2022

NuDiVe

Nuclear Disarmament Verification

Supplement to the Documentation of the NuDiVe 2022 exercise

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Contents

Preface

The »Supplement to the NuDiVe 2022 Documentation« provides additional exercise documents to the »NuDiVe 2022 Documentation[1].« It gives the Preliminary inspection reports given by Hosts and Inspectors, the full Step guide, the adapted and extended »Procedure descriptions« and further exercise related documents.

NuDiVe 2022 has been a challenging undertaking, requiring thousands of working hours from organizers and participants to reach its successful conclusion. The organizers hope that by aiming for transparency and publishing the methods and findings in the most complete manner, the impact of their efforts will be maximized by providing a fruitful basis for IPNDV authorities and the scientific community to develop and test verification methods and technologies fit for inspection regimes truly enabling verified, multilateral irreversible nuclear disarmament.

1 https://www.znf.uni-hamburg.de/media/documents/forschung/nudive2022-documentation.pdf

1. Host team preliminary inspection report

Background

The inspection was to verify the dismantlement of an Ipindovian nuclear warhead in accordance with our existing treaty. The verification was important to Ipindovia, which as a P6 state in good standing had invited the inspectors as spelled out in the treaty. Ipindovia wants to demonstrate to the world that it is committed to its treaty obligations. This was not the first time multinational inspectors visited Ipindovia under the current treaty, so the parties had already built some trust and confidence in each other. This was our basis for receiving the inspectors with a forward-leaning, positive and cooperative attitude – while at the same time of course maintaining our high health and safety standards and protecting proliferative and otherwise sensitive information.

The inspection

The Host Team reported daily to the Ipindovian government. The main contents of these reports are summarised below.

Day 1 – Tuesday 5 April 2022

- During the introductory meeting, Ipindovia presented its good standing as a NWS, its adherence to the treaty obligations and its willingness to be as transparent as possible during the dismantlement of one of its warheads this week.
- The Inspection Team appreciated the shared goal of an effective and cooperative inspection, and stated its intention to use a "no surprise" approach during its inspections.
- On request of the Inspection Team, the Host Team accompanied two inspectors into the controlled area for a short familiarization visit. This facilitated the development of a solid inspection plan by the Inspection Team.
- After the day's successful negotiations, the teams plan to start on Wednesday morning with step 1, aiming to work towards step 5. The host team has agreed to absence measurements of the non-destructive assay (NDA) room and simultaneous execution of steps 2a and 2b (on the condition that the Inspection Team does not use more than three inspectors on these tasks at any given time).

Day 2 – Wednesday 6 April 2022

- The revised intention of the Inspection Team was to complete steps 1 through 3 on Wednesday. The process proved more labour intensive than initially expected, however.
- The Inspection Team managed to perform step 1 (entering facility and facility verification) before lunch, and they completed step 2a (functionality check of CCTV and portal monitors) and 2b (sealing and documentation of potential diversion pathways) before the end of the day at 16:30.
- Overall, the inspections were conducted professionally and in the spirit good collaboration. The Inspection Team mostly conducted their inspections according to the plan agreed upon on beforehand, but deviated from this plan on the following issues:
  1. They requested measurements of the dimensions of all three rooms in the controlled area, instead of only the Dismantlement Room. This request was granted by the Host Team as it did not challenge safety, security or non-proliferation.
  2. They requested to adjust the field of view of the CCTV cameras to better suit their purpose. This request was also granted by the Host Team. The task, being important to both teams, turned out to be quite time consuming.
- The Inspection Team ended up using more time than expected also on sealing, both on checking old seals and on applying new ones.
- One lesson learnt on Wednesday was that with several Inspectors and several Hosts inside the controlled area at the same time, it becomes increasingly difficult to ensure that unwanted activities are not taking place. Extra care will be taken in the future to reduce potential safety and security risks.

- Another lesson learnt is that the team leaders should be easily accessible or physically present to quickly resolve any problems that may arise.
- The Host Team had some problems with its internal communication. The walkie-talkies that were provided turned out to be difficult to use, maybe because of poor training. In many cases, the Host team ended up using WhatsApp instead and thereby not communicating as openly and transparently as we would have liked to do.
- At the end of the day, the Inspection Team presented their inspection plan for Thursday 7 April, which had the goal of completing steps 3 through 8.

Day 3 – Thursday 7 April 2022

- On Thursday, the Inspection Team successfully completed steps 3 through 8 of the dismantlement verification process, as originally planned. The Inspection Team expressed their appreciation for the good cooperation that they received from the Ipindovian Host Team.
- Based on Tuesday's experiences, the Host Team agreed with the Inspection Team on the addition of a "floating inspector" to monitor the safety and wellbeing of the other inspectors in the controlled area. This worked well and was greatly appreciated by the inspectors. For its part, the Host Team included a "floating host" to monitor the overall situation inside the controlled area.
- The day's inspections included
    - gamma scanning with the Compton camera of the dismantlement room;
    - neutron sweeping of the NDA and dismantlement rooms;
    - authentication of the previous TRIS template of a warhead in its container;
    - TRIS confirmation of the treaty accountable item (TAI) against this template;
    - surveillance of the movement of the TAI and its components following its dismantlement;
    - surveillance and sealing of the special nuclear material (SNM) container with an EEOS seal after dismantlement of the TAI;
    - generation of a new TRIS template for the removed SNM in its container; and
    - transfer of inspection data from the controlled area to the inspectors for review.
- The morning verification activities focused on preparing the controlled area for the dismantlement of the TAI. The absence verification tasks were executed in an efficient and effective manner, enabling the further progress on verification that was accomplished in the afternoon.
- In the afternoon, the TAI was moved into the controlled area and dismantled. This was successfully accomplished under the agreed verification procedures.
- Following the completion of the day's activities, the Inspection Team raised the following concerns:
    - Having only one Inspector monitoring the chain of custody is insufficient, especially when sealing the SNM container after dismantlement.
    - Due to a mistake on both sides, the container with SNM was moved to the Equipment Room for sealing. Among other things, this led to confusion over possible loss of Chain of Custody. As a remedy, the Inspection Team has requested to review the CCTV footage of the Equipment Room to confirm that material was not diverted during the sealing process.
    - The Inspection Team noted a number of internal communication challenges. The team lead struggled to instruct her team members on several occasions, and this led to misunderstandings.
- On Friday, the Inspection Team aims to complete the dismantlement verification process through step 12, which includes absence measurements of the dismantlement room, reviewing the CCTV footage, and concluding inspections.

Day 4 – Friday 8 April 2022

- The Inspection Team successfully completed the remaining steps of the verification process.
- After much consideration, the Inspection Team reported that they did not consider our dismantlement properly verified. This followed from the mutual mistake yesterday when the SNM container had been moved into the Equipment Room for sealing. This should have taken place in the Dismantlement Room. One or two inspectors were always within eyesight of the container and they had CCTV coverage most of the time, but they determined that neither permitted complete Chain of Custody.
- We hope that the Multinational Body will find that the verification process was indeed satisfactory when it decides on the matter.
- There were no problems or incidents during Friday's verification work, and the Inspection Team expressed their appreciation for the good cooperation that they had received from the Ipindovian Host Team.

The incident on Thursday of moving the SNM container into the Equipment Room

- The Host Team was under the impression that there was only one laptop available for the EEOS sealing of the SNM container, namely the laptop that was connected to the CCTV systems in the Equipment Room and that needed to stay connected at all times.
- Based on this misunderstanding, the Host Team proposed to move the SNM container from the Dismantlement Room into the Equipment Room for the EEOS sealing. The inspectors agreed, and did not ask to consult with their Team Lead.
- The Host Team proceeded to move the SNM container into the Equipment Room, making use of the portal monitor in the hallway as requested by the inspectors. The inspectors did not lose visual contact with the SNM container during this process as one inspector was clearly positioned such as not to lose visual observation of it.
- In hindsight, the Inspector Team decided that this incident prohibited them from ensuring the chain of custody, since the Equipment Room had not been scanned previously. The fact that the Equipment Room was under constant CCTV surveillance did not suffice to restore the confidence either, since parts of the CCTV footage were missing due to technical errors.

The number of Host Team members present during the inspections

The number of Host Team members present in the controlled area at any given time was a returning topic of discussion throughout the inspection activities. As we failed to address this properly at our initial meeting, we see a need to emphasise the general principles here:

- It is the privilege of the Host Team at any time to decide how many and who of our team should be present in the controlled area. It is our facility, and we are familiar with the relevant security and safety concerns.
- It is obviously in our interest to keep the number of people present as low as reasonably achievable.
- Some Host Team members were present to actively assist the inspectors, others were specialists required to operate the sophisticated equipment used. This cannot be a topic of negotiations.

Host Team summary

1. The Host Team is confident that the overall result demonstrates Ipindovia's commitment to and compliance with the treaty.
2. The Host Team strived to optimise transparency and attempted to be flexible whenever possible while always adhering to our safety, security and non-proliferation obligations.
3. The inspections were conducted professionally and in a good cooperative spirit by both teams.
4. The incident with the SNM container should never have happened, and the misunderstanding was partly the fault of the Host Team. The incident and its consequences

will presumably be evaluated later by the Treaty Commission. It is the opinion of the Host Team that no SNM could have been diverted under the circumstances.

5. In retrospect, the Host Team could have been better drilled on the procedures and on the actual use of all relevant equipment. However, in our view, the verification goals were met in spite of some challenges.

2. Inspection team preliminary inspection report

A verification activity was conducted at the Ipindovia nuclear weapons dismantlement facility, located at the Jülich Forschungszentrum Research Institute between 4-8 April, 2022. The objective of the verification activity was to:

a) Verify the dismantlement of one (1) treaty accountable item (TAI) and;
b) confirm the absence of diversion of the removed special nuclear material (SNM).

Observations

1) Throughout the verification activity, the Inspection team observed and received good cooperation from the Host team. Disputes were discussed and there were concerted efforts to resolve them in mutually acceptable ways.

An example of this was when the Inspection team requested flexibility from the Hosts with respect to the number of Inspectors permitted per task, as well as the ability to perform certain tasks simultaneously. The Inspectors made this request at the closing Host/Inspector meeting of Day 1 of the verification activity. They noted that there was precedent from the previous inspection where the Hosts permitted multiple Inspectors to conduct multiple tasks simultaneously. Additionally, the Inspectors noted that there was an inconsistency between the detailed inspection procedures and the "steps" guide, with the former permitting two (2) inspectors per task and the later permitting only one (1) (see step involving the verification and application of seals). The Inspection Team's request was also founded on:

a.i. the need for more than one inspector to ensure safety. The inspectors observed early into the verification activity that they were overheating quickly in their full Tyvek suits, which caused dehydration, dizziness and the potential for collapse;

a.ii. the need for a second set of "eyes and ears" in case of a dispute, to assist a fellow Inspector to confirm an observation or note a potential issue, such as a questionable seal; and

a.iii. a desire to improve efficiency. Two inspectors working together on the same task saves time while also permitting some tasks to take place simultaneously.

At first, the Host team denied the Inspectors request for an added Inspector, noting that for security reasons, the number had to remain to what was written in the "step" procedures. However, on day two of the verification activity, the Inspectors informed the Host team in their morning meeting that they would insist on a second Inspector to ensure the safety of the Inspection team. The Inspectors also noted that working with fewer Inspectors was causing serious delays, which put the entire verification activity at risk of not being completed in the allotted period of time.

The Host team proceeded to offer an additional Host to act as a "float". The "float" Host would monitor the health and safety of the Inspector as well as act as a second set of "eyes and ears". This was not acceptable to the Inspection team, in particular because it set up a situation where the Inspector would not have another Inspector to corroborate their account of events/observation in the instance of a possible dispute or issue. The Inspection team requested that an additional Inspector be permitted to accompany the "float" Host. The Host team agreed to this on the condition that the "float" Inspector would not undertake any verification activities while in the dismantlement area.

The “float” inspector would be restricted to monitoring their fellow inspectors, and when requested, join a conversation or review/observe something to render their opinion.
The Inspection team appreciated the Hosts’ willingness to agree to this compromise which would permit at least two Inspectors in the dismantlement room at all times. They also permitted simultaneous tasks, but only if the Inspectors were in separate areas of the dismantlement area.

2) The Inspection team also observed that the Host team was helpful and responsive to the Inspection teams request for past inspection reports, data regarding previously applied seals, and other information requests for the purposes of the inspection eg: dimensional data for the dismantlement room.

3) It was further observed on several occasions that the Host team did not always follow procedures, which resulted in incidents which caused delays or a serious breach to the chain of custody.
    3.a. One example of this occurred during the commissioning of the CCTV cameras. While the Inspectors were verifying the authenticity of the cameras, a Host was observed touching and then repositioning a CCTV camera without being instructed to do so by an Inspector. This resulted in the need to reposition and re-seal some of the cameras. This incident lead to a significant time delay.
    3.b. Another example of this was observed during a critical phase of the inspection, following the dismantlement of the TAI. The procedures required that the application of the EOSS seal was to be performed in the dismantlement room. However, the Inspectors were not permitted in this room by the Hosts, sighting security concerns. The Inspection team were prepared to allow for the EOSS seal to be applied in the NDA room as it had undergone gamma sweeping and was also where the TRIS measurements were performed. However, in this instance, when the SNM container left the dismantlement room without an EOSS seal, a Host instructed an Inspector to move the SNM container into the equipment room. The reason given for this instruction was that the computer required for the application of the EOSS electronic seal was in the equipment room and could not be moved. The Host failed to respect the procedures by instructing the Inspector to undertake this action. It should also be noted that the Inspector also failed to respect the procedures by accepting the Host instructions, permitting the SNM container to be moved into the equipment room, and taking this action without the presence of or consulting a second Inspector. The result was that the SNM container was move outside of the dismantlement room without a seal and then further placed in a room that was never intended to contain SNM. The equipment room had not undergone gamma and neutron sweeping or sealing activities to rule out diversion pathways.
4) On several occasions, a disproportionate number of Hosts in the dismantlement were also observed. This caused unnecessary confusion, distraction and was also a violation of the agreed upon procedures. The procedures not only specified the number of Inspectors permitted in the dismantlement room per task, but also the number of Hosts. On several occasions, it was observed that the number of Hosts significantly outnumbered the number of inspectors. Eg: during the application of the EOSS seal, up to 6 Hosts for only 1 Inspector was observed.
5) The Inspection team noted the significant value-added that the new technologies contributed to the inspection, notably the Compton Gamma Imaging Camera, the TRIS and the EOSS seal. All technologies greatly improved efficiency of the inspection activity, as well as provided more points of data by which to gain confidence in non-diversion of the SNM.

Overview of Incident with the SNM Container

The movement of the SNM container from the dismantlement room without an EOSS seal and its subsequent placement into the unswept/unsealed equipment room represented a serious incident in the verification activity. The Inspection team met to analyze if the chain of custody was maintained and the impact this incident had on their ability to render a conclusion on the non-diversion of the SNM.

The Inspection team noted that the movement of the SNM container from the dismantlement room without an EOSS seal and then its subsequent presence in the unswept/unsealed equipment room was a serious concern which created several opportunities for diversion. The Inspectors did note however that the equipment room was under CCTV surveillance, hence, had one chain of custody option at their disposal. The Inspection team opted to review the footage from the CCTV cameras to determine if diversion could be ruled out for the time that the SNM container was in the unauthorized equipment room. The CCTV footage revealed the following:

a) After the unsealed SNM container was moved into the equipment room, it was placed at the back of the room. This meant only one CCTV camera had a view of the container. From the angle, it appeared that the container was put against the back wall of the room.
b) Once the unsealed SNM container was placed in the equipment room, it was left alone for a period of time while the lone Inspector that authorized its move and several Hosts spoke in the dismantlement area hallway. At one point, without being instructed to do so by an Inspector, a Host entered the equipment room, opened a box containing equipment, rummaged inside it, then left. This Host did not approach the unsealed SNM container before leaving the room. It was unclear why he entered the equipment room and what he may have retrieved, if anything, from the box he had handled.
c) The lone Inspector and a significant number of Hosts re-entered the equipment room and began the procedures for applying the EOSS seal to the SNM container. At this point, the Host that had entered the equipment room and rummaged through a box was standing near the still unsealed SNM container, and at one point, leaned over it. The lone Inspector present in the equipment room was distracted by his EOSS seal application, so likely overlooked this action by the Host. This not only represented a radiation hazard, but the Inspectors reviewing the CCTV footage could not rule out the possibility that this Host was engaged in a diversionary action by placing or removing items from the still unsealed SNM container or the cart it was on.
d) A second Inspector eventually joined the original lone Inspector. He immediately cleared the room from the over-represented Hosts and proceeded to swap the original lone Inspector with a fresh Inspector. There were now two Inspectors in the equipment room overseeing the EOSS seal application.
e) At this point, the only CCTV camera that had a visual on the SNM container in the equipment room froze, and then went blank. It stayed blank for over 20 minutes. This meant that for 20 minutes, the only chain of custody on the SNM container rested on the visual observation of the two Inspectors. There was no other way to verify the chain of custody on the SNM container during this CCTV blackout.
f) The CCTV camera image was restored shortly before the SNM container was transferred from the equipment room to the NDV room.

Analysis

The Inspection team carefully considered the data and evidence before them. From the CCTV footage, it was clear that chain of custody was compromised. The fact that the unsealed SNM container appeared to be against the back wall of the equipment room could not rule out the possibility that there was a hidden pathway that could be accessed to move SNM in or out. A gamma/neutron sweep and sealing would have been able to rule this out, but was never performed as the room was never intended to contain SNM. Additionally, The SNM container was on a cart.

The cart itself was never swept for gamma and/or neutron sources. It had only ever passed through the portal monitors and later underwent a second TRIS template measurement with the SNM container on it. This meant that the Inspectors could not rule out the possibility that some SNM was separately adhered to the cart as a means of diversion.
While the original lone Inspector did lose visual observation of the SNM container after it entered the equipment room, the CCTV footage did provide some assurance that no one approached or handled the SNM container while the room was empty. This was until the single Host entered the room to access a box without instruction from an Inspector. While this Host did not approach the SNM container at this time, he was later observed leaning over the still unsealed SNM container when a crowd of Hosts and the original lone Inspector re-entered the equipment room to begin applying the EOSS seal. The CCTV footage indicated that the original lone inspector was distracted by the EOSS seal application, so likely did not notice this Host leaning over the other end of the SNM container. As the container was still unsealed, the Inspectors could not rule out the possibility that he had either added or removed something from the container or the cart it was on.
Eventually, when two Inspectors were in the equipment room maintaining visual observation of the SNM container, the only CCTV camera with a view of the SNM container failed for nearly 20 minutes. This meant that the Inspection team had no way to verify if diversion may have occurred while the two Inspectors in the equipment room were potentially distracted, or perhaps coerced or bribed into facilitating diversion. Lastly, because the error was not detected quickly enough, the SNM container and the cart it was on were moved out of the dismantlement area and the facility as a whole before the Inspection team could request that the cart, on its own, be measured and passed through the portal monitors to rule out any undeclared SNM on it. The Inspection team would also have liked to preform a second TRIS measurement on the SNM container on a difference cart then the one used when the container was in the equipment room.
In future, the Inspectors would benefit from more thorough preparation and practice with regards to the sequence of the inspection based on the procedures. It is also suggested that the procedures be reviewed to ensure all relevant equipment is available in the agreed upon room, in this case the dismantlement room, to allow EOSS sealing to occur at the earliest possible point following dismantlement.

Conclusions
The Inspection Team concluded that given the serious breach of procedures, which resulted in the SNM container moving from the dismantlement room without an EOSS seal and then placed in an unswept/unsealed room created a legitimate diversion scenario. Efforts to use the CCTV cameras and other chain of custody measures were not able to give the Inspectors enough data to confirm, with confidence, that diversion could not have occurred. As a result, the Inspection team concluded that the inspection was unable to determine, with confidence, that the dismantlement activity took place without diversion of the removed SNM.

3. Final evaluation team report

Summary of observations

The Nuclear Disarmament Verification (NuDiVe) exercise organized by Germany and France tested, under representative conditions, a key step in an inspection process for multilateral verification of the dismantlement of a Nuclear Explosive Device (NED). To support this exercise, “inspection" and “host” teams comprised of experts from multiple IPNDV participant countries exercise verification measures associated with preparing for, conducting, and verifying the notional dismantlement of an NED, and the subsequent verification of non-diversion of fissile material. Managed access, radiation safety practices and written procedures that includes both a formal procedure description and a checklist styled Step Guide served to add realism to the exercise and provided a simulation of the protection of sensitive design information and operational controls to protect human health. The Procedures were prepared by the exercise organizers, and development of the Step Guide sought to resolve perceptions of overcomplication that were expressed by the users of the previous version of the full procedure by creating a more check-list style approach. Checklists are a great tool for well-trained and experienced users. An independent evaluation team observed the exercise. Preliminary observations from the exercise included:

The following preliminary findings were presented at the post exercise hotwash in brief terms, and will be expanded upon in this short report. This initial assessment doesn’t include the detailed analysis of the pre and post evaluation surveys and the interview results that will provide a unique understanding of where the minds of each player were regarding their roles, responsibilities, perceptions and understanding.

It was obvious from the environment, structure, and resources so carefully crafted for this exercise that the organizing team expended extensive effort to deliver an exercise that represented as closely as possible, an environment and the conditions expected for dismantlement verification. From the onsite of planning for this NuDiVe exercise, the planners were faced with a number of challenges to overcome, some within their control to address and others outside, that they could only hope could be overcome by the actions and efforts of others.

The ongoing factor of Covid and its influence on the timing, planning and participation availability for this exercise complicated readiness activities, planning and communication, both with the organizing team and between the host and inspector team participants. Because of changes in availability, teams ended up smaller than hoped, and many participants did not become sufficiently familiar with the full procedure to make the step-by-step procedure effective.

Arrangements for lodging and transportation were effective at keeping participants separated by function. Some other examples of the organizing team’s efforts included the application of radiation access practices and the involvement of actual experts in radiation safety, who provided a very realistic experience. The availability of both detailed procedures and a step-by-step checklist were also very valuable in depicting that the activities being performed would be done by experts and while the detailed procedures listed each and every action, the step-by-step guide would be used by a well-trained team to ensure each activity had been performed. Familiarization with and preparation for deploying those procedures were left to the teams and players.

Challenges

c) Team members and availability changed multiple times creating very limited team sizes and impacting planning to a degree. The Host and Inspector personnel numbers listed in the full-length procedures conflicted in some places with the personnel numbers in the step-by-step guide. Because the step-by-step guide was a checklist, the full-length procedures should have been the governing document. Additionally, the conflicts between these two documents created unnecessary tension, lost time, and created ongoing arguments over which information was correct.

d) Some equipment and resources became available to the organizers very late, and there wasn't sufficient time to practice and prepare with them, and there was not time for a Dry Run, which could have shaken out some of the bugs. TRIS for example, had been rattled nearly apart and the Sandia experts literally had to put it back together because there were so many screws loose.

e) The interruption of inspection activities for a lunch hour, was unnecessary. While previous participants may have complained, the reality is that you would not stop mid inspection to go to a cafeteria and eat, box lunches or delivered food would more likely be offered so that participant personnel could continue activities and rotate lunch shifts. These scheduled, all participant lunch breaks also impacted exercise efficiency not only due to the break period but also by introducing an opportunity for out of exercise conversations to and from the cafeteria, making it more difficult to return to exercise formality in the afternoon.

The organizer team relied upon the host and inspector teams to really drive the direction of the exercise, taking more of an observer/facilitator role in most cases.

6) There were several instances when an observer Controller, would have been valuable to move the activities along, including during sealing and when actions were taken by the host and inspector players that deviated from the planned process.

7) There were several instances when inspectors were only allowed a single inspector to conduct a task, which would never be allowed by the inspectorate due to safety. Inspection activities should always follow the two-person rule. Also, the application of this limitation seemed arbitrary as the host personnel limits were not followed in most of those circumstances. In one case there was a single inspector surrounded by as many as six hosts (some of whom were "technical support personnel," who if not acting as hosts should have been in a different colored shirt). There were a few times when those technical support personnel were used beyond their technical support role to also "watch the inspector", filling a host role. Therefore, a decision needs to be made regarding the role/function of Technical Support personnel, and that decision should be permanent, not flexible. This situation resulted in increased difficulty performing inspection activities, especially associated with maintaining continuity of knowledge over equipment and the assurance that no host actions were being taken outside of inspector purview.

7.a. The CoK over i.e., the TRIS was not continuous. This could lead to a situation in which all future disarmament could be fake (which is far more serious than the potential diversion of the item that is dismantled in this exercise).

Role and function of hosts and inspectors were not universally well understood. The mission, purpose, and function were not clear to all players.

g) There appeared to be inconsistencies in pre-exercise engagements between the players on both the host and inspector teams.

g.a. Note: The players in the previous exercise expended significant pre-exercise training, planning and preparation efforts through multiple meetings on the fringes of IPNDV plenaries, and the challenges associated with time differences and schedules as a result of the virtual nature of IPNDV during Covid are likely a factor in this difference in readiness.

h) Perspectives on who was authorized to make and relay decisions or to take actions, created significant confusion between and amongst the teams.

h.a. People inside the Controlled area were making decisions without conferring with the rest of the teams and several of those decisions deviated from procedure, creating issues that led to loss of confidence. Team members outside of that area had no idea of the changes and were surprised or had to be corrected based upon a change that occurred. Evaluation team understanding is that the organizers had hoped that by not being overly controlling, that increased flexibility for decision-making between the host/inspector could occur. However, it was noted that there were challenges in assuring that all deviations were fully vetted and understood, and the effects of those deviations, fully communicated to both host and inspector teams and the evaluators/observers. Deviations from procedures should have only come through formal introduction by the Controllers. Minor adjustments to how procedures were performed i.e., parallel processes or efficiencies that followed procedure but combined actions in single locations could have been either negotiated between host and inspector teams as they were, or notations could have been placed in the procedure to accommodate allowing a sequence of steps to be performed on an individual item together, before repeating the same sequence of steps on subsequent items. **Deviations could have occurred if required but should have come as an inject by the Controller and be communicated to all before action was taken. Actual deviations from approved procedures – not to include efficiencies should have only been in response to unexpected situations that would have hampered the inspection and needed to be removed so that it could proceed.**

a.i. There was one host who repeatedly took independent action without the knowledge or instruction of the host lead, or of the inspectors. These actions disrupted CCTV verification and created questions regarding where equipment went when it should have been in a box in the equipment room.

h.b. Equipment that had not been listed for the activity or verified by the inspector was introduced into the Controlled Area and connected to the seal that was supposed

to be the final layer of confidence. That equipment failed, and a second unverified piece of equipment was rushed in to replace it. That second piece of equipment simply stated that the seal worked as expected with the first but couldn't be verified until the second reviewed it. This was a huge challenge because the inspector would have no way to verify that nefarious code had not been introduced to the seal with the first, failed piece of equipment, thus rendering the seal untrustworthy. Verification by the second piece of equipment did not return confidence because there is no way to confirm that the second device didn't just affirm the nefarious code. As such, the perception is that the material could have been diverted post seal verification. **This could have been also addressed through formal Controller inject for the equipment and even after failure, the Controller could have stated that the inspectors would have witnessed verification information.**

h.c. Communication, expectations and planning for host and inspector teams. It was observed by the Evaluation team that there was a relative absence of command post function in both the host and inspection team rooms. There is a need for better communication between command personnel and teams in the controlled area which could have included better eyes on activities (CCTV footage, or on-scene commander if video was not possible); better communication devices and established communication timing (by step, activity, or transition etc.) to assure that the command center was always aware of what was happening in the Controlled Area. No decisions should have been made in the Controlled Area without the direct authorization and confirmation of the Command. White boards or other tools could have been leveraged more effectively to assure that each assignment was clear, and each update was captured. This would have assured that all team members in the command room could have a better grasp of the situations in the Controlled area and how to react.

h.d. Inspector communication with the host was often muffled and difficult to understand. It's important that directions are loud and clear, so that the host understands what is expected.

Recommendations to IPNDV partners

Overall, while there were a number of challenges, the Evaluation Team believes that there were a number of great lessons to learn from this exercise, and while a lot is learned from success, often even more is learned from failure. The breadth of impact created by Covid was likely not as well understood as hoped, and its effects were very obvious on participant preparation, knowledge, and communication. A Dry Run (including NWS inputs as to realistic environment, process, practices, and advice on flexibilities) would have been a beneficial tool for assuring that all the preparation was complete, and that an Inspector need/perspective were considered when environment, activities and restrictions were set in place.

Post-exercise evaluation

Overview of the NuDiVe Exercise

The overarching goal of NuDiVe 2022 was similar to its predecessor in 2019 but allowed for the insertion and evaluation of new technologies that would lend themselves to effectively determine material characteristic comparisons between original configuration and dismantled configuration. In addition to these technology applications NuDiVe 2022 utilized IPNDV-identified inspection approaches, procedures, and a diverse set of participants with differing experience levels to exercise and evaluate those approaches and procedures.

The exercise focused specifically on bringing verification theory from paper to practice, to validate the veracity of the IPNDV thinking on verification to date. The implementation of inspection approaches focused on step 8, nuclear weapons dismantlement, but excluded the manipulation of High Explosives (HE), instead focusing on the verification of nuclear material and non-diversion of SNM materials through their simulation by use of surrogate proxies to allow triggering of radiation detection and measurement devices.

Key IPNDV-develop inspection approaches tested in NuDiVe *8.2 Confirm chain of custody for the item to be dismantled*
Prior to dismantlement, the inspection team checks tags, seals, and UIDs on the accountable item to be dismantled and observes and verifies surveillance data for the item.

8.2) If needed to re-confirm consistency with declarations of each accountable item to be dismantled, an inspection team3:
Observes and measure item attributes (mainly radiation measurements) to confirm consistency with declared verifiable characteristics; and/or
checks against an applicable template for the item.

While the focus of the exercise was on step 8.2, action ns around 8.2. which involve the reverification of the “managed access” facilities and equipment, were also exercised prior to the simulated dismantlement. Some of these reverification steps could be found in steps 8.3 and the monitoring of the material from the facility subsequent to the verification also serve to support step 8.4.

8.3) Confirm that no SNM or HE is present in the dedicated dismantlement area prior to or following dismantlement
Inspection team “sweeps” the area under managed access, using hand-held monitoring equipment to detect any SNM or HE.

8.4) Confirm that the only accountable items to enter or leave it are those which have been declared and that no SNM is diverted during the course of the dismantlement operations
Inspection team:
o Makes visual observations and/or applies portal monitoring and other applicable C&S measures to ensure that the declared NED and empty component containers are the only accountable items to enter or be removed from the dedicated dismantlement area.
o Applies seals in the dismantlement area at potential diversion pathways
o Checks host staff entering and leaving the dismantlement area by radiation monitors.

The scenario for the exercise focused on inspection activities at a notional multi-purpose facility, that is: a facility where various nuclear weapon-related activities take place, but where a designated location within a "controlled area" is used for verified dismantlement. All inspection activities, aside from planning and data analysis, were conducted in the controlled area, which consisted of three rooms and an adjacent corridor.

The exercise was conducted as a gameplay exercise, with participants assigned roles in the following groups:

3. Host and technical personnel, including Jülich staff supporting the exercise (blue shirt);
4. host team, representing "Urania" (red shirt)
5. inspection team, from a notional multilateral verification entity (black shirt)
6. evaluation team (green shirt)

The exercise took place over five days. The first day and a half was for introductions and training of external participants in behavioral rules, and the technologies to be used in the exercise; the remainder of the week, the host and inspection teams planned, and discussed daily activities independently, and then conducted inspection activities jointly. There were opportunities to discuss and negotiate challenges related to expectations, some of which delivered agreement, while others showed to be inflexible. The inspection team also prepared daily reports (to a notional inspectorate headquarters) describing its daily activities and challenges. The final day included the final "in game" determination of success or failure from the inspection team, and the communication between inspectors and hosts in the morning. After lunch a post-exercise "hot-wash" was hosted by the Jülich organizers, and preliminary perspectives were delivered by participants for all of the different player and facility teams.

Evaluation process and methodology

The four-person evaluation team comprised of Ichiro Akiyama (JPN), Nico van Xanten (NDL), Jens Wirstam (SWE) and Leesa Duckworth (USA) observed all inspector-host interactions and most internal team game discussions and captured as frequently as possible comments and behaviors of the exercise players. Interviews were conducted with exercise organizers and team leaders, and all players completed questionnaires at the beginning and end of the inspection phase of the exercise. Comments during the post-exercise hot wash were also noted.

Intention of the Evaluation Team:

The evaluation structure will follow the same basic framework developed by Malcolm Coxhead, and team for the 2019 NuDiVe exercise. As such, we will establish the following evaluation structure:

Paired evaluation team members will split between the assigned team discussion room and exercise area, and will observe all inspector-host interactions and most internal, individual team discussions. As such, evaluators will select a function for either each day, or for the duration of the exercise, and will capture what information they can glean during those observations.

Evaluators will establish perception based upon direct observation of exercise activities, including in-game comments made by the exercise players that are not part of the planned step by step activities.

Additionally, outside of exercise play, interviews will be conducted with exercise organizers and team leaders to understand their perceptions, actions, and activities associated with preparing for and conducting the exercise, including their beliefs regarding the expectations of both the hosts and inspectors and any specific actions that were necessary to accommodate beyond normal expectations.

All players will complete a questionnaire at the beginning and end of the inspection phase of the exercise. (Specific questions to be generated at the Evaluation Team's first meeting). Comments during the post-exercise hot wash will also be noted. Table 1 contains the list of key questions to assist with the evaluation process.

Methodology Topics	Question
Use and performance of inspection technologies	1) What do the technologies do well? What do they not do well? 2) What are the gaps in technical capability and design
Value of inspection approaches and procedures	1) What do the inspection approaches and procedures do well / not so well? 2) Were the procedures easy to use and understand? 3) To what extent were inspection approaches and procedures effective in confirming the object of the inspection? 4) To what extent were inspection approaches and procedures efficient in minimizing the time and effort needed to complete the inspection? 5) If applicable, how well were discrepancies resolved? 6) How well did managed access measures related to proliferation risk and national security/safety work for the inspected state?
Interaction between the inspection and host teams	1) To what degree did security / safety measures impact conduct of the inspection? 2) What matters needed to be negotiated "on the ground" and were the outcomes mutually satisfactory?

Overall assessment of inspection activities	1) To what degree did the inspection activities provide confidence that state declarations were accurate? Detract from confidence? 2) How close are we to inspection approaches and technologies that are technically and practically sound?
Assessment of the exercise scenario design, venue and organization for testing IPNDV and ideas	1) Was the exercise effective for testing IPNDV-developed verification concepts? 2) What lessons are there for future exercises? 3) Was the training on the procedures / technologies adequate to accomplish the exercise objectives? 49 Was useful knowledge shared between the NNWS and NWS participants?
Understanding the role that perceptions of participants play in verification confidence in the exercise	1) In addition to the information gleaned through observation, how do the host/inspector participants express that they feel about the cooperation and honesty of the other? 2) Do each host and/inspector feel like information is being shared as needed and that unnecessary things are not being requested? 3) Are the inspectors' perceptions of success/failure consistent with what was observed by the evaluation team? Are there other psychological factors that influences their perceptions (feeling of cooperation or feelings of conflict; honesty/dishonesty; acting in good faith/withholding information)?

Table 1: List of key questions applied to the evaluation process.

Player Role	Questions
Host	As the host, do you feel that you can fulfill your verification obligations effectively with the technical equipment provided, and achieve confidence?
	What is your perspective on flexibility vs

	rigidity? When/where would you feel comfortable showing flexibility to help the inspectors achieve their verification mission?
	How do you expect the engagement with the inspection team to feel, more tense or more collegial?
	What role do security requirements play in the feel of the exercise?
	Are you sufficiently trained/competent in the operation/application of the technical equipment?
Inspector	
	What is your experience level with verification, and do you have a technical or non-technical background?
	Do you believe that you can achieve confidence through the verification plan and technologies proposed, if everything works as expected?
	Was the training sufficient to provide you confidence in your knowledge of the functions and operations of each technology?
	If a non-destructive assay technology didn't function as expected or the host had to deviate from the operating procedure you were trained to, how do you think that would impact your confidence?
	How do you think host behaviors, safety/security training, and processes and procedures affect your perception of the authenticity of the objects for verification?
	Do you believe that you have all the technical equipment and contextual information necessary to successfully complete verification? If not, what's missing?

Table 2: List of key questions used for the Host and Inspector Pre-Exercise Surveys.

Player Role	Questions
Host	Did you feel that you were successful in providing sufficient information to deliver inspector confidence in the verification?
	Did you have the requirement or opportunity to demonstrate flexibility and help the inspectors meet their mission?
	Were engagements with the inspectors tense of collegial, and how did that affect the inspection?
	Did security influence your conduct during the exercise, and did that have an impact on the inspections?
	Were you comfortable handling/applying all of the technical equipment, and did it operate as expected?
	Overall, how was your experience with the exercise? Did you feel like you gained understanding of the process/procedures needed to conduct verification? What could be improved?
Inspector	
	Beyond verification, what did you learn from the exercise? Was anything you learned unexpected?
	How effective was the instrumentation used for verification activities? Did the equipment leave any confidence gaps? If so, did any other factors help fill the gaps?
	Did the technologies function as expected, and were the results provided by each technology sufficient to make you confident? Were there any deviations from the expected procedures, did anything weird happen?
	How did the host's behaviors, safety, security and operational conditions of the facility add to or detract from your confidence?
	Did the technical equipment and contextual

	information used for verification satisfy your needs, or was anything missing that would have been impactful?
	Overall, how was your experience with the exercise? Did you feel like you gained understanding of the process/procedures needed to conduct verification? What could be improved?

Organizer	What was most complicated in preparing for this exercise, and how did you simplify it?
	How was the preparation/implementation of this exercise different from those for previous exercises?
	What advantages are there to having the exercise here at Jülich, what benefits does it offer?
	In preparation for this exercise, what assumptions did you make regarding the inspector expectations and host responsibilities?
	Why did you choose the specific technologies offered for this exercise? Why did you add more technologies, and if you have the opportunity, would you add more?
	What do you think should be the next NuDiVe exercise, and what would you want included?
Observer	What is it that you were hoping to learn from this exercise?
	In your perspective, what is the value of these exercises?
	What do you think should be the next NuDiVe exercise, and what additional things would you like to be included, or what additions would provide the biggest challenges?
	What were your ideas of how the exercise should have played out, and what would you like to have seen that wasn’t?

	Would it be useful to have exercises on different steps?

Table 3: List of key questions used for the Host and Inspector Post-Exercise Surveys.

Evaluation results: Use and performance of inspection technologies

NuDiVe 2022 utilized the same technologies from the previous exercise, listed below, but for this exercise also added Sandia's Trusted Radiation Identification Systems (TRIS), the Japan Atomic Energy Agency's Gamma Ray Imaging Technology, and applied the Electronic Optical Sealing System (EOSS) Seal. However, these technologies and some of the previously utilized and trusted technologies each faced its own challenges during the exercise; for example, the TRIS was nearly shaken apart in shipment and the Sandia Team quite literally had to reassemble it and hope it worked, the CCTV function was intermittent and sketchy at best in the equipment room, and the CCTV is one of the elements that weighed most heavily on the inspectors determination of confidence.

- sealing kit (transparent bag, handheld cameras, camera batteries and SD memory cards, adhesive seals, reflective particle matrix)
- portal monitor units and associated gamma and neutron test sources
- CCTV cameras
- computer terminals (laptops) for portal monitor and CCTV cameras
- neutron search detector
- handheld gamma detector
- handheld camera, camera batteries and SD memory cards
- SD flash memory for cameras and clear plastic vials for transfer from the controlled area
- tape measure and laser distance meter
- fixed-line telephone for communication between the controlled area and the inspection team's office
- high-density polyethylene (Tyvek) inspection suit, plus overshoes and latex gloves
- dosimeter and handheld contamination monitor (for health and safety purposes).

CCTV

Based upon its perceived successful application in the NuDiVe 2019 exercise, the organizers determined that CCTV was again a good monitoring option to employ for NuDiVe 2022. CCTV was relied upon for monitoring spaces and movement within and around spaces as an important tool for maintaining Continuity of Knowledge over the spaces, equipment and items considered part of the verification agreement. While the inspectors did not necessarily watch with intensity, every bit

of footage, the CCTV system did become critical when physical chain of custody was lost to a deviation from approved processes and procedures. This is also the point in which the failure of the CCTV system was the straw that could have saved or destroyed inspector confidence, and as a result of its problems in the particular space where the deviation occurred, confidence could not be recovered.

- Additional CCTV cameras may be needed to maintain line of sight (there were blind spots in this exercise).
- CCTV triggering may be a tool that can make footage verification easier. Without movement in the periphery of the camera's view, recording would just stop, but it would still be essential that the entire space is under observation.
- Challenges occurred in both setting up and sealing the cameras, as unobserved host personnel were caught on camera, manipulating the CCTV cameras after they had already been verified. Additionally, the CCTV camera set up process was overly arduous and would benefit from some streamlining to assure that all set up and sealing steps are done on an individual camera before moving to the next, vice doing one step on each camera before starting on the next step.

Portal Monitor and hand-held neutron and gamma detectors

Portal monitors and hand-held neutron and gamma detectors worked effectively to alarm on surrogate SNM as it entered and departed the facility. neutron and gamma detectors.

While some of the physical and functional challenges associated with each did persist, there was two- layer coverage methodology in those areas, providing some relief from the need for perfection.

The inspection process would benefit from a sweeping strategy that could be linked with sealing and could possibly eliminate unnecessary sealing and reduce the time it took for the facilities to be ready.

Sealing

Inspectors applied a large number of seals during the exercise. While there may have been suggestions for improvement upon the sealing process after that previous exercise, they may not have been fully incorporated. As a result, a significant amount of time was spent sealing things that probably didn't need to be sealed and missing out on the opportunity to paid sealing with sweeping techniques.

- Consistency in the photographing of seals and their reflective particle matrix still proved to be challenging, especially where seals were applied in locations where use of a camera was difficult.
- It would be valuable to educate and train inspectors on what to seal, why to seal, and how to seal, for the next exercise. Inspectors would have benefitted from having a hypothetical description of the product of concern so they would know if it was tiny enough to fit in an air hose, and a sealing strategy that was clearly explained before the sealing started taking place.

- The application of the EoSS Seal, while a useful example, ended up instead also being a disaster because of problems with the computer equipment, which let to unauthorized movement of unapproved equipment into and out of the controlled area.

Local Communications

Local communication continued to be problematic during NuDiVe 2022. Initially the phone did not work in the inspector room, and even once that got rectified communication access to the inspectors in the controlled area was not managed consistently by all hosts. In some cases inspection team members were able to speak directly to their Team Lead while the host held the phone and at other times messages were relayed with limited consistency, between the inspection team lead and inspectors in the controlled area, through the host escort, without access to hear what the inspection Team Lead said directly.

Additionally, communication on the host team did not appear to be as clear as it could have been either, as some hosts thought they had authority to make decisions without asking the host team lead, which is what let to the material staging deviation that created the lost custody and ultimately lost confidence situation. Some inspectors interpreted their support role in way that inspired them to take actions without the notification of the other host members, creating confidence issues with equipment (CCTV cameras) and the “secure” equipment container as well. The Secure equipment container was also not secured and resealed after each opening and closing.

High-density polyethylene (Tyvek) inspection suits were used by inspectors in the controlled area to prevent swipe sampling. The impact of hot and uncomfortable suits on inspector performance and wellbeing was a subject of considerable discussion during the exercise in 2019. This same approach was used for NuDiVe 2022 and heat related health issues did appear to manifest themselves again during this time. The exercise spaces were quite warm, and the inspector rotation strategy was not sufficiently controlled to assure that inspectors rotated out frequently enough. Additionally, because of communication challenges, the inspector team was at times unable to communicate directly with their members, to ascertain health conditions and had to depend on others stating that an inspection team member didn’t look well or was sweating profusely and needed to be replaced.

Facility design

NuDiVe 2022 was conducted in the same facilities as the previous 2019 NuDiVe exercise, with some of the same challenges. In an attempt to mitigate those challenges, some facility features and characteristics were marked outside of play from the beginning. However, because of the absence of a clear sampling strategy and training, later on, additional objects needed to be eliminated from game play to allow the exercise to move forward.

An excessive amount of time was spent sealing features that may not have needed to be sealed, simply because inspectors thought that they had to seal anything that could be a potential diversion pathway, without the context of what constituted a diversion pathway for the dismantlement end product, to size and form. A briefing as to the general characteristics of that object of interest and a sealing and sweeping strategy based upon that information would have saved a lot of time and effort at the first half of the exercise.

Evaluation results: Value of inspection approaches and exercise procedures

In the end, the inspection team was unable to attain sufficient confidence to affirm the dismantlement had been completed and no diversion had taken place, the evaluation teams has ascertained the reasons for which are detailed below.

Inaccurate Preparation Assumptions

From the onset, the host and inspector teams faced challenges that they may not have even realized. The organizers (according to interview data) had expected both teams to have self-educated, planned and prepared before coming to the exercise. The Procedure Descriptions were expected to have been discussed and organization and strategies constructed around performing those tasks using the step guide, because the teams would have been well trained.

As a result of Covid, and the virtualization of IPNDV multinational communication, training and strategy building discussions that had previously been performed on the fringes of 2018/2019 IPNDV meetings, were no longer readily available because virtual audiences are not captive audiences as in-person audiences are.

Additionally, personnel assignments changed several times over the preparation duration as a result of Covid issues, providing both, smaller exercise player teams and imbalanced player mixes between experienced and non-experienced players (pre-exercise survey indicated that 4 of 6 inspector team members had limited if any verification experience or technical understanding and there wasn't any pre-training to give them confidence that they understood the processes and procedures). On top of this, the Inspector Team Leader had a collaborative leadership style requiring and implementing ideas and inputs from their team and allowing the team members a significant level of autonomy to make decisions and determinations while inside the controlled area. This became a challenge when inspector players, unfamiliar with processes and protocols of verification, allowed the also unfamiliar host (2 of 4 host pre-inspection respondents said they were novices to verification and had little technical understanding of the equipment and procedures) to move the "dismantled" item under verification Chain-of-Custody (CoC) to be moved into an unauthorized location (The Equipment room), and it just so happens that the unauthorized location also had a CCTV malfunction, resulting in the item being unobservable during its stay in that location. This is in part what led to the inability to attain confidence that there was no diversion.

Confusing and changing host communications

While the host team's strategy did exist, there were several host players who made suggestions, statements or decisions without the confirmation and approval of the host team leader. The movement of the item into an unauthorized location was one of these decisions. The statement by the host team that this location would be acceptable, was made to inexperienced inspectors who did not have sufficient understanding to know that the change should have been questioned and team leaders called before any deviation from approved processes were made.

Crowded and Chaotic Controlled Areas

There were a number of times during the exercise when it was difficult to understand who were hosts, and who were the technical people, as sometimes people wore dual hats to fill spaces. At times there were a huge number of "observers" just lingering around watching and chatting. This

made it both difficult to see and at times, difficult to hear as well. There were host team personnel doing technical verifications (CCTV Camera Serial Numbers) and getting tools and instruments and swapping off who was watching the inspectors so that they were confused several times who they were with.

Ineffective Procedures used for the Inspection

As mentioned above, the Step Guide assumed that the users would be well-trained teams and would know the detail of the Procedure Descriptions sufficiently to use the checklist style guide. This was not the case with the NuDiVe 2022 Inspection Team and the full procedures should have been used instead. Because of that unfamiliarity, steps in the Step Guide that could have been done in sequence and then repeated in the same sequence on multiples of the same equipment, instead was done one step on each item, then next step on each item, making the set-up require a much longer evolution. Additionally, the inspection team personnel numbers in the Step Guide and Procedure Descriptions did not always match, and there were instances where a single inspector was left alone to conduct verification steps in the presence of several hosts.

Influence of the systems approach perspective from NuDiVe 2019

The 2019 NuDiVe Evaluators felt that inspectors may be able to fulfil their task with less effort than was needed in the exercise if inspection tasks could be prioritized based on a holistic approach to risk. For example, the effort required for placement and checking of seals by inspectors could be reduced. IPNDV has begun a discussion on applying a “systems approach” to verification on the basis that not all verification measures would need to be applied at every step, and confidence in the overall effort is built through the combination of activities throughout an ongoing dismantlement process. In light of the NuDiVe experience, the evaluators recommend that IPNDV further discusses how a systems approach could be applied to the design of C&S systems, with the aim of identifying efficiencies.

The adoption of a systems approach in inspections requires that inspectors are well briefed on the physical scenario they will face on the ground and on the history of (and future plans for) verification at the site. Because this did not occur with the NuDiVe 2022 players, the intended approach to gain efficiencies that was applied, was unsuccessful.

Evaluation results: Interaction between the inspection and host teams

Inspector-host team dynamics

While a collaborative feel was apparent at the beginning of the exercise and at the start of day 2, as each day went on, the collaborative feel appears to wear thin. When inconsistencies in inspection personnel numbers authorized in the controlled area appeared inconsistent with the procedure description numbers, there was little to no flexibility in increasing that number of personnel on the grounds of inspector health and safety. This is inconsistent with verification reality as an inspection team would never send a lone inspector into an area, there would always be at least 2. Additionally, the host did not appear to have awareness over the visible health indications of the inspectors and a health and safety officer did not assess inspectors for heat-related conditions or limit the time a “dressed-out” inspector could be in the controlled area without replacement. Additionally,

replacement protocols did not allow for effective hand-off of information between replacement inspection team members as they rotated new inspectors into the controlled area, under the grounds of inspection personnel limits.

Dispute management

Differences of view between the inspection and host team were managed respectfully. Not all disputes were resolved to the satisfaction of both sides, however. In part, this was due to time limitations in the exercise. While exercise artificiality may have been a factor, limited understanding of the larger context of verification, national concerns, and high-risk/high-security protocols, also played heavily into how each side responded to differences in perspectives. Additionally, while both teams may have played to be competitive rather than to resolve a real problem, internal competition also may have influenced player behaviors driving some to want to stay in and work even though they were exhausted or ill, or that they wanted to be the one leading the activity.

Managed access

Managed access constraints on inspector were built into the protocols for the exercise. Access donning and doffing of PPE practices were consistent with expectations for this type of environment and the management of those practices were done well.

Additional Effects of Exercise Artificiality – New Seal and Authorized Equipment Challenges

One of the challenges with a managed access environment and the introduction of a new CoC technology is assuring that the necessary operating equipment is considered in the approval and control protocols and there is a recovery plan that is known and articulated in the case that something goes wrong. The application of the EOSS Seal was one such case. The laptop needed to operate the EOSS Seal was a host employee's personal laptop, and because it was in use by that employee until when it was needed for the seal application, it was not pre-verified and under seal by the inspector. Additionally, that laptop failed to provide the results to show the seal was successfully applied, while it was connected to the Seal. Instead of removing that seal, a second, unverified laptop was rushed in to replace it that belonged to another staff member, and the seal simply read that it had been sealed but didn't show the sealing process. This raises not only questions regarding the validity of the sealing process because there was no way to verify what was done to the seal by the first laptop, but also because the second just showed sealed, didn't add confidence that the seal couldn't have been corrupted or tampered in the process of switching between laptops.

Evaluation results: Overall assessment of inspection activities

As mentioned above, the inspection team could not achieve verification and non-diversion confidence as a result of the many things discussed in these sections. The host seemed surprised at the end of the inspection when that was announced, and the organizers concerned and disappointed. However, because the participants are learning, the exercise was not a failure. While technically, it did not meet the inspection's mission objectives, a lot was learned about what IPNDV as a body can do to continue to help these NuDiVe exercises become stronger, more effective, and more consistent with the protocols and practices within high-risk/high-security weapons environments. The

applicable IPNDV-developed inspection concepts and approaches are sound, but there are many polishing elements that still need attention.

It was obvious from the environment, structure, and resources so carefully crafted for this exercise that the organizing team expended extensive effort to deliver an exercise that represented as closely as possible, an environment and the conditions expected for dismantlement verification. From the onsite of planning for this NuDiVe exercise, the planners were faced with a number of challenges to overcome, some within their control to address and others outside, that they could only hope could be overcome by the actions and efforts of others.

The ongoing factor of Covid and its influence on the timing, planning and participation availability for this exercise complicated readiness activities, planning and communication, both with the organizing team and between the host and inspector team participants. Because of changes in availability, teams ended up smaller than hoped, and many participants did not become sufficiently familiar with the full procedure to make the step-by-step procedure effective.

Arrangements for lodging and transportation were effective at keeping participants separated by function. Some other examples of the organizing team's efforts included the application of radiation access practices and the involvement of actual experts in radiation safety, who provided a very realistic experience. The availability of both detailed procedures and a step-by-step checklist were also very valuable in depicting that the activities being performed would be done by experts and while the detailed procedures listed each and every action, the step-by-step guide would be used by a well-trained team to ensure each activity had been performed. Familiarization with and preparation for deploying those procedures were left to the teams and players.

Evaluation results: Assessment of the exercise scenario design, venue and organization

Team members and availability changed multiple times creating very limited team sizes and impacting planning to a degree. The Host and Inspector personnel numbers listed in the full-length procedures conflicted in some places with the personnel numbers in the step-by-step guide. Because the step-by-step guide was a checklist, the full-length procedures should have been the governing document. Additionally, the conflicts between these two documents created unnecessary tension, lost time, and created ongoing arguments over which information was correct.

Some equipment and resources became available to the organizers very late, and there wasn't sufficient time to practice and prepare with them, and there was not time for a Dry Run, which could have shaken out some of the bugs. TRIS for example, had been rattled nearly apart and the Sandia experts literally had to put it back together because there were so many screws loose.

The interruption of inspection activities for a lunch hour, was unnecessary. While previous participants may have complained, the reality is that you would not stop mid inspection to go to a cafeteria and eat, box lunches or delivered food would more likely be offered so that participant personnel could continue activities and rotate lunch shifts. These scheduled, all participant lunch breaks also impacted exercise efficiency not only due to the break period but also by introducing an opportunity for out of exercise conversations to and from the cafeteria, making it more difficult to return to exercise formality in the afternoon.

The organizer team relied upon the host and inspector teams to really drive the direction of the exercise, taking more of an observer/facilitator role in most cases. There were several instances when an observer Controller, would have been valuable to move the activities along, including during sealing and when actions were taken by the host and inspector players that deviated from the planned process.

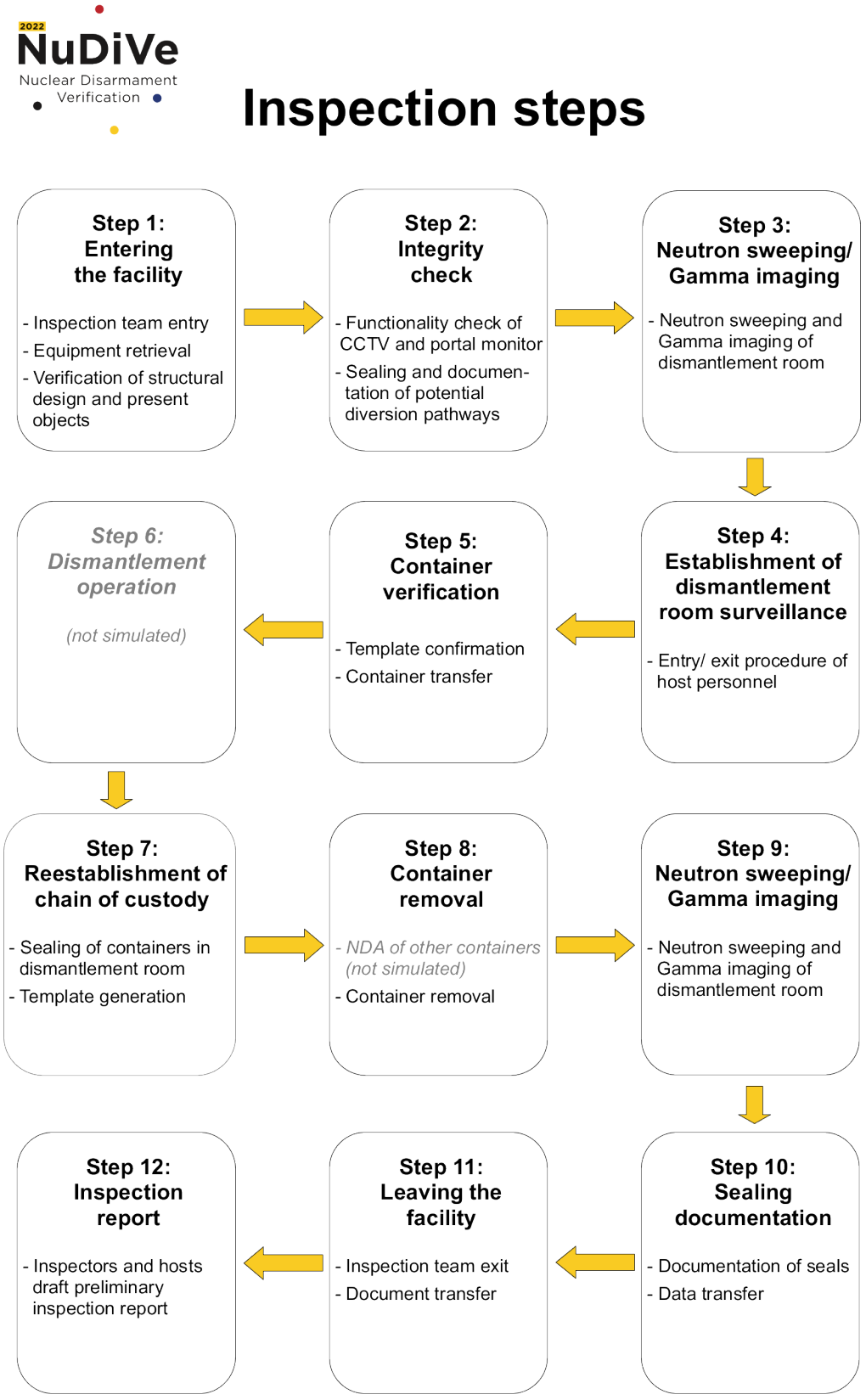
There were several instances when inspectors were only allowed a single inspector to conduct a task, which would never be allowed by the inspectorate due to safety. Inspection activities should always follow the two-person rule. Also, the application of this limitation seemed arbitrary as the host personnel limits were not followed in most of those circumstances. In one case there was a single inspector surrounded by as many as six hosts (some of whom were "technical support personnel," who if not acting as hosts should have been in a different colored shirt. There were a few times when those technical support personnel were used beyond their technical support role to also "watch the inspector, "filling a host role. Therefore, a decision needs to be made regarding the role/function of Technical Support personnel, and that decision should be permanent, not flexible. This situation resulted in increased difficulty performing inspection activities, especially associated with maintaining continuity of knowledge over equipment and the assurance that no host actions were being taken outside of inspector purview. The CoK over i.e., the TRIS was not continuous. This could lead to a situation in which all future disarmament could be fake (which is far more serious than the potential diversion of the item that is dismantled in this exercise).

Role and function of hosts and inspectors were not universally well understood. The mission, purpose, and function were not clear to all players.

Concluding remarks

While this particular NuDiVe Inspection team could not achieve confidence, NuDiVe continues to deliver an excellent venue and forum to continue to refine, practice and exercise the procedures and protocols involved with verifying different elements of the 14 steps because of the facility's structure and capabilities and the passion and enthusiasm of its organizers. As such it is critical that in developing these next NuDiVe exercises that pre-training, strategy development and practice are baked into IPNDV's efforts to support providing the teams to exercise each new step activity. Lastly, there are a number of other training/educational topics that IPNDV could pursue adding to help participants to understand which will make them more successful and interested players in future exercises. These topics might include things like foundational verification practices in high-risk/high-security, managed access environments; what, when and why to seal something; understanding health and safety in full PPE, and several others. Inspection team leads can be provided a framework on what tools they need to provide their teams and activities can be offered to help establish that education. Because of all we learned through these evaluation efforts, I believe the purpose of NuDiVe was met, and that we as a team, learned a lot.

4. Flow chart


2022
NuDiVe
Nuclear Disarmament Verification
Inspection steps
Step 1: Entering the facility
- Inspection team entry
- Equipment retrieval
- Verification of structural design and present objects
Step 2: Integrity check
- Functionality check of CCTV and portal monitor
- Sealing and documentation of potential diversion pathways
Step 3: Neutron sweeping/ Gamma imaging
- Neutron sweeping and Gamma imaging of dismantlement room
Step 4: Establishment of dismantlement room surveillance
- Entry/ exit procedure of host personnel
Step 5: Container verification
- Template confirmation
- Container transfer
Step 6: Dismantlement operation
(not simulated)
Step 7: Reestablishment of chain of custody
- Sealing of containers in dismantlement room
- Template generation
Step 8: Container removal
- NDA of other containers (not simulated)
- Container removal
Step 9: Neutron sweeping/ Gamma imaging
- Neutron sweeping and Gamma imaging of dismantlement room
Step 10: Sealing documentation
- Documentation of seals
- Data transfer
Step 11: Leaving the facility
- Inspection team exit
- Document transfer
Step 12: Inspection report
- Inspectors and hosts draft preliminary inspection report

5. Step guide

CONTENT

ENTERING THE FACILITY

FACILITY ENTRY

DESCRIPTION

Inspection team members are required to follow certain procedures and necessary actions when entering the radiation protection area.

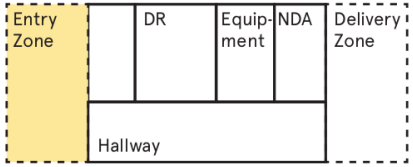
REFERENCE

Procedure description: Facility entry & exit procedure p. 1

EQUIPMENT

- ☐ Inspector`s ID
- ☐ Clipboard and pen
- ☐ Inspection logsheet and documents
- ☐ Dosimeter
- ☐ Dosimeter assignment list
- ☐ Radiation protection log sheet
- ☐ Lanyard
- ☐ Hand and foot monitor
- ☐ Tape
- ☐ Inspection suit, gloves and overshoes

LOCATION



PERSONNEL

1 Inspector | 2 Hosts

AGENDA

1) INSPECTION TEAM ENTRY

- ☐ Request access to radiation protection zone
- ☐ Verify inspector`s ID
- ☐ Store documents at designated spot
- ☐ Assign dosimeter, fill out radiation protection log sheet with inspector`s information, prepare lanyard with dosimeter and inspector`s ID
- ☐ Sign radiation protection log sheet
- ☐ Use hand foot monitor
- ☐ Dress inspector with new suit, gloves and overshoes
- ☐ Tape suit into sleeves of inspection gloves and into inspection overshoes
- ☐ Hang lanyard with ID and dosimeter around inspector`s neck
- ☐ Pick up clipboard, pen and documents
- ☐ Permit escorted entrance

Repeat for every inspector

COMMENTS

Inspection team member is accompanied by a host team member to entry of radiation protection area

Inspection team member is escorted by at least one host team member at all times

1 ENTERING THE FACILITY

FACILITY VERIFICATION

DESCRIPTION

Before the SNM dismantlement process, the structural conditions (dimensions, openings, pipes,...) of the radiation protection area and the dismantlement room (DR) have to be verified and the DR has to be checked for undeclared objects and unsealed potential diversion pathways.

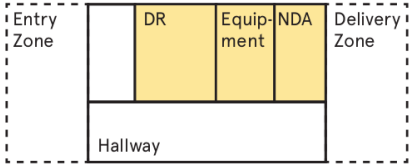
REFERENCE

Procedure description: Equipment retrieval and locking procedure p. 7, Visual inspection and photography procedure p. 15

EQUIPMENT

- ☐ Building plan of the facility
- ☐ Laser distance meter
- ☐ Sealing kit incl. camera
- ☐ Step stool (to be used if necessary)

LOCATION



PERSONNEL

2 Inspectors | 2 Hosts

AGENDA

1) EQUIPMENT RETRIEVAL

- ☐ Retrieve sealing kit → X2
- ☐ Retrieve laser distance meter → X2

2) VERIFICATION OF STRUCTURAL DESIGN AND PRESENT OBJECTS

- ☐ Compare structural design with building plan of facility
- ☐ Compare CCTV locations with markings in building plan
- ☐ Compare portal monitor locations with markings in building plan
- ☐ Indicate specific dimensions to be measured
- ☐ Measure indicated dimension with laser distance meter or tape measure

3) EQUIPMENT RETRIEVAL

- ☐ Put laser distance meter back in storage box → X2

COMMENTS

Further equipment retrieval and locking will not be stated explicity and executed at inspector`s demand

X1

X2

X3

INTEGRITY CHECK

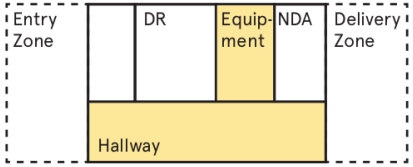
FUNCTIONALITY CHECK OF CCTV AND PORTAL MONITOR

DESCRIPTION
CCTV and radiation portal monitor have been commissioned during a previous inspection. Now the systems have to be checked on their functionality. Further seals have to be documented to ensure the equipment`s integrity.

REFERENCE
Procedure description: Portal monitor procedure p. 25, CCTV procedure p. 33

EQUIPMENT
- ☐ List with numbers of authentication seals (from previous inspection)
- ☐ Neutron/Gamma test source
- ☐ Sealing kit incl. camera

LOCATION



PERSONNEL
2 Inspectors | 2 Hosts

AGENDA

1) CCTV CHECK

☐	☐	Verify authentication IDs of CCTV cameras and CCTV terminal
☐	☐	Document seals on CCTV cameras and CCTV terminal
	☐	Break seal on CCTV terminal
☐	☐	Verify field of view
☐	☐	Make sure all cameras broadcast live material

If no data is being transfered

☐	☐	Apply & document seal on CCTV terminal → X1

2) PORTAL MONITOR CHECK

☐	☐	Verify authentication IDs of portal monitors and portal monitor terminal
☐	☐	Document seals on portal monitors and portal monitor terminal
☐	☐	Verify authentication ID of test source containment
☐	☐	Document seals on test source containment
	☐	Break seals on test source storage containment
	☐	Retrieve Neutron/Gamma test source
	☐	Place Neutron/Gamma test source in portal monitor measurement area
	☐	Demonstrate functionality of portal monitor
☐	☐	Apply and document seal on portal monitor terminal → X1

Other detectors' functionality will (automatically) be checked before usage

COMMENTS

Test source brought by radiation protection officer

Both lights should be flashing and a time stamp should appear in the alarm logfile

INTEGRITY CHECK

SEALING AND DOCUMENTATION OF POTENTIAL DIVERSION PATHWAYS

DESCRIPTION

The dismantlement room (DR) has to be checked for potential diversion pathways which have to be sealed before the actual dismantlement takes place. This was already done during a previous dismantlement, but seals have to be documented to ensure their integrity. Also further seals may be applied.

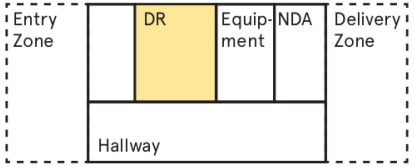
REFERENCE

Procedure description: Sealing procedure p. 21
(Visual inspection and photography procedure p. 15)

EQUIPMENT

- ☐ Sealing kit incl. camera

LOCATION



PERSONNEL

1 Inspector | 1 Host

AGENDA

1) DOCUMENT SEALED POTENTIAL DIVERSION PATHWAYS

- ☐ Indicate seal which is to be documented
- ☐ ☐ Document seal

Repeat for every seal in DR

2) SEARCH FOR UNSEALED POTENTIAL DIVERSION PATHWAYS

- ☐ Indicate unsealed potential diversion pathway
- ☐ ☐ Document unsealed potential diversion pathway

If possible

- ☐ ☐ Seal potential diversion pathway and document seal → X1

Repeat for every potential diversion pathway

If sealing not possible on the spot

- ☐ ☐ Discuss issue with team leaders

If at any point deemed necessary

- ☐ Close and seal DR door from outside
- ☐ ☐ Document seal on DR door

COMMENTS

If deemed necessary by the inspectors

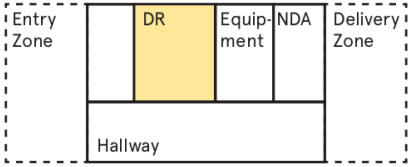
NEUTRON SWEEPING/ GAMMA IMAGING

NEUTRON SWEEPING

DESCRIPTION
Neutron sweeping scan of the dismantlement room (DR) with a handheld neutron detector to ensure the absence of undeclared neutron sources

REFERENCE
Procedure description: Handheld neutron sweeping procedure p. 39

EQUIPMENT
☐ Handheld neutron detector

LOCATION


PERSONNEL
2 Inspectors | 2 Hosts

AGENDA

1) BACKGROUND MEASUREMENT OUTSIDE DISMANTLEMENT ROOM

		COMMENTS
☐	Choose spot in center of hallway or equipment room	
☐	Press "power on/off button" for 5s to switch detector on	
☐	Note measurement result and location	
	If signal < 0.3 cps: proceed with 2)	Do not turn off detector

2) BACKGROUND MEASUREMENT INSIDE DISMANTLEMENT ROOM

☐	Choose spot in center of DR	
☐	Select INTEGRAL mode and execute integrated measurement for 30s	
☐	Note measurement result and location	
	If display shows "N ≤ B": retake background measurement	

3) NEUTRON SWEEPING

☐	Indicate measurement spot and direction of movement	
☐	Select SEARCH mode and start measuring from indicated spot on by moving detector slowly near surface in instucted direction	**Inspector indicates pace**
	If relevant rise in count rate	
☐	Select INTEGRAL mode and execute measurement for 30s	Proceed if value does not exceed threshold

NEUTRON SWEEPING/ GAMMA IMAGING

GAMMA IMAGING SCAN

DESCRIPTION

Gamma imaging scan of the dismantlement room (DR) with a Compton imaging detector to ensure the absence of undeclared gamma sources.

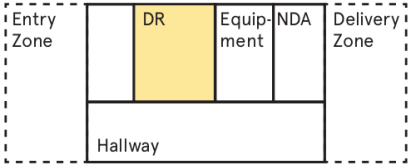
REFERENCE

Procedure description: Gamma imaging procedure p. 45
Back-up: Handheld gamma sweeping procedure p. 51

EQUIPMENT

- ☐ Gamma imaging detector
- ☐ Test source
- ☐ Laser distance meter
- ☐ Adhesive tape

LOCATION



PERSONNEL

2 Inspectors | 2 Hosts

AGENDA

1) FUNCTIONALITY TEST

- ☐ Press red button to start detector
- ☐ Indicate measurement spot and direction
- ☐ Place test source in 1 m distance
- ☐ Confirm distance with detector-implemented laser rangefinder
- ☐ Turn on near-field-correction
- ☐ Select Ba-133 isotope
- ☐ Start measurement of 10 min

After measurement

- ☐ Confirm peaks, correct signal in optical image and count rate exceeding threshold

2) GAMMA IMAGING SCAN OF DISMANTLEMENT ROOM

- ☐ Indicate measurement spot and direction
- ☐ Mark position with tape
- ☐ Measure distance to the next wall with detector-implemented laser rangefinder
- ☐ Measure distance to other walls with laser distance meter
- ☐ Turn on near-field-correction
- ☐ Select "Dose" option
- ☐ Start measurement of 60 min

After measurement

- ☐ Confirm absence of peaks, signal in optical image and count rate not exceeding threshold

COMMENTS

Test source brought by radiation protection officer

Can be counter-checked with laser distance meter

Marked position should be verified when repeating measurement after dismantlement

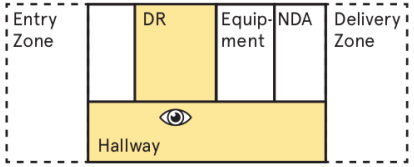
ESTABLISHMENT OF DISMANTLEMENT ROOM SURVEILLANCE 7

ENTRY AND EXIT PROCEDURE

DESCRIPTION
During the actual dismantlement process, a host might enter or leave the dismantlement room (DR). The inspectors supervise entry and exit with the radiation portal monitor.
In case the portal monitor raises an alarm, a body scan is performed with neutron and gamma detectors.

REFERENCE
Procedure description: Dismantlement room Entry/Exit procedure p. 69

EQUIPMENT
- ☐ Portal Monitor
- ☐ Handheld gamma detector
- ☐ Handheld neutron detector

LOCATION


PERSONNEL
2 Inspectors | 4 Hosts

AGENDA

1) PREPARATION
If deemed necessary
- ☐ Prepare handheld neutron and gamma detector

2) HOST DISMANTLEMENT ROOM ENTRY
- ☐ Stay in center of portal monitor for 20s

If there is no alarm
- ☐ Permit host entry to DR

3) HOST DISMANTLEMENT ROOM EXIT
- ☐ Inform host outside DR about exit
- ☐ Announce exit to inspectors outside DR
- ☐ Leave DR and stay in center of portal monitor area for 20s

If there is no alarm
- ☐ Permit host to leave portal monitor area

Repeat for every person entering/exiting the DR

COMMENTS

The neutron detector should always be turned on as initial background measurement takes a lot of time

If there is an alarm: neutron and gamma body scan
(see Procedure Description: p. 70)

If there is an alarm: neutron and gamma body scan
(see Procedure Description: p. 70)

CONTAINER VERIFICATION

8

TEMPLATE CONFIRMATION

DESCRIPTION

A gamma template measurement with the TRIS system of the Special Nuclear Material (SNM) signature emitted by the Treaty Accountable Item (TAI) container is taken to verify its integrity. Inspectors can verify the SNM in advance of the dismantlement by comparing the signature to a previously measured template.

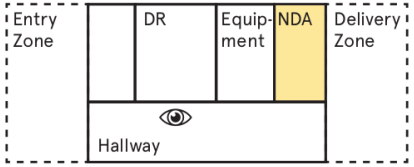
REFERENCE

Procedure description: Template procedure p. 61

EQUIPMENT

- ☐ TAI container
- ☐ TRIS system
  - ☐ Firmware hash key
  - ☐ Red & black hash side value
  - ☐ Public key iButton
  - ☐ Template iButton

LOCATION



PERSONNEL

2 Inspectors | 2 Hosts

AGENDA

1) PREPARE TRIS SYSTEM

- ☐ Start TRIS system
- ☐ Give firmware hash key
- ☐ Verify red and black side hash values
- ☐ Reject option to generate new template
- ☐ Give host public key iButton to connect it to black side of trusted processor
- ☐ Execute functionality test
- ☐ Connect template iButton to red side
- ☐ Ensure that trusted processor verifies template signature with public key

2) ARRIVAL OF TAI CONTAINER (→NEXT PAGE)

3) COMPARING TAI SIGNATURE TO AN EXISTING TEMPLATE (→NEXT PAGE)

COMMENTS

Caution: DR surveillance maintained

CONTAINER VERIFICATION

TEMPLATE CONFIRMATION

AGENDA

2) ARRIVAL OF TAI CONTAINER

- ☐ Enter dismantlement room (only one host)
- ☐ Ensure that portal monitor terminal is closed
- ☐ Move TAI container from delivery zone to NDA room
- ☐ Confirm container's id and integrity of its seal
- ☐ ☐ Document seal

3) COMPARING TAI SIGNATURE TO AN EXISTING TEMPLATE

- ☐ Confirm position of NaI detector
- ☐ Background collection and calibration
- ☐ Spectrum collection
- ☐ Ensure that measurement is confirmed against template

COMMENTS

Host must enter dismantlement room before TAI container arrives at dismantlement area

CONTAINER VERIFICATION

10

CONTAINER MOVEMENT

DESCRIPTION

Transfer of containers from the non-destructive assay (NDA) room to the dismantlement room (DR) with a portal monitor measurement.

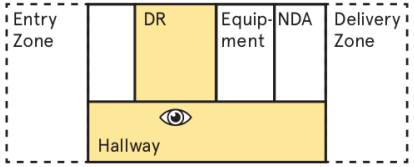
REFERENCE

Procedure description: Container movement procedure p. 55, Handheld neutron sweeping procedure p. 39, Handheld gamma sweeping procedure p. 51

EQUIPMENT

- ☐ Portal monitor
- ☐ Handheld gamma detector
- ☐ Handheld neutron detector
- ☐ TAI container
- ☐ Empty SNM container
- ☐ Empty OC container

LOCATION



PERSONNEL

1 Inspector | 2 Hosts

AGENDA

1) TAI CONTAINER TRANSFER: NDA ROOM → DISMANTLEMENT ROOM

- ☐ Verify presence of one host in the DR
- ☐ Ensure that portal monitor terminal is closed
- ☐ Move TAI container from NDA room to portal monitor measurement area
- ☐ Verify gamma and neutron alarm of portal monitor flashlights
- ☐ Hand over TAI container to host in DR

2) TRANSFER OF EMPTY CONTAINERS: NDA ROOM → DISMANTLEMENT ROOM

Execute task seperately for empty SNM and empty OC container

- ☐ Move empty container from delivery zone to portal monitor measurement area
- ☐ Verify container ID
- ☐ Verify absence of portal monitor`s gamma and neutron alarm

If deemed necessary by inspectors

- ☐ Perform gamma and neutron sweeping on empty container
- ☐ Hand over empty container to host in DR

COMMENTS

Caution: DR surveillance maintained

Nobody must enter the DR simultaneously with the TAI container

1 2 3 4 5 **6** 7 8 9 10 11 12 X1 X2 X3

DISMANTLEMENT OPERATION

11

not simulated

REESTABLISHMENT OF CHAIN OF CUSTODY

SEALING OF CONTAINERS AND TEMPLATE GENERATION

DESCRIPTION

After dismantlement, seals on the SNM (Special Nuclear Material) container and the OC (other Components) container must be applied and documented to reestablish the chain of custody. Inspectors take a new template in NDA room for later verification.

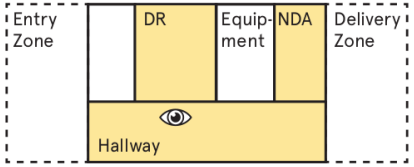
REFERENCE

Procedure description: Sealing procedure p. 21,
Template procedure p. 61, Container movement procedure p. 55,
SNM container sealing procedure p. 83

EQUIPMENT

- ☐ Sealing kit incl. camera
- ☐ TRIS system
  - ☐ Firmware hash key
  - ☐ Red & black hash side value
  - ☐ iButtons (host and inspector random number seed, Public key and Template iButton)

LOCATION



PERSONNEL

2 Inspectors | 2 Hosts

AGENDA

1) SEALING OF SNM CONTAINER WITH EOS SEAL

- ☐ ☐ Apply EOS seal on SNM container
- ☐ ☐ Document EOS seal

2) SEALING OF OC AND EMPTY TAI CONTAINER

- ☐ ☐ Apply and document (adhesive) seal on OC container → X1
- ☐ ☐ Apply and document (adhesive) seal on empty TAI container → X1

3) PREPARE TRIS SYSTEM (→NEXT PAGE)

4) MOVE SNM CONTAINER TO NDA ROOM (→NEXT PAGE)

5) GENERATE TEMPLATE (→NEXT PAGE)

COMMENTS

Caution: DR surveillance maintained

REESTABLISHMENT OF CHAIN OF CUSTODY

SEALING OF CONTAINERS AND TEMPLATE GENERATION

AGENDA	COMMENTS
2) PREPARE TRIS SYSTEM	
☐ Start TRIS system	
☐ Give firmware hash key	
☐ Verify red and black side hash values	
☐ Generate new template	
☐ Give host random number seed iButton to connect it to black side of trusted processor	
☐ Connect template iButton to red side	
☐ Create private/public key pair and save public key on public key iButton	
☐ Take public key iButton and random number seed iButton	Keep both iButtons in line of sight of host
☐ Execute functionality test	
3) MOVE SNM CONTAINER TO NDA ROOM	
☐ Ensure that portal monitor terminal is closed	**Nobody must enter the Dismantlement room simultaneously with the TAI container**
☐ Move SNM container from dismantlement room to portal monitor measurement area	
☐ Verify gamma and neutron alarm of portal monitor flashlights	
☐ Hand over SNM container to host in hallway	
☐ Move SNM container to NDA room	
4) GENERATE TEMPLATE	
☐ Confirm position of NaI detector	
☐ Background collection and calibration	
☐ Spectrum collection	
☐ Observe automatic signing of template with private key	
☐ Write template to iButton	
☐ Repeat measurement for template confirmation	

CONTAINER REMOVAL

CONTAINER MOVEMENT AND NDA

DESCRIPTION

The SNM container is moved from the NDA room to the delivery zone. The remaining containers are then transferred from the dismantlement room (DR) to the NDA room and the delivery zone.

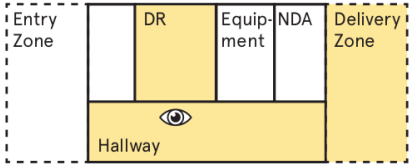
REFERENCE

Procedure description: Container movement procedure p. 55, Handheld neutron sweeping procedure p. 39, Handheld gamma sweeping procedure p. 51

EQUIPMENT

- ☐ Portal monitor
- ☐ Handheld gamma detector
- ☐ Handheld neutron detector
- ☐ SNM container
- ☐ OC container
- ☐ Empty TAI container

LOCATION



PERSONNEL

1 Inspector | 2 Hosts

AGENDA

1) FURTHER NDA OF SNM CONTAINER (NOT SIMULATED)

2) SNM CONTAINER TRANSFER: NDA ROOM → DELIVERY ZONE

- ☐ Ensure that portal monitor terminal is closed
- ☐ Move SNM container from NDA room to delivery zone

Execute 3), 4) and 5) for empty TAI container and OC container

3) TRANSFER OF REMAINING CONTAINERS: DISMANTLEMENT ROOM → NDA ROOM

- ☐ Move container from DR to portal monitor measurement area
- ☐ Verify absence of portal monitor's gamma and neutron alarm

If deemed necessary by inspectors

- ☐ Perform gamma and neutron sweeping on container

- ☐ Hand over container to host in hallway
- ☐ Move container to NDA room

4) NDA ON OC AND EMPTY TAI CONTAINER (NOT SIMULATED)

5) FINAL CONTAINER TRANSFER: NDA ROOM → DELIVERY ZONE

- ☐ Move container from NDA room to deliver zone

COMMENTS

Caution: DR surveillance maintained

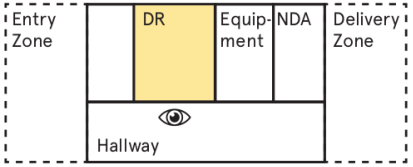
NEUTRON SWEEPING/ GAMMA IMAGING

NEUTRON SWEEPING

DESCRIPTION
Neutron sweeping scan of the dismantlement room (DR) with a handheld neutron detector to ensure the absence of undeclared neutron sources.

REFERENCE
Procedure description: Handheld neutron sweeping procedure p. 39

EQUIPMENT
- ☐ Handheld neutron detector

LOCATION


PERSONNEL
2 Inspectors | 2 Hosts

AGENDA

1) BACKGROUND MEASUREMENT OUTSIDE DISMANTLEMENT ROOM
- ☐ Choose spot in center of hallway or equipment room
- ☐ Press "power on/off button" for 5s to switch detector on
- ☐ Note measurement result and location

If signal < 0.3 cps: proceed with 2)

2) BACKGROUND MEASUREMENT INSIDE DISMANTLEMENT ROOM
- ☐ Choose spot in center of DR
- Select INTEGRAL mode and execute integrated measurement for 30s
- ☐ Note measurement result and location

If display shows "N B": retake background measurement

3) NEUTRON SWEEPING
- ☐ Indicate measurement spot and direction of movement
- ☐ Select SEARCH mode and start measuring from indicated spot on by moving detector slowly near surface in instucted direction

If relevant rise in count rate
- ☐ select INTEGRAL mode and execute measurement for 30s

COMMENTS

Caution: DR surveillance maintained

Do not turn off detector

Inspector indicates pace

Proceed if value does not exceed threshold

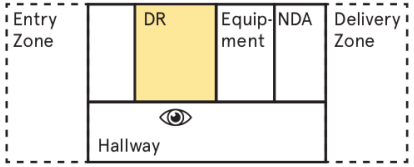
NEUTRON SWEEPING/ GAMMA IMAGING

GAMMA IMAGING SCAN

DESCRIPTION
Gamma imaging scan of the dismantlement room (DR) with a Compton imaging detector to ensure the absence of undeclared gamma sources.

REFERENCE
Procedure description: Gamma imaging procedure p. 45
Back-up: Handheld gamma sweeping procedure p. 51

EQUIPMENT
- ☐ Gamma imaging detector
- ☐ Test source
- ☐ Laser distance meter
- ☐ Adhesive tape

LOCATION


PERSONNEL
2 Inspectors | 2 Hosts

AGENDA

1) FUNCTIONALITY TEST

- ☐ ☐ Press red button to start detector
- ☐ Indicate measurement spot and direction
- ☐ Place test source in 1 m distance
- ☐ ☐ Confirm distance with detector-implemented laser rangefinder
- ☐ Turn on near-field-correction
- ☐ Select Ba-133 isotope
- ☐ Start measurement of 10 min

After measurement

- ☐ Confirm peaks, correct signal in optical image and count rate exceeding threshold

2) GAMMA IMAGING SCAN OF DISMANTLEMENT ROOM

- ☐ ☐ Indicate measurement spot and direction
- ☐ Mark position with tape
- ☐ Measure distance to next wall with detector-implemented laser rangefinder
- ☐ Measure distance to other walls with laser distance meter
- ☐ Turn on near-field-correction
- ☐ Select "Dose" option
- ☐ Start measurement of 60 min.

After measurement

- ☐ ☐ Confirm absence of peaks, signal in optical image and count rate not exceeding threshold

COMMENTS

Caution: DR surveillance maintained

Test source brought by radiation protection officer

Can be counter-checked with laser distance meter

DR surveillance may be lifted

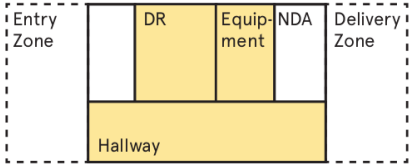
SEALING DOCUMENTATION

DOCUMENTATION OF ALL APPLIED SEALS

DESCRIPTION
The seals of potential diversion pathways, of the portal monitors and of the CCTV system have to be documentated at the end of the disarmament to verify their integrity.

REFERENCE
Procedure description: Sealing procedure p. 21

EQUIPMENT
- ☐ Seal documentation (from previous inspection)
- ☐ Sealing kit incl. camera

LOCATION


PERSONNEL
1 Inspector | 1 Host

AGENDA

1) POTENTIAL DIVERSION PATHWAYS IN DISMANTLEMENT ROOM
   - ☐ | ☐ Document seal

2) CCTV SYSTEM
   - ☐ | ☐ Document seal

3) PORTAL MONITOR
   - ☐ | ☐ Document seal

COMMENTS

LEAVING THE FACILITY

FACILITY EXIT

DESCRIPTION

Inspection team is required to follow specific actions to exit the radiation protection area. Special care will be taken to ensure that no documentation or objects are improperly taken out of the radiation protection area.

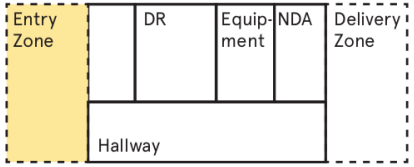
REFERENCE

Procedure description: Facility entry & exit procedure, p. 1

EQUIPMENT

- ☐ Dosimeter with lanyards
- ☐ Hand and foot monitor
- ☐ Scissors
- ☐ Refuse bin for inspection suits, gloves and overshoes

LOCATION



PERSONNEL

1 Inspector | 2 Hosts

AGENDA

1) INSPECTION TEAM EXIT

- ☐ Request exit to radiation protection area
- ☐ Place all documents in designated area
- ☐ Recover dosimeter
- ☐ Remove inspection suits, gloves and overshoes
- ☐ Use hand and foot monitor
- ☐ Accompany inspector to inspectors` office

Repeat for every inspector to leave the facility

COMMENTS

This may be performed at any time the inspectors wish to exit the facility

Caution not to touch inspectors clothes with outer surface of suit, gloves or overshoes!

1
2
3
4
5
6
7
8
9
10
11
12
X1
X2
X3

INSPECTION REPORT

19

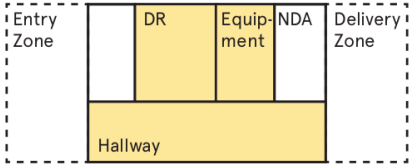
Inspectors and hosts draft preliminary inspection report

SEALING

20

DESCRIPTION
To ensure integrity, the dismantlement room and potential pathways need to be sealed as well as the equipment used.

EQUIPMENT
- ☐ Sealing kit incl. camera

LOCATION


REFERENCE
Procedure description: Sealing procedure p. 21

PERSONNEL
2 Inspectors | 2 Hosts

AGENDA

1) SEAL APPLICATION
- ☐ ☐ Indicate location of seal
- ☐ ☐ Apply adhesive seal
- ☐ ☐ Apply reflective particle matrix on the right half of the seal

2) SEAL DOCUMENTATION
- ☐ ☐ Note seal number in inspection logsheet
- ☐ ☐ Take photo of seal`s complete bar code and reflective particle matrix
- ☐ ☐ Check if the photo is focused and shows complete seal including bar code and reflective particle matrix

COMMENTS

Keep camera and seal within line of sight till seal is documented

Photograph in approx. 30cm distance

X1

X2

X3

EQUIPMENT RETRIEVAL AND LOCKING

21

DESCRIPTION

During the dismantlement process, the inspection team needs different types of authenticated equipment. To ensure integrity, all equipment will be stored in (sealed) storage when not in use. The retrieval and locking of equipment must be documented.

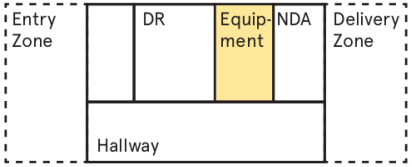
REFERENCE

Procedure description: Equipment retrieval and locking procedure p. 7

EQUIPMENT

- ☐ Sealing kit incl. camera

LOCATION



PERSONNEL

2 Inspectors | 2 Hosts

AGENDA

1) EQUIPMENT RETRIEVAL

If storage box is sealed AND sealing kit is locked inside

- ☐ Break seal on storage box and affix it on broken seal documentationon sheet
- ☐ Retrieve sealing kit and second camera
- ☐ ☐ Document seal of camera 1 with camera 2 and vice versa
- ☐ Put camera 2 back
- ☐ ☐ Document seal of storage box

If storage box is sealed AND sealing kit is outside

- ☐ ☐ Document seal of storage box
- ☐ Break seal on storage box and affix it on broken seal documentationon sheet

- ☐ Retrieve object
- ☐ ☐ Document authentication seal of object

If inspector's surveillance can not be ensured

- ☐ Confirm that storage box is in camera's field of view
- ☐ ☐ Apply and document seal on storage box → X1

2) EQUIPMENT LOCKING (→ NEXT PAGE)

COMMENTS

EQUIPMENT RETRIEVAL AND LOCKING

22

AGENDA

2) EQUIPMENT LOCKING

If storage box is sealed

- ☐ ☐ Document seal of storage box
- ☐ ☐ Break seal on storage box and affix it on broken seal documentationon sheet

- ☐ ☐ Document authentication seal of object
- ☐ ☐ Put object in storage box

If sealing kit is going to be locked

- ☐ Prepare adhesive seal for later sealing storage box
- ☐ ☐ Document not yet applied seal
- ☐ Recover memory cards of camera 1 and 2 → X3
- ☐ Put sealing kit in storage box

If inspector`s surveillance can not be ensured

- ☐ Confirm that storage box is in camera`s field of view
- ☐ ☐ Apply and document seal on storage box → X1

COMMENTS

Inspector remains in line of sight of seal

DATA TRANSFER

DESCRIPTION

During the dismantlement process, photo and CCTV cameras produce data which are saved on memory cards or on the CCTV terminal hard drive. The data of the memory cards needs to be transfered to the hard drive. A digital fingerprint (hashvalue) will be generated (one for all photo files, one for all CCTV footage video files) to secure the data. The hashvalues are then transmitted verbally to an inspector outside the radiation protection area.

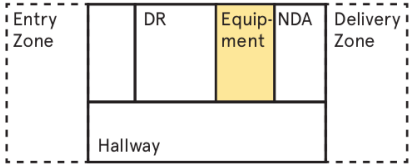
REFERENCE

Procedure description: Data transfer procedure p. 75

EQUIPMENT

- ☐ Sealing kit incl. camera
- ☐ Second camera
- ☐ New battery for camera (if needed)
- ☐ 2 new memory cards

LOCATION



PERSONNEL

2 Inspectors | 2 Hosts

AGENDA

1) RECOVERY OF DATA ON MEMORY CARD

- ☐ Retrieve second camera from storage box → X2
- ☐ ☐ Document seals of first camera with second camera and vice versa
- ☐ Remove memory cards from both cameras and read out the number of both memory cards
- ☐ ☐ Document number of both memory cards
- ☐ Keep memory cards in line of sight of inspector
- ☐ Check camera's battery and replace if necessary
- ☐ Retrieve two new memory cards from storage box and read out their numbers
- ☐ ☐ Document number of new memory cards
- ☐ Insert new memory cards in both cameras
- ☐ ☐ Verify that new memory cards are empty
- ☐ Seal memory slit of both cameras
- ☐ ☐ Document seals of first camera with second camera and vice versa
- ☐ Put second camera back in the storage box

2) DATA TRANSFER (→NEXT PAGE)

3) DOCUMENT TRANSFER (→NEXT PAGE)

COMMENTS

DATA TRANSFER

AGENDA

2) DATA TRANSFER

- ☐ ☐ Document seal on CCTV terminal
- ☐ Break seal on CCTV Terminal

If sealing kit is goint to be locked afterwards

- ☐ Prepare one adhesive seal to later seal terminal
- ☐ ☐ Document (not yet applied) seal

- ☐ Insert memory cards in CCTV terminal card reading slot
- ☐ Save data on CCTV terminal in a single folder and review it
- ☐ Compress folder of photo datafiles to a single archive
- ☐ Save compressed archive on memory card or other storage device
- ☐ Execute hashing algorithm on single compressed photo archive file
- ☐ ☐ Document filename and last 12 digits of hashvalue

If CCTV footage is going to be saved

- ☐ Compress CCTV video datafiles in a single archive
- ☐ Execute hashing algorithm on single compressed CCTV archive file
- ☐ ☐ Document filename and last 12 digits of hashvalue
- ☐ Save compressed archive on memory card or other storage device

2) DOCUMENT TRANSFER

- ☐ Verbally transmit filenames and corresponding hashvalues via radio or at controlled boundary
- ☐ Place all inspection documents in designated area
- ☐ Retrieve documents from designated area after they have been checked for contamination
- ☐ Check documents for sensitive information

COMMENTS

Compress photo and video files separately

Memory cards transferred by host at later point

6. Procedure descriptions

Procedure description: I) Facility entry and exit procedure

Purpose of the procedure

The Inspection Team is required to follow certain procedures when entering or exiting the radiation protection area. This document describes the necessary actions for any Inspection Team member to enter or exit the radiation protection area. The Inspection Team must comply with the 'Behavioral Rules' documentation.
Special care will be taken during this procedure to ensure that no documentation is improperly taken out of the radiation protection area.
Special care will also be taken to ensure the standard inspection suits, gloves and overshoes are removed from the Inspection Team and no swipe samples could be taken out of the radiation protection area.

Remarks

Host’s entering and leaving process of the radiation protection area is not described here as it does not require Inspectors’ attendance. All Hosts escorting Inspectors inside the radiation protection area are expected to be already inside the area at the beginning of this procedure. Analogously, the Host personal outside the area necessary for the exit process has to be informed early enough to position itself at the boundary of the radiation protection area on time. In order to speed up the entrance process by preparing inspection suits and overshoes beforehand the Hosts should know/request each inspector’s suit and shoe size.
This procedure comprises two tasks: Inspection team entrance task, Inspection team exit task.

Location

This procedure takes place at the main entrance/exit of the IEK-6 radiation protection area.

Participants
Host1 (or as many Hosts as necessary) inside the radiation protection area.
Host2 outside the radiation protection area.
Host3 outside the radiation protection area, supporting Host2 during the exit process.
At least one Inspection Team member to enter or exit the radiation protection area, hereafter referred to as **Inspector1**.

Entering radiation protection area

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Inspection team entrance task					
	Host1 at controlled boundary, Host2 outside radiation protection area	*Inspector1, maybe more Inspectors, outside radiation protection area*			
1		Inspector1 requests access to radiation protection area			
	Host team leader designates who to accompany Inspection team member(s) to enter radiation protection area				
2	Host1 prepares inspection suits, gloves and overshoes for expected Inspector(s)		Inspection suit, Inspection gloves, Inspection overshoes		
3	Host2 meets Inspector1 at entrance of radiation protection area, verifies ID and escorts Inspector1 through security door to radiation protection barrier cupboard		Inspector's ID		
4		*If Inspector carries document(s):* Inspector1 puts document(s) at designated spot	Documents		
5 ***(if not already done that day)***	Host2 assigns dosimeter, fills out radiation protection log sheet with Inspector1's information and prepares a lanyard with dosimeter and Inspector's ID		Dosimeter assignment list, Dosimeter, Radiation protection log sheet, Lanyard		
		Inspector1 signs radiation protection log sheet			
6	Host2 organizes and monitors Inspector1's use of hand and foot monitor	Inspector1 uses hand and foot monitor	Hand and foot monitor	Hand and foot monitor alerts	Dispute settlement procedure
7	Host2 dresses Inspector1 with new inspection suit, gloves and overshoes		Inspection suit, Inspection gloves, Inspection overshoes,		

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
			Tape		
8	Host2 checks inspection suit is taped into sleeves of inspection gloves and into inspection overshoes				
9	Host2 hangs lanyard with ID and dosimeter around Inspector1's neck		Lanyard, ID, Dosimeter		
10		*If required:* Inspector1 picks up pen and clipboard from tray as well as brought along documents	Pen, Clipboard, Documents		
11	Host2 guides Inspector1 to Host1 waiting behind door to radiation protection area				
Repeat stages 1 to 8 for every Inspection team member					
12 ***(once all Inspection team members are dressed and wear dosimeters)***	Host1 permits escorted entrance to radiation protection area				
	At least one Host team member escorts one Inspection team member	Every Inspection team member is escorted by at least one Host team member			
End of Inspection team entrance task					

Leaving radiation protection area

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Inspection team exit task					
	Host1 inside radiation protection area supervising waiting Inspectors, Host2 (at controlled boundary) and Host3 outside radiation protection area	*Inspector1 inside radiation protection area*			
1	Host1 phones Host2 and asks Host2 to prepare Inspector's exit Host1 escorts Inspector1 out of radiation protection area	Inspector1 requests to leave radiation protection area	Inspection logsheet Clipboard Trays for pens and clipboards		
2	Host1 instructs exiting Inspector1 to place all documentation in designated area in preparation of Document transfer task[2] and all pens and clipboards in designated tray	Inspector1 places all documentation in designated area and all pens and clipboards in designated tray			
3	Host2 meets Inspector1 at exit of radiation protection area, while Host1 and remaining Inspectors wait inside radiation protection area	Inspector1 leaves radiation protection area and goes to controlled boundary			
4	Host2 recovers dosimeter. It will be analyzed and results will be communicated to Inspector later		Dosimeter, Dosimeter assignment list		
5	Host2 removes inspection suit, gloves and overshoes by cutting them off with scissors making sure to avoid any contact of suit's exterior with cloths of Inspector1		Scissors	Suit is damaged	Decontamination
6	Used inspection suit, gloves and overshoes		Refuse bin		

2 *see*: Procedure description: XII) Data transfer procedure

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
	are disposed into designated bins. Care is taken so that Inspector1 does not handle inspection suit, gloves and overshoes				
7	Host2 organizes and monitors Inspector1's use of hand and foot monitor		Hand and foot monitor	Hand and foot monitor alerts	Dispute Settlement procedure
		Inspector1 uses hand and foot monitor			
8	Host3 organizes and monitors hand washing		Soap, Paper towels		
		Inspector1 enters washroom and washes hands			
	Host3 ensures paper towels are disposed in designated bin				
Repeat stages 1 to 6 for every Inspector to exit facility					
End of Inspection team exit task					

Appendix: List of materials

- Radiation protection log sheet
- Standard inspection suit
- Standard inspection overshoes
- Standard inspection gloves
- Tape
- Dosimeter with lanyards assigned to each Inspection team member
- Dosimeter assignment list
- Pens (stored inside radiation protection area)
- Clipboards (stored inside radiation protection area)
- Trays for pens and clipboards
- Hand and Foot Monitor
- Scissors
- Refuse bin for inspection suits, gloves and overshoes

Procedure description:
II) Equipment retrieval and locking procedure

Purpose of the procedure

During the dismantlement process the inspection team needs different types of authenticated equipment. To ensure the integrity, the equipment will be stored in sealed storage boxes when not in use. This document describes the actions to retrieve and to lock any kind of equipment from/in the storage box.
Host must hold object(s) always in line of sight of Inspectors.

This procedure comprises two tasks: Equipment retrieval task, Equipment locking task.

Location

This procedure takes place in the Equipment room, a CCTV supervised area.

Participants

Host1 to perform the main retrieval/locking actions.
Host2 to assist Host1 and (if already retrieved) carrying the sealing kit.
(More Hosts if necessary to handle more objects)
Inspector1 as the leading inspector.
Inspector2 to keep the minutes (inspection logsheet).

Retrieval of material from Storage box

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Equipment retrieval task					
	Host1, Host2 in Equipment room	*Inspector1, Inspector2 in Equipment room*			
If storage box is not sealed: *continue with stage 7*					
1 ***(if sealing kit is already at hand and)***	Host2 executes Sealing documentation task on seals of storage box	Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task[3] on seals of storage box Inspector2 executes Sealing documentation task on seals of storage box	Camera, Inspection logsheet		
2	Host1 breaks seal of storage box, affixes it on *broken seal documentation sheet* and notes time and previous place	Inspector1 asks Host1 to break seal of storage box and affix it on *broken seal documentation sheet*		Seal previously damaged or broken	Dispute settlement procedure OR Withdrawal of storage box and implementation of backup box
If sealing kit is already outside the box: *continue with stage 7*					
3	Host1 affixes broken seal on *broken seal documentation sheet* and notes time and previous place of attachment	Inspector1 asks Host1 to affix broken seal on *broken seal documentation sheet* and note time and previous place of attachment	Broken seal documentation sheet, Pen		
4	Host1 retrieves sealing kit from storage box and hands it over to Host2	Inspector1 asks Host1 to retrieve sealing kit from storage box	Sealing kit		

3 *see*: Procedure description: IV) Sealing procedure

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
5 ***(if sealing kit is retrieved first time)***		Inspector1 asks Host1 to retrieve second camera from storage box	Second camera (No.2)		
	Host1 retrieves second camera				
		Inspector1 asks Host1, Host2 and Inspector2 to execute Sealing documentation task with camera No.1 on seal of camera No.2 and vice versa	Camera No.1, Camera No.2, Inspection logsheet		
	Host1 and Host2 execute Sealing documentation task with camera No.1 on seal of camera No.2 and vice versa	Inspector2 executes Sealing documentation task			
		Inspector1 asks Host1 to put camera No.2 back into storage box	Camera No.2		
	Host1 puts camera No.2 back into storage box				
6		Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task on broken seal of storage box	Inspection logsheet, Camera No.1		
	Host2 executes Sealing documentation task on broken seal of storage box	Inspector2 executes Sealing documentation task on broken seal of storage box			
If sealing kit is already outside the box proceed from here					
7		Inspector1 asks Host1 to retrieve *object*	*Object*		
	Host1 retrieves *object* from storage box				
8		Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task on authentication seal of object	Camera, Inspection logsheet	Authentication seal number of *object* does not match with earlier noted number	Dispute settlement procedure
	Host2 executes Sealing documentation task	Inspector2 executes Sealing documentation task			
9	Host1 keeps *object* in line of sight of Inspector1			Interruption of line of sight	Inspector2 checks identification number of *object* OR Dispute settlement procedure

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Repeat stages 7 to 9 for every object *which needs to be retrieved from storage box*					
10	Host1 closes storage box and puts it into CCTV cameras' field of view	Inspector1 asks Host1 to close storage box and to put it in CCTV cameras' field of view			
If inspectors surveillance of storage box or equipment room cannot be guaranteed					
11 ***(if Inspection team will leave Equipment room afterwards)***	Host1 executes Seal application task on storage box	Inspector1 asks Host1 to execute Seal application task[4] on storage box	Adhesive seals, Reflective particle matrix		
	Host2 executes Sealing documentation task	Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task Inspector2 executes Sealing documentation task	Camera, Inspection logsheet		
End of Equipment retrieval task					

4 *see*: Procedure description: IV) Sealing procedure

Locking of material in Storage box

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Equipment locking task					
	Host1, Host2 in Equipment room	*Inspector1, Inspector2 in Equipment room*	*Storage box in CCTV supervised area*		
If storage box not sealed: *continue with stage 3*					
1 ***(if storage box is sealed)***	Host2 executes Sealing documentation task on seals of storage box	Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task on seals of storage box Inspector2 executes Sealing documentation task on seals of storage box	Inspection logsheet, Sealing kit		
2 ***(if storage box is sealed)***	Host1 breaks seal of storage box, affixes it on *broken seal documentation sheet* and notes time and previous place	Inspector1 asks Host1 to break seal of storage box and affix it on *broken seal documentation sheet*	Broken seal documentation sheet	Seal previously damaged or broken	Dispute settlement procedure
If only camera (sealing kit) is going to be locked: *continue with stage 8*					
3	Host2 puts *object* in storage box	Inspector1 asks Host2 to put *object* in storage box	*Object*		
Repeat stage 3 for every object *which needs to be locked in storage box.*					
If inspectors surveillance of storage box or equipment room <u>can</u> be guaranteed: *follow only stages 4 and 7.* ***If surveillance <u>cannot</u> be guaranteed:*** *proceed as follow.*					
If ***sealing kit is going to be locked*** *follow stages 8 to 13.* ***If sealing kit is <u>not</u> going to be locked follow stages 4 to 7.***					

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
4	Host1 closes storage box	Inspector1 asks Host1 to close storage box			
5	Host2 executes Seal application task	Inspector1 asks Host2 and Inspector2 to execute Seal application task on storage box Inspector2 executes Seal application task	Sealing kit		
6	Host2 executes Sealing documentation task	Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task Inspector2 executes Sealing documentation task	Camera, Inspection logsheet		
7	Host1 ensures that storage box is in CCTV supervised area	Inspector1 asks Host1 to ensure that storage box is in CCTV supervised area	Storage box	**End of task**	
If sealing kit is going to be locked proceed from here					
8	Host1 prepares one adhesive seal with reflective particle matrix to later seal storage box	Inspector1 asks Host1 to prepare one adhesive seal to later seal storage box	Adhesive seal, Reflective particle matrix		
9	Host2 executes Sealing documentation task on not yet applied seal	Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task on not yet applied seal Inspector2 executes Sealing documentation task	Camera, Inspection logsheet		
10	Host1 keeps seal in line of sight of Inspector1	Inspector1 maintains line of sight to seal		Interruption of line of sight	Prepare new adhesive seal and return to stage 8
11		Inspector1 asks Inspector2 and Host2 to recover memory cards of cameras No. 1 and	Camera No. 1 and 2, CCTV Terminal		

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
		2 by executing Memory card recovery task[5]			
	Host2 executes Memory card recovery task	Inspector2 executes Memory card recovery task			
12		Inspector1 asks Host2 to put sealing kit (incl. camera) in storage box	Sealing kit		
	Host2 puts sealing kit in storage box				
13		Inspector1 asks Host1 to close and seal storage box and ensure it is in CCTV supervised area	Adhesive seal	Adhesive seal damaged	Recover new adhesive seal from storage box and return to stage 8
	Host1 closes storage box, seals it and ensures it is in CCTV supervised area				
End of Equipment locking task					

5 *see*: Procedure description: XII) Data transfer procedure

Appendix: List of materials

- Storage box
- Inspection logsheet
- Sealing kit (Transparent bag, Camera (No. 1), Adhesive seals, Reflective particle matrix)
- Camera (No. 2)
- Inventory list with authentication seal numbers

Procedure description:
III) Visual inspection and photography procedure

Purpose of the procedure

Before the dismantlement process the radiation protection area, and more precisely the dismantlement room (DR), has to be inspected visually. The structural conditions (dimensions, openings, pipes ...) have to be confirmed and the DR has to be checked for potential diversion pathways. Deviations from agreed conditions and potential diversion pathways will be documented photographically and in written form. No radiation measurements are undertaken at this point.

The necessary equipment is expected to be already retrieved in advance.

This procedure comprises different tasks: Design verification task, Diversion pathway search task, General documentation task.

Location

This procedure takes place in the radiation protection area with main focus on the DR.

Participants

Host1 executing
Host2 supervising
(more Hosts if necessary)
Inspector1
Inspector2

Search for potential diversion pathways

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Design verification task					
	Host1, Host2 anywhere in radiation protection area	*Inspector1, Inspector2 anywhere in radiation protection area*			
1		Inspector1 compares structural design with building plan of facility	Building plan of facility	Deviation from building plan	Inspector2 documents deviation AND/OR Dispute settlement procedure
2		Inspector1 compares attachment markings for/locations of CCTV cameras with markings in building plan		Deviation from building plan	Inspector2 documents deviation AND/OR Dispute settlement procedure
3 ***(repeat stage 3 as needed)***	 Host1 measures indicated distance with distance meter	Inspector1 asks Host1 to measure a specified dimension	Laser distance meter, Tape measure	Deviation from building plan	Inspector2 documents deviation AND/OR Dispute settlement procedure
4	 Host1 measures dimensions of portal monitor measurement areas	Inspector1 controls markings of portal monitor measurement areas/detector position and asks Hosts1 to measure dimensions	Building plan of facility, Tape measure	Deviation from building plan	Inspector2 documents deviation AND/OR Dispute settlement procedure
End of Design verification task					

Verification of structural design

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Diversion pathway search task					
	Host1, Host2 in DR	*Inspector1, Inspector2 in DR*			
1		Inspector1 searches room for (unsealed) potential diversion pathways *(such as vents, hatches, cupboards, doors, shafts, windows, drainage, taps)*			
2		Inspector2 documents potential diversion pathway in Inspection logsheet and Inspector1 performs General documentation task	Inspection logsheet		
End of Diversion pathway search task					

Documentation of pathways

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
General documentation task[6]					
	Host1, Host2 in DR	*Inspector1, Inspector2 in DR*			
1	Host1 takes photo of potential diversion pathway or appropriate *object*	Inspector1 asks Host1 to take photo of potential diversion pathway or any appropriate *object*	Camera		
2	Host1 shows photo to Inspector1	Inspector1 checks photo to be focused and to show complete potential diversion pathway or *object*	Camera	Photo does not fulfill Inspector1's criteria	Host1 takes another photo OR Dispute settlement procedure
3		Inspector2 notes time and number of photo	Inspection logsheet		
End of General documentation task					

6 *This task can be used for general documentation purpose*

Appendix: List of materials

- Clipboard
- Pen
- Building plan of facility
- Laser distance meter
- Tape measure
- Inspection logsheet
- Camera (as part of the sealing kit)
- Step stool

Procedure description:
IV) Sealing procedure

Purpose of the procedure

During the dismantlement process, the radiation protection area has to be checked for potential diversion pathways which have to be sealed before the actual dismantlement takes place. This document describes the actions to execute the sealing of the interior of the dismantlement room (DR). Seal application and sealing documentation is also needed on other occasions, e.g. opening and closing the equipment box.

This procedure comprises different tasks: Seal application task, Sealing documentation task.

Location

This procedure can take place anywhere in the radiation protection area.

Participants

Host1 applying seals.
Host2 handling the camera and carrying the sealing kit.
Inspector1 giving instructions.
Inspector2 keeping the minutes (inspection logsheet).

Application of adhesive seals and reflective particle matrix

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Seal application task					
	Host1 applying seal, *Host2 carrying sealing kit*	*Inspector1 giving instructions,* *Inspector2 maintains overview*			
1		Inspector1 indicates location where Host1 ought to apply seal	Adhesive seals	Adhesive seal damaged	Use another adhesive seal and repeat stage 1
	If surface is dusty: Host1 dusts off surface	*If surface is dusty:* Inspector1 asks Host1 to clean surface			
	Host1 takes one adhesive seal from Host2 and applies it to indicated location *NB : no tampering occurs, bar code is completely readable and not distorted*				
2		Inspector1 asks Host1 to apply reflective particle matrix	Reflective particle matrix	Reflective particle matrix on bar code	Use another adhesive seal and return to stage 1
	Host1 takes reflective particle matrix from Host2 and applies it on right half of adhesive seal			Reflective particle matrix inadequate	Reapply reflective particle matrix OR Use new seal (stage 1)
3	Host1 hands reflective particle matrix back to Host2 who keeps camera and seals in line of sight of Inspector2		Camera	Interruption of line of sight	Inspector2 checks identification number of camera OR Dispute settlement procedure
		Inspector2 keeps camera and seals within line of sight			
Proceed with Sealing documentation task					
End of Seal application task					

Documentation of sealing

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Sealing documentation task					
	Host1 reading seal numbers, *Host2 handling camera*	*Inspector1 giving instructions,* *Inspector2 writing inspection logsheet*			
1	Host1 reads out seal number	Inspector1 asks Host1 to read out seal number and Inspector2 to fill out inspection logsheet Inspector2 notes seal number	Inspection logsheet		
2	Host2 takes photo of seal's complete bar code and reflective particle matrix in approx. 30 cm distance rectangular to surface **I*f bar code and reflective particle matrix can not be captured in one photo*:** Host2 takes two separate prhotos	Inspector1 asks Host2 to take photo of seal's complete bar code and reflective particle matrix	Camera		
4	Host2 shows photo(s) to Inspector1	Inspector1 checks photo(s) to be focused and to show complete seal including bar code and reflective particle matrix	Camera	Photo does not fulfill Inspector1's criteria	Return to stage 2 OR Dispute settlement procedure
5 ***(if data transfer required)***	Host2 executes Memory card operating task 1 & 2	Inspector1 asks Host2 and Inspector2 to execute Memory card operating task 1 & 2[7] Inspector2 executes Memory Card operating task 1 & 2			
End of Sealing documentation task					

7 *see:* XII) Data transfer procedure

Appendix: List of materials

- Clipboard
- Pen
- Inspection logsheet
- Sealing kit (Camera, Adhesive Seals, Reflective particle matrix, Transparent bag)

Procedure description:
V) Portal monitor procedure

Purpose of the procedure

This procedure describes the commissioning and decommissioning of the radiation portal monitor as well a function test with small radioactive test sources.
The setup, commissioning, decommissioning and disassembly will be done by a technical staff member of the Host team. The Inspectors are only present to verify the correctness of the process. The functional test should be done after the setup and anytime the Inspectors consider it necessary. Since the display of the laptop that is connected with the portal monitor pillars shows potentially sensitive information, the hosts have to make sure the laptop is closed (at least) during the time where the TAI or SNM is near (i.e. the container passage and the dismantlement). The portal monitor then works with a pre-set alarm threshold and alarm lights for neutron and gamma alarm that act as an information barrier.

This procedure comprises different tasks: Portal monitor commissioning task, Portal monitor functional test, Portal monitor decommissioning task.

Location

This procedure mainly takes place in the hallway, but the portal monitor has to be fetched from the Equipment room first and brought there again afterwards.

Participants

Host1, a technician of the Host team, guiding the whole process.
Host2, radiation protection supervisor, assisting Host1.
Host3 keeps track of the present inspector(s) and carries sealing kit.
Inspector1 observing the process.
Inspector2 keeping the minutes (inspection logsheet).

Setup and commissioning

Stages	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Portal monitor commissioning task					
	Host1, Host2 and Host3 in hallway	*Inspector1 and Inspector2 in hallway*			
1 ***(repeat for both boxes)***		Inspector1 asks Host3 to perform Sealing documentation task on portal monitor box	Portal monitor boxes, Camera		
	Host3 performs Sealing documentation task[8] on seals on portal monitor box	Inspector1 and Inspector2 perform Sealing documentation task			
2		Inspector1 asks Hosts to carry Portal monitor box and portal monitor equipment box into hallway	Two portal monitor boxes		
	Host1, Host2 and Host3 carry Portal monitor boxes into hallway				
3		Inspector1 asks Host1 to open Portal monitor boxes			
	Host1 breaks seals and opens Portal monitor boxes				
		Inspector1 asks Host1 and Host2 to set up Portal monitor			
4 ***(repeat for both portal monitor pillars)***	Host1 retrieves tripod legs from portal monitor box and screws together tripod		Tripod		
	Host1 attaches feet to tripod and places tripod at marked (agreed) spots	Inspector1 checks correct placement			
5 ***(repeat for both portal monitor pillars)***	Host1 and Host2 retrieve detector from Portal monitor box and mount it on tripod		Detector		
	Host1 retrieves battery from Portal monitor box and mounts it on tripod		Battery		
	Host1 retrieves cable from Portal monitor box and connects battery with detector		Cable		

8 *see:* Procedure description: IV) Sealing procedure

Stages	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
	Host1 retrieves alarm lights from Portal monitor box and attaches it on top of detector		Alarm lights		
	Host1 retrieves antenna from Portal monitor box and attaches it on top of detector		Antenna		
		Inspector1 checks integrity of authentication seals including the Sealing documentation task of the seals			
		Inspector1 checks green power indicating light is on			
6	Host1 retrieves laptop, power cable and laptop antenna and sets it up on desk in hallway	Inspector1 checks integrity of authentication seals	Laptop, Power cable(s), Computer antenna		
	Host1 boots laptop and establishes connection to detector		Laptop		
7		Inspector1 asks Host3 to execute Seal application task[9] to connect both tripods to floor	Sealing kit		
	Host3 executes Seal application task and seals both tripods to floor				
8		Inspector1 asks Host3 to execute Sealing documentation task on applied seals	Sealing kit		
	Host3 executes Sealing documentation task on applied seals				
Check functionality after setup → ***Portal monitor functional test task***					
END of Portal monitor commissioning task					

9 *see:* Procedure description: IV) Sealing procedure

Functionality test

Stages	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Portal monitor functional test task					
	Host1, Host2 and Host3 in hallway	*Inspector1 and Inspector2 in hallway*			
1		Inspector1 asks Host2 to get test source	Gamma and neutron test sources		
	Host2 gets neutron and gamma test sources	Inspector1 checks authentication seals			
2		Inspector1 asks Host3 and Inspector2 to execute Sealing documentation task on test sources	Camera, Inspection logsheet		
	Host3 executes Sealing documentation task[10] on test sources	Inspector2 executes Sealing documentation task on test source			
3 ***(repeat for both portal monitor pillars)***		Inspector1 asks Host2 to hold gamma test source next to portal monitor pillar	Gamma test source, Pair of tongs	No portal monitor gamma alarm	Host1 checks configurations and Host2 repeats step 3 OR Dispute Settlement
	Host2 holds gamma test source next to portal monitor pillar			Portal monitor gamma alarm (red light)	Continue with step 4
4 ***(repeat for both portal monitor pillars)***		Inspector1 asks Host2 to hold neutron test source next to portal monitor pillar	Neutron test source, Pair of tongs	No portal monitor neutron alarm	Dispute Settlement
	Host2 holds neutron test source next to portal monitor pillar			Portal monitor neutron alarm (blue light)	**END of Portal monitor functional test task**
END of Portal monitor functional test task					

10 *see:* Procedure description: IV) Sealing procedure

Disassembly and decommissioning

Stages	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Portal monitor decommissioning task					
	Host1, Host2 and Host3 in hallway	*Inspector1 and Inspector2 in hallway*			
1		Inspector1 asks Host3 to perform Sealing documentation task on all seals (including authentication seals) on portal monitor	Camera, Inspection logsheet		
	Host3 performs Sealing documentation task[11] on all seals (including authentication seals) on portal monitor	Inspector1 and Inspector2 perform Sealing documentation task			
2		Inspector1 asks Host1 and Host2 to decommission portal monitor	Laptop, Laptop antenna		
	Host1 shuts down portal monitor laptop				
	Host1 disconnects laptop antenna and puts it together with laptop and power cable in designated box				
3 ***(repeat for both detector pillars)***	Host1 dismounts antenna and alarm lights on detector and puts them in designated box		Antenna, Cable, Battery, Portal monitor box		
	Host1 unplugs cable from battery and detector and puts it in designated box				
	Host1 dismounts battery and puts it in designated box				
4	Host1 and Host2 dismount detector from tripod and put it in designated box		Detector, Tripod, Portal monitor box		
	Host1 disassembles tripod and puts it in designated box				
5		Inspector1 asks Host3 and Inspector2 to perform Seal application task on box(es)	Sealing kit		
	Host3 closes box(es) and performs Seal application task	Inspector2 performs Seal application task			

11 *see:* Procedure description: IV) Sealing procedure

Stages	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
6		Inspector1 asks Host3 and Inspector2 to perform Sealing documentation task	Camera, Inspection logsheet		
	Host3 performs Sealing documentation task	Inspector2 performs Sealing documentation task			
7		Inspector1 asks Host1 and Host2 to bring boxes in Equipment room	Portal monitor boxes		
	Host1 and Host2 carry boxes in Equipment room				
END of Portal monitor decommissioning task					

Appendix: List of materials

- Sealing kit (transparent bag, adhesive seals, reflective particle matrix, camera)
- Portal monitor in Portal monitor box
- Portal monitor terminal (laptop)
- Portal monitor equipment (antennas, cables, etc.) in Equipment box
- Neutron test source
- Gamma test source
- List with numbers of authentication seals

Procedure description:
VI) CCTV procedure

Purpose of the procedure

The NuDiVe exercise will employ the use of closed circuit television cameras (CCTV) as part of the containment and surveillance activities. The CCTV procedures outlined here are used to demonstrate the general benefits that CCTV might offer to an Inspection Team when inspectors cannot be physically present in an area of interest.

The CCTV cameras will stream via a protected connection to the CCTV Terminal computer, which remains sealed while recording the footage. Via another protected connection, a copy is forwarded to the CCTV Host Terminal, which the Host can access at all time to review footage. By default, the CCTV Host Terminal is placed in the Equipment Room, but placing it in an adjacent room is possible.

This procedure comprises three different tasks: CCTV commissioning task, CCTV decommissioning task.

Location

The CCTV will be used to monitor the dismantlement room doorway (Hallway) and the Equipment room. Data recovery will be accomplished via access to the CCTV terminal in Equipment room (the sole access to the network).

Participants

The Host Team will be responsible for the installation and maintenance of the CCTV system. The Inspection Team will have right to request access to the recorded data. Up to **two hosts** and **two inspectors** are needed to execute the corresponding tasks.

Commissioning of CCTV system

Stage	Hosts	Inspectors	Equipment	Event
CCTV commissioning task				
	Host1, Host2 in Equipment Room	*Inspector1, Inspector2 in Equipment Room*		
1		Inspector1 asks Inspector2 and Host2 to execute Sealing documentation task[12] on authentication seal of CCTV terminal computer	CCTV terminal computer, Computer cables, Camera, Inspection logsheet	
	Host2 executes Sealing documentation task	Inspector2 executes Sealing documentation task		
		Inspector1 asks Host1 to set up CCTV terminal in Equipment Room		
	Host2 sets up CCTV host terminal in Equipment Room, so screen is not visible to planned cameras, and activates it according to CCTV manual			
2		Inspector1 asks Inspector2 and Host2 to execute Sealing documentation task[3] on authentication seal(s) of CCTV host terminal	CCTV host terminal computer, Camera, Inspection logsheet	
	Host2 executes Sealing documentation task	Inspector2 executes Sealing documentation task		
		Inspector1 asks Host1 to set up CCTV host terminal in Equipment room		
	Host2 sets up CCTV terminal computer in Equipment room and activates it according to CCTV manual			
3 ***(if not already done before)***		Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task on authentication seal of CCTV camera	Inspection logsheet, Camera	
	Host2 executes Sealing documentation task on authentication seal of camera	Inspector2 executes Sealing documentation task		
From here on: ***If all inspectors leave Equipment room, close CCTV terminal and apply seal using Seal application task and Sealing documentation task***				

12 *see*: Procedure description: IV) Sealing procedure

4		Inspector1 verifies location of camera mount	Building plan of facility	
5	Host1 attaches CCTV camera to camera mount, attaches antenna and establishes power connection	Inspector1 asks Host1 to attach CCTV camera to camera mount	Camera mount, CCTV camera, CCTV Antenna, Electric cables, *if necessary:* Step stool	
6	Host2 executes Seal application task to seal CCTV camera and mount	Inspector1 asks Host2 to execute Seal application task[13] to seal CCTV camera and mount	Adhesive seals, Reflective particle matrix	
	Host2 executes Sealing documentation task	Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task Inspector2 executes Sealing documentation task	Inspection logsheet, Camera	
7	Host1 turns on CCTV camera per CCTV manual	Inspector1 asks Host1 to turn on CCTV system	CCTV terminal	
8	Host1 demonstrates that CCTV camera is recording correctly and in right angle	Inspector2 verifies CCTV camera functionality and angle at CCTV terminal in Equipment room	CCTV terminal	No recording
Repeat stages 3 to 9 for every agreed CCTV location				
9	Host2 executes Seal application task on CCTV Terminal	Inspector1 asks Host2 to execute Seal application task on closed CCTV Terminal, so it cannot be opened without authorisation	Adhesive seals, Reflective particle matrix	
10	Host2 executes Sealing documentation task	Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task Inspector2 executes Sealing documentation task	Inspection logsheet, Camera	
END of CCTV commissioning task				

13 *see*: Procedure description: IV) Sealing procedure

Decommissioning of CCTV system

Stage	Hosts	Inspectors	Equipment	Event
CCTV decommissioning task				
	Host1, Host2	*Inspector1, Inspector2*		
1		Inspector1 checks number and integrity of seal on CCTV camera and camera mount	Inspection logsheet, Camera, *if necessary:* Step stool	
		Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task[14] on seal		
	Host2 executes Sealing documentation task	Inspector2 executes Sealing documentation task		
2		Inspector1 asks Host1 to detach CCTV camera from camera mount	CCTV camera mount, CCTV camera, *if necessary:* Step stool	
	Host1 detaches CCTV camera from camera mount			
3		Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task on CCTV camera's authentication seal	CCTV camera, Inspection logsheet	
	Host2 executes Sealing documentation task on CCTV camera's authentication seal	Inspector2 executes Sealing documentation task on CCTV camera's authentication seal		
4		Inspector1 asks Host2 to execute Equipment locking task[15] on CCTV camera	CCTV camera	
	Host2 executes Equipment locking task on CCTV camera			
Repeat stages 1 to 4 for every CCTV camera				
5		Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task on CCTV terminal and CCTV host terminal	CCTV terminal computer, CCTV host terminal	
	Host2 executes Sealing documentation task	Inspector2 executes Sealing documentation task		

14 *see*: Procedure description: IV) Sealing procedure

15 *see:* Procedure description: II) Equipment retrieval and locking procedure

Stage	Hosts	Inspectors	Equipment	Event
		Inspector1 asks Host1 to break seals on CCTV terminals.	computer	
	Host1 breaks seals on CCTV terminals			
		Inspector1 asks Host1 to shut down CCTV terminals		
	Host1 shuts down CCTV terminal and CCTV host terminal as described in CCTV manual			
6		Inspector1 asks asks Host2 and Inspector2 to execute Seal application task on CCTV terminal and CCTV host terminal	Inspection logsheet, Camera	
	Host2 executes Seal application task	Inspector2 executes Seal application task		
		Inspector1 asks asks Host2 and Inspector2 to execute Sealing documentation task on CCTV terminal and CCTV host terminal		
	Host2 executes Sealing documentation task	Inspector2 executes Sealing documentation task		
7		Inspector1 asks Host2 to decommission CCTV terminal and CCTV host terminal and to execute Equipment locking task[16] on it	Camera, Seals, CCTV terminal computer, CCTV host terminal computer	
	Host2 decommissions CCTV terminals and executes Equipment locking task on them			
END of CCTV decommissioning task				

16 *see*: Procedure description: II) Equipment retrieval and locking procedure

Appendix: List of materials

- Inspection logsheet
- Building plan of facility
- CCTV camera mount and installation materials
- *if necessary:* step stool
- CCTV cameras
- CCTV camera antennas
- CCTV camera cables and extension cables
- Blank memory cards in storage box
- 2 CCTV terminal computers (Laptops) for viewing CCTV footage

Procedure description:
VII) Handheld neutron sweeping procedure

Purpose of the procedure

This procedure describes the sweeping scan of the Dismantlement Room (DR)[17] with a handheld neutron detector to ensure the absence of undeclared neutron sources. It describes the procedure for one Inspector-Host pair handling one device. The neutron sweeping can be done parallel to the gamma sweeping measurement.
As a confidence interval for the alarm threshold, 2 sigma has been chosen so as not to exaggerate type II errors, i.e. to avoid not detecting a present source. The device automatically calculates the alarm threshold from the result of the background measurement. To prevent the tampering of the neutron background level, the background measurement has to be compared to a background measurement outside the room.
For a detailed description of the detector's operation and functionality refer to the *Neutron Search Detector KSAR1U.06 Operating Manual*.

This procedure comprises two different tasks: Background measurement task, Neutron sweep task.

Location

This procedure takes place in the Hallway and the Dismantlement Room (DR), before the Nuclear Explosive Device (NED) enters or after it left the room.

Participants

Host1 operating the neutron search detector.
Host2 watching the Inspectors.
Inspector1 supervising Host1.
Inspector2 keeping the minutes (inspection logsheet).

17 *this procedure is also applicable to other rooms inside the radiation protection area*

Neutron background measurements outside and inside DR

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Background measurement task					
	Host1 and Host2 in Equipment room	*Inspector1 and Inspector2 in Equipment room*			
1	*If not already done:* Host1 gets neutron detector according to Equipment retrieval task[18]	*If not already done:* Inspector1 asks Host1 to get neutron detector			
2	Host1 moves to spot and places detector in a way Inspector1 has clear view of display	Inspector1 chooses spot in centre of hallway or Equipment room and asks Host1 to go there	Neutron detector		
§	Host1 starts neutron detector by pressing “power on/off” button for 5 s. Device will start warm-up process (~60 s), followed by background count rate measurement over 300 s	Inspector1 asks Host1 to switch on detector	Neutron detector		
4	Host2 notes measurement result	Inspector1 reads out and Inspector2 writes down result of first background measurement and place it was measured at	Pen, Inspection logsheet	Value lower than 0.3 cps Value higher than 0.3 cps	**Don’t turn off detector!** Continue with stage 7 Continue with stage 5
5 ***(if value is higher than 0.3 cps)***	Host1 repeats first background measurement at indicated spots via “retake background” option in device’s Setup Menu	Inspector1 asks Host1 to repeat first background measurement at two other spots Inspector1 reads out and Inspector2 notes results and places of measurements	Neutron detector, Pen, Inspection logsheet	Values vary by order of magnitude	Dispute Settlement Procedure

18 *see:* Procedure description: II) Equipment retrieval and locking procedure

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Background measurement task					
6 ***(if value is higher than 0.3 cps)***		Inspector1 asks Host1 to set median result of the three measurements as reference for background measurement inside DR			
	Host1 keeps median result in detector (if it was result of last measurement) or retakes background at spot where median result was measured at (Do NOT turn off device after that![19])				
7		Inspector1 asks Host1 to enter DR			
	Host1 enters DR with detector still running to keep measured background value in its memory	Inspector1 enters DR			
8		Inspector1 chooses spot in centre of DR and asks Host1 to execute integrated measurement over 30 s there	Neutron detector, Pen, Inspection logsheet	Display shows “N > B”, i.e. measured count rate is 2 sigma over background	See stage 9
	Host1 places detector at indicated spot, selects INTEGRAL mode and executes integrated measurement over 30 s (to compare with preparatory background measurement)	Inspector1 reads out and Inspector2 writes down measurement result and place it was taken at		Display shows “N ≤ B”	Continue with stage 10
9 ***(if display shows “N>B”)***		Inspector1 asks Host1 to repeat measurement twice at same spot	Neutron detector, Pen, Inspection logsheet	Display shows “N > B” in 2nd or 3rd measurement	Dispute Settlement procedure
	Host1 repeats integrated measurement over 30 s twice at same spot as before	Inspector2 writes down measurement results		Display shows “N ≤ B” in both measurements	Continue with stage 10
10		Inspector1 asks Host1 to take new background measurement in DR	Neutron detector		
	Host1 takes new background measurement in DR that defines threshold for coming sweeping process				
END of Background measurement task					

19 *Switching off will erase all data on the device including the measured background value that is needed in the following stage*

Scanning room for neutron sources

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Neutron sweep task					
	Host1 and Host2 in DR	*Inspector1 and Inspector2 in DR*			
1		Inspector1 indicates spot and direction and asks Host1 to start measurement in SEARCH mode	Neutron detector	Relevant rise of count rate occurs *(Inspector1 decides if rise of count rate is relevant)*	See stage 2
	Host1 selects SEARCH mode and starts measuring from indicated spot on by moving detector slowly near surface in instructed direction *(Inspector1 decides if pace is reasonable or if measurement has to be repeated in slower pace)*			No relevant rise of count rate is noticeable	See stage 3
2 ***(if relevant rise of count rate occurs)***		Inspector1 asks Host1 to perform integrated measurement (INTEGRAL mode) at suspicious spot	Neutron detector, Pen, Inspection logsheet	Value does not exceed threshold (2 sigma)	Continue with stage 3
	Host1 selects INTEGRAL mode and executes integrated measurement at suspicious spot for 30 s	Inspector2 notes spot and measurement result		High count rate occurs again	Dispute settlement procedure
3 ***(if no relevant rise of count rate is noticeable)***		Inspector1 proceeds by instructing Host1 on how to sweep rest of room bit by bit	Neutron detector	Relevant rise of count rate occurs *(Inspector1 decides if rise of count rate is relevant)*	See stage 2
	Host1 continues to sweep rest of room as instructed by Inspector1			No relevant rise of count rate is noticeable	Continue stage 3
END of Neutron sweep task					

Appendix: List of materials

- Neutron search detector
- Pen
- Clipboard
- Inspection logsheet
- Step stool

Procedure description:
VIII) Gamma imaging procedure

Purpose of the procedure

This procedure describes the gamma imaging scan of the Dismantlement Room (DR)[20] with a Compton imaging detector to verify the absence of undeclared gamma sources. The gamma imaging can be done in parallel to the neutron sweeping measurement or other verification activities.

The setup and handling will be done by a technical staff member of the Host team. Inspectors are only present to verify the correctness of the process. The functionality test should be done before any measurement and repeated if the Inspectors consider it necessary. The typical *background count rate* is below about *20 counts per second (cps)*. If a signal's count rate within its three sigma margin (σ: square root of total count) exceeds 20 cps it is assumed to be significant.

This procedure comprises two different tasks: Functionality test task, Gamma imaging task.

Location

This procedure takes place in the Dismantlement Room (DR), before the Treaty accountable item (TAI) container enters and after the Special nuclear material (SNM) container left the room.

Participants

Host1 operating the Compton imaging detector.
Host2 watching the Inspectors.
Inspector1 supervising Host1.
Inspector2 keeping the minutes (inspection logsheet).

20 *this procedure is also applicable to other rooms in the radiation protection area*

Testing functionality of detector

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Functionality test task					
	Host1 and Host2 in Hallway or Equipment room	*Inspector1 and Inspector2 in Hallway or Equipment room*			
1		Inspector1 chooses spot in centre of hallway or Equipment room and asks Host1 to go there	Compton imaging detector		
	Host1 moves to spot and places Compton imaging detector at desired position while holding the tablet such that Inspector1 has clear view on detector and display				
2		Inspector1 asks Host1 to switch on detector			
	Host1 starts detector by pressing and releasing the red button. Device will go into power-up process finishing with a laser rangefinder measurement (~90s)				
3		Inspector1 asks Host2 to place Test source at 1m distance to detector in its field of view	Test source, Laser distance meter		
	Host2 places Test source at 1m distance to detector in its field of view				
	Host1 confirms distance with detector-implemented laser rangefinder measurement	Inspector1 confirms measured distance			
		Inspector1 asks Host1 to turn on near-field correction			
	Host1 turns on near-field correction				
		Inspector1 asks Host1 to select “Dose” option in isotope library			
	Host1 selects “Dose” option in isotope library				
4		Inspector1 asks Host1 to set measurement time to 10min and start measurement			

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Functionality test task					
	Host1 sets measurement time to 10min and starts measurement				
5 ***(when measurement is finished)***		Inspector1 confirms that signal source is coherent with optical image		Signal source not coherent with optical image	Dispute settlement procedure
		Inspector1 confirms count rate's margin of $\pm 3\sigma$ to exceed threshold of 20 cps		Count rate smaller than threshold of X cps	
		Inspector2 notes count rate			
END of Functionality test task					

Gamma imaging scan of Dismantlement Room (DR)

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Gamma imaging task					
	Host1 and Host2 in DR	*Inspector1 and Inspector2 in DR*			
1 ***(before dismantlement)***		Inspector1 chooses spot in DR and asks Host1 to go there	Adhesive tape		
		Inspector1 asks Host2 to mark position for measurement(s) with adhesive tape			
	Host2 marks position with adhesive tape				
2	Host1 places Compton imaging detector at marked position while holding the tablet such that Inspector1 has clear view on detector and display		Compton imaging detector		
3		Inspector1 asks Host2 to measure distance to the next wall within detector's field of view	Compton imaging detector		
	Host2 measures distance to next wall in detector's field of view with detector-implemented laser rangefinder measurement.	Inspector2 notes and confirms distance			
		Inspector1 asks Host2 to measure distances to other adjacent walls with laser distance meter	Laser distance meter		
	Host2 measures distance to other adjacent walls with laser distance meter	Inspector2 notes and confirms distance			
4		Inspector1 asks Host1 to turn on near-field correction			
	Host1 turns on near-field correction				

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
		Inspector1 asks Host1 to select “Dose” option in isotope library			
	Host1 selects “Dose” option in isotope library				
5		Inspector1 asks Host1 to set measurement time to 60min and start measurement			
	Host1 sets measurement time to 60min and starts measurement				
6 ***(when measurement is finished)***		Inspector1 confirms that no located signal source is observable in optical image		Located signal source observed in optical image	Dispute settlement procedure
		Inspector1 confirms threshold of 20 cps to be within the count rate’s margin of $\pm 3\sigma$		Count rate exceeding threshold of X cps	
END of Gamma imaging task					

Appendix: List of materials

- Compton imaging detector
- Test source (Ba-133)
- Laser distance meter
- Adhesive tape
- Pen
- Clipboard
- Inspection logsheet

Procedure description:
VIII-B) Handheld gamma sweeping procedure

Purpose of the procedure

This procedure describes the sweeping scan of the Dismantlement Room (DR)[21] with a handheld gamma detector to ensure the absence of undeclared gamma sources. It describes the procedure for one Inspector-Host pair handling one device. The gamma sweeping scan can be done parallel to the neutron sweeping scan.
There are two modes of operation: The FINDER mode for the sweeping scan itself and the DOSE rate mode as an extra measurement in case something suspicious comes up during the sweeping scan. In the FINDER mode a radioactive source should be visually noticeable by a rise of the count rate in the graph on the display. Additionally as help for the inspector an alarm sound goes off when values exceed 2 sigma of the background count rate. In the DOSE rate mode the absolute alarm threshold is chosen so that 50 g of plutonium with little shielding should be detectable.
For a more detailed description of the detector's operation and functionality, refer to the operating manual.

This procedure comprises one task: Gamma sweeping task.

Location

This procedure takes place in the Dismantlement Room (DR), before the Treaty accountable item (TAI) container enters and after the Special nuclear material (SNM) container left the room.

Participants

Host1 operating the handheld gamma detector.
Host2 watching the Inspectors.
Inspector1 supervising Host1.
Inspector2 keeping the minutes (inspection logsheet).

21 *this procedure is also applicable to other rooms inside the radiation protection area*

Searching for undeclared gamma sources

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Gamma sweep task					
	Host1 and Host2 in DR	*Inspector1 and Inspector2 in DR*			
1	Host1 moves to spot and holds detector in a way Inspector1 has clear view of display	Inspector1 chooses spot in centre of DR and asks Host1 to go there	Gamma detector		
2	Host1 starts detector and selects FINDER mode	Inspector1 asks Host1 to switch on detector and to change to FINDER mode	Gamma detector		
3	Host1 starts measuring from indicated spot on by moving detector slowly near surface in instructed direction *(Inspector1 decides if pace is reasonable or if measurement has to be repeated in slower pace)*	Inspector1 indicates spot and direction	Gamma detector, Pen, Inspection logsheet	No relevant rise of dose rate is noticeable	See stage 5
				Relevant rise of dose rate occurs *(Inspector1 decides if rise of dose rate is relevant)*	See stage 4
4 ***(if relevant rise of dose rate occurs)***	Host1 selects DOSE rate mode and executes measurement at suspicious spot for ~30 s	Inspector1 asks Host1 to perform measurement in DOSE rate mode at suspicious spot	Gamma detector	Value does not exceed alarm threshold	Continue with stage 5
				High dose rate occurs again	Dispute settlement procedure
5 ***(if no relevant rise of dose rate is noticeable)***	Host1 continues to sweep rest of room as instructed by Inspector1	Inspector1 proceeds by instructing Host1 on how to sweep rest of room bit by bit	Gamma detector	No relevant rise of dose rate is noticeable	Continue stage 5
				Relevant rise of dose rate occurs *(Inspector1 decides if rise of dose rate is relevant)*	See stage 4

Appendix: List of materials

- Handheld gamma detector
- Pen
- Clipboard
- Inspection logsheet
- Step stool

Procedure description: IX) Container movement procedure

Purpose of the procedure

This procedure describes the movement of containers through the portal monitor measurement area.
Before and after the dismantlement process all containers have to be checked for radiation to assure that only the ones that are designated as such contain SNM. To enable an undisturbed sweeping scan, the containers containing radioactive material must be absent during the first sweeping scan and need to leave the DR again before the final sweeping. Therefor they are going to pass the portal monitors twice where they are checked for radiation.

Remark: While the inspectors are not allowed to witness any movement of the containers that includes lifting they are allowed to watch the containers being moved horizontally. Hence the container has to be ready for transport at the beginning of this procedure. All preparations such as lifting the container onto a transporting device has to be done in advance by the host personnel in absence of inspectors and is not part of this procedure.

When the SNM is near the portal monitor the portal monitor laptop could show potentially sensitive measurement data. Thus the hosts have to make sure that the laptop is closed (at least) during the time where the container is close by (< 30 m). During that time the portal monitor uses only the alarm lamps as alarm indicators functioning as an information barrier.

This procedure comprises two tasks: Container entrance task, Container exit task.

Location

This procedure takes place in front of the Dismantlement Room (DR) where the radiation portal monitors are set up.

Participants

Host1 as the leading host.
Host2 moving the container inside the portal monitor secured area.
Host3 moving the container outside the portal monitor secured area.
Host4 carrying sealing kit and operating the camera.
Inspector1 to witness the movement.
Inspector2 to assist with the sealing documentation.

Container entering the dismantlement room

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Container entrance task					
	Host1, Host2, Host3 and Host4 outside portal monitor secured area	*Inspector1, Inspector2 outside portal monitor secured area*			
1	Host1 informs Inspector1 about intention to move one (or more) container(s) into DR ***If TAI container to be moved:*** Host1 makes sure portal monitor terminal is closed before container enters hallway				
2 ***(before container enters hallway)***	Host1 steps into portal monitor's measurement area and waits until measurement is completed (20 s)		Portal monitor	No alarm within 20 s Portal monitor alarms	Host1 exits measurement area and waits in front of DR Dispute settlement procedure
3 (before container enters hallway)	Host2 steps into measurement area and waits until measurement is completed (20 s)		Portal monitor	No alarm within 20 s Portal monitor alarms	Host2 exits measurement area and waits in front of DR Dispute settlement procedure
4	Host3 brings container into hallway	Inspector2 logsheets time and container's ID (in case of TAI container) and checks integrity of seals	Pen, Inspection logsheet		
5	Host4 executes Sealing documentation task	Inspector1 asks Host4 and Inspector2 to execute Sealing documentation task[22] Inspector2 executes Sealing documentation task	Pen, Inspection logsheet, Camera		

22 *see*: Procedure description: IV) Sealing procedure

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
6	Host3 moves container into portal monitor area	Inspector1 checks positioning of container	Container, Transporting device	Container larger than measurement area	Reposition container after measurement and repeat step 5 & 6 until complete container has been measured
7	Host3 steps back and waits in a distance of >1 m from portal monitor until measurement is completed (20 s)		Portal monitor	No alarm within 20 s	*For TAI-container:* Dispute settlement *For empty container:* Continue with step 7
				Portal monitor alarms	*For TAI-container:* Continue with step 7 *For empty container:* Dispute settlement
For TAI container: *continue with stage 10*					
8	Host1 executes Neutron sweeping on container	Inspector1 asks Host1 to execute Neutron sweeping[23] on container Inspector1 indicates pace and direction	Handheld neutron detector	Relevant rise of count rate	Dispute settlement
9	Host1 executes Gamma sweeping on container	Inspector1 asks Host1 to execute Gamma sweeping[24] on container Inspector1 indicates pace and direction	Handheld gamma detector	Relevant rise of dose rate	Dispute settlement
10	Host1 opens door to DR and Host2 moves container into DR		Container		
Repeat stages 4 to 10 for every container *which needs to be moved into the DR.*					
END of Container entrance task					

23 *see*: Procedure description: VII) Handheld neutron sweeping procedure
24 *see*: Procedure description: VIII-B) Handheld gamma sweeping procedure

Container exiting the dismantlement room

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Container exit task					
	Host1 and Host2 inside DR, Host3 and Host4 outside portal monitor secured area (in hallway)	*Inspector1 and Inspector2 outside portal monitor secured area (in hallway)*			
1	Host1 informs Inspector1 about intention to move one (or more) container(s) out of DR				
	Host1 makes sure laptop of portal monitor is closed before container enters hallway				
2	Host4 enters DR executing Inward transfer task[25]	Inspector1 and Inspector2 enter DR			
3		Inspector asks Inspector 2 and Host4 to execute Seal application task on container(s)[26]			
	Host4 executes Seal application task on container(s)	Inspector2 executes Seal application task on container(s)	Sealing kit, Inspection logsheet		
		Inspector asks Inspector 2 and Host4 to execute Seal documentation task on container(s)[27]			
	Host4 executes Sealing documentation task	Inspector2 executes Sealing documentation task	Sealing kit, Inspection logsheet		
4	Host4 leaves DR executing Outward transfer task[28]	Inspector1 and Inspector2 leave DR			
5	Host2 moves container from DR into portal monitor area		Container, Transporting device	Container larger than measurement area	Reposition container after measurement and repeat until complete container has been measured
		Inspector1 checks positioning of container			
6	Host2 steps back and waits in a distance of >1 m		Portal monitor	No alarm within 20 s	*For SNM-container:*

25 *see*: Procedure description: XI) Host DR Exit/Entry procedure
26 *see*: Procedure description: IV) Sealing procedure
27 *see*: ibd.
28 *see*: Procedure description: XI) Host DR Exit/Entry procedure

	from portal monitor until measurement is completed (20 s)				Dispute settlement *For non-SNM-container:* Continue with step 3
				Portal monitor alarms	*For SNM-container:* Continue with step 3 *For non-SNM-container:* Dispute settlement
For TAI container: *continue with stage 9*					
7	Host1 executes Neutron sweeping on container	Inspector1 asks Host1 to execute Neutron sweeping[29] on container Inspector1 indicates pace and direction	Handheld neutron detector	Relevant rise of count rate	Dispute settlement
8	Host1 executes Gamma sweeping on container	Inspector1 asks Host1 to execute Gamma sweeping[30] on container Inspector1 indicates pace and direction	Handheld gamma detector	Relevant rise of dose rate	Dispute settlement
9	Host3 moves container out of measurement area into hallway	Inspector1 does visual check on container and notes time and container's ID number	Pen, Inspection logsheet		
Repeat stages 5 to 7 for every container *which needs to be moved out of the DR.*					
END of Container exit task					

29 *see*: Procedure description: VII) Handheld neutron sweeping procedure
30 *see*: Procedure description: VIII-B) Handheld gamma sweeping procedure

Appendix: List of materials

- Portal monitor
- Handheld neutron detector
- Handheld gamma detector
- Container:
  - TAI
  - SNM
  - OC
- Transporting device(s)
- Inspection logsheet
- Pen
- Sealing kit (Transparent bag, Camera, Adhesive seals, Reflective particle matrix)

Procedure description:
X) Template procedure

Purpose of the procedure

This procedure describes the gamma template measurement of special nuclear material (SNM) with the TRIS system to verify the integrity of the investigated object. With the template procedure inspectors can verify the Treaty accountable item (TAI) container in advance of the dismantlement by comparing its signature to a previously measured template. After the dismantlement inspectors can take a new template for the SNM container to verify it at a later point.

The setup and handling will be done by a technical staff member of the Host team. Inspectors are only present to verify the correctness of the process.

This procedure comprises two different tasks: Template confirmation task, Template generation task.

Location

This procedure takes place in the Non-destructive Assay (NDA) room before and after the dismantlement operation.

Participants

Host1 operating the TRIS system
Host2 watching the Inspectors.
Inspector1 supervising Host1.
Inspector2 keeping the minutes (inspection logsheet).

Comparing signature to an existing template

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Template confirmation task					
	Host1 and Host2 in NDA room or DR	*Inspector1 and Inspector2 in NDA room or DR*			
1		Inspector1 asks Host1 to start the TRIS system and run the Spiral Tamper Board Tests	TRIS system	Spiral Tamper Board Tests fail	Dispute settlement procedure
	Host1 starts the TRIS system which automatically runs the Spiral Tamper Board Tests				
2	Host1 asks Inspector1 to give firmware hash key for Firmware Integrity Verification		Firmware has key		
		Inspector1 gives firmware hash key for Firmware Integrity Verification			
	Host1 enters firmware hash key and runs Firmware Integrity Verification and shows the resulting red and black side hash values to Inspector1		Red and black side hash values	Output hash values do not match with agreed values	Dispute settlement procedure
		Inspector1 verifies the red and black side hash values			
3		Inspector1 asks Host1 to reject option to generate new template			
	Host1 rejects option to generate new template				
4	Host1 asks Inspector1 for public key iButton		Public key iButton	Error while reading iButton	Dispute settlement procedure
		Inspector1 gives Host1 public key iButton to connect it to black side of trusted processor			
	Host1 connects public key iButton to black side				
5		Inspector1 asks Host1 to execute functionality test			
	Host1 installs the tungsten shield on the NaI detector				

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
	Host1 initializes functionality test				
6		Inspector1 asks Host1 to connect template iButton to red side	Template iButton	Error while reading iButton	Dispute settlement procedure
	Host1 connects template iButton to red side				
		Inspector1 ensures that trusted processor verifies template signature with public key		Error while verifying template	
	Host1 confirms template				
7		Inspector1 asks Host2 to move in TAI container / SNM container[31]	TAI container/SNM container, Sealing kit		
	Host2 moves in TAI container / SNM container and places it in measurement area				
		Inspector2 logsheets time and container's ID and checks integrity of seals			
		Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task[32]			
	Host2 executes Sealing documentation task	Inspector2 executes Sealing documentation task			
8		Inspector1 asks Host1 to confirm the position of the NaI detector wrt. the TAI container/SNM container			
	Host1 confirms the position of the NaI detector wrt. the measurement are and ensures that the tungsten shield is in place				
		Inspector1 asks Host1 to start background collection and calibration			
	Host1 starts background collection and calibration				

31 *see*: Procedure description: IX) Container movement
32 *see*: Procedure description: IV) Sealing procedure

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
9		Inspector1 asks Host1 to start spectrum collection		Calibration error	Dispute settlement procedure
	Host1 removes the tungsten shield from the NaI detector				
	Host1 starts spectrum collection				
		Inspector1 makes sure that the measurement was confirmed against the template		Measurement not confirmed	Dispute settlement procedure
END of Template confirmation task					

Creating a new template from signature

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Template generation task					
	Host1 and Host2 in NDA room or DR	*Inspector1 and Inspector2 in NDA room or DR*			
1		Inspector1 asks Host1 to start the TRIS system and run the Spiral Tamper Board Tests	TRIS system	Spiral Tamper Board Tests fail	Dispute settlement procedure
	Host1 starts the TRIS system which automatically runs the Spiral Tamper Board Tests				
2	Host1 asks Inspector1 to give firmware hash key for Firmware Integrity Verification		Firmware has key		
		Inspector1 gives firmware hash key for Firmware Integrity Verification			
	Host1 enters firmware hash key and runs Firmware Integrity Verification and shows the resulting red and black side hash values to Inspector1		Red and black side hash values	Output hash values do not match with agreed values	Dispute settlement procedure
		Inspector1 verifies the red and black side hash values			
3		Inspector1 asks Host1 to choose option to generate new template			
	Host1 chooses option to generate new template				
4	Host1 asks Inspector1 for random number seed iButton		Inspector random number seed iButton	Error while reading iButton	Dispute settlement procedure
		Inspector1 gives Host1 random number seed iButton to connect it to black side of trusted processor			
	Host1 connects Inspcector random number seed iButton to black side				

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
		Inspector1 asks Host1 to connect Host random number seed iButton to red side	Host random number seed iButton		
	Host1 connects Host random number seed iButton to red side				
5		Inspector1 asks Host1 to create a private/public key pair			
	Host1 creates a private/public key pair				
		Inspector1 asks Host1 to save public key on public key iButton	Public key iButtons	Error while writing to iButton	Dispute settlement procedure
	Host1 saves public key on two public key iButtons				
		Inspector2 notes serial numbers of both public key iButtons			
	Host1 keeps one public key iButton				
	Host1 hands over second public key iButton and random number seed iButton to Inspector1				
	Host2 maintains line of sight to iButton	Inspector1 takes public key iButton and random number seed iButton and keeps it in line of sight of Host2			
6		Inspector1 asks Host1 to execute functionality test			
	Host1 installs the tungsten shield on the NaI detector				
	Host1 initializes functionality test				
7		Inspector1 asks Host2 to move in TAI container / SNM container[33]	TAI container/SNM container, Sealing kit		
	Host2 moves in TAI container / SNM container and places it in measurement area				

33 *see*: Procedure description: IX) Container movement

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
		Inspector2 logsheets time and container's ID and checks integrity of seals			
		Inspector1 asks Host2 and Inspector2 to execute Sealing documentation task[34]			
	Host2 executes Sealing documentation task	Inspector2 executes Sealing documentation task			
8		Inspector1 asks Host1 to confirm the position of the NaI detector wrt. the TAI container/SNM container			
	Host1 confirms the position of the NaI detector wrt. the measurement are and ensures that the tungsten shield is in place				
		Inspector1 asks Host1 to start background collection and calibration			
	Host1 starts background collection and calibration			Calibration error	Dispute settlement procedure
	Host1 removes the tungsten shield from the NaI detector after calibration				
9		Inspector1 asks Host1 to start spectrum collection			
	Host1 starts spectrum collection			Measurement error	Dispute settlement procedure
		Inspector1 confirms spectrum collection			
10		Inspector1 observes signing of template with private key			
	Host1 resinstalls tungsten shield				
		Inpsector1 asks Host1 to write template to iButton on red side	Template iButton	Error while writing to iButton	Dispute settlement procedure
	Host1 writes template to template iButton on red side				

34 *see*: Procedure description: IV) Sealing procedure

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
		Inspector2 notes serial number of template iButton			
Repeat stage 9 for template confirmation					
11		Inspector1 confirms template confirmation			
END of Template generation task					

Appendix: List of materials

- TRIS system
  - Black and red processor
  - NaI detector
  - Multi channel analyzer
  - Tungsten shield
  - iButtons: Random number seeds (inspectors and host), public key (inspectors), template (hosts)
  - Firmware hash key
  - Red and black side hash values
- TAI container / SNM container
- Pen
- Clipboard
- Inspection logsheet

Procedure description:
XI) Dismantlement room entry and exit procedure

Purpose of the procedure

During the actual dismantlement process a host might enter or leave the DR. This document describes the actions to execute the movement of host personnel into or out of the DR. The alarm threshold of the portal monitor is chosen to detect an amount of 50 gram of weapon-grade plutonium with little shielding inside the measurement area.
In case something is detected by the radiation portal monitor the handheld neutron and gamma detectors should be at hand to perform a body scan on the suspicious person. It is therefore advisable to keep them within reach during the dismantlement process, so not much time is wasted by retrieving them from the storage box in case of need. As the neutron detector also takes a lot of time for initial background measurements it should be already turned on.

This procedure comprises two tasks: Outward transfer task, Inward transfer task.

Location

This procedure takes place in the hallway outside the Dismantlement room (DR).

Participants

Host1 to leave the DR.
Host2 to enter the DR.
Host3 and **Host4** in the hallway, outside the portal monitor secured area.
Two Inspectors to supervise the procedure, in the hallway, staying in the agreed places.

Outward transfer of host personnel

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Outward transfer task					
	Host1 in DR, Host3 and Host4 in Hallway	*Inspector1 and Inspector2 in Hallway*			
1	Host1 signals Host3 about intention to leave DR Host3 informs Inspector1 Host3 makes sure present Inspectors are positioned in agreed place and have no visual access to DR	Inspector1 and Inspector2 stay in agreed place during outward transfer	Fixed telephone		
2	Host3 signals Host1 in DR		Fixed telephone		
3	Host1 opens door, steps out of DR				
4	Host1 step into marked portal monitor area stays in its centre of until new instructions come up	Inspector1 asks Host1 to step into portal monitor area and to stay in its centre for 20 s	Portal monitor	No alarm within 20 s Portal monitor alarms continuously	See stage 5 See stage 6
5 ***(if no alarm within 20 s)***	Host1 steps out of portal monitor area	Inspector1 asks Host1 to leave portal monitor area		**END of Outward transfer task**	
6 ***(if portal monitor raises an alarm continuously)***	Host1 steps out of portal monitor area	Inspector1 asks Host1 to step out of portal monitor area			
7	Host3 scans Host1 with handheld gamma	Inspector1 asks Host3 to perform body scan on Host1 with handheld gamma detector Inspector1 observes measurement	Handheld gamma detector	No alarm Alarm	See stage 8 Dispute settlement

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
	detector from top to bottom in slow pace including shoes from below. Host3 performs measurement both on front and on backside of Host1				procedure, See stage 9
8		Inspector1 asks Host3 to perform body scan on Host1 with handheld neutron detector in SEARCH mode	Handheld neutron detector	No alarm	Repeat portal monitor measurement (stages 3 and 4)
	Host3 scans Host1 with handheld neutron detector from top to bottom in slow pace including shoes from below. Host3 performs measurement both on front and on backside of Host1	Inspector1 observes measurement		Alarm	See stage 9
9 ***(if handheld detector raises an alarm)***		Inspector1 asks Host3 to inform Inspection team leader and asks Host1 to stay in measurement area	Fixed telephone		
	Host3 signals Hosts in DR and informs both team leaders				
10	Host team leader executes *Dispute settlement procedure*	Inspection team leader executes *Dispute settlement procedure*			
END of Outward transfer task					

Inward transfer of host personnel

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Inward transfer task					
	Host2, Host3 and Host4 in hallway outside of portal monitor secured area	*Inspector1 and Inspector2 in hallway outside of portal monitor secured area*			
1	Host2 informs Inspector1 about intention to enter DR				
	Host3 makes sure present Inspectors are positioned in agreed place and have no visual access to DR				
		Inspector1 and Inspector2 stays in agreed place during inward transfer			
2		Inspector1 asks Host2 to step into portal monitor area	Portal monitor		
	Host2 steps into portal monitor area				
3		Inspector1 asks Host2 to stay in centre of portal monitor area for 20 s	Portal monitor	No alarm within 20 s	See stage 4
	Host2 stays in centre of portal monitor area for 20 s			Portal monitor alarms continuously	See stage 5
4 ***(if no alarm within 20 s)***	Host3 signals Hosts in DR		Fixed telephone		
	Hosts inside DR open door				
	Host2 steps in DR and closes door			**END of Inward transfer task**	
5 ***(If portal monitor raises an alarm continuously)***		Inspector1 asks Host2 to step out of portal monitor area			
	Host2 steps out of portal monitor area				

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
6		Inspector1 asks Host3 to perform body scan on Host2 with handheld gamma detector	Handheld gamma detector	No alarm	See stage 7
	Host3 scans Host2 with handheld gamma detector from top to bottom in slow pace including shoes from below. Host3 performs measurement both on front and on backside of Host1	Inspector1 observes measurement		Alarm	Dispute settlement procedure, See stage 8
7		Inspector1 asks Host3 to perform body scan on Host2 with handheld neutron detector in SEARCH mode	Handheld gamma detector	No alarm	Repeat portal monitor measurement (stages 2 and 3)
	Host3 scans Host2 with handheld neutron detector from top to bottom in slow pace including shoes from below. Host3 performs measurement both on front and on backside of Host1	Inspector1 observes the measurement		Alarm	See stage 8
8 ***(if handheld detector raises an alarm)***		Inspector1 asks Host3 to inform Inspection team leader and asks Host2 to stay in same place	Fixed telephone		
	Host3 informs both team leaders				
9	Host team leader executes *Dispute settlement procedure*	Inspection team leader executes *Dispute settlement procedure*			
END of Inward transfer task					

Appendix: List of materials

- Clipboard
- Pen
- Inspection logsheet
- Portal monitor
- Neutron detector
- Gamma detector
- Fixed telephone

Procedure description:
XII) Data transfer procedure

Purpose of the procedure

During the dismantlement process, photo and CCTV cameras produce data which will be saved on memory cards or a hard drive. This document describes the necessary actions to remove the data carriers from the photo cameras and retrieve the stored data.

This procedure comprises three different tasks: Memory card recovery task, Data transfer task, Document transfer task.

Location

This procedure takes place in the Equipment room.

Participants

Host1
Host2
Inspector1
Inspector2

Recovery of memory card

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Memory card recovery task					
	Host1, Host2 in Equipment room	*Inspector1, Inspector2 in Equipment room*			
1 ***(if not already done)***		Inspector1 asks Inspector2 and Host1 to execute Equipment retrieval task[35] on camera No.2	Camera No.2		
	Host1 executes Equipment retrieval task on camera No.2	Inspector2 executes Equipment retrieval task on camera No.2			
2		Inspector1 asks Host1, Host2 and Inspector2 to execute Sealing documentation task with camera No.2 on seal of camera No.1 (and vice versa, if not already done so)	Camera No.1, Camera No.2, Inspection logsheet		
	Host1 and Host2 execute Sealing documentation task with camera No.2 on seal of camera No.1 (and vice versa if not already done so)	Inspector2 executes Sealing documentation task with camera No.2 on seal of camera No.1 (and vice versa if not already done so)			
3	Host1 reviews photos with Inspector1	Inspector1 and Host1 do a joint review of the photos		Photo is security sensitive	Dispute settlement Delete photo
				Photo is blurred	*If possible:* Retake photo
4	Host1 removes memory card from camera No.1 and reads out number of memory card	Inspector2 notes number of first memory card	Memory card (from camera No.1)		
	Host1 removes memory card from camera No.2 and reads out number of memory card	Inspector2 notes number of second memory card	Memory card (from camera No.2)		
	Host1 maintains both memory cards in line of sight of Inspector2	Inspector2 maintains line of sight to both memory cards			
		Inspector1 asks Host1 and Inspector2 to execute Data transfer task with first memory card			
	Host1 executes Data transfer task with first memory card	Inspector2 executes Data transfer task with first memory card	CCTV Terminal		

35 *see*: Procedure description: IV) Sealing procedure

		Inspector1 asks Host1 and Inspector2 to execute Data transfer task with second memory card			
	Host1 executes Data transfer task with second memory card	Inspector2 executes Data transfer task with second memory card	CCTV Terminal		
5		Inspector1 asks Host1 to retrieve two new memory cards from storage box	2 Memory cards, Inspection logsheet		
	Host1 retrieves two new memory cards from storage box				
		Inspector1 asks Host1 to insert new memory cards into camera No.1 and camera No.2			
	Host1 inserts new memory cards into camera No.1 and camera No.2	Inspector2 notes number of memory cards			
6 ***(if necessary)***		Inspector1 asks Host1 to replace camera's battery	Camera No. 1 or 2, Spare battery		
	Host1 replaces old battery with spare battery from utility box and puts old battery in storage box				
7	Host1 verifies that new memory cards are empty	Inspector1 verifies that new memory cards are empty			
8		Inspector1 asks Host1 to execute Seal application task[36] on memory card slits of cameras No.1 & 2	Sealing kit		
	Host1 executes Seal application task on memory card slits of cameras No.1 & 2				
		Inspector1 asks Inspector2 and Host1 to execute Sealing documentation task on camera No.1 & 2	Inspection logsheet		
	Host1 executes Sealing documentation task on camera No.1 and camera No.2	Inspector2 executes Sealing documentation task on camera No.1 and camera No.2			
9 ***(if camera(s) is(/are) going to be locked)***		Inspector1 asks Inspector2 and Host1 to continue executing Equipment locking task[37] on (both) camera(s)			
	Host1 continues executing Equipment locking task on (both) camera(s)	Inspector2 continues executing Equipment locking task on (both) camera(s)			

36 *see*: Procedure description IV) Sealing procedure
37 *see*: Procedure description II) Equipment retrieval and locking procedure

Digital data transfer

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Data transfer task					
	Host1	*Inspector1, Inspector2*			
	Possible host concerns regarding security sensitivity of data must be resolved by now				
1 ***(if not already done)***		Inspector1 asks Inspector2 and Host1 to execute Sealing documentation task on CCTV terminal	Inspection logsheet, CCTV terminal		
	Host1 executes Sealing documentation task on CCTV terminal	Inspector2 executes Sealing documentation task on CCTV terminal			
		Inspector1 asks Host1 to break seal of CCTV terminal			
	Host1 breaks seal of CCTV terminal				
2 ***(if sealing kit is going to be locked afterwards)***		Inspector1 asks Host1 to prepare one adhesive seal to later seal CCTV terminal	Sealing kit		
	Host1 prepares one adhesive seal for later application				
		Inspector1 asks Inspector2 and Host1 to execute Sealing documentation task on not yet applied seal	Inspection logsheet		
	Host1 executes Sealing documentation task on prepared seal	Inspector2 executes Sealing documentation task on prepared seal			
	Host1 keeps seal in line of sight of Inspector1	Inspector1 maintains line of sight to seal		Interruption of line of sight	Prepare new adhesive seal
3 ***(if data originates from mem. card)***		Inspector1 asks Host1 to insert memory card in CCTV terminal card reading slot	Memory card		
	Hos1 inserts memory card in CCTV terminal card reading slot				
	Host1 stores data from memory card on CCTV terminal	Inspector1 instructs Host1 to store data on CCTV terminal			

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Data transfer task					
4		Inspector1 asks Host1 to compress data in single archive			
	Host1 compresses data in single archive				
5		Inpsector1 asks Host1 to execute hashing algorithm on compressed archive			
	Host1 executes hashing algorithm on compressed archive				
		Inspector2 documents filename and last 12 digits of unique hash value of data in inspection logsheet	Inspection logsheet		
Repeat stages 4 and 5 for every set of data *which needs to be transferred.* *Follow stages 6 and 7* ***if sealing kit is to be locked*** *afterwards.* *Proceed with stage 8* ***if sealing kit is <u>not</u> going to be locked*** *afterwards.*					
6		Inspector1 asks Host1 to close and seal CCTV terminal with prepared seal	Prepared seal	Adhesive seal damaged	Prepare new adhesive seal (see stage 2)
	Host1 closes CCTV terminal and seals it with prepared seal				
7		***For security reasons:*** Inspector1 asks Inspector2 and Host1 to execute Sealing documentation task on CCTV terminal			
	Host1 executes Sealing documentation task on CCTV terminal	Inspector2 executes Sealing documentation task on CCTV terminal			
		Inspector1 asks Host1 to make sure that CCTV terminal is located within CCTV supervised area			
	Host1 moves CCTV terminal in CCTV supervised area				
Proceed from here ***if sealing kit is <u>not</u> going to be locked*** *afterwards.*					
8		Inspector1 asks Host1 to close CCTV Terminal			
	Host1 closes CCTV terminal				
		Inspector1 asks Host1 to execute Seal application	Sealing kit		

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Data transfer task					
		task[38] on CCTV terminal			
	Host1 executes Seal application task on CCTV terminal				
		Inspector1 asks Inspector2 and Host1 to execute Sealing documentation task on CCTV terminal	Inspection logsheet		
	Host1 executes Sealing documentation task on CCTV terminal	Inspector2 executes Sealing documentation task on CCTV terminal			
		Inspector1 asks Host1 to make sure that CCTV terminal is located within CCTV supervised area			
	Host1 moves CCTV terminal in CCTV supervised area				
Host team ensures that hashed data is later transferred to Inspection team via a memory card.					
End of Data transfer task					

38 *see*: Procedure description IV) Sealing procedure

Document transfer

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Document transfer task					
	Host1 outside of radiation protection area	*Inspector1 inside of radiation protection area* *Inspector2 outside of radiation protection area*			
1		Inspector1 verbally transmits filename(s) and corresponding twelve digits of unique hash value(s) to Inspector2 Inspector2 notes down filenames and last six digits of unique hash value	Inspection logsheet		
2		Inspector1 places all inspection documents in designated area	Documents		
3	Host1 retrieves documents from designated area after they have been checked for contamination		Documents		
4	Host1 checks documents for sensitive information		Inspection logsheet, Documents	Unauthorized information noted in document	Host1 blacks out corresponding passage Dispute settlement procedure
5	Host1 ensures that photo copy of reviewed documents is handed over to Inspection team		Photocopier		
End of Document transfer task					

Appendix: List of materials

- Sealing kit (including Camera No. 1)
- Camera No. 2
- Memory cards
- CCTV terminal
- Photocopier
- Documents
- Inspection logsheet

Procedure description:
XIII) SNM container sealing procedure

Purpose of the procedure

The SNM-container is sealed by the host in the Dismantlement Room under the supervision of an inspector. For this purpose, an Electronic Optical Sealing System (EOSS) is applied on the SNM-container. The seal-wires are pulled through two opposite eyelets, which are mounted on the lid of the SNM-container. The EOSS must be applied properly before the SNM-container is transported out of the Dismantlement Room!

This procedure comprises two tasks: Preparation task, Seal setting task.

Location

This procedure takes place in the Dismantlement room (DR).

Participants

Host1 setting the seal.
Two Inspectors to supervise the procedure, in the Dismantlement Room, staying in the agreed places.

Preparing the electronical optical sealing system

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Preparation task					
	Host1 in DR	*Inspector1 and Inspector2 in DR*			
1	Host1 starts EOSS terminal with EOSS reader software (in administrator mode) Host connects the USB extension cable to the EOSS-USB-Interface and to insert the EOSS USB interface and the EOSS crypto to-ken into the USB ports	Inspector1 asks Host1 to connect the USB extension cable to the EOSS USB interface and to insert the EOSS USB Interface and the EOSS crypto token into the USB ports	EOSS EOSS fibre optical cable EOSS terminal EOSS USB interface EOSS crypto token	Status LEDs of both devices must flash after connection	
2	Host1 enters crypto token password: EOSS	Inspector1 asks Host1 enter crypto token password: EOSS			
3	Host1 to connect the data cable to the EOSS USB interface and to one of the two data ports on the EOSS	Inspector1 asks Host1 to connect the data cable to the EOSS USB interface and to one of the two data ports on the EOSS seal	Data cable		
4	Host1 opens EOSS reader software and enters inspector IDs	Inspector1 asks Host1 open EOSS reader software and enter inspector IDs		Do not activate expert mode	
5	Host1 searches for the seal in the EOSS reader software using the binocular symbol (may take				

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
	a few minutes)				
		Inspector1 compares the serial number of the seal with the one displayed in the software (in the left column) and logs it			
	Host1 clicks on the seal in the left column to display the seal memory				
		Inspector1 confirms that only agreed logs are displayed and that it says "*Seal wire: open*"			
END of Preparation task					

Setting the electronic optical seal

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Seal setting task					
	Host1 in the DR	*Inspector1 and Inspector2 in the DR*			
1		Inspector1 notes time of seal setting and asks Host1 to close and seal the SNM container with the EOSS		The LED on the seal flashes three times briefly to confirm that the seal has been set correctly.	
	Host1 closes the latches of the eyelets of the cover of the SNM container				
	Host1 guides the end of the fibre optic cable through the two eyelets of the cover while the green protective caps of the fibre optic cable are fitted				
	Host1 removes the red protective caps on the EOSS and the green protective caps on the EOSS fibre optic cable while paying attention to not pulling out the data cable				
	Host1 connects the EOSS fibre optic cable to both sockets of the EOSS				
	Host2 steps into portal monitor area				
2		Inspector1 asks Host2 to click on the “Refresh” symbol in the EOSS reader software.			
	Host2 click on the “Refresh” symbol in the EOSS reader software.				
		Inspector1 asks Host2 to be allowed to watch the current status on EOSS terminal.			
	Host2 allows to to watch the current status on EOSS terminal.				

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
		Inspector1 checks if status is: Seal wire closed and notes the date and time of the seal as displayed in the software.			
3		Inspector1 asks Host2 to close the software on EOSS terminal.			
	Host2 closes the software on EOSS terminal and confirm the saving of the saving of the database by clicking “yes”				
		Inspector1 asks Host2 to remove the data cable from the EOSS, the EOSS USB interface and to remove the EOSS USB-Interface and the EOSS crypto token from the EOSS terminal and pack them, together with green and red sealing flaps into the bag.			
	Host2 removes the data cable from the EOSS, the EOSS USB interface and removes the EOSS USB interface and the EOSS crypto token from the EOSS terminal and packs them, together with green and red sealing flaps into the bag.				
END of Seal setting task					

Appendix: List of materials

- Clipboard
- Pen
- Inspection logsheet
- EOSS
- EOSS fibre optical cable
- EOSS terminal
- EOSS USB interface
- EOSS crypto token

Procedure description:
XIV) Dispute Settlement

Purpose of the procedure

The Dispute Settlement Procedure enables the Inspectors to resolve disputes and ambiguities that could potentially weaken the outcome of the inspection. Any Inspector may raise an objection at any time, whereupon the Host will halt the inspection if possible and try to clarify the issue on the spot. If this is not successful, or if the issue is only noticed later on, it can be recorded and raised again outside the radiation protection area. If the following consultations still cannot clarify the issue, it will be noted in the inspection report, commented by the host and brought up in a committee as established by the underlying disarmament treaty.

This procedure comprises different tasks: Dispute settlement task 1, 2 and 3.

Location

This procedure takes place wherever an issue arises.

Participants

Inspector1 raising the issue.
Any affected **Host** personnel.
Inspection Team Leader and
Host Team Leader should be called in as soon as possible.

On-site consultation

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Dispute settlement task 1					
	Host Team Leader and other Hosts. Position according to current task	*Inspection Team Leader and other Inspectors. Position according to current task*			
1		Inspection Team Leader, aided by Inspector1, explains problem and how it may affect outcome of Inspection			
2	Host Team Leader considers issue and tries to negotiate a compromise			Inspection Team Leader believes issue is resolved	Inspection Team Leader declares issue resolved, **End of Dispute Settlement**
				Issue not resolved	Continue Dispute Settlement Procedure
3		Inspector1 notes incident in inspection logsheet	Inspection logsheet		
If issue is declared resolved during on-site consultation, the procedure is finished. Otherwise, proceed with Dispute settlement task 2					
END of Dispute settlement task 1					

Off-site consultation

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Dispute settlement task 2					
	Host Team Leader and involved Host(s) in meeting room	*Inspection Team Leader and involved Inspector(s) in meeting room*			
1		Inspection Team Leader requests conflict resolution from Host Team Leader and gathers all Inspectors involved in issue			
	Host Team Leader gathers Host personnel involved in issue if possible				
2	Inspection Team Leader and Host Team Leader discuss issue and try to find solution. This may include agreeing on alterations to some remaining inspection procedures, inclusion of additional inspection procedures or other measures		Inspection logsheet	Inspection Team Leader believes issue is resolved	Inspection Team Leader declares issue resolved, **End of Dispute Settlement**
				Issue not resolved	Continue Dispute Settlement Procedure
3		Inspection Team Leader notes result of consultation in inspection logsheet	Inspection logsheet		
4 ***(if additional measures were agreed in stage 2)***	Host Team Leader distributes information about additional measures to all Host personnel	Inspection Team Leader notes additional measures in inspection logsheet and briefs Inspection team accordingly	Inspection logsheet		
END of Dispute settlement task 2					

Incident report

Stage	Hosts	Inspectors	Equipment	Event	Provision to be taken in case of event
Dispute settlement task 3					
	Host Team Leader and involved Host(s) in Hosts' room	*Inspection Team Leader and involved Inspector(s) in Inspectors' room*			
1		Inspection Team Leader gathers all Inspectors involved in issue and drafts statement for inspection report			
2	Host Team Leader and Inspection Team Leader discuss issue and exchange views				
	Host Team Leader informs Inspection Team Leader on intended statement in inspection report	Inspection Team Leader informs Host Team Leader on intended statement in inspection report			
3		Inspection Team Leader writes appendix to inspection report detailing issue	Inspection report		
	Host Team Leader writes comment to said appendix, detailing view on issue, which is also added to inspection report				
END of Dispute settlement task 3					

Appendix: List of materials

- Inspection logsheet
- Inspection report

7. Manuals

7.1. Cryptographic hash algorithm SHA-256 operating manual

Overview

The cryptographic hash function SHA-256 (Secure Hash Algorithm 256) is used

to secure data by generating a unique digital fingerprint called hashvalue. The integrity of the data can be verified at any given time by running the algorithm again and checking if the newly generated hashvalue matches the original one.

SHA-256 was first published by the National Institute of Standards and Technology (NIST) as a U.S. federal standard and is also declared as a secure hashing algorithm by the German Federal Office for Information Security. The algorithm can be freely downloaded on the internet and is usually preinstalled on Mac, Windows and Linux distributions. Running the algorithm on any given datafile will generate a hashvalue consisting of 64 hexadecimal characters (256 bit). This hashvalue is unique to the datafile, the smallest possible change in data will result in a completely different sequence. The algorithm only works one way, it is not possible to create a datafile with a specific hashvalue.

Operating procedure

To run the algorithm, the data must first be saved on the hard drive. Two separated folders should be saved on the CCTV terminal: One folder, containing all photo files from the memory cards and one folder containing all video files from the CCTV footage. For each folder, the files have to be compressed into one single zip-file (see fig. 1 and 2).

Figure 1: Compressing all datafiles to one zip-file

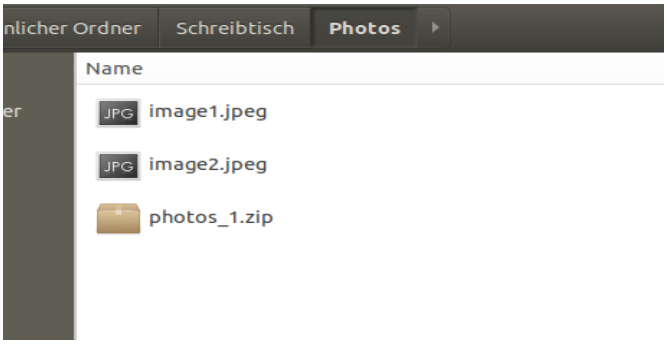


Figure 2: Folder containing the datafiles

and the compressed zip-file

To run the algorithm on a Linux distribution, the terminal must be opened. Go with the "cd" command to the directory of the compressed data file. Generate the hashvalue by typing in the command "sha256sum filename.zip" with the given filename as shown in fig. 3. The algorithm outputs a 64 long sequence of hexadecimal characters, of which the first 12 digits are noted down for later integrity verifications. It is important to note that another compression of the same datafiles will result in a different hashvalue. It is therefore vital to always keep the zipfile and not to render

it, as it has then lost its integrity. The compressed zip-file can be copied or renamed, this will not change the hashvalue.

To run the algorithm on Mac, type in the terminal the algorithm command "shasum -a 256 filename.zip" and for windows "certUtil -hashfile filename.zip SHA256".

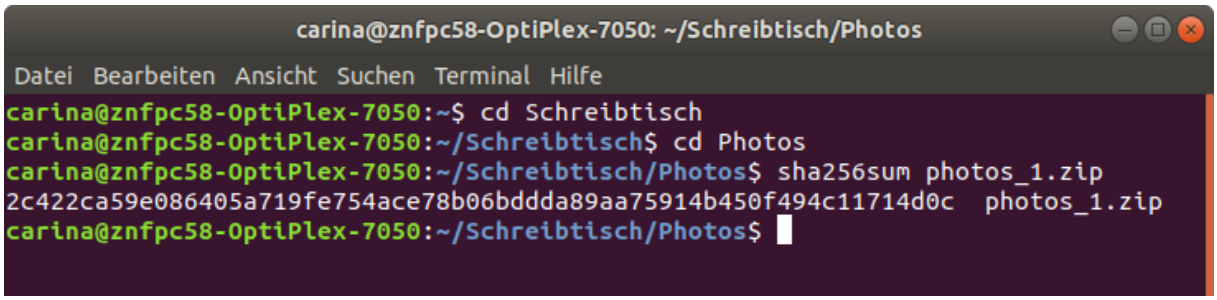


Figure 3: Terminal commands for running the hash algorithm on a Linux distribution

8. Scenario and background information

8.1. Nuclear Weapons Reduction Treaty background information

General information on Ipindovia:

Background: Ipindovia is a large regional power. Ipindovia has ca. 100 million inhabitants and is a democracy with a free press and free speech. Ipindovia possesses an army, navy, and air force, but does not operate any military bases beyond its borders.

Political-legal situation: Ipindovia's international commitments include a permanent seat in the UN Security Council and it is an NPT signatory nuclear-weapon state in good standing. It is in compliance with all relevant international obligations, including an IAEA Voluntary Offer Agreement under which it has declared its entire civilian nuclear fuel cycle (see below). It is not involved in any national or international conflict; nor are there any conflict zones on or near its borders.

Geography: Ipindovia has access to open seas as well as land borders with neighboring states. Ipindovia has fully developed/modern transport links between major cities/other significant locations, including military and nuclear bases. These transport links include but are not necessarily limited to roads, train, airports/airfields. (A map of Ipindovia and relevant sites is provided on the next page).

Nuclear arsenal: Ipindovia possesses a full nuclear triad, with a total nuclear stockpile of 1000 warheads.

- 900 of these warheads are located at deployment bases:
  - 200 warheads located at nuclear bomber bases (gravity bombs and ALCMs).
  - 300 warheads located at submarines bases (SLBMs)
  - 400 warheads located at ground-based ICBM bases (both in silos and road-mobile).
- 100 warheads are located at the Primary Nuclear Weapons Site (LADDU) described below.

These numbers represent individual warheads, not delivery vehicles. For example, a bomber that carries six nuclear weapons counts as six, not as one. The ICBMS have single reentry vehicles per delivery vehicle; the SLBMs have MIRVs. Each SLBM carries 5 warheads, so that Ipindovia has 60 SLBMs in operation. Each submarine carries 10 missiles and Ipindovia has 6 submarines. Of Ipindovia's 6 SSBNs, two are deployed, two are transiting to and from deployment areas (though still capable of launching SLBMS), and two are always undergoing refurbishment. The missiles and warheads of the two SSBNs undergoing refurbishment are considered among the 900 warheads located at deployment bases.
Of the 100 non-deployed nuclear warheads, 80 are located in central storage either as reserves or awaiting dismantlement; 20 are waiting for or undergoing refurbishment. These activities occur at the same facility.
Ipindovia warheads are of two different types : the SH type for aircrafts (ALCM and gravity bomb, and the A type for ICBMs and SLBMs. .

The Nuclear Weapons Reduction Treaty (NWRT)

Disarmament Obligations: Ipindovia is under an obligation to reduce its arsenal from 1000 to an agreed limit of 500 warheads under a binding disarmament agreement. Both its reduction to that

agreed limit and the absence of undeclared warheads over and above the limit of 500 are to be verified. The agreement also provides for the following specific reductions of warheads :

- Elimination of 150 SLBM warheads associated with SLBMs
- Elimination of 100 warheads associated with road mobile systems
- Elimination of 100 warheads associated with silo based ICBMs
- Elimination of 100 bomber warheads
- Elimination of 50 warheads not located on deployment bases but at the Primary Nuclear Weapon Site.

In addition to Ipindovia, the agreement involves other NWS reducing their arsenals to the 500-warhead limit, beginning with another country that is the same as Ipindovia in terms of numbers, posture, etc.
Verification is carried out by an inspection body consisting of nationals form both NWS and non-NWS.
The agreement provides that all parties must make an Initial Declaration identifying all nuclear weapons on their territory, under their jurisdiction and control, as items declared as weapons and all facilities where those weapons may be located. Military-related facilities not associated with nuclear weapons need not be declared. After the NWRT has entered into force, additional information must also be declared, including three different types of declarations:

- *Baseline declarations***:** Important to reductions to a specified/agreed limit. A baseline declaration by a State to the verification entity sets out plans and data necessary to prepare for and conduct verification activities.
- *Periodic*: time-driven declarations: At least annually a State provides an update of its declarations to the verification entity. Such periodic declarations facilitate the allocation of resources and planning of inspections by the verification entity. It allows progress in terms of reductions to be tracked. The State updates all of the data that is exchanged.
- *Notifications:* Ad hoc, incident-driven declarations. Reflects the changes that have occurred in the relevant data.

The agreement also specifies that technical measurements for the presence or absence of nuclear materials/warheads as agreed by the Parties in a separate annex will be permitted. It specifically cites the types of measurements provided for in the U.S.-Russia New START Treaty as an example of the types of measurements to be permitted.
The 500 warheads scheduled for reduction will in fact be eliminated; they will move through all 14 steps of the dismantlement process. The fissile material derived from the warheads or otherwise available is not covered by the NWRT.
Ipindovia still relies on nuclear deterrence for its national security. Production, refurbishment, and modernization activities may occur at the same sites and facilities where the warheads to be eliminated are located. These facilities will therefore continue to operate, complicating verification efforts.

The verification protocol was built foreseeing three types of inspections to verify to whole dismantlement process:

i) Type A - Baseline inspections: these inspections are facility-focused, and take place to assess the facilities associated with the treaty (declared design verification), to jointly decide and set up verification equipment in facilities (CCTV cameras spots, measurement equipment location…), and more generally to prepare future disarmament inspections in said facilities ;

j) Type B – Inventory inspection: these inspections are focused of the flow of items within the disarmament process. These inspections are used in order to introduce declared TAI into the verification system (CoC, measurements) through initialization steps. The same type of inspection is used to follow items after dismantlement has occurred.

k) Type C - Dismantlement inspection: these inspections are focused on the dismantlement process and follow (CoC) and/or measure (NDA, presence and absence measurements…) the treaty accountable items (TAI) as it goes through the dismantlement process. They are aimed at assuring the continuity of CoC throughout the dismantlement process. **The NuDiVe 2021 exercise will display a Type C inspection.**

In accordance with its obligations originating from the NWRT, Ipindovia allows multilateral inspections (Type A, B and C) to verify the different processes pertinent to the elimination of nuclear warheads. This process takes fully into account the principle of non-proliferation and concerns related to national security, as well as safety and security regulations. These inspections are implemented on the basis of an agreed verification protocol, pursuant to the NWRT.

Ipindovia nuclear warhead dismantlement is implemented within a military campus used for multipurpose activities related to the monitoring of its nuclear arsenal (Primary Nuclear Weapons Site – LADDU).

Background information about NuDiVe 2021 exercise:

The declared treaty accountable items (TAIs) to be dismantled on the side of Urania are nuclear warheads of different types composing its nuclear arsenal:

- Elimination of 150 SLBM warheads associated with SLBMs
  - 150 A2-N warheads mounted on Neptune-S2 SLBMs, including 100 deployed reserve and 50 deployed active;
- Elimination of 100 warheads associated with road mobile systems
  - 100 A2-G warheads mounted on Juno road-mobile ICBMs, all of them deployed active
- Elimination of 100 warheads associated with silo based ICBMs
  - 100 A2-G warheads mounted on Jupiter silo ICBMs, all of them deployed active
- Elimination of 100 bomber warheads
  - 100 SH-2 warheads mounted on ALCM-1 aircraft-launched cruise missile, all of them deployed;
- Elimination of 50 warheads not located on deployment bases but at the Primary Nuclear Weapon Site (LADDU).
  - 25 A2-G warheads previously associated with Juno road-mobile ICBMs, inactive stockpile
  - 25 A2-N warheads previously associated with Neptune-S2 SLBMs, including 15 inactive reserve and 10 inactive stockpile

In Jülich (LADDU) **for the NuDiVe 2021 exercise**, dismantlement operations under the NWRT will deal with type *SH-2* warhead (explosive yield of ca. 150 kt TNT) which are mounted on aircraft-launched cruise missiles of type *ALCM-1 Vreddesbringer*. The special nuclear material used within these warheads is weapon-grade Plutonium.

Origin of the warhead:

Twenty SH-2 warheads were separated from their *ALCM-1 Vreddesbringer* vectors on the aircraft bases without an inspection team allowed to be present (Step 1). Inspectors – a team composed of members of all signatory states except Ipindovia – had first access to the TAIs already loaded into containers in the temporary storage at the deployment site (Step 2 – Type B inspection). There, the first team of inspectors performed a non-destructive assay (NDA) on the TAIs and could confirm the presence of plutonium. Thereafter the devices were loaded into special transportation containers of type *C-1* designed by the Ipindovian autorities. They meet the safety specifications of all States included in the treaty. They are equipped with a optic fiber tamper indication system, a tumbler tamper indication system and accelerometers (which do not transmit the data out of the C-1 container but store it for a later check-up). In this sense, the chain of custody (CoC) was established.

Transfer to Jülich:

From that point, the TAIs in C-1 containers were transported under military protection to the multipurpose dismantlement campus LADDU in Jülich– (Step 3/5). Inspectors were not present during the transfer. At the facilities, the TAIs were loaded into temporary storage sites which are under CCTV surveillance (Step 6). Right after the arrival, a second inspecting team (Type B inspection) checked the integrity of the CoC by reviewing transfer information, tags and seals.

At the facility:

At the multipurpose campus LADDU in Jülich special operational rooms were set up for the purpose of dismantling the TAI. In parallel other operations like maintenance and refurbishment of warheads may take place.

After the check-up of tags and seals (CoC check) performed by the inspectors (Step 6), the TAI was then moved to the Dismantlement buildings with the inspectors being present (Step 7).

The inspectors thus have just restricted access to the declared facilities where the high-explosive (HE) dismantlement and the special nuclear material (SNM) dismantlement are separated. In Jülich, the dismantlement operations take place in two separate buildings for two distinct steps: Step 8.1 (separation of HE from the TAI) and Step 8.2 (separation of SNM and other materials). Each of this step is inspected in order to confirm complete dismantlement of the weapon.

Previous measurements:

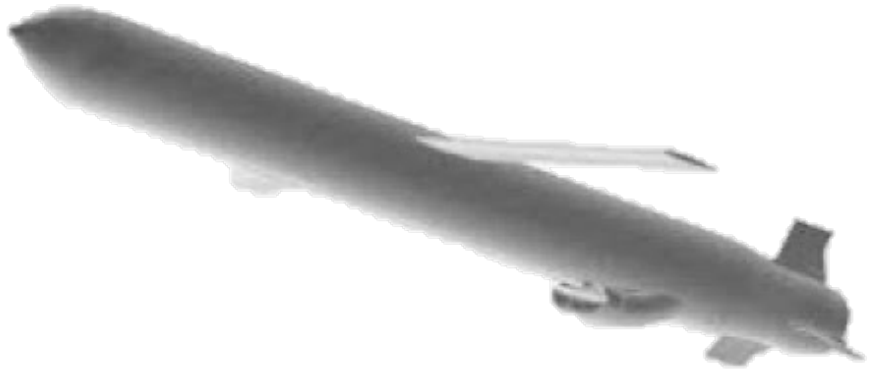
NDA check: Using a jointly designed information barrier, attribute measurements are performed, protected by information barriers: determination of presence/absence of plutonium and isotopic ratio of plutonium-239 to plutonium-240 via passive gamma radiation measurements and determination of minimum plutonium mass via a passive neutron measurement.

NDA measurements are made at the arrival of the TAI at LADDU in Jülich just before Step 8.1, just after Step 8.1 and after Step 8.2 on the separate containers.

Nuclear Weapons Reduction Treaty

Information sheet

ALCM-1 Vreddesbringer



2022

The nuclear explosive devices (NEDs) declared by Ipindovia within the Nuclear Weapons Reduction Treaty or NWRT are nuclear weapons of two different types : SH type (aircraft), and A type (SLBM and ICBMs).

One of the declared weapon type is the *SH-2* warhead (explosive yield of ca. 150 kt TNT) mounted on aircraft-carried cruise missiles of type *ALCM-1 Vreddesbringer*. The special nuclear material used within these warheads is weapon-grade Plutonium.

Data for **ALCM-1 *Vreddesbringer*:**

Length	7 m
Diameter	0.72 m
Weight	1.270 kg
Range	1.500 – 2.500 km
Speed	250 m/s (900 km/h)
Propulsion	Schlum-Tech Corp. turboreactor (liquid fuel)
Warhead	SH-2 thermonuclear (150 kT)

8.2. Ipindovia nuclear weapons systems

	Platform					**Delivery systems**				
	Designation	**total built**	**active**	**inactive**	**destroyed**	**Designation**	**total built (incl. test rounds)**	**active**	**inactive**	**destroyed (incl. in tests)**
Aircraft	**Honeybee**					GB-1				
	Wasp					**GB-2**				
	Dragonfly (N)					**ALCM-1**				
Submarine	**Kraken**	7	0	2	5	Neptune-S1	70	0	60	10
	Leviathan	**6**	**4**	2	0	Neptune-S2	70	60	5	5
Ground-based ICBM					Road-mobile	**Juno**	375	300	50	25
					Silo	**Jupiter**	150	100	25	25
Experimen-tal Test Objects										

	Warheads*									NWRT obligations	
				deployed warheads		inactive (LADDU)					
	Designation	**total built**	**tested**	**Deployed active warheads**	**Deployed reserve**	**Inactive reserve**	**Inactive stockpile**	**Disassembled**	**Remaining total**	**Total to be disassembled**	**Final limit**
Aircraft	SH	80	5					75	0	0	0
	SH-1	165	5	50				110	50	0	50
	SH-2	190	5	150		15	10	10	175	100	75
Submarine	A1-N	100	5					95	0	0	0
	A2-N	30	5					25	0	0	0
	A2-N	325		200	100	15	10		325	175	150
Ground-based ICBM	**A2-G**	785	10	200			25	550	225	125	100
	A2-G	235	10	200		25			225	100	125
Experimen-tal Test Objects		10	5					5	0		0
	totals	1920	50	**800**	100	55	45	**870**	**1000**		1000
				900		**100**					
				1000						**500**	**500**

*Warhead status:

Deployed Active	Fully operational warheads
	Mated to delivery system. For SLBMs, the S2 missile is always loaded onto submarine if armed with warheads. For ALCM, the CMN2m is assigned to a specific Hornet [N] delivery system.
Deployed reserve	Fully operational warheads
	Ready to be mated to delivery system
Inactive reserve	Warhead with some mechanical parts removed to maintain system health whilst in storage. Held in central storage. Can be made active rapidly in case of necessity.
Inactive stockpile	Warhead held in central location. Some parts removed to maintain system health whilst in storage. Stockpile aiming at being dismatled or waiting for/undergoing refurbishment
Disassembled	Weapon system broken down into fissile and non-fissile components. Explosives no longer associated with fissile material. Any or all components may either be in storage, recycled or destroyed.