the information exchanged as part of the MDEP in meetings and the MDEP Library is for the sole use of the participating national regulatory authorities. The members of the working groups also follow the communications protocol to share new information related to new reactors with other members prior to its public release. A large portion of the information shared may not be proprietary or sensitive; however, all participating members must protect and properly handle the information which an originator considers to be proprietary or sensitive.

MDEP WGs have documented their work and results, including individual final 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 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 would manage access to the MDEP Library by non-MDEP countries. For access requests to non-proprietary information held in the library, it was agreed that the NEA Secretariat could use its discretion. For access requests 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 a much wider group of national regulators will benefit from MDEP. The MDEP Library will continue to be a central repository for MDEP.

### 3.4 Common Positions

MDEP has developed a process for identifying and documenting Common Positions on specific issues among the member regulators based on existing standards, national regulatory guidance, best practices and group member inputs. Design Specific Common Positions document common conclusions that each of the working group members have reached during design reviews. Discussions among the members and the sharing of information in these areas help to strengthen the individual conclusions reached.

Generic Common Positions apply generically rather than only to one specific design. Generic Common Positions document practices and positions that each of the working group members find acceptable. The Common Positions are intended to provide guidance to the regulators in reviewing new or unique areas and will be shared with the IAEA and other standards organisations to be considered in standards development programmes. After a Common Position is agreed within a working group, it is presented to the MB for endorsement. Upon endorsement by the MB, the proposed Common Positions are made publicly available on the NEA MDEP website in order to keep external stakeholders informed of the work completed within MDEP. Those Common Positions will become commendable practices, recommended by MDEP. There is no obligation on the part of any regulatory body to follow them. A key concept throughout the work of MDEP is that national regulators retain sovereign authority for all licensing and regulatory decisions. If a regulatory body chooses to formally adopt a Common Position, it will be through that country's regular processes.



## 4. Interactions with other organisations

MDEP strives to maintain an awareness of, and interacts with, other organisations that are implementing programmes to facilitate international co-operation on new reactors. Interactions focus on ensuring that MDEP does not duplicate efforts and benefits from the outputs of these organisations.

A key outcome of MDEP's co-operation with external organisations was the MDEP Conference. MDEP has organised five conferences, and these events provided a forum for MDEP stakeholders (including industry representatives, standard development organisations and other international organisations) to share the results of their engagement with the programme and to deliver presentations on ongoing activities related to new reactor licensing. On 24-25 April 2023, the NEA, with the support of NDK (the Turkish Regulatory Authority), held the 5<sup>th</sup> MDEP conference on New Reactor Design Activities in Antalya, Türkiye, gathering participants from 18 different countries, the IAEA and the WNA. The following countries were represented at the 5<sup>th</sup> MDEP Conference: Argentina, Belarus, Canada, China, Czechia, Finland, France, Germany, Hungary, Japan, Pakistan, Russia, South Africa, Korea, Türkiye, the United Arab Emirates, the United Kingdom and the United States.

### 4.1. CNRA

The CNRA launched a new framework in 2023 and it is currently reviewing the activities of the newly established working groups. It is expected that the CNRA Working Group on Policy and Licensing (WGPL) will be a focal point of interactions between MDEP and the CNRA and its working groups and will assist in co-ordinating communications and requests between the two activities in order to ensure that MDEP's efforts take full advantage of the work already being done by the CNRA. The WGPL is focusing on issues related to policy and licensing for both operating nuclear reactors and proposed new reactors (including those under construction) in NEA member and partner countries. The WGPL aims to facilitate an active and timely exchange of commendable practices, as well as lessons learnt to help regulators perform their policy and licensing functions more effectively and efficiently. To avoid an overlap of activities between the groups, the WGPL focuses on general procedures and guidance, while MDEP focuses on design-specific issues.

In accordance with the PG decision in 2020 to transfer the MDEP VICWG activities to the NEA, MDEP has co-operated with the CNRA leadership to undertake the transfer of additional activities to the CNRA. VICWG activities were closed under the current MDEP framework at the end of 2021. During 2022, the VICWG worked with the CNRA under the NEA auspices on the process of transition, and in the new CNRA structure it was merged into the Working Group on Supply Chain (WGSUP). Also, since the EPRWG members have identified additional work related to operating reactors that is beyond the MDEP framework, the EPRWG activities were also transferred to the CNRA. Currently, they are continued in the Working Group on Reactor Oversight (WGRO). The benefits of continued co-ordination among regulators on these topics have been recognised both within and outside of MDEP.

### 4.2. IAEA

The IAEA takes part in the work of MDEP through participation in the Management Board and in any possible future Issue Specific Working Group meetings. In addition, the generic Common Positions developed in MDEP are shared with the IAEA for consideration in the IAEA standards development programme.

### 4.3. Industry

The MDEP working groups are very interested in understanding the perspectives of the design vendors, codes and standards organisations, component manufacturers and the challenges they face in dealing with numerous regulators and regulatory systems. The MDEP working groups interact with industry groups and invite them to participate in selective portions of meetings and other activities. For example:

- The VVER Working Group continues to interact with the Russian nuclear industry, as well as invited representatives of Rosatom, Rosenergoatom and design organisations (such as Atomenergoproekt, Atomproekt, and Gidropress) to take part in the meetings of the VVERWG and its subgroups to acquire additional information about safety-significant design solutions. Also, VVERWG held a second workshop with industry on 27-29 October 2021, via teleconference, during which the following topics were discussed: usage of PSA in the nuclear power plant design, supply chains and validation/verification of “first-of-a-kind” equipment. The next workshop will be held in 2024 to discuss issues related to VVER-1200 design differences, first-of-a-kind (FOAK) tests and long-term heat removal design solutions.
- The HPR1000 Working Group meets with Hualong Nuclear Power Technology Co., Ltd and the HPR1000 licensees in China. The HPR1000WG also plans to organise a first workshop with industry in 2024.

### 4.4. WNA

The WNA’s Working Group on Co-operation in Reactor Design Evaluation and Licensing (CORDEL) acts as the industry counterpart to MDEP. Since both MDEP and CORDEL have expressed interest in and have established a goal of furthering harmonisation of reactor designs, regulatory practices, and industry and international standards, the MDEP PG has agreed that co-ordination of efforts with CORDEL is appropriate in some cases. While co-ordinating efforts in areas of mutual interest, MDEP members will always retain their individual and independent regulatory roles and positions. CORDEL has participated in meetings of the MDEP VICWG. And the MDEP Technical Secretariat provided an updated information on the MDEP activities during the CORDEL regional workshop in 2022.

While MDEP is a regulatory forum and CORDEL is an industry organisation, both parties agree they can benefit from communications and cooperation where the organisations share common goals. Both MDEP and CORDEL maintain strong interests in the harmonisation of new reactor designs and design reviews, regulatory safety standards and practices, and related industry and IAEA standards. MDEP values continued interaction to assist in achieving these goals while each organisation functions in a manner consistent with its appropriate roles and responsibilities.

## 5. Current activities

The activities of MDEP have been 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. MDEP also maintained until the end of 2021 one issue specific working group that scrutinised technical and regulatory process areas within the programme of work. Each working group has a lead and co-lead regulator designated as chair and vice chair, and has developed a programme plan, which identifies specific activities, schedules and contacts.

The design-specific working groups leverage national regulatory resources by sharing information and experience on the regulatory safety design reviews with the purpose of enhancing the safety of the design and enabling regulators to make timely licencing decisions. Design-specific working groups achieve this goal through:

- exchanging experiences and lessons learnt on licensing process implementation, design reviews, and design-related construction and commissioning activities;
- working to understand the differences in regulatory safety review approaches in each country to support potential use of other regulators' safety design evaluations, where appropriate;
- identifying and understanding key design differences, including those originating from regulatory requirements, and then documenting the reasons for differences in regulatory requirements;
- looking for opportunities to provide input to Issue Specific Working Groups on potential topics of significant interest;
- documenting common MDEP positions on aspects of a review;
- documenting the group's activities in Technical Reports to ensure knowledge transfer;
- communicating and co-ordinating communications on MDEP views and Common Positions to vendors and operators regarding the basis of safety evaluations and standardisation.

While the Design Specific Working Groups typically address issues that the members find challenging, specific to each design, some topics are addressed by several working groups. Two such topics are the Fukushima Daiichi lessons learnt and hydrogen management.

### ***Fukushima Daiichi Nuclear Power Plant accident lessons learnt***

Lessons learnt from the Fukushima Daiichi Nuclear Power Plant accident have been discussed by all of the DSWGs and each working group has developed a Common Position that identifies common approaches to address potential safety improvements, as well as common general expectations for new nuclear power plants. As directed by the MDEP PG, the STC and working groups developed an integrated MDEP Common Position on the lessons learnt from the Fukushima Daiichi Nuclear Power Plant accident. The STC finalised this document in 2016 and placed it on the MDEP public webpage. MDEP recognises that other related international initiatives have been implemented that are focused on operating plants. Therefore, it is important for new MDEP designs, such as the HPR1000, to address the Fukushima Daiichi lessons learnt. In November 2020, the HPR1000 Working Group finalised a Common Position addressing Fukushima Daiichi Nuclear Power Plant accident-related issues, which supplements the MDEP Common Position developed by the STC.

## Hydrogen management

The challenges in addressing hydrogen recombiner reliability and effectiveness during the plant life have been discussed within EPR, AP1000, APR1400, VVER and HPR1000 DSWGs and each working group has published a Technical Report on hydrogen management to identify a common understanding of the regulatory requirements of the member regulators. These were follow-up efforts from the 2016 Severe Accident TESGs workshop.

### 5.1 VVER Working Group (VVERWG)

The VVER Working Group includes the regulatory authorities of China, Hungary, Russia and Türkiye. Finland withdrew from the VVERWG in May 2022 due to the cancellation of the Hanhikivi-1 Nuclear Power Plant project. The working group members are reviewing plants at various stages of design and construction. In Russia, the Leningrad-II Nuclear Power Plant unit 1 is in operation, unit 2 received an operational licence and minimum controlled power level in the end of August 2020 and entered commercial operation on 23 October 2020; while units 3 and 4 have siting licences. The Novovoronezh-II Nuclear Power Plant unit 1 is in operation; unit 2 entered commercial operation in the end of October 2019. The Kursk-II Nuclear Power Plant units 1 and 2 are under construction. The Smolensk-II Nuclear Power Plant siting licences have been issued for units 1 and 2. In Rostov Nuclear Power Plant, VVER-1000 units 3 and 4 are in operation. At Akkuyu in Türkiye, units 1, 2, 3 and 4 are under construction. In China, four VVER-1000 units are in operation at Tianwan Nuclear Power Plant, VVER-1200 unit 7 is under construction and the First Concrete date for VVER-1200 unit 8 is the 25 February 2022. Two more VVER-1200 at Xudapu Nuclear Power Plant are under construction and their first concrete date is the 19 May 2022. In Hungary, a VVER-1200 unit 5 is under construction at Paks Nuclear Power Plant, while Construction License Application is under review for unit 6.

#### Accomplishments and plan of work

The VVERWG currently includes four technical expert subgroups that are addressing specific technical issues: severe accidents (SA TESG), Fukushima Daiichi 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 frameworks related to new designs.

In 2021-2023 the VVERWG published one Common Position after obtaining approval from the STC:

- CP-VVERWG-03: Reactor pressure vessel and primary component's reliability for AES-2006 designs.

And two technical reports approved by the MB:

- TR on Preliminary Analyses & Comparison of Design differences between VVER-1000 Reactors.
- TR on Regulatory Requirements and Practices for Uncertainty Evaluations of Deterministic Safety Analysis.

The T&A TESG has identified topics for the further development of technical reports, such as environmental qualification, while the SA TESG started to develop a Technical Report on long-term heat removal from the containment. Both groups are currently considering combining their efforts and on 26 April 2023 the two had their first joint meeting.

The Fukushima Daiichi TESG is developing a draft Common Position addressing the Vienna Declaration on Nuclear Safety.

The RPV&PC TESG is developing a technical report on additional technical issues related to reactor pressure vessel and primary component reliability for AES-2006 designs, focusing on such topics as: evaluation of surveillance programmes for justification of RPV integrity; qualification of a FOAK component; qualification of non-destructive testing (NDT); and welding personnel and special processes.

Regarding the Technical Report on Preliminary Analyses and Comparison of Design Differences between VVER-1200 Reactors, the group is considering the best approach to follow considering differences in referential designs within the group and with other MDEP countries. Such differences will be one of the

topics of the next Industry Workshop. The group will also continue to document lessons learnt from design reviews and design issues faced during construction and commissioning and early phases of operation.

Finally, a second VVERWG workshop with industry was held on 27-29 October 2021, via teleconference, during which the following topics were discussed: usage of PSA in nuclear power plant design, supply chains and validation/verification of FOAK equipment. As a follow-up, there are two topics under consideration within the working group as potential new activities: supply chains and risk informed regulatory activities. The next workshop will be held in 2024 to discuss issues related to VVER-1200 design differences, results of the FOAK tests performed by then and long-term heat removal design solutions.

**Figure 5.1: MDEP participants visiting Akkuyu NPP construction site**



## 5.2 HPR1000 Working Group (HPR1000WG)

The MDEP HPR1000 Working Group (HPR1000WG) was approved by the MDEP Policy Group in September 2017. The group is focused on safety design reviews of Hualong Nuclear Power Technology Co., Ltd. HPR1000 design. The HPR1000WG includes the regulatory authorities of Argentina (ARN), China (NNSA) and South Africa (NNR). The United Kingdom (ONR) left the Working Group towards the end of 2022.

On 30 January 2021, the first HPR1000, Fuqing unit 5 in China, reached commercial operation. Two HPR1000 units are currently operational – Fuqing units 5 and 6; twelve more are under construction; and sixteen are under preparation. Two units have been approved for construction: Lufeng 5 and 6. On 13 May 2021, NNSA completed the site review for Lufeng units 5 and 6, which will build two more HPR1000 units in Guangdong, China.

In the United Kingdom, the Generic Design Assessment (GDA) of the UK HPR1000 officially commenced in January 2017 and was finished at the end of 2022.

In Argentina, the decision to build an HPR1000 has been declared in the Secretary of Energy's planning by the current government of Argentina. The ARN has developed a Memorandum of Understanding (MoU) where a set of "high-level" requirements complementing Argentina's standards were defined as mandatory for the HPR1000 project. The MoU has been submitted to the Licensee, Nucleoeléctrica Argentina S. A. (NA-SA). The EPC contract was signed on 1 February 2022.

South Africa has not yet decided on a design for its new build programme.

### **Accomplishments and plan of work**

During this reporting period, the HPR1000WG members have continued to share information and experience on regulatory issues and the status of HPR1000 projects in their respective countries. The working group has discussed the ONR Regulatory Observations (ROs) and the associated resolution plans as well as other important technical matters identified in the GDA for the UK HPR1000. As China progressed in the construction phase, the working group has discussed the NNSA safety reviews on design changes and construction events of the HPR1000 units in China.

In 2021-2023 the HPR1000WG published two Common Positions and one technical report after obtaining approval from the MB:

- a common position (CP) of the IRWST Strainer Performance and Downstream Effects of HPR1000 after LOCA;
- a CP addressing In-Vessel Retention strategy for HPR1000;
- a technical report (TR) on Internal and External Hazards.

The group has also finalised a Common Position on the Vienna Declaration on Nuclear Safety. Currently the group is reviewing the interests of the members and plans to investigate potential new activities for supply chains and for the PSA application. It also plans to organise its first workshop with industry in 2024.

### **5.3 Vendor Inspection Co-operation Working Group (VICWG)**

In 2020, the MDEP Policy Group decided to transfer the VICWG to the CNRA. To facilitate a smooth transition, the VICWG has managed the transfer to maintain the existing core functionality while identifying opportunities to target further risk reduction of supply chain management and vendor activity, reviewed the Programme Plan and Governance given the potential increased membership and wider mandate, and learnt from the transfer of the other MDEP ISWGs including the on-boarding new members.

The VICWG activities closed under the MDEP's former framework at the end of 2021. The VICWG participated in 2022 in a workshop led by the CNRA Working Group on Inspection Practices (WGIP) that considered the COVID-19 impacts on inspection practices. The CNRA agreed with the VICWG activity's transition to the CNRA as an interim step during 2022. During 2022, the VICWG worked with the CNRA under the NEA auspices on the process of the transition, and the official transition is expected in the year 2023. For one year, the VICWG became an autonomous sub-group of the CNRA WGIP. In 2023, the activities addressed by the VICWG were transferred to the WGSUP in the new CNRA framework.

### **5.3 EPR Working Group (EPRWG)**

Regarding the Policy Group's (PG) action item 14-02, the EPRWG members have discussed options for continued co-operation under the CNRA framework and explored joining the CNRA as a sub-group under the Working Group on Operating Experience (WGOE). This proposal was presented to the CNRA in December 2021. In 2023, the group will be exploring joining the CNRA as an Exchange Forum.

### **5.4 AP1000 Working Group (AP1000WG)**

AP1000WG's activities have been closed, and the group has provided its closure report. The closure report was approved for publication.

### **5.5 APR1400 Working Group (APR1400WG)**

The APR1400WG's activities have been closed and both groups provided their final reports. The final report was approved for publication.

## 5.6 Fifth MDEP Conference: “International Cooperation: Past, Present and Future”

On 24-25 April 2023, the NEA held the 5<sup>th</sup> MDEP conference on New Reactor Design Activities with the support of the NDK (Turkish Regulatory Authority) in Antalya, Türkiye, gathering participants from 18 different countries, the International Atomic Energy Agency and the World Nuclear Association. The event provided an opportunity to discuss the key achievements and lessons learnt from the MDEP programme, as well as the current challenges and regulatory expectations within international efforts to understand and harmonise regulatory practices in a long-term perspective with other high-level participants. The Conference also provided an opportunity for participants to tour the Akkuyu Nuclear Power Plant.

Among the topics covered during the 5<sup>th</sup> MDEP Conference, the speakers and participants discussed: MDEP’s key achievements and lessons learnt; international co-operation frameworks for new designs; global supply chain management; considerations for expanding international co-operation; and challenges for new technologies. The conference was able to achieve its objectives: several areas for future co-operation were clearly identified, important feedback from MDEP member countries was provided, new nuclear design, construction and test results were presented in relation with several technical reports produced within MDEP working groups, and proposals for future actions were clearly set up.

Some of the future MDEP activities agreed on during the conference were: the launch of the activities in order to establish an MDEP Safety Assessment School, with early discussions taking place with Khalifa University; a potential workshop with industry aimed at SMR designs under construction or licensing as well as the possible creation of a working group focusing on SMR technology; the need to consider other nuclear technologies and the promotion of MDEP activities aimed particularly at non-NEA countries for the purpose of opening membership to the Programme.

Figure 5.2: Participants of the 5<sup>th</sup> MDEP Conference





## 6. Interim results

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

- The publication by the VVERWG of a Common Position on Reactor pressure vessel and primary component's reliability for AES-2006 designs (CP-VVERWG-03), in October 2021; and two technical reports on Preliminary Analyses and Comparison of Design differences between VVER-1000 Reactors; and on Regulatory Requirements and Practices for Uncertainty Evaluations of Deterministic Safety Analysis.
- The completion, by the HPR1000WG, of a Common Position on the Vienna Declaration on Nuclear Safety and the approval of three documents: a Common Position (CP) of the IRWST Strainer Performance and Downstream Effects of HPR1000 after LOCA; a Common Position addressing In-Vessel Retention strategy for HPR1000; and a technical report (TR) on Internal and External Hazards.



## 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 two more five-year periods in 2012 and 2017 by the Policy Group based on the value gained by the members. At its September 2019 meeting, the Policy Group decided to transform the organisational structure of MDEP in its current form by 2022, as the EPRWG, AP1000WG and APR1400WG were expected to complete all planned activities specified in the programme plan by 2022. The active MDEP designs (VVER and HPR1000) continued their work under the governance of the Management Board, while the Policy Group approved the closure of the EPRWG, AP1000WG and APR1400WG in December 2021. The Policy Group also decided to transfer the VICWG to the CNRA by the end of 2021.

The regulatory authorities that are members of the VVER and HPR1000 Design Specific Working Groups, as existing members, are upholding the successful and mutually beneficial collaboration under a new streamlined MDEP framework for international co-operation for new designs, governed and implemented by an MDEP Management Board (MB) with the Nuclear Energy Agency (NEA) serving as the Technical Secretariat.

The 5<sup>th</sup> MDEP Conference, which was held on 24-25 April 2023 in Antalya, Türkiye, provided an opportunity to review the MDEP lessons learnt and successes achieved over the last 17 years and to assess the challenges that potential co-operation areas present. Valuable feedback was received from the conference participants (current and former MDEP members as well as those who are not involved in the Programme's activities). Among the key recommendations, the following points were highlighted:

- Facilitating the early integration of the regulators' feedback into the design.
- Upholding MDEP as an efficient and flexible platform for new designs and new reactor technologies.
- Promoting MDEP products as an efficient tool to support national regulators and improving their regulatory activities, as shown by the case of FANR (UAE).
- Recognising regulatory differences through MDEP products to develop regulatory agility.
- Facilitating the licensing review process by encouraging industry to support regulators during review of a certain design.
- Facilitating MDEP co-operation with suppliers.
- Establishing a clear understanding of what harmonisation means.
- Undertaking the involvement and contribution to the NHSI IAEA Initiative (regulatory track) implementation.
- Promoting further MDEP – WNA/CORDEL interaction.
- Considering the establishment of new MDEP SMR issue(s) specific working group(s), broadening the membership by inviting the countries interested in SMRs.

These recommendations were thoroughly discussed at the 4<sup>th</sup> Management Board meeting on 26 April 2023, and some of them have already resulted in concrete initiatives. In particular, the two design-specific working groups are considering new areas for research, such as Risk Informed Regulatory Activities and Supply Chain Issues related to each design; the two areas of research will require enhancement of co-operation with the designers and suppliers. For this reason, both groups plan to organise two independent design-focused workshops with industry. The Management Board also decided to start working on the position paper on harmonisation, which will attempt to provide a common understanding of MDEP views around this notion. The MB also discussed potential new activity on light-water SMRs, with a need to focus on the specific technical areas for the matured SMR designs. For this reason, a workshop

with industry aimed at SMR designs under construction or licensing is currently being considered. The creation of a working group focusing on HTGR technology is also under consideration. As part of the promotion of MDEP activities and of the potential benefits for non-MDEP countries, a proposal to launch an MDEP Safety Assessment School was supported, with early discussions taking place with Khalifa University, which might provide support for such a platform. The other recommendations are also taken into consideration.

## Appendix 1. List of abbreviations and acronyms

CNRA	Committee on Nuclear Regulatory Activities (NEA)
CORDEL	Co-Operation in Reactor Design Evaluation and Licensing
CP	Common Position
DSWG	Design Specific Working Group
EPRWG	EPR Working Group
FANR	Federal Authority for Nuclear Regulation (United Arab Emirates)
FOAK	First-of-a-kind
FPOT	First plant only tests
GDA	Generic design assessment
GSAR	Group on the Safety of Advanced Reactors
I&C	Instrumentation and controls
IAEA	International Atomic Energy Agency
ISWG	Issue Specific Working Group
LOCA	Loss-of-coolant accident
MDEP	Multinational Design Evaluation Programme
NDK	Nuclear Regulatory Authority (Türkiye)
NEA	Nuclear Energy Agency
NNSA	National Nuclear Safety Administration (China)
ONR	Office for Nuclear Regulation (United Kingdom)
PC	Primary Circuit components
PG	Policy Group
PSA	Probabilistic safety assessment
RPV	Reactor pressure vessel
SDO	Standard development organisation
SMR	Small modular reactor
STC	Steering Technical Committee
STUK	Säteilyturvakeskus (Radiation and Nuclear Safety Authority of Finland)
TESG	Technical Experts Subgroup
TR	Technical Report
UAE	United Arab Emirates
VICWG	Vendor Inspection Co-operation Working Group
VVER	Water-water energetic reactor (Russian design)
VVERWG	VVER Working Group
WGIP	Working Group on Inspection Practices (NEA/CNRA)
WNA	World Nuclear Association

## Appendix 2. Revised or new documents and publications

### Working group programme plans

- CP-EPRWG-01 Common Positions on the EPR Instrumentation and Controls Design, May 2020, [www.oecd-nea.org/mdep/documents/CPEPRWG01\\_I&C\\_2020.pdf](http://www.oecd-nea.org/mdep/documents/CPEPRWG01_I&C_2020.pdf).
- TR-EPRWG-06 Technical Report on Hydrogen Management for EPR, May 2020, [www.oecd-nea.org/mdep/documents/EPRWG06\\_TechnicalReport\\_Hydrogen\\_Management.pdf](http://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, May 2020, [www.oecd-nea.org/mdep/documents/EPRWG07\\_TechnicalReport\\_2A%20LOCA\\_public.pdf](http://www.oecd-nea.org/mdep/documents/EPRWG07_TechnicalReport_2A%20LOCA_public.pdf).
- TR-AP1000WG-03 Technical Report on AP1000 Technical Exchanges during the Design, Construction, and Commissioning of AP1000 Reactors, November 2019.
- TR-AP1000WG-04 Common Understanding of the Hydrogen Control System for the AP1000 Design, September 2020, [www.oecd-nea.org/mdep/documents/Technical\\_Report\\_AP1000\\_Hydrogen\\_Control\\_System\\_Approved\\_Sept2020\\_FINAL.pdf](http://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, May 2021, [www.oecd-nea.org/mdep/documents/AP1000\\_TR\\_LessonsLearnt\\_ImplementationCP\\_FPOT\\_final.pdf](http://www.oecd-nea.org/mdep/documents/AP1000_TR_LessonsLearnt_ImplementationCP_FPOT_final.pdf).
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- CP-APR1400WG-04 Common Position on Irradiation Effect on the APR1400 Fuel Bundle Spacer Grid Strength, October 2019, [www.oecd-nea.org/mdep/common-positions/cp\\_apr1400wg\\_01\\_fuel%20seismic.pdf](http://www.oecd-nea.org/mdep/common-positions/cp_apr1400wg_01_fuel%20seismic.pdf).
- TR-APR1400WG-04 Technical Report on Hydrogen Re-combiner Survey Results for APR1400WG design, March 2021, [www.oecd-nea.org/mdep/documents/TR-APR1400WG-04\\_hydrogenrecombiner\\_surveyreport\\_final.pdf](http://www.oecd-nea.org/mdep/documents/TR-APR1400WG-04_hydrogenrecombiner_surveyreport_final.pdf).
- TR-APR1400WG-05 Technical Report on Regulatory Requirements for Probabilistic Risk Assessment (PRA) APR1400 nuclear power plants, April 2021, [www.oecd-nea.org/mdep/documents/TR-APR1400WG-05\\_ComparisonRegulatoryRequirements\\_PRA\\_NPP\\_Final.pdf](http://www.oecd-nea.org/mdep/documents/TR-APR1400WG-05_ComparisonRegulatoryRequirements_PRA_NPP_Final.pdf).
- CP-VVERWG-02 Common Position Addressing Ex-Vessel Corium Stabilisation in Core Catcher, June 2021, [www.oecd-nea.org/mdep/documents/CP-VVERWG-02\\_CoriumStabilization\\_CoreCatcher\\_final](http://www.oecd-nea.org/mdep/documents/CP-VVERWG-02_CoriumStabilization_CoreCatcher_final).
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- TR-VVERWG-04 Technical Report on Core Catcher, June 2021, [www.oecd-nea.org/mdep/documents/tr-vverwg-04\\_CoreCatcher\\_Final.pdf](http://www.oecd-nea.org/mdep/documents/tr-vverwg-04_CoreCatcher_Final.pdf).
- TR-VVERWG-05 Technical Report on Hydrogen Recombiners, June 2021, [www.oecd-nea.org/mdep/documents/TR-VVERWG-05\\_HydrogenRecombiners\\_final](http://www.oecd-nea.org/mdep/documents/TR-VVERWG-05_HydrogenRecombiners_final).
- CP-HPR1000WG-01 Common Position Addressing Fukushima Daiichi NPP Accident-Related Issues, November 2020, [www.oecd-nea.org/mdep/documents/CP-HPR1000WG-01\\_CP\\_AddressingFukushimaDaiichiNPPAccident-RelatedIssues.pdf](http://www.oecd-nea.org/mdep/documents/CP-HPR1000WG-01_CP_AddressingFukushimaDaiichiNPPAccident-RelatedIssues.pdf).

- TR-HPR1000WG-01 Hydrogen Control During Severe Accidents, September 2020, [www.oecd-nea.org/mdep/documents/TR-HPR1000WG-01%20Hydrogen%20Control%20During%20Severe%20Accidents\\_clean%20copy\\_FINAL.pdf](http://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, December 2020, [www.oecd-nea.org/mdep/documents/TR-HPR1000WG-02\\_TR\\_RegulatoryRequirements\\_Practices\\_Severe%20Accidents.pdf](http://www.oecd-nea.org/mdep/documents/TR-HPR1000WG-02_TR_RegulatoryRequirements_Practices_Severe%20Accidents.pdf).
- CP-VICWG-02 Common Position on Witnessed, Joint and Multinational Vendor Inspection Protocol, November 2020, [www.oecd-nea.org/mdep/documents/CP-VICWG-02\\_RevApproved\\_28Jan2021\\_final.pdf](http://www.oecd-nea.org/mdep/documents/CP-VICWG-02_RevApproved_28Jan2021_final.pdf).
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- NEA/CNRA/R(2019)3 Proceedings of the 2018 Committee on Nuclear Regulatory Activities/MDEP Workshop on Nuclear Supply Chain Management, November 2019.

## MULTINATIONAL DESIGN EVALUATION PROGRAMME

The Multinational Design Evaluation Programme (MDEP) was established in 2006 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, 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.

## MULTINATIONAL DESIGN EVALUATION PROGRAMME

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.



[www.oecd-nea.org/mdep](http://www.oecd-nea.org/mdep)