

**Knowledge Retention for Nuclear Safeguards and Non-Proliferation: a necessity for the next generations.**

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**ABSTRACT**

To maintain a contextual basis for the savoir-faire on nuclear safeguards and non-proliferation accumulated through decades of experience, it was decided to set-up a working group during the INMM/ESARDA Workshop in Japan in October 2019 on knowledge retention in these fields. This area of work is highly technical, has a strong legal basis and has been developing often in a complex political environment. It is deemed essential that knowledge is retained not only with respect to the tools and techniques deployed in safeguards and non-proliferation but also on the origin of the legal basis with its capabilities and limitations, often the result of long-term discussions and compromises. In most cases, proposed evolutions and related negotiations resulted from recognized shortcomings in the existing situation and previous approaches (like in the case of Iraq), the discovery of undeclared activities (e.g. North Korea, Iran) or of the challenges posed by globalization, such as in the unforeseen dissemination of sensitive technologies and associated knowledge (like in the case of Libya), additional tasks like disarmament verification in South Africa completing the knowledge legacy. All of the above evolved at times of specific political context which influenced the mindset and sensitivities of those who negotiated and finally authorized, or not, the implementation of the agreed verification measures and approaches.

The way this Knowledge Retention is approached is by identifying young professionals with relevant technical, legal and political backgrounds and guide them to interview renowned and seasoned international safeguards and non-proliferation experts, to both gather and document the foreground and the tacit knowledge and insights that those experts possess but that might not have been written down or published.

A draft canvas for the interviews has been developed and first tests are foreseen to be shortly presented in the paper. The publication summarizes the results of beginning this process and, at the same time raises awareness on the essential role of knowledge retention. It will serve as an invitation, both for young professionals and the seasoned experts, to come forward and volunteer to participate to this initiative which is planned to run over a number of years.

**INTRODUCTION**

ESARDA, the European Safeguards Research and Development Association and INMM, the Institute for Nuclear Materials Management, have since 2001 held joint workshops, about every 4 years. This complements the Symposia and Annual Meetings that both organisations hold yearly, in that the Workshop typically has a restricted number of participants and focusses on 2 or 3 very specific topics, with the objective that the participants and presenters engage in a real dialogue and work out together practical solutions about how specific challenges would best be addressed. The participants to these workshops include regulatory authorities, technical support organisations, industry representatives, research centres, universities and of course also nuclear safeguards inspectorates.

In the last 4 INMM/ESARDA Workshops, before the one from 2019, there was always a horizontal working group on Education and Training where many joint activities were discussed in the relevant

field. The focus was mainly on attracting young staff and providing both some partial input to nuclear academic programmes (to have at least a minimum “exposure” to nuclear safeguards) and developing and delivering the relevant training in appropriate facilities. In preparation of the 2019 event and in close discussion with the IAEA, it was judged opportune to focus on a specific aspect of capacity building, namely on providing background knowledge, insight and understanding, not only on what safeguards is and can be doing, but especially on WHY certain safeguards approaches are implemented the way they are, with certain constraints and boundary conditions based on history, experience, negotiations and compromises. In fact, many younger inspectors, after having been trained on the tools and techniques for safeguards (inspections and analysis) will be very skilled in implementing the approaches but without necessarily having the full appreciation of WHY it is done in the prescribed manner. Also, the way of interpreting findings and deciding upon the follow-up, is not up to the individual creativity of each inspectors as they are often agreed procedures and steps to deal with unforeseen findings or seeking for clarifications etc.

In the analysis of how best to deal with these challenges, one of the proposed initiatives is to collect, describe and digest the insights, hands-on experience, historical knowledge and legal and political appreciation of seasoned experts in nuclear safeguards and non-proliferation and make this knowledge available to the younger generation.

## **APPROACHES DEVELOPED FOR NUCLEAR SAFEGUARDS AND NON-PROLIFERATION KNOWLEDGE RETENTION**

### **Reporting on best practices and initiatives pursued by INMM and ESARDA members**

During the INMM/ESARDA Workshop in October 2019 a series of interesting presentations were made on how knowledge retention initiatives have been implemented. A short overview is provided here:

- Student-driven Nuclear Security Research: the UC Berkeley Nuclear Policy Working Group; Rebecca Krentz-Wee, University of California, Berkeley
- A Multi-Layered Approach to Safeguards Knowledge Retention at Los Alamos National Laboratory; Olga Martin, Los Alamos National Laboratory
- Essential Training Fundamentals on Nuclear Material Accounting and Control ; Perpetua Rodriguez, Japan Atomic Energy Agency
- Knowledge Management Initiatives for International Safeguards at the US NRC; David Hanks, Nuclear Regulatory Commission
- Lessons learned from Nuclear Security Professional Development and how they might be used to enhance International Safeguards Education: James Larkin, University of the Witwatersrand
- Human Resource Development in the field of Nuclear Non-Proliferation in Graduate School ; Hiroshi Sagara, Tokyo Institute of Technology

Just a few findings of these presentations are reported here as illustration of the topic:

- A Multi-Layered Approach to Safeguards Knowledge Retention at LANL was reported, which has developed a unique, multifaceted strategy for knowledge retention and establishing the fields of safeguards and nonproliferation as viable and attractive career paths for highly qualified individuals at every stage in the pipeline,
- The pipeline includes students at the undergraduate and graduate level, students that have completed their terminal degree (post-bachelors, post-masters, and post-doctoral), and laboratory staff members.
- Knowledge management at the NRC, is described as capturing critical information and making the right information available to the right people at the right time.

- It includes, but is not limited to: mentoring, seminars, databases, electronic reading rooms, formal and informal training, interviews, procedures, desk references, communities of practice, websites and portals.
- The NRC has done a great deal of foundational work around establishing a governance structure, creating a shared understanding around the concepts of KM, and developing various approaches and methodologies for applying KM practices, and implementing tools to increase knowledge capture, sharing and collaboration.

### **Crowd sourcing approaches**

As a complement to the specific reporting referred to above, there was a first hands-on approach prepared and implemented during the INMM/ESARDA meeting in October 2019, using the entire audience of the workshop as participants in an integrated exercise. The reference case selected for that were the safeguards and nuclear proliferation issues in Iraq (esp. in the early 90's). The activity was structured as follows:

1. J. Baute first presented the key features of the Iraqi time-line in 3 phases: Pre-discovery, Inspection-time and Lessons learned and follow-up.
2. Then, in the working session, the audience was divided in 3 groups focusing on technical, legal and political issues of this reference case. Each WG discussed a number of questions such as:
  - o Pre-discovery: How/why could this happen? Why was it not discovered before?
  - o Inspection: What was unique to the mandate & why? Could it be done better?
  - o Follow-up: What was learned? What was not implemented afterwards & why?

In the plenary reporting, one spokesperson per group reported the key findings and recommended how to document all this information for knowledge retention so that it can be used in a didactic manner for “teaching” future generations focusing on the following:

- What aspects / insights have to be elaborated and then documented further?
- Who can document this: i.e. volunteers for the INMM/ESARDA contributions?
- Is the structure above (3 phases/3 dimensions) fit for purpose or not / alternative?

As a result of this very valuable exercise, it was decided to start with the individual interviewing as is described below.

### **Individual interviews of experts by a multidisciplinary team of the young generation**

From the preliminary initiatives described above, it became clear that to further promote knowledge retention, and before key participants to the original definition of 21<sup>st</sup> century Safeguards vanish, it will be very valuable to interview specific, highly experienced, colleagues on specific topics. We thus started an initiative with the ESARDA Training and Knowledge Management Working Group and the INMM Education and Training Committee, to seek for interested young colleagues, ideally with mixed backgrounds (e.g. legal, technical, political science) to build a team of 3 and prepare jointly the interviews with seasoned experts. The approach proposed is for this trio to discuss a specific topic with the experts from multiple angles, write it up in the form of an article, submit it for the expert approval and release, and then publish it in the INMM/ESARDA relevant publications. We strongly believe that this effort will allow us to collect wisdom, insights and valuable lessons learned that we would like to make available for the generations to come.

It is appropriate to shortly stress here that nuclear safeguards and non-proliferation knowledge and insights combines typically technical, legal and political aspects, including the understanding of the historical context and boundary conditions in which treaties, protocols, regulations and practices were developed, starting from the Non-Proliferation Treaty and the original Safeguards defined in INFCIRC 153. Additionally, experience accumulated from real cases of nuclear proliferation typically triggered a further evolution of the safeguards and non-proliferation approaches (e.g. Iraq, South-

Africa, Libya, Syria, DPRK, Iran, etc.) as well as regional arrangements. Retaining the knowledge on how these cases came about, what was implemented to deal with it and which impact that had on the current way of working is essential to understand both the strength and limitations offered by the current approaches.

Many colleagues and former colleagues, unfortunately today spread across the globe, have deep insights and first-hand experience in these matters and it is felt very valuable, or even essential, to be able to capture their knowledge and wisdom, also on those issues that might not have been officially published or recorded, for future generations. In addition, emerging experts from the young generation are often “hungry” to gain background knowledge and would be well placed to “digest this historical lighting” of the current relevance and applicability of modern Safeguards.

To support the interview process, we developed a small guidance, recognizing that this is not meant to be prescriptive and any other format focusing on the documentation of the knowledge retention can work as well.

For the two pilot interviews that were carried out in July 2021 on specific topics and reported below, the following guidance was prepared:

#### ORIGIN

- Origin of the concern/topic/initiative (what triggered work in this area)
- Technical issues related to the origin
- Political issues related to the origin
- Legal issues related to the origin
- Barriers to be overcome
- Lessons learned in this (preparatory) phase

#### CREATION

- When and How was it finally addressed successfully for the first time
- In what constituted this success
- What was the reaction (in technical, political, legal terms)
- How was the initiative nurtured to continue to grow
- Lessons learned from this early kick-off stage

#### EVOLUTION

- WHY and HOW did the initiative evolve over time (possibly in multiple phases)
- Which shortcomings/failures were recognized (and remediated) that we can learn from
- Were/are there synergies with other initiatives
- Lessons learned from this evolution

#### OUTLOOK

- If it had to be redone, how would it be done differently in the current context
- What are the recommendations for the future
- Lessons learned from the future outlook evaluation

These suggested points were used by the interviewers as an “aide memoire” when formulating their questions

#### **RETURN OF EXPERIENCE OF THE FIRST INTERVIEWS**

For the two pilot interviews that took place with L. Rockwood and J. Baute, respectively on the Model Additional Protocol and the Iraq lessons learned, a team of 3 colleagues volunteered (Natalie McGirl, Riccardo Rossa and Christos Charatsis) and carried out the 1.5 to 2 hours interviews. The

feedback of the first test was fed into the second one and some of the return of experience is reported here below, with the view to proceed in the most efficient and effective manner for future interviews.

Each interview kicked off with a preparatory meeting between the interviewers, 30 min upfront of the full interview, in order to agree on the scope, implementation procedure and role play during the interview. After the first experience, it was identified to be advantageous for the interviewers to be able to read some limited reference material, whatever is available in a concise and structured manner, before the interview such as to familiarize a little better with the topic, beyond their knowledge acquired as part of their professional duties (each interviewer with a different angle of approach, depending upon their own background).

Lesson 1: Concise available information on the selected topic to be distributed to the interviewers before

The interviewers also agreed after the first pilot that it is good for the interviewee to know who are the interviewers, so a short introduction of their background and role in nuclear safeguards is appropriate at the onset of the interview.

Lesson 2: The interviewee might want to know who she/he has in front to assure to speak to the multiple dimensions of the issue at stake (which is also why a multidisciplinary team of interviewers is essential, to benefit all participants)

The interviewee should then also be allowed to present a little bit about her/his career, background, safeguards and non-proliferation experience in general etc, so that the interviewers feel comfortable to interact on the specific topic of the interview, after having understood the broader picture

Lesson 3: The interviewee should be allowed a time-slot to provide broader information on her/his background and safeguards/non-proliferation exposure, before diving into specific questions on the topic of choice.

During the interview and based on the dynamics of the interactions, there is the risk that one dimension gets more attention than another (e.g. legal vs political or technical vs legal). Therefore it was decided for the second pilot to introduce the role of “moderator” or “coach” of the interview. This role can be played by the “beneficiary” of this knowledge retention exercise, e.g. an experienced member of the ESARDA WG on Training and Knowledge Management and the INMM Education and Training Committee. This moderator should not dictate the question but just assure that the multiple dimensions of complicated issues are properly highlighted, that the time schedule is maintained and thus in general that the maximum of valuable input is collected in a minimum of time. Karen Hogue, who supported the first interview as observer, volunteered in this role of moderator during the second interview which was highly appreciated.

Lesson 4: It is recommended to assign a moderator or coach for the interview to support interviewers where necessary.

During the discussions, occasionally names of other colleagues come up, so it might be a wise idea to inform the interviewers that starting to tackle a specific topic with one expert, might lead to one or more follow-up interviews with other experts on the same topic and it is deemed beneficial that the team of interviewers can also work together in a subsequent phase.

Lesson 5: An expert interview on a specific topic is not necessarily a stand-alone event as multiple suggestions can be received to interview additional persons on the same topic. To estimate to amount of related work/time, it is recommended to ask the interviewee upfront, as soon as the topic is defined, which additional experts she or he would recommend to also interview on the same topic, so that the integrated effort to retain knowledge on a specific topic can be properly planned upfront.

Even if already indicated in the previous chapter, it is stressed here even more that the multidisciplinary composition of the team of interviewers is key to the success to this exercise. Only technical safeguards people might fail to appreciate the legal and/or political dimension while they need to better open their minds to such aspects. Additionally, some historical insights and knowledge about related developments (e.g. in the strategic trade control area or the field of nuclear disarmament) can be very valuable to have on board in the team of interviewers.

Lesson 6: The higher the degree of diversity / multidisciplinary composition of the team of interviewers, the higher the expected quality of the gathered knowledge. Having them come from different cultures, knowledge areas, employers and professional society environments is definitely an advantage.

The two pilot interviews are only at an initial stage of implementation, i.e. no follow-up interviews with other experts have taken place, nor did the interviewers already started to compile the integrated outcome of the interviews. So a full feedback cannot yet be provided but a few additional recommendations / lessons are nevertheless included here, to support the work of the future teams who participate in this exercise.

Lesson 7: It might be worthwhile to interview several experts on the same topic, and if the interviewed persons agree, try to consolidate the retained knowledge in a single article, rather than publishing “one story per person”. This might be challenging if strongly diverging views exist in which case the moderator can step in also and recommend to make individual write-ups.

Lesson 8: In many aspects there is not necessarily an absolute truth or one single possible interpretation of the facts, but exactly this kind of reflection / reasoning is also essential for the younger generation to appreciate the existence of diverging views. It is a valuable illustration of the complexity of the topic of nuclear safeguards and non-proliferation.

From the more practical point of view there are few additional points to signal also.

Lesson 9: The interviewee will be asked whether recording of the interview is fine or not. During the pilots we did one without recording and one where the interviewee did the own recording (to be able to review and edit afterwards, before releasing to the interviewers as material for background only). From just 2 interviews it is not straightforward what is best, but it is clear that the interviewee should be fully at ease. Because the entire exercise is meant to distill that part of the knowledge that is typically not present in published articles or alike, the barriers to share personal insights should be as low as possible. In fact, it should be emphasized that the interviews are aiming in a first instance to collect the tacit knowledge of the experts and thus will profit from a setting where she/he can speak most freely. Rehashing already public documents content, fully available to everyone, including the interviewers, would be a waste of the exercise.

Lesson 10 : Although we originally intended to focus almost exclusively on junior interviewers, some mix of also mid-career professionals with these juniors can be advantageous especially when more detailed points are addressed that already require a good practical insight in safeguards and non-proliferation. So we recommend for future teams to aim at a mixed composition in terms of background, as explained above, but also in terms of the level of experience, especially to grasp the “finesse” and “behind the scenes” reality of the experience / knowledge and nuanced details that the experts are sharing.

## **FOLLOW-UP AND FUTURE STEPS FOR EFFECTIVE KNOWLEDGE RETENTION**

After the first 2 pilot interviews, the interviewers are now going to write-up their findings and make it available to other colleagues. Therefore, this paper does not go into the details nor the outcomes of the interviews, not to steal the thunder from what the interviewers will report upon.

The main reason to publish this paper at this early stage is to identify both future candidate interviewers and experts to be interviewed such that an extensive knowledge pool can be created that will remain available also to future generations.

We thus warmly encourage both the ESARDA WG on Training and Knowledge Management and the INMM Education and Training Committee to solicit the interest of their members as interviewers and we invite the ESARDA and INMM leadership to support the availability of experts to be interviewed to the benefit of all ESARDA and INMM members and beyond, i.e. the community of present and future key players in Safeguards and nuclear Non-Proliferation.

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