

A Suggestion on New Roles of a Member State in Nuclear Safeguards After Covid-19

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Abstract

The COVID-19 pandemic revealed many uncomfortable facts that the international community had never imagined before in various areas including international nuclear safeguards regime. This led to some sensitive questions about the necessity and effectiveness of international nuclear safeguards regime. In the event of an epidemic such as COVID-19, and/or any situation where global movement is restricted again, the key issue will be how to maintain the reliability of the international watchdog system. In this paper, the roles of the SSAC in nuclear safeguards after the COVID-19 pandemic will be discussed, especially about the activities of the state authority required for attaining safeguards goals, and how to cooperate with the IAEA as well.

I. Introduction

The Covid-19 outbreak in 2019 has brought about greater change than any epidemic, disaster, or war that our human society has ever experienced, and it raises fundamental questions about the survival system we live in today. Covid-19 is having a tremendous impact not only on daily life such as medical care, food, education and culture, but also on national level areas such as finance, national defense, and security, and it is no longer possible to survive in a stable manner in the way we have done before. Fortunately, various vaccines have been developed to provide an opportunity for us to control Covid-19. But even if vaccination is completed and herd immunity is formed worldwide, it is expected that it will be impossible to return to pre-Covid-19. Covid-19 is demanding us to change and adapt in every way, and it seems that the international nuclear material verification system started from the NPT is no exception.

Despite controversy about the IAEA safeguards, it is clear that it has made a significant contribution to preventing the proliferation of nuclear weapons since its inception. However, discriminatory nature of the NPT itself between nuclear and non-nuclear states and the lack of universality in the implementation of safeguards shows that IAEA safeguards also have limitations. The evolution of IAEA safeguards reflects the lessons learned by the IAEA and its member states, which are parties to safeguards, in the course of their implementation. The nuclear development case of North Korea and Iran showed that without trust between the IAEA and its member states, safeguards could not perform their function properly, which led to the emergence of an additional protocol that caused controversy over sovereignty violations. While it is acceptable that additional verification measures are necessary for the functioning of the IAEA safeguards to function as intended, it is also undeniable that such measures may infringe upon the rights of Member States. The IAEA has been continuously evolving to find answers to optimized safeguards, and the recent 'national level approach' can be understood in this

context. At this point, with the outbreak of Covid-19, the IAEA safeguards are demanding a more radical transformation than has been experienced in the existing evolutionary process, which is evaluated as a new challenge that the IAEA and member states must continuously and jointly respond to.

Safety measures are a process to confirm that there is no diversion of nuclear material, and for this purpose, various means such as equipment for nuclear material verification, monitoring equipment, and sealing are used to maintain monitoring continuity. Although the IAEA's independent and exclusive verification of the accuracy of Member State reporting is required, maintaining communication with Member State's nuclear material control regulatory authorities is critical for access to inspected facilities and cooperation from facilities to address issues. do. In situations where movement and contact are restricted due to Covid-19, it can be said that on-site verification, which is essential in IAEA safeguards, will also be greatly affected. In addition to infectious diseases such as Covid-19, circumstances that may limit IAEA inspection activities within Member States, such as natural disasters, civil wars/riots, etc., may emerge beyond our expectations in various forms. Therefore, a new alternative that can draw conclusions about safety measures is needed even when on-site verification is limited. Fortunately, it seems that the answer can be found in the safety measures policy direction that the IAEA has continuously pursued and the 'national level approach'. In this paper, the changing factors of the safety measures environment brought about by Covid-19, diagnosis of its problems, and the roles and measures of the IAEA and member states necessary to solve them will be reviewed.

II. Covid-19 Impacts on International Safeguards

In order to understand the impact of Covid-19 on IAEA safeguards, it is necessary to first understand how IAEA safeguards are implemented, and what impacts on the IAEA, Member State regulators and nuclear facilities in the process.

IAEA safeguards are technical measures applied to nuclear facilities and materials, through which the IAEA can verify that nuclear facilities and nuclear materials are not used for purposes other than their original purpose, such as the development of nuclear explosive devices and are used only for peaceful purposes. The IAEA should exclusively and independently verify if Member States abide by their legal obligations to use nuclear material only for peaceful purposes through on-site verification and information obtained through various channels. The state must accept safeguards measures according to the Comprehensive Safeguards Agreements with the IAEA, and provide any technical assistance for streamlining IAEA safeguards activities including access to nuclear facilities. IAEA Safeguards activities are performed regularly by reflecting the characteristics of each facility, as following four steps.

1) Collection and evaluation of safeguards information in a Member State

The IAEA collects, analyzes and evaluates all available safeguards-related information for a Member State for the purpose of ascertaining that the nuclear power generation and R&D programs in the Member State are consistent with its declaration.

2) Development of safeguards approach according to the environment and characteristics of the Member State

The IAEA sets technical goals to be achieved in consideration of the size of nuclear fuel cycle, facility characteristics and technical capabilities of the Member State, and develops an approach that mobilizes available safeguards measures.

3) Implementation and evaluation of safety measures

The IAEA establishes specific action plans for safeguarding activities, including field verification activities at nuclear facilities in the Member State, and information analysis at IAEA headquarters. The IAEA evaluates the degree of achievement of technical goals for the results of safeguards measures, identify discrepancies, and establish necessary follow-up measures.

4) Drawing conclusions on safeguards implementation

The IAEA draws safeguards conclusions for the Member State based on independent verification and investigation results. In accordance with the conclusion of safeguards for the Member State, it is confirmed whether the Member State is faithfully fulfilling their international obligations under the CSA with the IAEA.

In order for the IAEA to achieve the purpose of safeguards during the process of implementation, various types of contacts with the Member State's regulatory authorities and nuclear facilities are required: face-to-face meetings to discuss outstanding safeguards issues and gather safeguards information in the country, on-site access to confirm design information of nuclear facilities, access to nuclear facilities for nuclear material verification such as PIV and RII, and installation or maintenance of safeguards equipment. In addition, there are many other chances to have close contacts such as education and training course for inspectors using specific facilities in the country, and seminars or workshops to share knowledge and experience acquired during safeguards implementation and discuss hot issues on safeguards implementation.

IAEA safeguards process cannot be completed by the IAEA alone, but is possible through close cooperation with other stakeholders – Member States and nuclear facilities. The cases mentioned so far suggest that the Covid-19 outbreak has forced us to limit active contacts between the IAEA and Member States, which will be a major obstacle to the implementation of IAEA safeguards. IAEA inspectors are no exception to quarantine measures such as self-quarantine when traveling between countries, which may cause disruptions in travel and facility visit plans. This will have a major impact on on-site verification of nuclear facilities, which is an essential activity for IAEA inspections, and there is a risk that the Continuity of Knowledge (COK) on the nuclear facilities may not be maintained.

From a Member State's point of view, the burden which can be caused by assisting the IAEA

inspections, such as various kinds of technical supports for streamlining on-site verification, may be alleviated, but in terms of the overall implementation process of IAEA safeguards, it is more likely to have a negative effect on the Member State as well. According to the State Level Approach of the IAEA, the technical objectives to be achieved are identified through the Acquisition Path Analysis of the nuclear material, these are matters that require on-site activities in many areas, including facility inspections. In some cases, it is possible to achieve technical objectives through other means without on-site activities, but under the circumstance where on-site verification is not performed properly, it is difficult to expect to get unbalanced safeguards conclusions. Therefore, from the point of view of the country, data and information at the level that IAEA inspectors can obtain from on-site verification must be additionally provided, which is highly likely to act as a new burden. In addition, timely access to the site is essential to check whether the resolution of long-term issues has been completed, periodic maintenance/repair of seal or monitoring equipment, malfunction/error repair of safeguards equipment, and COK restoration. If any outstanding safeguards issue persists for a long time without any compromise, this will be a very heavy burden not only on the IAEA, but also on the state regulatory authority and the operator of nuclear facility. From the point of view of the facility, there can be some concern that even any normal tasks which can be frequently happened at the facility may provoke unnecessary suspicions. Those are essential activities to maintain normal operation of the facility such as periodic maintenance, transfer of nuclear fuel, and/or movement of heavy equipment etc. The main problems expected in the situation where on-site verification and personal contacts are limited are as follows.

- i) limitation of opportunities for obtaining information by field verification activities (IAEA)
- ii) Difficulties in timely restoration of COK damage situation (IAEA)
- iii) Provision of additional information necessary to draw safeguards conclusions (SRA, facilities)
- iv) Difficulties in normal operation of the facility with unsolved pending safeguards issue (facility)

If Covid-19 continues for a long time (or in situations where movement and contact are restricted, such as Covid-19), the risks to be taken by safeguards stakeholders like the IAEA and Member States will be growing. So new means and/or changes in IAEA safeguards practices must be made to achieve safeguards objectives. The answer to this may sound paradoxical, but it can be found in the direction of the safeguards policy pursued by the IAEA so far.

III. Development of ROK SSAC – from CSA to SLA

Covid-19 has been an opportunity to reveal various problems in present international community that we have not been aware of, but it also provided an opportunity to shed new light on various areas including the evolution of the IAEA safeguards. The evolution of the IAEA safeguards, which can be summarized as a series from Comprehensive Safeguards Agreement, Additional Protocol, Integrated Safeguards to State Level Approach, is the result of efforts to achieve the purpose of safeguards and to pursue efficiency and effectiveness in the implementation process. It can be said that the SSAC (State

System for accounting for and control of nuclear material) specified in Article 7 of the INFCIRC/153 has also shared all the safeguards knowledge, experience, and even development history with the IAEA. The ROK's national system shows a representative example of model SSAC that the IAEA is aiming for, so it is helpful to review the history of development of ROK SSAC for explore proper roles of a Member State in this pandemic outbreak.

As a foundation member of the IAEA, the Republic of Korea joined the international non-proliferation regime by signing Comprehensive Safeguards Agreements with the IAEA in 1975. As mutual inspections were proposed as a way to resolve the North Korean nuclear issue in 1997, the Nuclear Control Technology Center was established in the the Korea Atomic Energy Research Institute, and the first national inspection on nuclear facilities was conducted, though primitive. After the initial declaration of the Additional Protocol in 2004, the ROK government recognized the necessity of a well-organized state nuclear control system and set out various works for improving its administrative structure and process for nuclear material control. In 2005, ISSAS (International SSAC Advisory Service) mission was successfully completed with several important recommendations. One of them is to make a new independent organization solely intended for nuclear control: safeguards, export control, and physical protection. As a result, an independent nuclear control agency (KINAC) was established in 2006. The establishment of KINAC can be seen as a practical starting point for the Republic of Korea's State Systems of Accounting for and Control of Nuclear Material (SSAC). Until then, jobs related IAEA safeguards were regarded as a small part of safety regulation attracting very little awareness in the regulatory field.

In 2008, as the IAEA included the ROK in the Broader Conclusion (BC) country group, integrated safeguards measures began to be applied, which is a turning point for the ROK's nuclear control system to take a new leap forward. After the Fukushima nuclear accident in Japan in 2011, the Nuclear Safety and Security Commission was established to strengthen the independence of nuclear regulations, and the role and expertise of KINAC as a nuclear non-proliferation and nuclear security technical support organization (TSO) were strengthened. The ROK maintained close cooperation with the IAEA from the starting point of their relationship in safeguards and through this, it has acquired a sufficient level of technical capability necessary for assisting the IAEA safeguards inspections. Going one step further, in 2012, for the first time at the national level, it signed Enhanced Cooperation Arrangements to further strengthen cooperation with the IAEA, and promoted the joint use of inspection equipment and information sharing between two parties. In addition, the State Level Approach with the aim of conducting UI (unannounced inspection) at LWRs was agreed in 2015, and the updated SLA was started to apply for all the nuclear facilities in the ROK from the year of 2016.

The updated SLA allowed the ROK SSAC to enlarge its role and technical capability and seek more efficient ways to allocate its limited resources for safeguards. Also, the role of facilities required for the updated SLA were redefined, which makes them to be prepared for anytime IAEA inspection. Recognizing the need to further strengthen its technical capability so that the ROK SSAC can respond flexibly to IAEA policy changes, the ROK introduced a new national inspection which is independent but totally different from the IAEA's inspection. Through the national inspection, it was expected that the technical capabilities of SSAC would be greatly enhanced and any risk of double regulations would

be avoided. Also, a plan to enhance SSAC's ability of collecting and analyzing safeguards information is underway using information technology. The development history of the ROK's national nuclear control system reflects the evolution history of IAEA safeguards. It presents the very unique example of model SSAC and has shown some good practices in safeguards implementation. The history of the ROK SSAC is summarized as shown in Table 1.

Phase	Milestones	SSAC Capabilities
1 st Phase (Beginning)	<ul style="list-style-type: none"> • 1975 Signing CSA • 1997 Establishing TCNC • 2002 Starting Enhanced Cooperation at LWRs 	<ul style="list-style-type: none"> • Basic Technical Assistance to the IAEA Inspections • Not enough independent inspection capability • NDA device
2 nd Phase (Growth)	<ul style="list-style-type: none"> • 2004 Initial Declaration of AP • 2005 ISSAS mission • 2006 Establishing KINAC 	<ul style="list-style-type: none"> • Establishing Safeguards Reporting System • Interim inspections at LWRs (on behalf of IAEA) • Participation in Verification Technology Development (IAEA MSSP)
3 rd Phase ()	<ul style="list-style-type: none"> • 2008 Starting Integrated Safeguards • 2011 Establishing NSSC • 2012 Singing Enhanced Cooperation Arrangements 	<ul style="list-style-type: none"> • Independent Development of Nuclear Material Verification Devices (PHWR OFPS) • Development of Safeguards Approach for New Nuclear Facilities • Basic Nuclear Material Analysis Capability
4 th Phase (Leading)	<ul style="list-style-type: none"> • 2015 UI rehearsal at LWRs • 2015 Stating National Inspection • 2016 Starting the Updated SLA 	<ul style="list-style-type: none"> • Independent Verification Capabilities • Information System for Nuclear Material Accounting • Establishing Independent NM Analysis System

Table 1. The History of the ROK SSAC Development

The role of the ROK's SSAC has expanded beyond fulfilling the obligations imposed by the CSA to the level of leading the international nonproliferation regime with the UAE's Nuclear Power Project. Now the ROK is disseminating the knowledge and experience acquired during in the process of

establishing its SSAC to the newcomer countries through various kinds of education and training programs.

IV. Suggestions on Expanding the Role of a Member State

In order to achieve the IAEA's safeguards objectives even in the environment where international movement and contact are restricted, such as Covid-19, any kinds of alternative measures should be devised to complement on-site verification activities. Basically, some actual measures to minimize movement and contact are needed, so IAEA inspectors' long term stay at site can be the first one anyone can come up with. And expanded use of unmanned monitoring system will be considered as well. However, fundamental questions may arise as to whether these methods are consistent with the IAEA safeguards policy direction so far, and it is expected to be undesirable in terms of cost. As the IAEA policy direction is changing to focus more on information analysis at headquarters rather than on-site verification along with the expansion of SLA application, the return to the traditional method like human surveillance is highly likely to cause other problems. As an alternative, recognizing the Member State as a partner of the IAEA, it can be considered to expand the role of the Member State which is one of major players in the implementation of safeguards. Of course, it is necessary to assume that the scope of the Member State's activities does not infringe on the IAEA's verification authority and does not affect the IAEA's independent safeguards conclusion process. Regarding PIV, DIV, or any other regular activities like maintenance of inspection equipment, if quarantine principles are strictly sustained there will not be any serious difficulties even under the Covid-19 situation because the schedules of those activities are to be determined so early enough that the facility operators are able to prepare inspectors' visit. However, it is a different story when frequent access is required, such as unannounced inspections at LWRs according to the updated SLA, RII, and urgent repair works for fixing malfunction or damage of safeguards equipment at sites. If the two-week mandatory quarantine upon entry will also applied to IAEA inspectors without exception according to quarantine measures, so it is actually impossible to effectively implement those missions. If an inspector is confirmed to be infected, the problem could be further exacerbated.

While applying the updated SLA from 2016 in the ROK, DIV and Closed Core PIV will not be conducted any more but RII is maintained with no prior notification. And the frequency of the unannounced RII is not to be notified, which implies the importance of unannounced inspections. Table 2. shows the changes of the updated SLA has changed for LWR compared to the Integrated Safeguards.

Facility Type	IAEA Inspection	Integrated Safeguards		updated SLA	
		frequency	notification	frequency	notification
LWR	PIV	1/year	10 days prior	1/year	10 days prior
	CCV	1/year (50%)	10 days prior	no CCV	-

	DIV	PIV (100%) core reloading (random)	10 days prior	n/a*	10 days prior
	RII	1/year (20%)	24 hours prior	n/a*	unannounced

* Annual Implementation Plan (not disclosed to the Member State)

Table 2. Changes in the Updated SLA at LWRs Compared to the IS

Therefore, if unannounced inspections are not carried out, there will be incompleteness in the implementation of safeguards, which inevitably affects the safeguards conclusions. This is an unacceptable situation even from the Member State's point of view, so supplementary measures should be devised for the completion of intended verification activities. Considering the fact that the national inspectors are relatively free to move and have contacts within the country, it may be suggested to delegate part of the verification role to the Member State. Additional discussion on the rights and obligations between the IAEA and the Member State should be preceded. Though some realistic procedures are to be prepared, it can be suggested that several activities be performed by the Member State on behalf of the IAEA as follows.

- i) Interim Inspection (regular)
- ii) Maintenance of Inspection Equipment (NDA, Unmanned Monitoring System)
- iii) Install and Removal of Seals
- iv) Environmental Sampling

It seems that it will not significantly violate the principle that no additional rights or obligations arise as presented in the SLC supplementary document. In the ROK, interim inspections at LWR had been delegated to the ROK national inspectors several times according to the LWR Enhanced Cooperation programs which was agreed in 2002. In 2012, Enhanced Cooperation Arrangements were signed which allow the joint use of verification equipment, sharing of inspection information, and cooperation in development of verification technology between two parties. It is expected that there will be no major technical problems in carrying out the above activities since the ROK possesses sufficient technical capabilities in safeguards implementation: independent development of verification devices, material analysis capability, inspection experiences in various types of nuclear facilities (fuel fabrication facilities, R&D facilities, NPPs, etc.) In particular, the time required for national inspectors to clear site access control is less than the time required for the IAEA inspectors, so if national inspectors are available to the works such as repair and installation of safeguards equipment in the facility, the required working time will be drastically reduced.

Contrary to the expectation when the SLA launched, IAEA inspection activities in Korea show an increasing trend despite Covid-19. For example, as shown in Table 3., the frequency of the LWR UI is on the increase. It is speculated that the work policy has been changed so that inspectors perform as

many duties as possible once they enter the country. So, it is difficult to see that the original purpose of unpredictability is achieved because facility operators only have to be vigilance during the staying period of IAEA inspectors.

	RII				UI					
year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 (~Jul)
no. of events	4	3	3	3	5	5	7	6	7	4

Table 3. Frequency of RII and UI at ROK LWRs

This is the opposite result from the expected direction of the introduction of the updated SLA, and if an inspector becomes a source of Covid-19 infection, it may seriously damage the reliability of IAEA safeguards. In the Covid-19 environment, based on the quarantine principle of minimizing movement and contact, the following should be considered in the implementation of safeguards.

- i) To make use of the technical capabilities of the Member State, but minimize direct visits of IAEA inspectors
- ii) To expand voluntary collection/analysis of information related to safeguards by a Member State and provision to the IAEA
- iii) To expand use of unmanned monitoring system

V. Conclusions

Covid-19 is paradoxically providing an opportunity to prove that the direction of IAEA safeguards policy that the IAEA has been pursuing so far is not wrong. As the basic concept of pursuing efficiency while ensuring the effectiveness of safeguards in the SLA must be applied without any changes in its basic spirit, safeguards activities should be more focused on information analysis using the latest information technology. And it is desirable that on-site verification by IAEA inspectors will be reduced in the long run and focus on inevitable parts. This is exactly the direction the IAEA has been pursuing, even if we are not in the Covid-19 environment. If the IAEA considers to solve the problem by gradually transferring the safeguards services to a Member State and facilities, and sharing the safeguards -related information acquired by the IAEA on the premise that the Member States possess enough technological capabilities.

IAEA safeguards cannot be implemented by the IAEA alone, and requires active cooperation and participation of a Member State's regulatory authorities and facilities. From the Member State's perspective, rather than a passive attitude proving that there was no diversion of nuclear material, it is

better to have an aggressive and active attitude toward the implementation of safeguards, such as strengthening national inspections, enhancing information analysis capability, and enhancing technical capability to support IAEA inspections. The risk of delegation safeguards activities to the Member State would be greater than the benefits that the IAEA could gain from the expanded role of the Member State. However, on the other hand, this can be used as an opportunity for the universalization of the Additional Protocol, which the IAEA has been pursuing for a long time.

An idea of ‘trade-off of safeguards information and on-site verification activities’ can be considered: the concept of transferring a part of verification activities in proportion to the provision of extended information by member states required by the Additional Protocol. Of course, this may vary depending on the new interpretation of the rights and obligations under the CSA and the Additional Protocol, and the level of technological capabilities of a Member State.

The new environment brought about by Covid-19 are calling for a new look for IAEA safeguards, and demanding new roles for a Member State and nuclear facilities as well. It can be said that the IAEA safeguards and the SSAC are inseparable from each other and have shared their respective origins and values of existence. As a partnership for maintaining the international nuclear non-proliferation regime, cooperation and communication between the IAEA and a Member state is very important, and by sharing the pain brought about by the new environment and sharing the role, the current difficulties will not be insurmountable.

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