EUROPEAN
COMMISSION

Brussels, 21.4.2022
COM(2022) 173 final

REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

on the progress made with the implementation of Directive 2009/71/Euratom establishing a Community framework for the safety of nuclear installations amended by Directive 2014/87/Euratom

{SWD(2022) 107 final}

I. INTRODUCTION

Council Directive 2009/71/Euratom establishing a Community framework for the safety of nuclear installations[1] was a major step towards achieving a legally binding nuclear safety framework within the European Union.

In the aftermath of the 2011 Fukushima nuclear accident, *Council Directive 2014/87/Euratom amending Council Directive 2009/71/Euratom*[2] (the 2009 Directive, as amended in 2014, is hereinafter referred to as 'Directive') strengthened the EU nuclear safety legal framework in response to a mandate given by the European Council[3]. It consolidated existing provisions and introduced new requirements, focusing on **regulatory independence** and an EU-wide high-level **nuclear safety objective** aiming at:

- Strengthening the **powers and independence of the competent regulatory authorities**[4], for instance through provisions on adequate human and financial resources or prevention and resolution of conflicts of interest.
- **Preventing accidents** and, should accidents occur, mitigating their consequences and **avoiding early and large radioactive releases**.

In addition, the amendments also cover:

- Increasing **transparency** by providing public information from regulatory authorities and licence holders[5] on normal operating conditions, on incidents and accidents, and enhancing cooperation between regulators.
- Providing opportunities for **public participation** in the decision-making related to the licensing of nuclear installations.
- Implementing the nuclear safety objective through **defence-in-depth** and measures to promote and enhance an effective **nuclear safety culture**.
- Performing an **initial installation-specific assessment**, supplemented by **Periodic Safety Reviews** (PSRs), at least every ten years.
- Enacting specific requirements for **accident management** and **on-site emergency preparedness and response** (EP&R).
- Setting up a European system of **Topical Peer Reviews** (TPR) carried out at least every six years.

The Directive required Member States to submit to the Commission the second and final round of national reports by 22 July 2020; all Member States complied with this obligation by

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1 OJ L 172, 2.7.2009, p. 18–22. The Nuclear Safety Directive was adopted under Chapter 3 "Health and Safety" of the Euratom Treaty, aiming to contribute to the protection of the health of workers and the general public against the dangers arising from ionising radiations.

2 Council Directive of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations, OJ L 219, 25.7.2014, p. 42–52.

3 European Council Conclusions (24/25 March 2011), EUCO 10 1/11.

4 Referred to in the report as 'regulatory authorities' or 'regulators'.

5 Referred to in the report as 'licensees'.

the end of 2020[6]. This second progress report to the Council and European Parliament is adopted by the Commission pursuant to Article 9(2) of the Directive.

This second progress report[7], more than ten years after the Fukushima nuclear accident, acknowledges the advances made by the Member States with the implementation of the Directive. At the same time, it identifies areas where the step change in the regulatory framework and practice, envisaged by the Directive, has not yet been fully accomplished. Further improvements in these areas are desirable and in this respect the current report presents a number of observations addressed to Member States (sections II and III on nuclear safety governance and safety of nuclear installations, respectively), resulting from the good practices and challenges identified in the evaluation and corresponding to the Directive's thematic areas[8], with due consideration of national specificities[9]. Taking account of these observations, the report makes specific key recommendations (section IV on conclusions and way forward) where there is scope for future action at EU level to continuously improve nuclear safety in the EU.

The report relies primarily on the Commission services' assessment of the 2020 national reports. However, to ensure a broad picture of nuclear safety in the EU, the report also takes into account additional sources, particularly the national measures taken by the Member States to transpose the Directive; the outcomes of the comprehensive risk and safety assessments ('EU Stress Tests') of nuclear power plants (NPPs) in the EU[10] and of the first TPR[11]; the findings of international peer-reviews; issues raised by EU citizens and other EU institutions through complaints, petitions and questions; findings of commissioned studies.

A Staff Working Document accompanies and supports the report. It specifies in more details the thematic assessments of the national approaches carried out (and synthesised in the Report) and gives an overview of the types of nuclear installations, as reported by Member States.

II. NUCLEAR SAFETY GOVERNANCE (Articles 4, 5, 7 and 8 of the Directive)

2.1. LEGISLATIVE, REGULATORY AND ORGANISATIONAL FRAMEWORK (Article 4)

All Member States have in place **national frameworks** to carry out the activities covered by the Directive, whose scope and level of detail vary significantly depending on the national nuclear profiles.

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6 https://ec.europa.eu/energy/topics/nuclear-energy/nuclear-safety_en

7 The first Commission progress report on the implementation of the 2009 Directive was issued in 2015 (COM/2015/0573 final).

8 The numbering of the articles from the consolidated version of the Nuclear Safety Directive (2009 Directive as modified in 2014) is used throughout the report.

9 Concerning Member States without nuclear installations, considering that the obligations of transposition and implementation of Articles 6, 8a, 8b, 8c and 8d of the Directive do not apply to them, the information on the above articles, if voluntarily included in their reports, was not reflected in the overall evaluation.

10 http://www.ensreg.eu/EU-Stress-Tests

11 https://www.ensreg.eu/eu-topical-peer-reviews

A review of the **allocation of responsibilities** reveals that while a single regulatory authority concentrates the nuclear safety competencies in the majority of Member States, in some others core regulatory competences (rule-making, licensing, assessment, inspection and enforcement) are shared by more than one entity. Moreover, the regulators work in **coordination** with ministries and other authorities, as well as cooperate with regional or local authorities. However, the clear allocation of nuclear safety responsibilities between the different national bodies is not entirely evident in some national reports.

The Member States have **national nuclear safety requirements**, either self-standing or linked to radiation protection provisions. In most cases, these requirements are incorporated in legally binding acts, while subsequent non-legally binding instruments (e.g. recommendations, guidelines) usually play a role in providing additional detail and implementation guidance. Generally, these requirements address all lifecycle stages of the nuclear installations as required by the Directive.

All Member States have **licensing systems** in place, and the operation of nuclear installations without a licence is prohibited. The licensing processes vary between countries, with the main differences concerning the role of the regulatory authority, the types of documents required for the application and the lifecycle stages covered by the licence(s). Procedures for licence modifications and renewals are also described.

The Member States have systems of **regulatory control**, performed by the regulatory authorities on a continuous basis, supported by procedures, strategies, plans, and follow-up arrangements. This monitoring is supported by **enforcement** mechanisms addressing identified breaches. In addition to regulators, other law enforcement bodies may be involved. As regards sanctions, most Member States follow a graded approach, ranging from issuing a warning to the suspension or revocation of the licence or even fines or criminal sanctions, depending on the severity of the breach.

Observations

- *Where several authorities are involved in the implementation and enforcement of the Directive's requirements, a clear, streamlined and well-documented allocation of responsibilities would enhance clarity on how the tasks are divided to avoid any omissions or undue duplications.*
- *Strengthened collaboration amongst regulatory authorities on licensing practices, while not explicitly required by the Directive, could bring benefits to all by identifying potential commonalities to promote consistency and best use of resources.*

2.2. COMPETENT REGULATORY AUTHORITY (Article 5)

A strong regulatory authority with effective independence from undue influence in the regulatory decision-making is a fundamental requirement for achieving a high level of nuclear safety. The Directive requires that regulatory independence is ensured through functional separation, absence of external instructions, robust and transparent decisions, appropriate financial and human resources, and avoidance of conflicts of interest.

The **legal status and structure** of the regulatory authorities differ among Member States, with three main organisational schemes being identified, namely regulators as independent authorities with legal personality and reporting channels to the Government/President/Prime Minister; regulators as independent authorities supervised by a Ministry not concerned with the promotion or utilisation of nuclear energy; and regulators as integral parts of a Ministry

not concerned with the promotion or utilisation of nuclear energy, having a precise mandate and distinct responsibilities. It follows from the above that those Member States that opted for the first scheme saw the benefits not only of **functional separation**, but also of legal separation from any other government structure.

The **absence of instructions** either results from express prohibitions in this sense or, implicitly, from the overall regulatory architecture.

The **regulatory decisions** are based on nuclear safety provisions that incorporate international and European requirements, as well as lessons from operating experience. Transparency is ensured through a wide array of communication tools, such as websites; annual activity reports; publications of safety-related documents, such as regulatory decisions and inspection reports; social media; press releases; meetings with stakeholders, including local authorities, and public consultations.

On the regulators' **financial resources**, two main financing models are identified, either relying on state budget or on a combination of budgetary funds and recovery of incurred costs from operators. The involvement of the regulators occurs, mainly, during the phase of planning of needs and in the autonomous implementation of the allotted funds. The majority of the Member States rely on the general national budgetary procedures. Possibilities of requesting additional resources or flexibility clauses are sometimes specified. Transparency on the budget's expenditure, through publication of annual reports or audit conclusions, is reported in some cases. However, only a few Member States lay down specific provisions requiring that the allocated financial resources are appropriate to fulfil the regulatory duties. Further follow-up on this issue is therefore needed to ensure effective implementation of the Directive's provisions.

With regard to the regulators' **human resources**, regulators generally play a key role in evaluating their own needs and, if necessary, requesting additional resources. Concerning staff qualifications, several common trends could be identified, such as education and expertise conditions upon recruitment, initial training for newcomers, and continuous training through a combination of in-house and external sources. Commonly, outside expertise is used to support regulatory decisions. Several Member States highlight difficulties in attracting and maintaining sufficient and/or qualified staff. Similarly to the financial resources, the requirements that regulators should have a sufficient number of staff, adequately qualified and trained, could be better specified in some Member States and their implementation therefore warrants further follow up. Promoting an increased attractiveness of the employment conditions at the regulatory authorities could improve the situation in recruiting and maintaining staff with adequate qualifications and expertise.

The Member States have, in general, rules on the prevention and resolution of **conflicts of interest** included in the general framework measures for all civil servants. Although many Member States adopted more specific requirements applicable to the regulatory authorities, the legal force and level of detail of these requirements varies. In particular, the situations of the rotation of staff with executive responsibility between the nuclear industry and the regulators, and the use of external expertise are often not specifically addressed by the dedicated rules.

The dissemination of nuclear safety-related **information** by the regulatory authorities without clearance from other bodies is either explicitly spelled out in the national legislation or it can be inferred from the institutional setup.

Concerning their main **regulatory tasks**, the regulators are involved, to a different extent, in the formulation of national nuclear safety requirements, depending on the architecture of the national legal system. The regulators are responsible for overseeing the implementation of these requirements on the ground by exercising their powers to perform regulatory assessments and take enforcement actions.

Observations

- *Regulatory authorities as self-standing legal entities, legally separated from any other public or private bodies, where not yet the case, would represent a further step in strengthening regulatory independence.*
- *Specific legal provisions requiring that adequate and dedicated financial and human resources (for the latter, both in terms of numbers and qualifications) are available to regulators, supported by effective mechanisms, criteria and procedures, would enhance their regulatory capacities. Such measures could be further strengthened by flexibility mechanisms allowing the regulators to receive additional resources in cases of supplementary workload or due to unforeseen circumstances, such as responses to nuclear safety events or to non-nuclear emergencies.*
- *Clear legal requirements defining the conditions, procedures and reasons for the appointment, suspension and dismissal of persons with executive responsibility within the regulators would enhance transparency and independence of the regulatory authorities.*

  The appointment of persons with executive responsibility from the regulators, as representatives in the management or supervisory entities of licensees could be reconsidered; if such approaches are maintained, they would benefit from a dedicated set of rules covering conflicts of interest.
- *Specific conflict of interest rules and procedures, tailored to the regulatory authorities, such as addressing the rotation of staff with executive responsibility between the nuclear industry and the regulators (both directions), and the use of external expertise, would help to strengthen the regulators' autonomy and accountability in decision-making.*

2.3. EXPERTISE AND SKILLS IN NUCLEAR SAFETY (Article 7)

The Member States lay down requirements on **education and training** mainly for the regulatory authorities and the licensees (including contractors and subcontractors) through in-house, national and international training programmes; this includes the topic of on-site EP&R. A number of Member States highlight the challenge of the ageing and retirement of the current nuclear workforce and difficulties to recruit new personnel; solutions to address this situation are sought, including public-private partnerships and development of university curricula.

Observation

- *In the context of the ageing workforce in the nuclear area, implementing a long-term systematic human resources planning, driven by an evaluation of the current and future needs of the nuclear programme, supported by activities to retain and attract new talent, as well as education and training partnerships, would contribute to preserving and transferring nuclear safety-related knowledge.*

2.4. TRANSPARENCY (Article 8)

In most cases, Member States enacted specific legal provisions, enabling the regulatory authorities and licensees to disseminate **nuclear safety-related information**, complementary to the general legislation on the right of free access to information.

Both actors use a wide range of methods to disseminate information, both in **normal operation conditions**, and in case of **incidents or accidents**, using national arrangements, complemented by international, regional and bilateral cooperation agreements.

Some regulatory authorities engage in enhanced **regulatory cooperation**, such as cross-border exercises, joint inspections, exchanges of personnel, mutual participation of experts in national emergency planning exercises, common training activities.

All Member States with nuclear installations have procedures in place to **consult the public during the main licensing phases**, particularly for siting, construction and decommissioning. However, these consultations are generally conducted in the context of the EU environmental legislation on Environmental Impact Assessments[12] or international "environmental" treaties, such as the Espoo[13] and Aarhus[14] conventions. This situation may lead to a lack of certainty as to whether all safety-significant aspects are covered. A small number of Member States conduct specific nuclear safety-related public consultations, including in relation to major operational changes or long-term operation (LTO) decisions.

Member States developed various consultation modalities, for instance, announcements in the press inviting replies within clear deadlines, non-technical summaries, public hearings, independent expert panels, dedicated organisations to provide information to the public and reports on how the public's comments were taken into account.

Observations

- *Enhanced cooperation between the regulatory authorities in particular of neighbouring countries, by, inter alia, organising regular joint exercises covering information exchange and operational arrangements, would further contribute to the consistency and coherence of the regulatory measures, including in case of incidents and accidents.*
- *A self-standing public consultation process on the licensing of nuclear installations from the perspective of nuclear safety would strengthen the effectiveness of public participation on nuclear safety matters.*

III. SAFETY OF NUCLEAR INSTALLATIONS (Articles 6, 8a – 8e of the Directive)

3.1. LICENCE HOLDERS (Article 6)

While all Member States with nuclear installations confirm that their national frameworks assign the **prime responsibility for nuclear safety** to the licensee, less detail is provided as

[12] Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment, as amended.

[13] Convention on Environmental Impact Assessment in a Transboundary Context.

[14] Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters.

regards the licensees' responsibility for the activities of **contractors and subcontractors**, whose activities might affect the nuclear safety of a nuclear installation.

The Member States with nuclear installations have various processes in place for licensees to **regularly assess and continuously improve safety**, for example through systematic inspection and maintenance of safety-related equipment, implementation of ten-year PSRs, systematic evaluation of events, operational experience feedback, regulatory review, and compliance monitoring. The application of the defence-in-depth principles is an integral part of the safety demonstration. Implementation of the Western European Nuclear Regulators Association (WENRA) reference levels, outcomes from European peer reviews (EU Stress Tests and TPRs), international peer reviews (e.g. World Association of Nuclear Operators (WANO), Safety Aspects of Long Term Operation (SALTO)) are also mentioned in some of the reports.

Several Member States set out regulatory guides or instructions addressed to the licensees covering associated topics such as verification of plant conditions, ageing management of components, PSRs, probabilistic and deterministic safety assessments, Design Extension Conditions, evaluation of internal and external hazards, as well as risks of core damage and release of radioactive substances. However, methodological differences exist.

Concerning the licensees' **financial and human resources**, the measures adopted by the Member States are diverse and include checks on the financial viability of licensees, before the granting of a licence and on a regular basis; definition of safety-critical functions and the level of education and training required; specific licence conditions for both human and financial resources; requirements on licensees' management systems; review of staff / organisational changes that could affect safety; requirements on contractors. Some Member States indicated that they earmark financial resources to cover all stages of the lifecycle of an installation.

Observations

- *Clear definition of the licensees' responsibility for the activities of the related contractors and subcontractors would provide clarity on the accountability and responsibility for safety and improve implementation on the ground when contracting is involved.*
- *Sharing experience amongst regulatory authorities on the national practices of carrying out safety assessments and developing regulatory guides and instructions based on identified good practices would be beneficial.*
- *Exchanging information and experience between regulatory authorities on their approaches to checking the adequacy of the licensees' financial resources would help increase their assessment capabilities on this topic.*

3.2. NUCLEAR SAFETY OBJECTIVE AND ITS IMPLEMENTATION (Articles 8a and 8b)

In view of the technical progress achieved at international level through the provisions of the International Atomic Energy Agency (IAEA) and WENRA, and responding to the lessons learned from the Fukushima nuclear accident and the EU Stress Tests, the nuclear safety objective requires that nuclear installations are designed, sited, constructed, commissioned, operated and decommissioned to **prevent accidents and, should accidents occur, to mitigate their consequences and avoid early and large radioactive releases**. This objective

fully applies to all new nuclear installations and is to be used as a reference for existing ones, through the timely implementation of reasonably practicable safety improvements[15]. An effective **nuclear safety culture** of both regulators and licensees, together with the application of defence-in-depth, are fundamental in implementing the safety objective, and thus achieving a high level of nuclear safety and its continuous improvement.

In general, the Member States with nuclear installations have adopted the requirements corresponding to the nuclear safety objective at a high level, reflecting the Directive's wording. However, the Member States' implementing approaches differ, with some cases where implementation is supported by more detailed regulations and regulatory guidance that lay down quantitative interpretation of the terms or define regulatory criteria for their demonstration. Some countries – particularly those pursuing the construction of new NPPs – point to their transposition into national regulations of the safety objectives for new NPPs established by WENRA, which explicitly call for the "practical elimination" of accidents with core melt which would lead to early or large releases.

The approaches vary in respect to the interpretation and quantification of accident prevention and the avoidance of early and large releases. While some countries focus on the avoidance of accident sequences that lead to early or large releases, others refer to the avoidance of the consequential radioactive releases. Still others use much earlier versions of the practical elimination concept, which primarily addressed early-large releases. In terms of quantification, some Member States define criteria in terms of the radioactive release limits, whilst others require analysis to show that risk criteria and consequential radiological dose limits are met. From a legal technique perspective, in some cases, the relevant provisions transposing the nuclear safety objective are included in a large number of different instruments, creating a fragmentation impacting the clarity and certainty of how the objective is to be applied nationally.

According to Member States' reports, the **new generation of power reactors** currently being licensed for construction in the EU are designed with a robust set of safety features to prevent severe accidents and to mitigate their effects and thus avoid significant radioactive releases.

Concerning the over 100 **existing power reactors**, the Member States indicate that **reasonably practicable safety improvements** have been identified and implemented, as required by the Directive[16]. Examples of measures include the use of bunkered safety systems, passive hydrogen recombiners, filtered containment venting, and accident management procedures. The use of additional fixed and mobile equipment and procedural measures based on the EU Stress Test findings and resulting from recent PSRs have increased the robustness of installations even further.

Some Member States explain that it is not possible to formulate comprehensive and unambiguous criteria for determining reasonably practicable safety improvements, and that such improvements and their timeliness have to be evaluated on a case by case basis. Only a few Member States have chosen to go further and develop more detailed regulatory

[15] The Directive distinguishes between 'new' installations (understood as those granted a construction licence for the first time after 14 August 2014) and 'existing' installations (understood as those granted a construction licence before 14 August 2014).

[16] In a few cases, Member States report that they took a more stringent approach than required by the Directive, by fully applying the nuclear safety objective even to existing installations.

requirements or guidance, often incorporating quantitative targets or design criteria. Therefore, differences in Member States' approaches to the implementation of safety improvements, and development of more systematic approaches for assessing what is reasonably practicable, could be the topics of further work.

Defence-in-depth measures and the minimisation of impacts of extreme external natural and unintended man-made hazards, are implemented according to the standards and guidance developed by the IAEA and WENRA, with a more advanced concept applying to new reactor designs.

The Member States demonstrate commitment to develop, strengthen and monitor **safety culture**, thus acknowledging the importance of organisational and human factors in nuclear safety. Typically, relevant requirements are detailed in internal procedural documents, supported by practical tools. However, as regards management systems, less detailed rules have been identified concerning regulatory authorities as, in some cases, the information provided refers solely to the licensees. Clear processes are in place for the internal and external safety-significant operating experience and reporting of safety-significant events, complemented by regulatory oversight and follow-up. The safety culture is also underpinned by education and training arrangements.

Progress with the post-Fukushima EU Stress Tests implementation

Some 11 years after the Fukushima accident several Member States have not yet reported the completion of their post-Fukushima National Action Plans. Some of the open actions concern significant safety improvements, e.g. emergency control centre, additional cooling measures, prevention of containment overpressure, emergency power supply, seismic reinforcement, spent fuel storage facility. The concerned Member States reported to the European Nuclear Safety Regulators Group (ENSREG) at the end of 2021 on the progress made to resolve outstanding actions. ENSREG will issue a status report in 2022.

Observations

- *Increasing the mutual understanding amongst regulatory authorities of the methods to demonstrate the avoidance of early and large releases by sharing the different national approaches, in particular by exchanging information on the quantitative and qualitative approaches to demonstrate avoidance of such releases, focusing first on the radiological acceptance criteria, would contribute to the consistent implementation of the nuclear safety objective.*
- *Exchanging experience amongst regulatory authorities on the similarities and differences of the case by case analyses for the application of the nuclear safety objective, focusing on the decision-making for identifying reasonably practicable safety improvements, would strengthen consistency and transparency in the regulatory approaches. These exchanges could take into account the national approaches for implementing safety improvements in response to the EU Stress Tests findings.*
- *Developing and formalising specific management systems of the regulatory authorities, alongside the licensees' systems, would contribute to enhancing the regulators' safety culture.*

3.3. INITIAL ASSESSMENTS AND PERIODIC SAFETY REVIEWS (Article 8c)

As regards the **initial assessment**, most Member States inform on the elements that have to be provided in the safety analyses reports associated with a construction or operation licence application.

On the **PSRs**, all Member States with nuclear installations report that ten-yearly reviews are conducted systematically, taking into account new/revised standards, and technical and scientific developments. Some Member States provide examples of measures taken at NPPs, including reinforcement of defence-in-depth. Although the safety factors laid down in the IAEA standards and the WENRA reference levels are frequently cited, few details are provided on the methodology of the review process, and, in particular, on how the safety objective is used as a reference to identify safety improvements, including in the context of LTO. Few Member States report on measures taken at other installations, such as research reactors.

Observation

- *Exchange of information amongst regulatory authorities on the regulatory practices concerning the scope and methodologies of the ten-year PSRs, and specifically on how the nuclear safety objective is taken into account systematically, would be beneficial for enhancing the effectiveness of national processes and increase consistency between national approaches.*

3.4. ON-SITE EMERGENCY PREPAREDNESS AND RESPONSE (Article 6(e) and 8d)

Member States highlighted that **on-site EP&R procedures**[17] cover all operating modes and accidents. Several measures for emergency situations were put in place in the aftermath of the Fukushima nuclear accident, such as additional capacities to cope with extreme natural events leading in particular to station blackout and/or loss of cooling, protocols organising mutual assistance between units on the same site or rapid reaction teams. However, not all Member States report explicitly on how they address situations affecting simultaneously several units, which was a key lesson from the Fukushima nuclear accident.

The countries also report that the on-site emergency plans as well as their **coordination and consistency with the national off-site EP&R arrangements** are regularly tested and verified by relevant authorities to ensure adequate interfaces, the suitability of the emergency equipment and its redundancy, the competency of the staff, and the effectiveness of the response.

Observation

- *Further developing on-site EP&R procedures and arrangements, taking account of sites with multiple units would respond to one of the lessons learned from the Fukushima nuclear accident.*

3.5. PEER-REVIEWS (Article 8e)

The requirement to invite every ten years an **international peer-review on the national framework and regulatory authority** started from the transposition deadline of the 2009

[17] The Nuclear Safety Directive covers exclusively on-site arrangements, while the Basic Safety Standards Directive (Directive 2013/59/Euratom) addresses both on-site and off-site arrangements. In this respect, this Report covers only on-site aspects and their consistency and continuity with off-site aspects at national level.

Directive i.e. 22 July 2011 and was agreed to be implemented via the IAEA Integrated Regulatory Review Service (IRRS), for which the Commission provides financial support. In the ten-year period to 22 July 2021 all Member States should, as a minimum, have performed an initial IRRS mission. By March 2022, all Member States have hosted an initial IRRS mission, though two Member States postponed their initial IRRS missions from 2020 to 2021 and 2022 respectively, due to the Covid-19 pandemic. Furthermore, almost all Member States – with the exception of three – have organised IRRS follow-up missions, recommended to take place no later than four years after the initial mission. While the peer review reports are systematically published on the IAEA website, their communication to the Commission does not take place consistently. The 28 IRRS missions carried out from 2015-2019 in EU Member States resulted in recommendations, suggestions and good practices on themes, such as coordination and cooperation among authorities, regulatory body staffing and competence, establishment of the regulatory body's management system. Follow-up missions showed good progress in implementing the recommendations and suggestions showing the value of the peer review approach in increasing the overall level of nuclear safety.

Concerning **TPRs**, ENSREG identified ageing management of NPPs and large research reactors as the subject for the first TPR held in 2017-2018. 16 EU Member States as well as Norway, Switzerland and Ukraine took part in the exercise; the public had also opportunities to participate. ENSREG drew up an Action Plan[18] setting out the follow-up required, both at the EU level and by individual Member States. Accordingly, Member States published their TPR National Action Plans by September 2019, and updated them in 2021, progress made being described in the ENSREG summary report in November 2021. The next update of National Action Plans is due at the end of 2023, followed by an ENSREG summary report by May 2024. TPR findings and recommendations addressed licensees' ageing management programmes and more specifically the ageing effects on reactor pressure vessels, electrical cables, concealed pipework and concrete containment structures.

ENSREG has chosen fire-protection at nuclear installations as the topic for the 2nd TPR, due to take place in 2023-2024. The Terms of Reference and Technical Specifications should be adopted in the first half of 2022.

Observations

- *Based on the lessons learned, improving the methodology of the TPR exercise by enhancing the consistency in identifying technical findings, and by formulating challenging recommendations to respond to the peer review observations, would strengthen the effectiveness of the peer-review process.*
- *The participation in the TPR process of Member States without relevant installations is essential, considering that nuclear safety is an EU-wide concern and its impact does not stop at national frontiers.*

IV. CONCLUSIONS AND WAY FORWARD

The Commission concludes that there is, overall, a good level of implementation of the Directive's obligations although there is room for improvement, as described in the previous sections of this report and summarised below.

Tangible progress

[18] HLG_p(2019-39)_163 ENSREG 1st TPR Action Plan

Member States have enhanced their nuclear safety legislative, organisational and regulatory arrangements by strengthening nuclear safety governance, and implementing measures for preventing and mitigating accidents at their nuclear installations. The independence and powers of the regulatory authorities were reinforced. Transparency on nuclear safety matters was improved, as reflected in the Member States' information and cooperation arrangements.

The construction of new reactors in the EU benefits from more robust design features aiming to prevent severe accidents and mitigate their effects, while existing NPPs, which constitute the majority of operating nuclear installations in the EU, are subject to continuous safety improvements as required by the Directive. Nuclear installations are subject nationally to PSRs, with the aim to assess, verify and improve nuclear safety throughout their lifetime.

The first TPR, focusing on ageing management of reactors demonstrated the benefits of cooperation to share knowledge and exchange good practices. There was also a commitment shown by the Member States to invite international peer-reviews of their national frameworks.

To respond to the lessons learned from the Fukushima nuclear accident and from the EU Stress Tests exercise, Member States have generally implemented significant safety improvements. However, some 10 years after the Fukushima accident, the implementation of some safety improvements has not yet been completed in some Member States; these outstanding improvements should therefore be implemented as a matter of priority.

Challenges ahead

Whilst the Directive resulted in nuclear safety enhancements in the Member States, there is still room to improve its implementation in a number of key areas, in line with the observations presented in sections II and III of the report.

In particular, the high-level nature of the provisions of the Directive leaves room for interpretation, leading to differing regulatory approaches in identifying the necessary safety improvements. Nuclear safety in the EU would benefit from a more coherent application of the nuclear safety objective based on a more systematic approach for assessing what is reasonably practicable. Consistency between national approaches and effectiveness of national processes could be enhanced through a more coherent implementation of safety assessments and in particular the PSRs, including in the context of LTO.

There is also scope for further enhancing the effective independence of the competent regulatory authority from undue influence in its regulatory decision-making by improving the effectiveness of national arrangements currently in place in a number of areas, such as functional separation, financial and human resources, and conflicts of interest. Public participation in the decision-making process related to the relevant lifecycle stages of nuclear installations could be strengthened, as well as the formal introduction of safety culture provisions in the documentation of management systems at some regulatory authorities. Further efforts should also be made to ensure sustainability and development of expertise and skills in nuclear safety.

Recommendations for future action at EU level

To enhance the effectiveness and consistency of the national approaches, some of the observations presented in sections II and III of the report can be supported by a more coordinated and collaborative action at EU level based on a structured exchange of views and experiences.

The following recommendations are therefore made to the Member States to work together towards developing common approaches at EU level:

- **Enhance the independence of the regulatory authorities from undue influence in their regulatory decision-making by elaborating a set of common guiding principles underlying essential features, such as:**
    - **effective separation from any other body or organisation concerned with the promotion or utilisation of nuclear energy;**
    - **dedicated and appropriate budget allocations;**
    - **appropriate number of staff with qualifications, experience and expertise, and preservation of knowledge;**
    - **prevention and resolution of conflicts of interest.**
- **Strengthen the capabilities of licence holders to exercise their prime responsibility for nuclear safety by elaborating a set of common guiding principles underlying essential features, such as:**
    - **preservation of knowledge and attracting qualified staff;**
    - **adequacy of the financial resources;**
    - **management of the activities of contractors and subcontractors.**
- **Promote and enhance an effective nuclear safety culture by exchanging information on national policies and arrangements and developing best practices, in particular on the regulators' own safety culture and management systems.**
- **Strengthen transparency by drawing up guidelines on effective public participation in the decision-making process related to the relevant lifecycle stages of nuclear installations, from a nuclear safety viewpoint.**
- **Support the implementation of the nuclear safety objective by:**
    - **developing a common understanding of the underlying technical basis and its application in practice, including, in particular, implementation approaches for the avoidance of 'early' and 'large' radioactive releases, and determination of reasonably practicable safety improvements for existing installations, which are increasingly being identified for LTOs.**
    - **enhancing coherence in implementing safety assessments, in particular PSRs, by developing guidance on the scope and methodologies of the process; it should also address the systematic use of the nuclear safety objective as a reference.**
- **Improve the effectiveness of the TPR exercise by strengthening consistency in identifying technical findings and drawing more challenging recommendations to respond to the peer review observations.**

The Commission will seek the views of Member States and their regulatory authorities, in the frame of ENSREG, of licensees, as well of other stakeholders, including civil society to define the concrete processes and timetables for initiating the above EU-level actions. As a result of this initial consultation process, the Commission will facilitate the implementation of these recommendations, including through organising workshops, conferences, meetings and studies. The Commission will take into account the views of the European Parliament and the Council in this process.

In view of the areas where further actions have been identified at the national level and at the EU level, Member States are encouraged to further report on progress with the Directive's implementation. This would further improve citizens' understanding of current nuclear safety issues, help in public engagement and participation, and enhance public confidence in the responsibilities and activities of licensees and national safety authorities.

In line with the EU Better Regulation[19] principles, the Commission intends to conduct in due course a standard evaluation of the Directive to assess to what extent it was successful in achieving its goals or whether there is scope for a future reform of the legislative framework to improve its effectiveness, relevance or coherent application, also taking into account the progress with the actions proposed in this report.

[19] See in detail the Commission's "Better Regulation Guidelines": https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox_en