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ON THE CRITERIA FOR "GOOD PRACTICES" OF THE JOINT CONVENTION

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The article provides an analysis of the possibilities for improving the definition of "good practice" used in the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. Based on Russian proposals for the application of the concept of "good practice", it considers some examples of their practical application.

Keywords: *Joint Convention, safety, radioactive waste, spent nuclear fuel, meeting of Contracting Parties, national report, good practice.*

Since 2014, adversarial principle has been actively discussed at the review meetings on the implementation of provisions stated under two international conventions, namely, the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management (hereinafter — the Joint Convention), along with another one on voluntary provision of information under the national reports regarding the fulfillment of relevant obligations — the principle being adopted by the international community [1, 2] and widely used by the contracting parties [3, 4]. Some tentative moves on implementing the former one were made under the definition of "good practice" adopted in May 2014 at the second Extraordinary Meeting of Contracting Parties [5, 6]:

"A Good Practice is a new or revised practice, policy or program that makes a significant contribution to the safety of radioactive waste and spent fuel management. A Good Practice is one that has been tried and proven by at least one Contracting Party but has not been widely implemented by other Contracting Parties; and is applicable to other Contracting Parties with similar programs."

The definition involves several important notions or concepts being considered as criteria the compliance with which allows to attribute relevant facilities or processes proposed by the contracting parties to the examples of "good practice".

The outcomes of the tentative moves made were analyzed showing that the first attempts of applying this definition in the identification of "good practices" did not demonstrate its effectiveness. At the Sixth Review Meeting of the Contracting Parties, following some ambiguous discussions on its objectivity, a consensus was finally reached on the approval of only six "Good Practices" [7].

Promotion of the adversarial principle in the absence of methodological recommendations, somewhat blurred goals and, as a result, blurred setup for its application did not yield any significant practical results, at least for the time being. Ineffective management of the decision-making process on" good practice" selection and the process modifications prompt a more in-depth study of the comparative parameters/criteria/concepts affecting the choice of "good practices" proposed by the contracting parties.

A number of possible ways enabling to adapt the principle to the goals of its practical application are discussed in [8].

To achieve the goals of the study, a decomposition of the basic essential concepts making up the definition of "good practice" is provided below.

The concept of "a significant contribution to the safety". The discussions held at the Review Meeting showed that the definition is deemed by some of the contracting parties in a way suggesting that the word combination "significant contribution to the safety" predetermines the need of choosing a "good practice" considered as the best one of all presented by the contracting parties providing relevant "contribution to the safety". This approach indeed triggered the adversary process inevitably prompting the comparison of the practices presented. However, due to the following reasons the process basically could not yield the results desired: no objective criteria allowing to compare the competitive proposals were available; only some qualitative, almost impromptu appraisals of the discussed "good practices" were provided directly at the Meeting in a limited time by one or another representative of a contracting party; the appraisals were not supported by any solid rationale behind and given the diversity of the "good practices" proposed for consideration were often expressed without deep enough immersion in the problem.

At the same time, to select an example of a "good practice", one can fall back on a method allowing a comparison not between various options proposed by the contracting parties, but with some paired alternative example. For example, open or closed nuclear fuel cycles, radioactive waste storage to reduce waste activity before disposal or "immediate" disposal can be considered as such paired alternative practices.

Most notably not a qualitative expert judgment is suggested as a criterion enabling to select one or another option, but some quantitative criterion, for example, collective dose of personnel and public exposure. This proposal is demonstrated below based on an applicable case study. Another important subjective criterion provides for the selection of *a proven "good practice"*. The latter one similar to the former one, is not clearly defined.

Correct application of a criterion that defines a "good practice" suggesting that it "has been tried and proven by at least one Contracting Party but has not been widely implemented by other Contracting Parties" should imply the availability of an accurate and unambiguous interpretation of the term "proven". However, this is not the case.

This reason has become one of the incentives prompting the use of the term *"significant progress"* by the contracting parties further blurring the concept of a "proven" practice. Apparently, the above term seems to be the only one allowing to indicate the maturity of a "good practice", nevertheless shutting out a maturity-based comparison of a process or facility to be used by other contracting parties as a "good practice". Moreover, completion of facility construction and program implementation could be deemed to occur in such a long run that significant progress could be the only thing to be discussed. For example, decades are required to demonstrate the feasibility RW disposal in geological formations with relevant R&Ds implemented in underground research laboratories. Nevertheless, the predicted (calculated) contribution to safety due to prevented hypothetical doses associated with the establishment of a disposal system can be nevertheless estimated.

The same non-quantitative criterion is the criterion associated with the concept of a "new or revised practice, policy or program". Often, even the novelty of a "good practice" cannot always be unambiguously identified, whereas to specify the degree of revision, very in-depth and careful studies involving more than one specialized expert are required with no guarantees for the unambiguity of the estimate. Accuracy of the criterion could be increased by removing the term "revised" from the definition. The "new practice" term being the only one present in the definition renders the criterion much more specific.

Another criterion is associated with the potential use of the selected examples, the essence of which suggests that "good practice" "is applicable to other Contracting Parties with similar programs". It should be particularly noted that most often the number countries that can use the chosen example of "good practice" is very limited and depends directly on the individuality of the example itself. This is especially true for large-scale "good practices" that can be applied only by countries with a high level of nuclear power development. Apparently, if such a country or several such countries are indicated by the contracting party in a proposal on introducing the applied practice as a "good" one, this would add certain rigidity and clarity to criteria application. For this reason, potentially interested parties will be provided below in the examples of Russian "good practices".

Considered below is the application of the described improvements to the definition and its criteria exemplified by the Russian proposal on a "good practice".

Example. Testing the components of SNF management system implemented under a closed nuclear fuel cycle at the integrated centralized complex of the Federal State Unitary Enterprise MCC, involving "wet" and "dry"-type storage facilities, SNF reprocessing and uranium-plutonium fuel fabrication.

At present time, the integrated centralized complex at FSUE MCC site features wet and dry storage facilities operating under industrial operation mode, a start-up SNF reprocessing complex with a capacity of 5 tons per year operating in the experimental mode with the first batch of fuel assemblies for the fast reactor unit BN-800 being manufactured based on mixed oxide uranium-plutonium fuel (MOX-fuel) and successfully tested for acceptability.

If completed as planned, the integrated complex ensures safe temporary storage of spent nuclear fuel (at least for 50 years); enhanced environmental safety of SNF reprocessing through the use of a technology generating zero liquid radioactive waste and converting radionuclides into a safe form suitable for long-term storage and subsequent disposal; nuclear fuel cycle closure.

Comparison of safety level achieved in case of implementing the good practice example proposed by the Russian Federation and an alternative option.

The integrated centralized complex is designed for ensure optimal implementation of the closed fuel cycle strategy. To date, a number of estimates have been made providing comparative analysis of various nuclear fuel cycle options. Referring to closed and open nuclear fuel cycle types being considered as the subjects of such comparison performed based on relevant studies, it becomes apparent that the closed NFC option seems more advantageous in terms of long-term radiation exposure of population. This is due to a number of reasons with the key ones involving the following aspects: decreasing need in natural uranium used in nuclear fuel fabrication, extraction of certain long-lived radionuclides (uranium and plutonium isotopes) from the spent nuclear fuel and their subsequent use as nuclear fuel components, conditioning of the main long-lived radionuclides into a more stable form of vitrified radioactive waste the properties of which reduce radionuclide release outside the disposal system. All of the above factors result in a decreasing collective effective dose to the population in the long term being applied as the main (or a main) radiological comparison criteria.

Parameters of adverse effects associated with open (ONFC) and closed fuel cycle (CNFC) are evaluated under research activities being focused on a comparative analysis of their implementation. The studies deal with dose loads formed in the long term due to radioactive waste generated during the operations performed at the disposal stage (including long-term impact on the population at the post-closure stage). Collective doses associated with radiation exposure of personnel and public both today and in the future were used as a numerical criterion enabling to compare the negative impacts of the two strategies. Conservative assumptions on the structure of human activities in the repository siting region, including possible water intake locations of future settlements along the radionuclide migration path from the repository, have been specified given that potential public exposure from the repository will manifest itself in a long run only.

Comparison of ONFC and CNFC with respect to the accepted dose criteria shows that the latter one results in lower personnel and public exposure which is explained by actinide engagement in commercial operations being sent for disposal under the ONFC option, as well as a decreasing RW generation during mining.

Testing the "good practice" an example. The "good practice" proposed by Russia is considered as a proven one. Moreover, a number of its components have already been under commercial operation for a long while. The timeline for putting its components into operation is provided below as an evidence confirming that the proposed "good practice" example can be indeed considered as a proven one.

"Wet" and "dry" storage facilities at FSUE MCC site. In 1985, construction of a centralized "wet" storage facility was completed. In 2011–2015, a centralized "dry" storage facility was completed. Since 2012, SNF has been routinely emplace into the "dry" storage facility.

SNF reprocessing at FSUE MCC site. In 2009-2015, design and construction of the first star-up complex of a pilot demonstration center for SNF reprocessing with a capacity of 5 tons per year was completed. 2020 will see the completion a full-scale reprocessing plant with a capacity of 250 tons of SNF per year the designs of which are based on a new generation of environmentally sound reprocessing technologies.

Industrial fabrication of MOX fuel. Capacities for industrial fabrication of MOX fuel has been deployed at FSUE MCC site. In 2018, the first serial batch of fuel assemblies designed for the fast reactor BN-800 based on mixed oxide uranium-plutonium MOX fuel was successfully tested.

New SNF management practice

Integrated Centralized Facility for SNF Management currently being established at MCC site and implementing a novel SNF management approach is considered as a "good" SNF management practice implemented at FSUE MCC, involving centralized "wet" and "dry" storage facilities, SNF reprocessing and uranium-plutonium fuel fabrication capacities.

Only some individual components of the complex being established in Russia are currently available abroad. These are, for example, centralized SNF storage facilities (Sweden, Finland, Germany), SNF reprocessing plants (France, UK, Japan), MOX fuel fabrication capacities for thermal reactors (France, UK). Such component integration into a single complex enabling nuclear fuel cycle closure is not yet available in any other country except for Russia.

Certain attempts were made by the US on pursuing a similar approach, but were ceased last but not least because of potential terrorist threats.

Furthermore, it should be noted that the integrated centralized complex is being developed accounting for two-component power market involving both thermal and fast reactors. Today, only two fast reactor units are under commercial operation in Russia, namely, BN-600 (1980) and BN-800 (2016) at Beloyarsk NPP site. All power-generating fast reactors built abroad have been shut down to date: Superphenix (France, 1985-1997), Monju (Japan, 1994-1995).

Applicability to other Contracting Parties with similar programs

The "good practice" of the Russian Federation on the establishment of an integrated centralized SNF management complex seems to be potentially applicable to France and China.

Thus, the analysis presented above opens up new possibilities and precise the approaches on improving the practical application of the "good practice" concept used under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Reasoning behind these approaches and their interpretation provided in the paper holds out a hope of applying the results presented as a basis triggering the development of recommendations to the Joint Convention focused on further increase in the efficiency and effectiveness of the decision making process on "good practice" selection and contributing to the safety in SNF and RW management.

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