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Innovative Safeguards Implementation Under COVID-19 Restrictions

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Abstract

The COVID-19 pandemic forced most organizations to rethink their way of working. While the nuclear industry has been solving how to keep their employees safe and still keep operation normal, the regulatory authorities have tried to figure out how to maintain regulatory impact without risking the health of their inspectors or the operators.

At the Finnish Radiation and Nuclear Safety Authority (STUK), nuclear safeguards has not been hindered by the pandemic. Instead, new innovative inspection methods have been deployed alongside the traditional ones. In addition to traditional meetings, we have utilized remote video meetings e.g. for interviews of nuclear material responsible persons and nuclear inventory verification. In the latter, a direct video stream to a small holder's nuclear material storage was established and NPP inspections were performed by a remotely operating safeguards inspector together with STUK's resident inspector at the NPP.

STUK emphasizes the responsibility of the operators. STUK involves them and their responsible persons in development of more efficient safeguards implementation. Practical communication channels, such as biannual meetings between STUK and the responsible persons, and competent personnel on both sides enable both STUK and the operators to adapt to the circumstances. Operator initiative is seen in one inspection case where the responsible persons brought accountancy documents to STUK's office for one day. An inspection was then held by video meeting.

After the pandemic, the efficient practices from these exceptional times should be promoted and seen as facilitators of efficient safeguards in new challenges where already established methods may prove expensive or difficult to arrange. Remote inspections can save money and time from both the inspectorate and the subject. For example, some modern small modular reactor concepts feature remote operation. If a nuclear facility can be operated remotely, it should also be possible to safeguard it remotely.

Introduction

COVID-19 created a world-wide disturbance in almost every branch of human activity, including the Nuclear industry and governmental organisations. NPPs are a part of the critical infrastructure and securing the person power capacity needed to keep them running is crucial. Functional nuclear Safeguards is a prerequisite for peaceful use of nuclear power, so keeping safeguards inspections functional in crisis situations is mandatory. Today's technical abilities gives us tools to rethink some of the ways we perform inspections, so that nuclear safeguards can be ensured also when physical travel is limited.

COVID-19 in Finland

The impact of COVID-19 pandemic on the Finnish society has been unpredictable although it has not been as extensive and massive as in many other countries. As the situation evolved the Government took strict measures to stop the spread of the virus (e.g. Emergency Powers Act). Finland has transferred gradually to a “hybrid strategy”, referring to a move from extensive restrictive measures to enhanced management of the epidemic [1].

The initial impact of the restrictions was, however, quite dramatic. Over the weekend March 14-15.2020 government institutions, including the Radiation and Nuclear Safety Authority (STUK), changed to remote working mode, i.e. everyone whose tasks allowed working remotely was requested to do so. The huge impact on network and vpn capacity was quickly handled by the Finnish government IT provider VALTORI and at least at STUK the transfer to remote working mode was smooth, with only few understandable inconveniences and occasional IT glitches. In the beginning everyone was requested to work disconnected, when possible, and avoid network heavy appliances, such as streaming media over vpn, but within some weeks these restrictions were lifted and today working remotely over vpn is almost as smooth as being at the office, from an IT point of view.

Travel restrictions have been imposed in Finland with some temporal variability from March 18, 2020 onwards. The Finnish constitution does not allow restricting Finnish citizens from travelling, and everyone is allowed to leave the country, but the recommendations on not to travel have been stringent and largely followed by the population. Foreign citizens from many countries have been banned from entering Finland, except on essential travel. The Finnish border guard keeps information on the internet on what constitutes essential travel [2].

From March 28 to April 19, 2020, the southern Finland around the capital city i.e. the Uusimaa region was closed from the rest of the country and only necessary travel was allowed over the regional border [3]. STUK and Loviisa NPP, both reside inside Uusimaa, but Olkiluoto NPP does not. While this restriction did not hinder inspectors from duty travel, it strongly affected the mental attitude towards travelling and arrangements for having inspectors from Uusimaa visiting the Olkiluoto NPP. Even the STUK local office at the NPP was not open for the inspectors from the main office.

Requirements for entry to the NPP's

In the first weeks of March 2020, the Finnish NPP's closed their premises for all non-essential visits and started implementing travel restrictions for their workforce. At the same time, they also changed to remote working mode, like the government institutions. In spring 2020 the official health recommendations did not include using facial masks, so masks were not mandatory at the NPPs in the beginning, but general hygiene instructions were issued at both NPPs. Workers that had travelled abroad on vacation in mid-March were not allowed to enter the NPP's, without a 14 days quarantine period.

The Finnish NPP's normally try to co-operate on non-confidential issues, so the requirements were quite similar in Loviisa and Olkiluoto. An important difference was the additional restrictions on people coming to Olkiluoto from the Uusimaa region, during the closing of Uusimaa. Olkiluoto has also implemented zoning of their sites, as there are two active building sites (OL3 and Posiva) on the island, in addition to the operating NPPs (OL1 and OL2). Zone borders should not be crossed without a quarantine period in between. If required, a special permit

Table 1. Safeguards field activities in Finland in May 2020 – May 2021

MBA /operator	Date	Inspection type	Inspections			Inspection person days		
			IAEA	EC	STUK	IAEA	EC	STUK
WOL1, WOL2	6.-7.5.	Pre-PIT PIV	2		2	4		2
WOL2	17.5.	OL2 CV			1			2
WOL1	5.6.	OL1 CV			1			2
WL0V	9.-10.6.	NDA (PGET)		1	1		2	4
WOL1, WOL2, WOLS	25.-26.6.	Post-PIT PIV, DIV, WOLS Site Survey	4	3	4	4	3	7
WL0V	21.-23.7.	Pre-PIT PIV, Tech activity	2	2	2	3	3	3
WL0V	11.8.	LO2 CV			1			2
WL0V	4.9. and 6.9.	Cask verification	1	1	1	2	2	3
Boliden Kokkola	17.9.	System inspection			1			1
WKK0	17.9.	PIV, System Inspection			2			2
WL0V	27.9.	Cask verification	1	1	1	1	1	1
WL0V	30.9.	LO1 CV			1			2
WOLE, WOLF	6-8.10.	DIV	2	2	2	12	12	6
WL0V	20.-21.10.	Post-PIT PIV, DIV	1	1	1	2	2	4
WFRS	22.10.	PIV	1	1	1	1	1	2
WOLS	26.-29.10.	NDA (PNAR)		1	1		4	7
WOL1, WOL2, WOLS	30.10.	Interim			3			3
WV1	9.11. and 13.11.	System inspection (RKT)			1			6
WOL1	11.11.	RII	1		1	1		1
WL0V, SSFLOVI	12.11.	Interim, Site			2			4
WOL3	1.-2.12.	PIV, DIV, Tech activity	2	2	2	2	2	2
WOLE, WOLF	1.-2.12.	System inspection (RTO)			1			8
WOL1, WOL2, WOL3, WOLS	7.-8.12.	System inspection (KTO)			1			5
WL0V	16.12.	RII	1	1	1	1	1	1
WHEL	17.12.	Interim (Remote)			1			2
WRRF	17.12.	PIV			1			1
TVO	22.1.20 21	International NM transfers			1			2
WOL1	17.2	RII	1	1	1	1	1	1
WNSC	19.2	Interim Inspection			1			1
WOL3	1.4	OL3, first core inspection	1	1	1	1	1	1
WOL1,WOL2	14-15.4	Pre-Pit PIV	2	2	2	2	2	2
SUM			22	20	43	37	37	90

can be issued to cross from the running plants to the construction sites, but not the other way around [4]. During the refuelling campaign in spring 2021, TVO required a negative COVID-19 test certificate from anyone entering the NPP and not regularly working there, including inspectors from STUK.

During the first weeks of the pandemic, the NPPs created their basic rules and instructions for avoiding the pandemic to affect the safe production of nuclear power. Since that, only minor changes to these rules and instructions have been implemented.

Impact on inspections and inspection activities

All essential national and international (IAEA&EC) inspections to the NPP's have been performed during the COVID-19 period. These inspections include physical inventory verifications at the NPP's (Pre-PIT PIV's Post-PIT PIV's), Core inspections, random interim inspections (RII) and DIV inspections to the Posiva underground repository under construction. Some inspections were postponed from spring 2020 to the autumn and two inspections to the minor MBA's WRRF (VTT, research reactor under decommissioning) and WHEL (University of Helsinki) that were planned by the EC were postponed to 2021, these MBA's were, however inspected by STUK in December 2020. [5]

To ensure smooth border passing by international inspectors, STUK asked the inspectors for their travel itineraries and communicated them to the Finnish Border Control. International inspectors have travelled with valid COVID-19 test certificates and also agreed to take a second COVID-19 test after arriving to Finland, when so requested by the NPPs. for the Core inspection of the newly loaded OL3 core in spring 2021, the inspectors from the IAEA and EC agreed to arrive a few days early to Finland, according to new rules by TVO for admitting travellers from abroad.

Novel ways to inspect

Before STUK issues a permit to close a reactor core after refuelling, a core inspection is performed together by the NPP personnel and a STUK safeguards inspector. This inspection has a 2S function, ensuring correct and safe core loading as well as fulfilling the safeguards PIV requirement. The core inspections at OL1 and 2, only shortly after the travel restrictions from Uusimaa were lifted, were arranged in a hybrid form, so that a resident STUK inspector at the site performed the actual visual inspection, while a remotely working safeguards inspector assumed the final responsibility of the inspection and the protocol. In these inspections no video or other technical verification signals were transferred from the NPP. The eyes of the resident inspector fulfilled the role, that potentially could be fulfilled by technical means in the future.

The core verification inspections at Loviisa NPP in autumn 2020 as well as the TVO core verification inspections in spring 2021 were performed in a normal way by STUK SG inspectors, partly because COVID-19 restrictions were more relax at those periods and partly because STUK local inspectors had a very high workload, due to refuelling activities.

As per Nuclear energy act [section 7i] The licence holder shall appoint the persons responsible for ensuring safeguards of nuclear material. Only people approved by the Radiation and Nuclear Safety Authority specifically for each task may be appointed as the person responsible and as their deputies. STUK interviews the responsible persons before the approval and during the pandemic, these interviews are being held remotely. For this kind of interviews remote connection is a satisfactory solution, but video connection is essential. In case of a new candidate the

identification of the person interviewed was considered an issue. During an interview the personal skills and technical knowledge of the candidate can be assured.

The STUK interim inspection at the Helsinki University was performed almost completely remotely in December. Only the safeguards responsible person of the operator was present at the University laboratory. The inventory verification, i.e. item counting and identification was carried out successfully using the camera of the operator's mobile phone and remotely followed by a colleague and the STUK inspectors. The accountancy was also inspected remotely. Typically, the EC inspects the small laboratories regularly but not necessarily annually. Following to this experience, this kind of a short 2 – 3 hours remote inspection could be shared with other inspectorates and this new procedure could reduce the EC travelling needs in the future.

STUK inspects the operators' accountancy of international uranium transfers. Currently, only TVO owns uranium outside Finland which is intended to be imported and is thus responsible for its bookkeeping and reporting. STUK's inspection of TVO's accountancy of international uranium transfers was postponed to 2021 because of a tight inspection schedule near the end of 2020. The inspection itself was a hybrid between remote and on-site, as TVO's responsible person brought the accountancy documents to STUK's office where inspectors then studied it. The premise and findings of the inspection were discussed remotely over video conferencing and the documentation returned to the operator after the inspection.

Audit-like system inspections and bi-annual safeguards verification meetings with the nuclear facilities have been held both remotely and in hybrid form, with some inspectors and experts present and some attending remotely. These kind of activities are especially well suited for remote communication and the possibility to participate remotely gives both inspectors and operator experts the possibility to attend flexibly, without having to travel and often only at the exact timeslot, when their specific expertise is required. Experiences show, that remote or hybrid inspections and meetings have a higher attendance, while at the same time saving travel cost and personnel time.

Remote communication considerations

During this period of COVID-19, intense discussions have been ongoing with the IAEA, the EC and Posiva on the safeguards infrastructure for the geological repository for spent nuclear fuel that is under construction by Posiva in Olkiluoto. Having these discussions under COVID-19 restrictions has been a double-edged sword. On one hand, meetings in person, where often difficult issues are more easily handled have been sorely missed, on the other hand the easiness of setting up remote meetings has been extensively utilized and has strongly benefitted speedy communication. From March 2020 to July 2021, 16 meetings were held, at different levels, between the IAEA, EC, STUK and Posiva experts and management. This intensity of communication would not have been possible to arrange with in person meetings and it is unlikely that we could have reached this, without the remote working skills that the COVID-19 restrictions brought both to experts and IT systems in all organisations.

Information security must be considered, and classified information cannot be shared on unsecured platforms like Teams. The government IT provider VALTORI has its own instance of Skype for business and that platform can be used for sharing information with the lowest confidentiality classification used in Finland. Most safeguards confidential material in Finland belongs to this classification. Practice has shown that it is very hard for experts who are discussing technical matters to strictly follow these security protocols.

For obvious reasons nuclear facilities follows very strict safety and IT security standards. In Finnish NPPs mobile communications (mobile phones, wlan) are not allowed in the areas where nuclear fuel is stored. Remote data transmission (RDT) to the international inspectorates is only possible through dedicated wires, that are physically separated from the NPP network infrastructure. Normally RDT transmission is delayed, but on special occasions, e.g. when testing remote operation of verification measurements, real time data transmission has been enabled. These kind of restrictions hampers the possibility to develop remote inspections at NPPs. A first step towards such development would therefore be to develop secure and reliable data transmission methods and acquire security acceptance for these both from the NPP and from the National Authority.

The future of safeguards inspections

There is much to learn and keep from this special period, when experts have been working closely together, while sometimes even thousands of kilometres apart. Working remotely and remote meetings are here to stay. These new practices can save costs as well as help us to achieve environmental goals, by lessening travel. At the same time participation activity and meeting frequencies can be bolstered by the ease provided by communicating remotely instead of travelling over long distances. IAEA and EC safeguards are already strongly backed by remote data transmission (RDT), that is installed for transferring surveillance data to the international inspectorates from all Finnish NPPs. RDT has already lessened the frequency of international inspection to Finnish NPPs. However, nuclear safeguards is obviously an area, where operating remotely cannot be entirely sufficient, at least with current technology. Inspectors must visit the fuel storages and verify the inventories in a very physical way from time to time.

It might feel hard to envision ways to substitute physical inspection activities with remote operation. However, the inspection STUK performed at WHEL showed that even PIV activities can be performed with an online data- and camera link. If there is basic trust between the inspectorate and the inspected, such activities could be further enhanced, e.g. by using measurement equipment, stored on site, in remote mode.

One special concern for the future is safeguarding small nuclear reactors (SMR). In Finland there are initial plans on building SMRs for district heating. This would require small units placed close to population centra around the country. There may be new ways of sharing the vendor, operator and owner responsibilities. Safeguarding these in the traditional way, with several inspection visits per year per unit would increase inspection effort to levels that could be hard for the international inspectorates to handle, given budget restrictions. Remote inspections may be a way to maintain sufficient inspection frequency at small SMRs while keeping the safeguards implementation costs reasonable. It is a current safeguards challenge to have optimal safeguards measures to be developed. for these new units.

The Finnish operator Posiva, is planning to start deposition of spent nuclear fuel in a geological repository in the mid 2020's. All nuclear fuel will be verified before encapsulation and this is verification is currently planned to be performed using joint use remotely operated measurements devices (PGET and PNAR), with the measurement and surveillance camera signals going from the NPP to EC in Luxembourg and split from there to IAEA and STUK. During the first campaigns, inspectors will certainly be present to check the operations, but to avoid extensive inspector presence the operations is planned to be fully remote in the future. Final disposal will also create several yearly fuel transfers from the NPP fuel pond to the encapsulation plant. In the beginning these transports are short and within the companies' premises, but as stringent continuation of knowledge (CoK) must be upheld from the verification measurement onwards,

containment and surveillance (C/S) of the transport canisters is needed. The JRC is currently working on creating seals and a sealing strategy that can allow the operator to both attach and remove the seal, under remote surveillance, without the need for an international inspector to travel to Finland for every campaign. These are examples of how also the international inspectorates are currently developing their ability to operate remotely to save travel and cost, while maintaining the high security standards required by nuclear safeguards.

The lessons learned on how to conduct remote inspections in a reliable, trustworthy and confidential manner can be very valuable in the future for all national, regional and international inspectorates. Remote inspections can have significant global applications and can be investigated further for instance under the auspices of Member States Support Programmes to the IAEA safeguards, INMM or ESARDA.

The Ministry of Finance made a decision on May 24, 2021 that all government duties shall be organized utilizing multi-locality and place independency made possible by smart technology. The major aims are to provide better services to people and companies, better working conditions for the staff and to save on cost and travel. The kind of practices described in this paper goes well with national policy [6].

Conclusions

Like all of society, the nuclear industry and inspectorates had to adjust their ways of working because of COVID-19. Especially working, meeting and collaborating remotely has taken a huge leap forward during the last year and a half. There is no going back to the old ways once this is over and neither should there be. The new ways we have all learned can provide great benefits and help us overcome future challenges, as safeguarding SMRs and Geological Repositories. Developing and ensuring secure and reliable data transfer as well as inspection methods and protocols is an essential step towards gaining much needed trust by both operators and inspectors.

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