SANDIA REPORT
SAND201X-XXXX
Unlimited Release
Printed Month and Year

Safeguards Knowledge Management & Retention at U.S. National Laboratories

Risa Haddal[1], Rebecca Jones[2], Bridget Bersell[2], Sarah Frazar[2], Roberta Burbank[2], Rebecca Stevens[3], Ron Cain[4], Bernadette Kirk[4], Sean Morell[4]

[1]Sandia National Laboratories (SNL)
[2]Pacific Northwest National Laboratory (PNNL)
[3]Los Alamos National Laboratory (LANL)
[4]Oak Ridge National Laboratory (ORNL)

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Issued by Sandia National Laboratories, operated for the United States Department of Energy by National Technology and Engineering Solutions of Sandia, LLC.

Available to DOE and DOE contractors from
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Telephone: (865) 576-8401
Facsimile: (865) 576-5728
E-Mail: reports@osti.gov
Online ordering: http://www.osti.gov/scitech

Available to the public from
U.S. Department of Commerce
National Technical Information Service
5301 Shawnee Rd
Alexandria, VA 22312

Telephone: (800) 553-6847
Facsimile: (703) 605-6900
E-Mail: orders@ntis.gov
Online order: https://classic.ntis.gov/help/order-methods/

SAND201X-XXXX
Printed September 2017
Unlimited Release

SAFEGUARDS KNOWLEDGE MANAGEMENT & RETENTION AT U.S. NATIONAL LABORATORIES

Risa Haddal[1], Rebecca Jones[2], Bridget Bersell[2], Sarah Frazar[2], Roberta Burbank[2], Rebecca Stevens[3], Ron Cain[4], Bernadette Kirk[4], Sean Morell[4]

[1]Sandia National Laboratories (SNL)
[2]Pacific Northwest National Laboratory (PNNL)
[3]Los Alamos National Laboratory (LANL)
[4]Oak Ridge National Laboratory (ORNL)

International Safeguards and Engagements
Sandia National Laboratories
P. O. Box 5800
Albuquerque, New Mexico 87185-MSXXXX

Abstract

In 2017, four U.S. National Laboratories collaborated on behalf of DOE/NNSA to explore the safeguards knowledge retention problem, identify possible approaches, and develop a strategy to address it. The one-year effort consisted of four primary tasks. First, the project sought to identify critical safeguards information at risk of loss. Second, a survey and workshop were conducted to assess nine U.S. National Laboratories' efforts to determine current safeguards knowledge retention practices and challenges, and identify best practices. Third, specific tools were developed to identify and predict critical safeguards knowledge gaps and how best to recruit in order to fill those gaps. Finally, based on findings from the first three tasks and research on other organizational approaches to address similar issues, a strategy was developed on potential knowledge retention methods, customized HR policies, and best practices that could be implemented across the National Laboratory Complex.

TABLE OF CONTENTS

FIGURES

TABLES

NOMENCLATURE

Abbreviation	Definition
ANL	Argonne National Laboratory
ANS	American Nuclear Society
AP	Additional Protocol
BNL	Brookhaven National Laboratory
CKO	Chief Knowledge Officer
CoP	Community of Practice
C/S	Containment and Surveillance
CSIS	Center for Strategic and International Studies
DOE	Department of Energy
FEVS	Federal Employee Viewpoint Survey
FY	Fiscal Year
HCAAF	Human Capital Assessment and Accountability Framework
HCD	Human Capital Development
HR	Office of Human Resources
HQ	Headquarters
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
INMM	Institute of Nuclear Materials Management
IM	Information Management
INL	Idaho National Laboratory
IT	Information Technology
KM	Knowledge Management
KR	Knowledge Retention
KM&R	Knowledge Management and Retention
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
MC&A	Material Accounting and Control
MOU	Memorandum of Understanding
NACCOIN	Nonproliferation and Arms Control Community of Interest Network
NASA	National Aeronautics and Space Administration
NDA	Nondestructive Assay
NFE	Nuclear Facilities Experience
NGSI	Next Generation Safeguards Initiative
NGSPN	Next Generation Safeguards Professional Network
NKM	Nuclear Knowledge Management
NNSA	National Nuclear Security Administration
NPAC	Nonproliferation and Arms Control Program
NRC	Nuclear Regulatory Commission
NSSPI	Nuclear Security Science and Policy Institute
ORNL	Oak Ridge National Laboratory
OPM	Office of Personnel Management

Abbreviation	Definition
ORISE	Oak Ridge Institute for Science and Education
PNNL	Pacific Northwest National Laboratory
POC	Point of Contact
PONI	Project on Nuclear Issues
SAT	Systematic Approach to Training
SG	Safeguards
SME	Subject Matter Expert
SNL	Sandia National Laboratories
SRNL	Savannah River National Laboratory
SWP	Strategic Workforce Planning
R&D	Research and Development

SAFEGUARDS KNOWLEDGE MANAGEMENT & RETENTION AT U.S. NATIONAL LABORATORIES

1. BACKGROUND

Loss of U.S. safeguards expertise within the Department of Energy, National Nuclear Security Administration's (DOE/NNSA) National Laboratory Complex due to attrition and retirement within the next five to ten years will be significant. According to a staffing study conducted by the Oak Ridge Institute for Science and Education (ORISE) for DOE/NNSA's Next Generation Safeguards Initiative (NGSI), approximately 81% of international safeguards specialists ages 45 and older are estimated to leave the field by 2024.[1, 2] One of the consequences of this substantial loss of expertise will be the decline in safeguards knowledge retention and the overall level of U.S. expertise in the field. That is, critical skills and core competencies such as nuclear material accounting and control (MC&A), nondestructive assay (NDA), containment and surveillance (C/S), and safeguards approaches, design and evaluation will be lost. Unless immediate, proactive steps are taken, mid-career and senior U.S. safeguards staff members with highly relevant knowledge, skills, abilities and experience will walk out the door and take their expertise with them. In support of ongoing NGSI efforts to prevent or slow the process, a safeguards knowledge management and retention strategy is needed across the DOE National Laboratory Complex. This strategy will include identifying the current safeguards knowledge retention and management challenges within the National Laboratory Complex, clarifying the knowledge and skills critical to the U.S. safeguards workforce, and developing recommendations on practical, adaptive methods to address knowledge loss that meet changing needs within the international nuclear safeguards community.

The safeguards knowledge management and retention challenge is not unique to the U.S. In 2012, the International Atomic Energy Agency's (IAEA) Nuclear Knowledge Management Section published a guidance document[3] for all 168 Member States to provide assistance to decision makers from nuclear research and development organizations on planning, implementing and sustaining knowledge management programs. The document is an acknowledgement that while most of the world's nuclear knowledge base was built in the 1950s, the pioneering generation has now long retired. The generations that were trained during the expansion period, including those in nuclear safeguards, are now also approaching retirement. Today's challenge will be retaining and sustaining practical safeguards skills and expertise. Within the U.S. National Laboratory Complex, robust, yet practical, initiatives are needed to retain knowledge, skills and expertise while preventing further losses.

---

[1] Office of Nonproliferation and International Security (NIS). Next Generation Safeguards Initiative (NGSI), *Human Capital Development (HCD) Program Review*. Fall 2015. Slides 7 and 8.

[2] Blair, L., Don Johnson, Jane Price, *Nuclear Nonproliferation International Safeguards Scientist and Engineer Workforce at U.S. Department of Energy National Laboratories*. Oak Ridge Institute for Science and Education, September 2010.

[3] IAEA-TECDOC-1675, *Knowledge Management for Nuclear Research and Development Organizations.* IAEA, Vienna, 2012

2. INTRODUCTION

In 2017, four U.S. National Laboratories[4] collaborated in a Knowledge Management and Retention working Group on behalf of DOE/NNSA to explore the safeguards knowledge retention problem, identify possible approaches, and develop a strategy to address it. The one-year effort consisted of four primary tasks. First, the project sought to identify critical safeguards information at risk of loss. Second, a survey and workshop were conducted to assess nine U.S. National Laboratories' efforts to determine current safeguards knowledge retention practices and challenges, and identify best practices. Third, specific tools were developed to identify and predict critical safeguards knowledge gaps and how best to recruit in order to fill those gaps. Finally, based on findings from the first three tasks and research on other organizational approaches to address similar issues, a strategy was developed on potential knowledge retention methods, customized HR policies, and best practices that could be implemented across the National Laboratory Complex.

As part of this effort, it was important to first define knowledge management (KM) and knowledge retention (KR) to ensure consistency between project team members and stakeholders. The IAEA defines KM as "***An integrated, systematic approach to identifying, acquiring, transforming, developing, disseminating, using, sharing, and preserving knowledge, relevant to achieving specified objectives.***"[5] KM is a broad category that includes both the management and sharing of knowledge to enable individuals to create new knowledge collectively to achieve organizational goals. The IAEA refers to KR in the context of a 'knowledge retention plan', which "*identifies critical knowledge and positions in an organization, and methods to be used for addressing potential knowledge loss through attrition, and the process that will ensure that the plan is continually updated to meet changing business needs.*"[6] In other words, KR seeks to identify specific critical knowledge at risk of loss and approaches for retaining it. It could be a subset of KM. During the FY17 workshop, participants agreed with the KM as defined by the IAEA. The group further agreed that KR was part of a solid KM program. Including KR as a part of a broader KM strategy was especially important to the group as the National Laboratories and DOE complex face a large portion of the safeguards workforce retiring.

As mentioned previously, a significant portion (81%) of the U.S. safeguards workforce within the DOE/NNSA National Laboratory Complex present in fiscal year (FY) 2009 were projected to retire or otherwise leave laboratory employment by 2024, based on retirement estimates for the 41% of staff age 55 and older, and 40% of staff age 45-55. Furthermore, the ORISE study noted that workers age 34 or younger tend to "have relatively high job turnover rates as they leave one employer and move on to another in their careers," which impacts those early- to mid-career staff who are being hired to replace retiring experts. This may create additional challenges related to knowledge retention based on their mentoring by more senior safeguards

[4] Sandia National Laboratories (SNL), Lead Lab; Pacific Northwest National Laboratory (PNNL); Los Alamos National Laboratory (LANL); Oak Ridge National Laboratory (ORNL).
[5] IAEA-TECDOC-1675, "Knowledge Management for Nuclear Research and Development Organizations." IAEA, Vienna, 2012, pg. 50.
[6] Ibid, pg. 51.

experts.[7] For staff who leave lab employment but continue to work, an estimated 35% are expected to remain in the field of international safeguards, according to the ORISE study. The DOE/NNSA National Laboratory Complex has been attempting to retain the safeguards knowledge of those experts on a laboratory-by-laboratory or group-by-group basis. In some cases, an unexpected retirement or under-prepared group may result in an unrecoverable loss of safeguards expertise.

In addition to concerns about knowledge loss through an aging workforce, there are also concerns about the ability to engage young professionals in safeguards work. The accidents at Three Mile Island and Chernobyl nuclear power plants had a "significant negative impact" on the public acceptance of nuclear energy, and led to a stagnation in the development of nuclear projects and the nuclear-related workforce.[8] In addition, nuclear engineering programs and other nuclear-related education were also scaled back. The so-called 'Nuclear Renaissance' that was expected in the early 2000's (which was later dampened by the events at the Fukushima nuclear power plant) led to concern regarding the aging nuclear workforce and its limited natural replacement through the engagement of young professionals in the field.

It is clear that senior experts in the field of safeguards are rapidly retiring and that critical safeguards information and expertise could be lost if knowledge retention steps are not implemented. Furthermore, the role of international safeguards in the nuclear nonproliferation regime makes it a "national security imperative for the U.S. to ensure the future succession of a strong cadre of technical experts in the international safeguards field."[9] Thus, the scope of the KR problem, its impacts, and its potential solutions are global in nature. In response, the IAEA has called for the launch of initiatives and campaigns to "recruit, train and retain" highly qualified safeguards staff as well as educate the next generation of safeguards specialists.[10] Such efforts aim to avoid some of the risks associated with a lack of nuclear safeguards knowledge management and retention efforts, as discussed in the next section. In addition to the IAEA's initiatives, other organizations such as the Nuclear Regulatory Commission (NRC), DOE and National Aeronautics and Space Administration (NASA) have developed programs to address knowledge loss and prepare for the future. We examine both the risks and these complementary efforts to address them in sections III and IV.

---

[7] Gastelum, Zoe. *Knowledge Retention for International Nuclear Safeguards: Literature Review*. Tracking number 553182. November 2016.

[8] International Atomic Energy Agency. *Knowledge Management and Its Implementation in Nuclear Organizations*. IAEA Nuclear Energy Series No. NG-T-6.10, 2016.

[9] Lockwood, Dunbar, Carrie Mathews, and Amy Seward. *Reversing the Trend – Creating a Growing and Sustainable Cadre of Safeguards Experts in the United States*. Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2008.

[10] Adeniji, Oluyemi, Lajos Bokros, Lakhdar Brahimi, Rajagopala Chidambaram, Lamerto Dini, Gareth Evans, Louise Frechette, Anne Lauvergeon, Kishone Mahbubani, Ronaldo Mota Sardenberg, Pius Yasebasi Ng;Wandu, Sam Nunn, Karl Theodor Paschke, Wolfgang Schussel, Evgeny Velikhov, Wang Dazhong, Hiroyuki Yoshikawa, and Ernesto Zedillo. *Reinforcing the Global Nuclear Order for Peace and Prosperity: The Role of the IAEA to 2020 and Beyond*. International Atomic Energy Agency, May 2008.

3. RISKS

What happens if we don't retain knowledge in the U.S. safeguards community?

Safeguards staff can separate from a national laboratory for several reasons. These separations can be caused by a variety of factors including: retirement, internal transfers and promotions, taking jobs with another laboratory or organization, or resignation where employees leave the NNSA Safeguards community.

As safeguards experts separate, they are taking with them a substantial amount of knowledge and corporate memory. Often this knowledge is undocumented and it requires years of training and experience to build it up again. This poses a risk to the sustainability of safeguards within the DOE National Laboratory Complex.

In the absence of a knowledge management program, much of the work is only passed on situationally. This means that staff may only receive critical knowledge if they know who and what to ask about. The absence of knowledge management results in very valuable information about historic work, processes, procedures, contacts and applications being lost, dooming new experts in the field to repeat those efforts in order to gain a knowledge foundation. One of the risks in this scenario is duplication of effort, time and valuable taxpayer resources. Moreover, the U.S. government risks losing its role as a global leader in the field of nuclear safeguards. For example, according to the 2009 ORISE study,[11] many factors contributing to an erosion of IAEA safeguards capabilities are also evident in the U.S., where budgets for safeguards technology are in decline and many experts are retiring or choosing to work on other national security programs. The study found that U.S. investment in safeguards technology, and thus safeguards knowledge and expertise, has become ad hoc and fragmented, has lost momentum and strategic direction, and is managed largely in response to specific requests.[12] The American Physical Society also came to this conclusion in 2005 and recommended that the U.S. take steps to strengthen and better focus the long-term capability of its safeguards technology base.[13] In order to do that and prevent a further decline in U.S. leadership in safeguards, the Next Generation Safeguards Initiative (NGSI) was launched. Knowledge retention and management needs to continue to be a part of the effort.

NNSA safeguards knowledge exists in both tacit (experience-based) and explicit (written, documented) forms. Both forms are required and complementary. It is entrenched in operating instructions, guides, databases, training materials, technical specifications, and procedures that are written down (explicit knowledge). It also exists as tacit subject matter expert (SME)

---

[11] Blair, Larry, Don Johnson, Jane Price, *Nuclear Nonproliferation International Safeguards Scientist and Engineer Workforce at U.S. Department of Energy National Laboratories*. Oak Ridge Institute for Science and Education, September 2010.

[12] Schanfein, A. *Calling for Action: The Next Generation Safeguards Initiative. The Nonproliferation Review*. 10 June 2009. http://www.tandfonline.com/doi/full/10.1080/10736700902969695?scroll=top&needAccess=true

[13] American Physical Society, "Nuclear Power and Proliferation Resistance: Securing Benefits, Limiting Risk." American Physical Society Panel on Public Affairs, May 2005. https://www.aps.org/policy/reports/popa-reports/proliferation-resistance/upload/proliferation.pdf

knowledge which can be difficult to transfer to another person by means of writing or verbalizing it since it is wholly embodied in the individual, rooted in practice and experience, expressed through skillful execution, and transmitted through training by watching and doing.[14] Collectively, all of this knowledge forms a "knowledge base" that needs to be maintained and kept aligned and consistent, both from a historical basis but over time to ensure a complete understanding of current operations. If the knowledge accumulated to date is lost, it may take years to build it back if that is even possible.

Within the safeguards community, knowledge management would help mitigate the risk to ensure that the history of technology development, thought process, procedures and applications are captured to ensure that capability development can be sustained even after the originators of those items are long gone. In addition to current efforts being pursued by some of the National Laboratories (see section 5), it is worthwhile to explore how various organizations are addressing the KM&R challenge. Such initiatives may offer useful insight for a U.S. National Laboratory-focused approach or strategic roadmap.

[14] INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) NUCLEAR ENERGY SERIES, No. NG-T-6.7, Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation, p. 3. INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 2011.

4. COPMLEMENTARY EFFORTS

The following section discusses efforts from organizations who have knowledge management concerns that are similar to the NNSA national laboratories. Their efforts to address knowledge management and retention challenges could be a resource for the U.S. National Laboratory Complex in its own efforts to maintain safeguards expertise.

4.1. International Atomic Energy Agency (IAEA)

The IAEA is investing heavily in knowledge management in the nuclear industry. Since 2002, the IAEA General Conference has included topics related to nuclear knowledge management (NKM)[15]. The IAEA also has a NKM section within the Agency to assist Member States in this issue. This section focuses on:

- Developing methodologies and guidance documents for planning, designing, and implementing NKM programs;
- Facilitating nuclear education, networking, and experience exchange;
- Assisting Member States by providing products and services for maintaining and preserving nuclear knowledge;
- Promoting the use of state of the art knowledge management technologies and supporting interested Member States in their use.

Some initiatives the IAEA is pursuing are:

- NKM School – Annual certificate course providing specialized education and training on development and implementation of knowledge management programs in nuclear science and technology organizations. Intended for young professionals in current or future leading roles in managing nuclear knowledge, the school focuses on NKM fundamentals, developing policies and strategies, methods and tools, practical guidance and projects, and networking.
- NKM Wiki – for NKM practitioners and professionals to collaborate more effectively, exchange opinions and share experiences on common issues and approaches.
- NKM Assist Visits – to promote NKM approaches, to form Community of Practice as well as to collect good practices for future IAEA publications.
- NKM Case Studies Catalogue – to encourage sharing among NKM practitioners and experts through capturing NKM experience and preservation of information of relevant practical knowledge in "Case Study" input template format, collected from various nuclear organizations.
- NKM Self-Assessment Tool – assist in identifying strengths to build upon and areas for improvement in an organization's overall NKM strategy.

[15] International Atomic Energy Agency Nuclear Knowledge Management section webpages https://www.iaea.org/nuclearenergy/nuclearknowledge/

- NKM Workshops – to communicate Knowledge Management Fundamentals and underlying concepts, as well as practical solutions and implementation for nuclear organizations.
- NKM Publications – developed on a variety of NKM topics, these publications are available from the IAEA website.

4.2. Department of Energy (DOE)

DOE at-large faces a challenge to capture and transfer the knowledge and experiences of its current professionals. According to the DOE 2016-2020 Strategic Human Capital Management Plan, 36% of DOE's (federal) workforce will be eligible to retire in 2020.[16] To address retention of DOE expertise and best practices, the Agency has initiated two separate programs.

4.2.1. DOE Knowledge Capture and Transfer Program

DOE has established a Knowledge Capture and Transfer Program to focus on both explicit (easily taught and learned) and tacit knowledge (experiences that are not easy to explain), as well as corporate knowledge (unspoken rules of an organization including its culture)[17].

The Knowledge Capture and Transfer Program is managed by the DOE Office of Learning and Workforce Development. The Office is working with departmental elements to document the knowledge critical to the DOE mission. There are three areas of focus within the Knowledge Capture and Transfer Program:

- Executive to Executive – This area focuses on the knowledge, skills, and topics of special interest attained by employees at the executive level and how they should be shared throughout the DOE community. There are several ways to disseminate this information, including interviews, articles, publications on best practices, and written papers.
- Leaders as Teachers – This area involves employees with particular expertise in certain subject matters. It involves formal training, development of curriculum to share knowledge with other employees, and other methods of information exchange.
- Partnerships with Institutions – Because institutions of higher learning are such rich resources of knowledge and information, this area involves leveraging these learning resources and providing expanded opportunities for developing talent within DOE.[18]

4.2.2. Phased Retirement

Phased retirement is a human resources tool used by Federal agencies to retain employees who would have fully retired, but who are willing to continue in Federal service for a period of time on a part-time schedule while engaging in mentoring. This allows managers to better provide unique mentoring opportunities for employees while increasing access to the decades of institutional knowledge and experience that retirees can provide. The DOE has recently implemented a Phased Retirement plan.[19]

---

[16] U.S. Department of Energy, Office of the Chief Human Capital Officer. 2016-2020 Strategic Human Capital Plan. (n.d.)

[17] National Nuclear Security Administration, Office of Leadership and Career Management Knowledge Capture and Transfer Program PowerPedia site. https://powerpedia.energy.gov/wiki/Knowledge_Capture_and_Transfer_Program. (n.d.)

[18] InnovateGov.org. DOE Takes Steps to Overcome Economic and Attrition Challenges article. Retrieved from http://innovategov.org/2014/01/22/doe-takes-steps-to-overcome-economic-and-attrition-challenges/ June 7, 2017.

4.3. Nuclear Regulatory Commission (NRC)

The U.S. Office of Personnel Management conducts a Federal Employee Viewpoint Survey (FEVS) every year to measure employees' perceptions of whether, and to what extent, conditions characterizing successful organizations are present in their agencies. In addition, OPM has developed a tool - the Human Capital Assessment and Accountability Framework (HCAAF) - to guide agencies toward meeting the Human Capital Standards for Success. OPM structured the Framework to help agencies determine what they need to do, how they can do it, and how they can measure their own human capital success. Agencies use the results of the FEVS in conjunction with the Framework to determine the effectiveness of their human capital strategies and programs.

One of the categories within the Framework is Leadership and Knowledge Management. The NRC is historically one of the highest rated agencies in this category. In 2016, NRC was rated at 73 while the government wide average is 59.[20]. The NRC formalized their knowledge management program in 2006 with the release of a Knowledge Management Program Policy (SECY-06-0164)[21]. The priority focus of the NRC program is on identifying knowledge that is both high value and high risk (of loss), then capture and preserve it for access by others. The policy identified four key actions for implementing the NRC KM program:

1. Establishing an explicit, visible structure and governance.
    a. Designating a KM champion for overall leadership, direction, and integration of the KM.
    b. Naming a senior manager at each Office Director and Regional Administrator to lead development and implementation of KM activities within his or her organization.
    c. Appointing senior staff KM to assist offices and regions in implementation of specific KM initiatives.
    d. Forming a steering group of office and regional KM champions to provide cross communication and integration of KM initiatives.
    e. Directing the Office of Human Resources (HR) to provide program support, coordination, and evaluation.
2. Identifying occupational priorities of NRC staff and critical bodies of knowledge where KM is most needed in their organizations.
    a. Occupational priorities are those positions where the office or region is most likely to lose significant relevant knowledge in the near term.
    b. Critical bodies of knowledge are technical and administrative areas of expertise where KM techniques are most needed to avoid losing significant mission-critical knowledge.
3. Developing a set of KM standard practices and techniques.
    a. Human resources processes, policies, and procedures
    b. Regulatory guides
    c. Standard review plans
    d. Mentoring
    e. Formal training and qualification programs

---

[19] U.S. Department of Energy, Office of the Chief Human Capital Officer. DOE Phased Retirement Implementation Plan. March 4, 2015.
[20] U.S. Office of Personnel Management. 2016 Federal Employee Viewpoint Survey. 2016.
[21] Nuclear Regulatory Commission. The NRC Knowledge Management Program Policy (SECY-06-0164). July 25, 2006.

f. Job aids
g. Best practices
h. Information Technology (IT) and Information Management (IM) solutions

4. Identifying IT/IM tools that NRC may incorporate and acquire to support KM and help achieve the Expanded Electronic Government Strategy to make it easier for NRC employees to acquire, access, and use information needed to perform their work.
   a. These tools may include content management systems, information portals, and "Google-like" indexing and search programs designed to make existing information available to all staff in a more user-friendly manner.
   b. Additionally, some existing tools, such as the Strategic Workforce Planning (SWP) system, may need expanded capabilities to meet the agency's KM needs.
   c. In cases where knowledge critical to NRC's regulatory mission exists primarily outside of the agency, IT tools will be employed that provide connectivity between staff and external knowledge resources.

One interesting initiative the NRC has implemented is marketing the month of November as KNOWvember to raise awareness and provide an opportunity to remind employees of the importance of KM. During this month, they offer special sessions and presentations on related topics to include historical presentations on the origins of key programs and practices within NRC.

4.4. National Aeronautics and Space Administration (NASA)

NASA has also historically ranked as one of the highest federal agencies in the HCAAF Leadership and Knowledge Management index, consistently receiving a 73 rating[22]. While their mission is not directly associated with that of the NNSA, they have a similar knowledge management challenge as the NNSA safeguards community. Both have knowledge ranging from highly codified scientific knowledge to technical craftsmanship to political savvy. Also, due to changes in mission priorities some of this knowledge is in danger of being lost. The ultimate goal of knowledge management at NASA is to ensure that the agency's practitioners have access to critical knowledge when they need it to increase the likelihood of mission success.

In 2012, NASA established a Chief Knowledge Officer [CKO] to serve as a single focal point to develop the policy and requirements necessary to integrate knowledge capture across programs, projects, and centers. Some tools used by NASA include:

- Knowledge Journal – an ongoing publication that serves to promote knowledge sharing and to communicate lessons learned and best practices, ensuring NASA remains a learning organization.
- My Best Mistake video series– an array of stories told by project managers and knowledge practitioners in the NASA Community. Each story tells how the author learned a lasting lesson from a mistake.
- Lessons Learned Database – provides access to official, reviewed lessons learned from NASA programs and projects. Each lesson describes the original driving event and provides

[22] https://www.fedview.opm.gov/2016FILES/AppendixG-FEVS_Indices_HCAAF.xlsx

recommendations that feed into NASA's continual improvement via training, best practices, policies, and procedures.

- Critical Knowledge Gateway – a portal connecting the NASA community to a vast array of NASA videos and video lessons. The portal is organized into topic areas such as system engineering, project management, operations, etc.
- Knowledge Toolbox – contains tools, resources, and information for individuals and teams to enhance their knowledge sharing efforts on real life projects and programs.[23]

The agencies discussed above have two items in common:

1. They all have a champion officially assigned, recognized, and empowered by the agency to lead the knowledge management efforts.
2. The efforts are formally organized and documented to provide consistent implementation.

Some or all of these initiatives could be drawn on to develop similar approaches at the U.S. National Laboratories in support of safeguards KM&R. We explore current efforts underway within the DOE/NNSA National Laboratory Complex and how, possibly in combination with other successful approaches, the safeguards KM&R challenge might be addressed.

[23] National Aeronautics and Space Administration. Office of the Chief Knowledge Officer website. https://km.nasa.gov/

5. KM&R AND THE U.S. NATIONAL LABORATORIES: CHALLENGES, SUCCESSES AND OPPORTUNITIES

As part of the Knowledge Retention effort in fiscal year 2017, several U.S. National Laboratories worked on tasks supporting the identification of knowledge retention issues around the complex. At a high level, Sandia National Laboratories circulated a survey to the laboratory complex to determine the current state of play in safeguards knowledge retention. Oak Ridge National Laboratory and Los Alamos National Laboratory both worked on tasks to identify competencies and knowledge relevant to safeguards that are at risk of being lost, and for identifying strategies to address this loss. The multi-lab working group, consisting of Sandia, Oak Ridge, Los Alamos and Pacific Northwest National Laboratories, worked throughout the fiscal year to coordinate these efforts and to develop a broader knowledge retention strategy for the complex, culminating in a workshop that was held in August 2017 and involved nine laboratories. These efforts are all described below.

5.1. Multi-Lab Survey on Knowledge Retention

In an effort to better understand the status of safeguards KM&R within the DOE/NNSA National Laboratory Complex, a survey was distributed to 9 U.S. National Laboratories[24] to solicit information on the status of KR at each lab. For example, the survey inquired about attrition of safeguards personnel, processes and procedures or requirements for KR activities for outgoing safeguards staff members, types of safeguards information that are critical to preserve, factors of influence, challenges and barriers to KR. The goal of the KR survey was to understand challenges and opportunities in key areas of KR as identified by the respondents. The findings of the survey helped to guide discussion at the KR workshop held at Sandia National Laboratories in 2017. The final results will be further discussed in the findings section below.

5.2. Identifying Critical Information at Risk of Loss: An ORNL Methodology

ORNL has developed an initial methodology to identify critical skills for technical experts (SMEs) in order to aid in succession planning. The initial methodology addresses the above recommendation to "identify and recommend best practices for transition planning, succession planning, workforce planning, exit interviews, and knowledge transfer."

The initial methodology involves selection of a nuclear facility, selecting the SMEs who are keys to the operation, an interview process, identification of the critical skills and an assessment. There is no straight formula for the methodology as it depends on the needs of a nuclear facility. Each step in the methodology is subject to such an adaptation. The initial methodology was implemented in a selected facility or group with the intent that critical skills can be identified

[24] Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Idaho National Laboratory (INL), Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), Oak Ridge National Laboratory (ORNL), Pacific Northwest National Laboratory (PNNL), Sandia National Laboratories (SNL), Savannah River National Laboratory (SRNL)

through interviews of SMEs and subsequent analysis of respective jobs. With the experience gained in the implementation of the initial methodology, a modified version will be finalized for recommendation.

The Methodology is broken into the following six steps.

1. Select a nuclear facility or group of experts at a DOE national laboratory
2. Select candidates
3. Interview candidates
4. Analyze interview results
5. Validate critical skills and level of criticality
6. Assess potentially-critical skills by listing and ranking them using the IAEA position risk factor scale of 1–5[25]

ORNL worked through this methodology with several SME's from the nuclear operations and nuclear safeguards world to further refine and understand the value. Interviews were conducted and the results summarized in a separate document.[26]

[25] IAEA. (2006). *Risk Management of Knowledge Loss in Nuclear Industry Organizations IAEA-1248.* Vienna, Austria

[26] Ron Cain, Shaheen Dewji, Carla Agreda, Bernadette Kirk, "Supplement to a Methodology for Succession Planning for Technical Experts", ORNL/TM-2017/XXX, August 2017 (In Review).

5.3. Identifying and Recruiting for Critical Knowledge Gaps in the Medium Term: A LANL Tool

Los Alamos National Laboratory (LANL) is using a data-driven workforce model that derives a set of competencies necessary to perform specific mission work based on a database of workforce competencies. This database lists over 6500 LANL employees and over 1500 competencies, which covers the gamut of technical and operational skills employees have identified. Each employee is identified with as many of these skills as they and their line manager have chosen. The high-fidelity information in this database is used to build up a network of competencies. In essence, each competency has a quantifiable overlap with other competencies based on the sum of employee inputs. Those with a strong overlap are sometimes called nearest-neighbor or sister competencies. This mapping process is shown below, where typical safeguards competencies for the safeguards technology group (NEN-1), such as non-destructive assay, are shown with some expected near-neighbors as well as some surprising relationships.

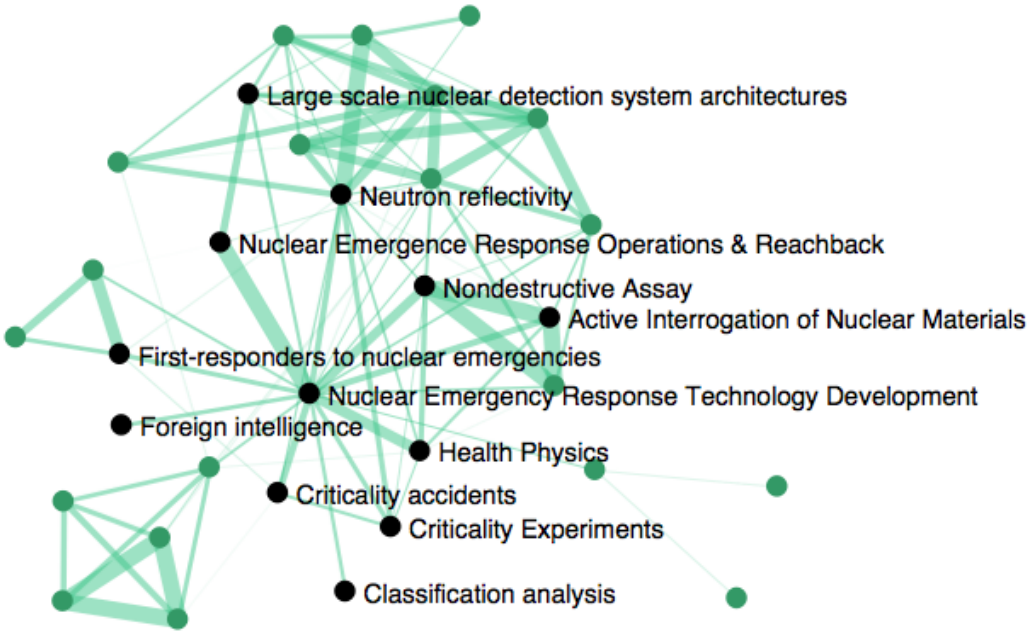


Figure 1. Near neighbor relationships in safeguards competencies.

This technique has been used in other mission areas at LANL to successfully build pipeline programs, expert-based teaming, and mentor/mentee identification for knowledge management.

The tasks of the Workforce Agility Team were to map safeguards competencies as identified at LANL, use those results to suggest mentor-mentee relationships, demonstrate the use of the tool for analyzing student resumes, and provide a summary for how the tool could be used within the

national laboratory complex to support the identification, capture, and sharing of knowledge between labs.

5.4. Workshop on Safeguards Knowledge Management and Retention

As a part of the multi-laboratory effort to identify and develop a strategy and identify best practices of KM&R in the field of international safeguards, SNL, ORNL, PNNL, and LANL co-hosted a Safeguards Knowledge Management and Retention Workshop at Sandia National Laboratories on August 29-30, 2017. The purpose of this workshop was to clearly identify challenges related to safeguards knowledge retention at the U.S DOE/NNSA National Laboratory Complex, and to develop recommendations and practical steps to mitigate those challenges.

The KM&R Workshop assimilated findings from three separate but related activities, described above, that were pursued under a project funded by NNSA's Nonproliferation and Arms Control Program (NPAC). Workshop participants reviewed the current status of each activity, discussed remaining gaps in knowledge, and documented findings for NNSA/NPAC's consideration. The outcome of these discussions, included in the following chapter of this reports, is a set of recommendations for NNSA on practical steps it can take to promote safeguards KM&R within the DOE complex.

The workshop was attended by fourteen Safeguards professionals representing nine national laboratories. Also in attendance was a PNNL facilitator to guide sessions and two Sandia interns to learn and provide support. Attendance list attached in Appendix D.

6. FINDINGS

6.1. Challenges and Recommendations: Findings from a Multi-Lab Survey on Knowledge Retention

The multi-lab survey responses demonstrated both challenges and opportunities in key areas of KR such as infrastructure (i.e., access to safeguards information, documents and knowledge experts); resources and incentives (i.e., time, funding to engage in KR); training (i.e., training, mentoring and transferring knowledge to the next generation); and processes and procedures. Based on survey feedback, certain key recommendations were identified. The detailed survey results can be found in Appendix B.

- Infrastructure: Develop a user friendly shared platform repository where relevant project materials, training, curriculum, presentations, etc. can be accessed.
- Resources and Incentives: Fund and incentivize mentoring
- Training: Fund training
- Processes and Procedures: Identify and recommend best practices for transition planning, succession planning, workforce planning, exit interviews, and knowledge transfer

These high-level recommendations formed the basis for certain themes at the KR workshop held in August 2017.

6.2. ORNL Succession Planning Methodology

The identification of critical competencies plays an important role in succession planning. An initial methodology to identify such competencies was described earlier. ORNL took the initial methodology and performed a test drive to demonstrate its utility.[27]

To test the methodology, interviews of seven technical experts were conducted. Each interview led to a critical competency analysis based on the questions that were asked. The table of critical competencies for each SME was developed by the interviewers from the answers to the interview questions. Out of the seven interviews, the table was modified and verified in four cases by either the immediate supervisors and/or the interviewee.

The methodology is subject to changes and can be refined further by respective institutions that may want to adopt it. Similarly, the interview questions can be modified.

The table below shows the possible competencies of a research and development engineer in nuclear safeguards. More information can be found in the cited report.

[27] Ron Cain, Shaheen Dewji, Carla Agreda, Bernadette Kirk, "Supplement to a Methodology for Succession Planning for Technical Experts", ORNL/TM-2017/XXX, August 2017 (In Review).

Table 1: Critical Competencies with Position Risk Factor for Safeguards SME

Critical Competencies for Safeguards SME - R&D Senior Nuclear Engineer/Scientist	1	2	3	4	5
Performs independently in a specialty area (radiation detection/measurement technologies) and actively imparts knowledge to others					□
Ability to apply and develop DA and NDA measurement methods, automated accounting methods, and containment and surveillance measures for SNM materials and processes					□
Plans and coordinates programs and large-scale projects		□			
Deep understanding of what affects measurements, including uncertainty quantification and uncertainty propagation					□
Ability to perform modeling and simulations of detectors, materials, containers, and experiments using state-of-the-art software				□	
Ability to interact with international experts and the IAEA staff				□	
Ability to train national and international safeguards personnel				□	
Performs independent research and reviews, studies and analyses in support of technical projects					□
Generates creative solutions to work situations			□		
Computer skills				□	
Maintains high personal standards of performance, responsibility and professionalism					□
Ability to write research papers and presentations				□	
Availability to attend required training and certification	□				
Ability to communicate with other staff					□
Ability to accept criticism				□	
Ability to face a difficult situation				□	
Ability to face constant time pressure			□		
Critical thinking					□
Complex problem solving (nuclear safeguards)					□
Judgment and decision making (nuclear safeguards)					□
Active listening				□	

6.3. LANL Workforce Agility Tool

The findings of the Workforce Agility team show that the tool provides an ability to mine data on employee competencies, where it exists, to provide helpful insights such as:

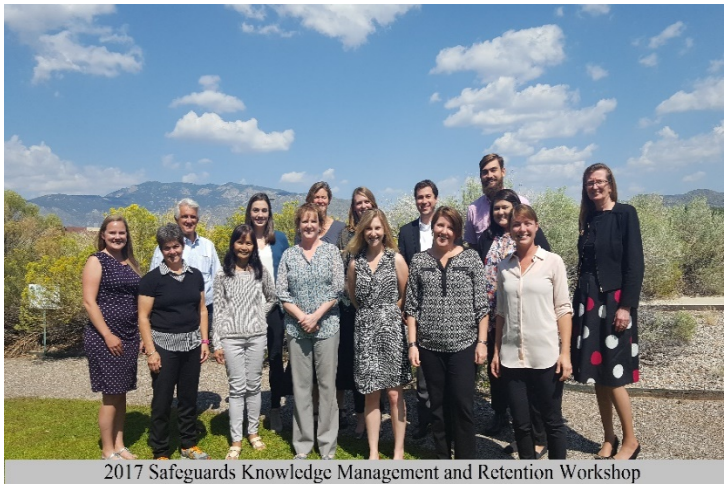
- Mapping near-neighbor relationships to a specific safeguards-related competency is helpful in identifying employees with skills useful to safeguards who could be involved in safeguards projects or requested to mentor safeguards professionals in new areas. This has proved to be true at Los Alamos, where workers with operational experience and

competencies in criticality measurements have supported projects involving novel nuclear material measurements.

- Near-neighbor relationships also show where professionals with safeguards-relevant competencies also have or develop new competencies that might be important to new safeguards work. As an example, employees with non-destructive assay competencies also identified competencies in big-data analytics, an area where safeguards work is evolving.
- Finally, these relationships can help when scanning resumes to find students or mid-career transition potential, even if those candidates were not specifically looking for safeguards-related jobs at the outset. Identifying these competencies may also help to pinpoint knowledge that is important to tap into, that may previously have been unknown because it was not within the immediate safeguards sphere.

To make use of the functionality of the competency matching algorithm across the lab complex, other users would also need to use or establish a competency database similar in structure to the database used by Los Alamos. Setting up such a database could add a range of functionality to the capabilities of the Safeguards Repository, currently under development. Repository users could enter a profile with competencies and/or interests when logging in to add documents, thus effectively creating safeguards-specific competency database within the complex. This could be used to identify mentoring or training opportunities, knowledge capture priorities, or new trends in safeguards expertise.

6.4. Workshop Results



2017 Safeguards Knowledge Management and Retention Workshop

The Knowledge Management and Retention workshop consisted of presentations and brainstorming sessions. The presentations covered current laboratory initiatives regarding knowledge management. The brainstorming sessions discussed defining knowledge management for our purposes and to come up with strategies to implement a successful knowledge management program both across the Enterprise and at each individual laboratory. Agenda attached in Appendix C.

After the workshop introduction the plenary discussed a definition of knowledge management to apply to the Office of International Nuclear Safeguards. After discussion it was agreed upon that the IAEA definition given above would fit Office of International Nuclear Safeguards needs but it was important to define "specified objectives" for Office of International Nuclear Safeguards to accompany this definition.

In order to define objectives, the overall goal of the program was discussed and agreed upon as follows:

> *Office of International Nuclear Safeguards goal for knowledge management in the U.S. international safeguards community is to identify and capture knowledge that can be shared and transferred across the community to foster collaboration, break down silos, and ensure the retention of important knowledge in order to ensure sustainability, gain efficiencies, and promote innovation.*

Then the objectives to achieve this goal were defined as follows:

- Identify and prioritize what knowledge needs to be learned and retained
- Capture knowledge so that it is available and accessible
- Transfer knowledge
- Encourage the use and integration of knowledge

Once these objectives were defined, the subsequent brainstorming sessions were to determine appropriate strategies for achieving each of these objectives. Since it is unlikely that each laboratory could implement every strategy discussed, the lists developed identified strategies which could serve as options for each individual laboratory to consider. The strategies identified are included in Appendix A. Each laboratory was challenged to take these lists and develop a sustainable knowledge management strategy that will work for their laboratory.

The workshop was very useful for all participants. Good momentum was achieved toward achieving our goal. As one participant put it "I have been talking about doing some of these things but after this I have the push to put actions behind my words."

Furthermore, it was suggested that the participants could form a knowledge management community of practice (CoP) to share ideas, discuss challenges, and keep the momentum moving.

7. NEXT STEPS: A SAFEGUARDS KM&R STRATEGIC ROAD MAP FOR THE DOE/NNSA NATIONAL LABORATORY COMPLEX

The four objectives identified in the workshop summary became the basis for developing a complex-wide strategy for knowledge retention. Discussion on these objectives spanned both days of the workshop and is summarized in Appendix A. A short summary is provided here, as a basis for what emerged as a first draft of a complex-wide strategic plan.

Objective 1: Identify and prioritize what knowledge needs to be learned and retained.

Identifying knowledge – especially implicit and tacit knowledge – is a perennial challenge. The predicted attrition of safeguards expertise due to retirement and other factors makes it clear that knowledge is at risk of being lost, but even so, determining what aspects of a SME's knowledge can be captured and retained is not always easy. Much of that knowledge is in the form of experience, professional contacts and interaction, institutional memory, and personality and other traits that are uniquely suited to the tasks they perform.

The Oak Ridge methodology for identifying critical competencies provides one approach for identifying and prioritizing safeguards knowledge and lessons learned from interviewing experts and documenting the findings are ones that all labs can benefit from. Another discussion within the workshop took place during the presentation of the Los Alamos workforce agility tool, which relies on the self-identification of experts and the competency clusters in which their expertise might be shared or passed on to new experts in the field. This is a tool that might have promise for use within the knowledge repository being developed to capture knowledge both in explicit forms (like documentation) as well as more implicit forms like expert competencies that are available to the larger safeguards community.

Objective 2: Capture knowledge so that it is available and accessible

Once specific knowledge is identified, the process of capturing that knowledge in a way that all users benefit from is also a challenge. Repositories and databases run the risk of either being difficult to enter information into, difficult to extract information from, or both. The process of documenting knowledge is often tedious, and unless systems are in place to do this in a continuous, sustainable way, it often isn't done. While knowledge capture may evolve to work well within an institution, knowledge capture across institutions is perhaps more challenging, particularly at the edge of knowledge capture and knowledge transfer, where the sharing of information and expertise is often resisted. The Knowledge Repository task, which was presented and discussed quite often during the workshop, is perhaps the best tool for safeguards knowledge capture within our CoP. Part of our strategy will be to ensure a well-defined process for positing information to the repository, with value-added meta-data that captures not only the

information, but also some of the essence of the knowledge and experience of the experts that provided that information.

Objective 3: Transfer knowledge

The line between knowledge capture and knowledge transfer is not always clear. Often, the act of knowledge capture – an expert presentation, for example – is simultaneous with the act of knowledge transfer. But not always. Ensuring that processes are in place for mentoring and knowledge exchange not only within labs but also between labs is essential. Exchange programs, panel sessions for experts across the complex, and greater participation in conferences are all ideas that were discussed as a way to ensure the transfer of knowledge to new experts in the field. Evolving this as part of the complex-wide strategy may be the most challenging step, due to funding and other considerations.

Objective 4: Encourage use and integration of knowledge

Once knowledge transfer is 'achieved' it still needs to be integrated into the daily practice of an SME, preferably through hands-on, practical implementation. The break-out groups identified the need for opportunities for early career staff to develop as leaders, whether through taking part in training development and execution, taking the lead on proposal writing or project management, or at least having the chance to shadow experts while they perform their jobs. These strategies can also work within the complex, and additional opportunities were identified throughout the workshop.

7.1. Objectives and Strategic Actions

In these categories, several possibilities stand out as a basis for further progress towards knowledge retention within the larger safeguards community. These include sharing good practices in identifying and prioritizing knowledge that needs to be retained within the community; devoting time to building up a safeguards knowledge repository that is available to all lab users; sharing SME between labs and to the wider safeguards community; and building on that knowledge sharing to develop a safeguards CoP in which exchange of information and ideas becomes an integral part of safeguards work. The link between our objectives and these themes is shown in Figure 2, and further discussed below.

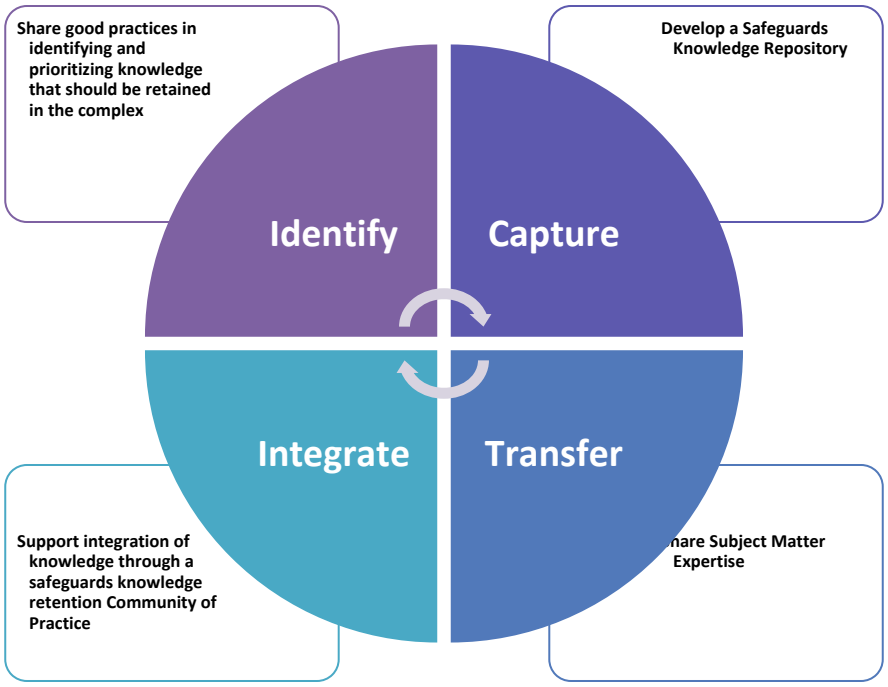


Figure 2: Knowledge Retention Objectives and Strategic Actions for the Complex

Identify and Prioritize Knowledge that Should be Retained

For a complex-wide strategy to be effective, each lab will need to determine the best ways to prioritize safeguards knowledge for retention and transfer. As each lab works to identify priority knowledge preservation areas, this information should be captured for the complex to access (and the participants agreed that the knowledge repository will be the best place for this.) In addition to documenting explicit information, participants agreed that it would also be important to document lessons learned and to update important documents, such as the ORISE report, on a regular basis.

Developing a Safeguards Knowledge Repository

The ANL effort to develop a safeguards knowledge repository is underway, and members of that team joined the knowledge retention working group for the workshop to share status and updates on the repository. It was generally agreed that this is a needed tool, provided it is structured in a way that fully elicits the open sharing of data, together with the meta-data that makes the information itself more 'value added'.

Sharing Subject Matter Expertise

Lab experts with a long career in safeguards are an asset to the entire complex, not just the lab where they reside. Opportunities for them to take part in training, panel discussions, or other workshops and technical meetings are already well utilized, but perhaps additional opportunities can be capitalized on, particularly within the group of experts who are retired and are now serving in a consulting role.

Another area for sharing expertise could be through exchanges between labs or between lab analysts and operations. Institutional support and funding for these types of exchanges would be a huge incentive to make them cross-institutional.

A third area of sharing expertise is in the shared use of instructional and outreach material. Following the two-day knowledge retention workshop, for example, a separate meeting to present the development of the Integral Nonproliferation Introductory Teaching and Learning (INITIAL) module was held in a forum of open exchange to encourage other SME's to use the outreach materials for their engagements with Universities. This type of information sharing could be done in other venues.

Growing a Safeguards Community of Practice

The term 'Community of Practice' was raised several times during the workshop to describe how a complex-wide Knowledge Retention effort might function. One description, from the social learning experts Etienne and Beverly Wenger-Trayner defines a Communities of Practice as "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly."[28] According to the authors, a Community of Practice must have a domain of interest, a community built on relationships between people who are practitioners, or experts, in a given field. Viewed in this way, practitioners of safeguards, coming together to learn from one another how to better retain the knowledge in their field and within their community, could be viewed as Community of Practice. Implicit in this concept is the fact that, through interacting regularly, practitioners will improve not only their knowledge, but the knowledge and competence of the group at large. A safeguards knowledge retention CoP could be as simple as the workshop group maintaining regular interactions, either by phone, through evolution of the safeguards repository, or in regular meetings, with the aim of breaking down institutional barriers to the sharing of safeguards knowledge to benefit the complex as a whole.

As a strategy, this could be a set of actions in which members identify themselves in a shared form (the repository, perhaps) and commit to the common goal of curating and adding value to the repository of information on safeguards within the U.S. safeguards community. This could be further supplemented by regular teleconferences, meetings or other information exchanges. While ostensibly an informal structure, adopting the term 'community' promotes a common objective of sharing and group development.

[28] From the author's website, http://wenger-trayner.com/introduction-to-communities-of-practice/

The workshop itself was an opportunity to share various projects, including the ORNL and LANL projects implemented this year. One strategic element would be to have a forum like this on a yearly basis to continue the sharing of lessons learned. Another possibility would be to have a mechanism to share practices directly in the knowledge repository.

These strategies, what has been done to date in each area, and what could be incorporated in FY18 and beyond, are summarized in Table 2.

Table 2. Summary of Complex-wide Strategic Actions for Knowledge Management and Retention

Strategic Area	Actions	Done or Underway	Future possibilities
Sharing good practice and lessons learned in identifying and prioritizing safeguards knowledge that needs to be retained	Share results of FY17 HCD task: ORNL Tool on Identifying critical information at risk of loss	Preliminary results of this tool were shared at KR workshop (8/29/17)	
	Share results of FY17 HCD task: LANL tool on workforce agility	Preliminary results of this tool were shared at KR workshop (8/29/17)	
	Regular information sharing forums	The KR workshop (8/29-30/17) is one such forum.	A yearly gathering, either in a dedicated meeting or on the sidelines of another meeting would be valuable
	Information sharing forum as part of knowledge repository		
Sharing Subject Matter Expertise	Specific engagements with retired/soon-to-retire SMEs for the whole complex		
	Lab exchanges (lab-to-lab, lab-to-Federal government, or lab-to-operational facility)		
	Sharing of outreach	INITIAL modules	

	material	and labs shared at inter-lab workshop (8/31/17)	
Evolving the Safeguards Knowledge Repository	Discuss structure and content of repository		
	Each lab uploads and tags information for repository		
	Regular user-group (CoP) exchanges		
Developing a Community of Practice for Safeguards knowledge management	Regular user-group exchanges	In FY17, the knowledge retention working group held quarterly teleconferences	This practice could continue for any interested parties

8. CONCLUSION

The purpose of the Safeguards Knowledge Management and Retention working group was to bring the lab's different proposals on knowledge retention strategies together as part of a larger, complex-wide strategy for knowledge retention. As Sandia, Oak Ridge, Los Alamos, And Pacific Northwest National Laboratories undertook their projects, it became more and more apparent that all labs face similar challenges with respect to identifying knowledge at risk of being lost and knowing what to do about it. The lab-wide survey highlighted the fact that many formal and informal approaches are available to address the problem of knowledge retention, and that sharing these practices among DOE labs, as a Community of Practice, could go a long way towards supporting each lab in formulating their own knowledge retention strategy as well as helping to develop a complex-wide knowledge retention strategy. The culmination of the working group's collaboration was the Knowledge Management and Retention workshop, which brought together not only members of the knowledge retention working group, but representatives of all the labs as well as members of the parallel effort to building a knowledge repository for safeguards. This workshop helped to further refine a knowledge retention strategy for the complex, and was very much a Community of Practice in safeguards knowledge retention.

That complex-wide strategy, based on the elements of identifying, capturing, transferring and integrating knowledge, is likely to evolve during the next year, as each lab works to put into practice a strategy that is most appropriate for their knowledge retention needs and identifies additional means of contributing to a complex-wide strategy. We hope that, as we share our action plans for fiscal year 2018, we gradually build consensus around a strategy that is sustainable across the complex. At this point, following the conclusion of the workshop, the main themes that emerged for a complex strategy include: sharing good practice in identifying knowledge, sharing subject matter expertise, evolving the safeguards repository, and building a CoP for safeguards knowledge retention, as discussed in the preceding section. With that as a starting point, we look forward to learning from each other on how to preserve safeguards knowledge within the country, and toward that end, hope for the chance to reconvene to share lessons learned again, after new efforts are undertaken.

9. APPENDIX A: NOTES FROM THE STRATEGY SESSIONS

9.1. Strategies to Achieve Objectives

Notes: some of the strategies cross cut across objectives. For instance, a tool used to capture knowledge may be the same tool used to transfer knowledge. However, follow-on actions may be necessary in order to achieve these cross-cutting objectives. For example, recording a SME explaining a mission-critical aspect of safeguards may have captured that particular knowledge, yet this recording would then have to be viewed and understood in order to successfully transfer it to the next professional.

Objective 1: Identify and prioritize what knowledge needs to be learned and retained.
How do we identify knowledge that we are in risk of losing?
Strategies include:

- Have staff complete a competency survey
- Use SMEs to identify hard copies of documents that should be saved/digitalized
- Review OSTI Database for safeguards information
- Use a standard Post Project Lessons Learned questionnaire (LANL has example) for when a resource is transitioning from one task to another or when an activity is completed
  - This could be an NA-241 requirement at the end of the FY or following milestones
  - These lessons learned could be documented on the Safeguards KM Repository so that other individuals can benefit from lessons learned of similar or relevant projects
- Collect information from BNR for post projects – collect reports (etc.)
- Summarize country interactions (i.e. negotiating histories and additional protocol (AP) history)
- Talk to new staff to find out what they need, what they want to know
- Interview SMEs to determine what knowledge to capture and where to find it – broad interview
  - Interview x# of senior experts in different topical fields within safeguards. Suggest each lab conduct own interviews with their experts and share results with other labs.
  - Mid-Level can answer: what do you now know that you wish you knew when you started?/Who did you ask/where did you go when you needed to find information?
- Gather ideas from ORISE report study to help experts think about what is important – 20-25 areas already identified. Use these areas as the first cut as areas of focus.
  - From Topics, identify SMEs to interview
  - Ask SME: what knowledge to capture, how best to capture the knowledge, and the priority/importance
- Develop staff: Development and career maps for early and mid-career staff so they can begin focusing on topics and areas of interest
- Review lab external releases for information to be captured
- Create point-of-contact (POC) list for topics
- Document lessons learned during projects
  - Consider as a requirement for all those receiving HCD funding
- Interview mid-level staff

    - What do you wish you knew (five years) ago?
    - What are the most important things you learned to help you on your job?
    - What documents have you found most useful?
- Conduct gap analysis on new/mid-level staff
- Compile reference documents
- Capture processes/procedures formally
- Identify core competencies/current capabilities
- Craft a collection of articles with commentary – like National Security Archive, see "Nuclear Vault" example at http://nsarchive2.gwu.edu//nukevault/ebb/index.htm

How do we prioritize the knowledge to capture?

Factors to Consider:

- Bench depth (numbers of staff in this area)
- Current events/emerging threats
- Lab focus or mission
- Retirement timing (How soon will people with the knowledge be retiring)
- Emerging technology/ new knowledge (i.e. Big data/ data analytics/cyber/etc.)
- Availability of the information and speed of recoverability of information
- How soon the information will be needed (do you have time to find and hire the right person or not)

Other Thoughts Related to This Objective

- It would be helpful to develop templates to formalize knowledge capture activities
- Be sure to capture what to ask, who to ask, etc.
- Challenge – How do we capture (and appropriately share) classified or sensitive information?
- Need to build a culture where individuals value passing knowledge down and impart on early and mid-career level staff
- Need to develop resources on How to… such as mentoring/accepting mentorship
- How do we capture new knowledge that may be coming on the horizon
    - May be found at common themes during conferences
    - Need to share post Conference presentation/report
- Look at IAEA Risk Matrix as a prioritization reference (combine knowledge competencies/critical skill from ORNL task with Risk matrix)
- This needs to be a continuous process; Need to constantly be updating the knowledge to capture and priorities because they will be changing…every 5 or 10 years
    - Cross discipline
    - Periodic meetings

Objective 2: Capture knowledge so that it is available and accessible

What strategies do we use to capture the knowledge?

Strategies include:

- Leverage computer technology – Document Repository
    - Open literature and publications
    - References
    - Lessons Learned Section

- Conduct and document interviews
  - Use form or template
  - Video
  - Person to person and write down answers
- Develop video libraries on various SG topics
  - How to…
  - History of…
  - Use similar model to Nuclear Security Science and Policy Institute (NSSPI) at Texas A&M has basic information, would be good to do for SGs
- Provide SMEs self-guided knowledge capture tools
  - Ask experts to do it on their own to identify where info is located and share that, if in your head write it down…in a 1 – 2 page guidance document
  - Have them focus on what is relevant
  - Develop guides/Templates for their use
- Use experts to develop training materials
  - Capture knowledge that is amenable to a training forum and that will survive the SME
  - Pair SMEs and mentees to develop training
- For existing training, have SMEs provide narration of training slides
  - Annotated briefings – a brief narration of a slide of information by the SME
  - Use INSEP training as a basis for thinking about core competencies
  - Use systematic approach to training (SAT) or a graded approach to SAT
- Develop toolkits
- Have Senior and Junior staff partner together on a project to allow for capturing and transferring information (Junior staff could capture as both documentation and a learning activity)
- Use experts (current staff or retired staff) to provide lectures and talks
  - SG lecture series and Project on Nuclear Issues (PONI) Nuclear Scholars
  - Expert Talks
  - Expert Panels
- Have new employees and interns talk about their experiences thus far
- Sponsor brown bags (share what you are doing within your area of expertise)
- Facility/Site tours
- Completing the post project lessons learned form
- Provide suggestions for core references, i.e. if interested in a certain topic, here is a list of recommended documents, videos, etc. to review.
  - Use levels of information: beginner to more complex levels or different techniques, like a syllabus…101 level and 201 level
- Develop and share processes and procedures
  - Done differently at each lab and who does it is different as well.
  - Join lab specific processes and procedures with what sponsor wants
  - Identify and recommend current practices for transition planning, succession planning, workforce planning, exit interviews, and knowledge transfer
- Formal and informal mentoring
  - Provide funding for capture what to do and lessons learned
  - Provide funding for time
  - Incentivize mentoring

    - Participate in Institute of Nuclear Materials Management (INMM) and other informal events
    - Recognize value of informal mentoring (SG playlist, social get-togethers, memes
    - Provide formal training to be a mentor and mentee (LANL and PNNL have)
        - Discuss knowledge management during formal mentor training to convey the importance of teaching mentees your craft
- Exit interviews/Outboarding toolkit
    - IAEA has a good model
        - They start the process 3 months before staff member leaves
        - Talk to not only the person leaving but their peers
- Provide more support for conference attendance
    - Conferences are the ideal venue for knowledge transfer and management, and the infrastructure already exists, we just need to better utilize it
    - Have more working groups on the side lines at the conferences
    - Capture and share what staff learn from the attending conferences
- Share SG reports with the community
- Subcontract with former employees to capture knowledge

Other Thoughts Related to This Objective

- How do you effectively capture with limited resources?

Objective 3: Transfer knowledge
What strategies do we use to transfer the knowledge?
Strategies include:

- Have retirees come back and be mentors
    - They will have more time available
    - Don't allow not being paid to be the "norm" (Cannot encourage not doing so during your work life as a "carrot" for being brought back and paid during retirement)
    - Bring retirees back when there are no other experts with the knowledge and transition it to current staff (incentivize bringing a person back)
        - Note – ideal scenario would capture knowledge prior to loss via attrition or retirement; care must be taken to not over utilize this method as a stopgap or a crutch. If retired individual is brought back, primary goal should be to capture or transfer the critical knowledge.
- Use mentorships (i.e. fellows program have funding)
    - See discussion under capture
- Make November – "Knowvember" (Based on NRC initiative)
    - November becomes the month to focus on knowledge management
    - Special events, talks, contests etc related to Safeguards knowledge
    - Give awards related to KM (Mentor of the year!)
- Provide a vehicle for lab staff and HQ staff to rotate between labs and HQ to gain experiences (policy or nuclear experience)
    - Short term (3-4 months to limit impact)

    - Amanda Rynes got an experience at DOS (set up a memorandum of understanding (MOU)) for a 4 month stint and they treated her as a DOS employee…great experience. Others have spent time at NA-241; consider "mini-M&Os" to help with short-term projects.
- Make explicit knowledge coherently accessible
    - Strong, high-quality IT infrastructure is essential to making repository-type systems effective
    - Capturing knowledge is of no use if people don't know it exists or can easily retrieve it
    - Repository or other mechanism – meta data will be important for usability
    - Training on how to use systems (portals, repository)
- Host lecture series similar to SG lecture series but hold in person
    - Run through the Center for Strategic and International Studies (CSIS) PONI – Nuclear scholars initiative – Include a safeguards lecture
        - Support student/young employees participation in CSIS program to go to DC once a month
    - Encourage one-on one conversations between senior experts and junior experts
    - Send students/young employees to a couple labs a year to experience a mini lecture series, suggest 2 days in length.
- Continue Next Generation Safeguards Professional Network (NGSPN) – allows for students/young professionals to be exposed to what other national labs are doing, network, and broaden understanding
- Continue investing in Nuclear Facilities Experience (NFE)
- Host safeguards career day (each lab)
    - Let other lab member know what careers exist within Safeguards
    - Could use poster sessions
- Disseminate core references to new employees
    - Collaborate with HR or through management
    - Potential to leverage HR funding, lab dependent
- Conduct brown bags (cafeteria discussions) to share knowledge
    - Allows for cross pollination and open discussions, and are great for sharing information between early and senior experts
    - Conduct via video teleconference so it can by an interlab activity
- Demonstrate transfer of knowledge by demonstrating the skill (exponential learning)
    - Jr. professional/interns coached through presentation by professional. Then asked to give the presentation.
    - Builds confidence
- Use both active and passive participation
    - Sit in on calls with sponsors
    - Job shadowing
    - Attend international engagement opportunities
- Help organize courses
    - Help build a course
    - Take ownership in developing the training materials (then have senior staff provide feedback)
- Conduct peer reviews
    - Junior staff conduct peer review of Sr staff projects to learn, ask questions

    - Senior staff peer review junior staff products to impart knowledge and correct misconceptions
- Develop proposals (interns or Jr staff)
    - Allows for learning and developing better writing skills
    - Research of previous published work leads to learning
    - May be cost effective (lower lab costs)
    - Down side is many times they don't know how to write the proposal, which may create extra work for the reviewer to correct the proposal
- Provide short term, rotational assignments
    - Safeguards positions intralab or interlab
    - Make sure everyone know the scope of work
- Provide short term leadership opportunities
    - When lead needs to "step away," delegate to an early-career staff as a growth opportunity
- Make training more effective
    - Make training hands-on as much as possible
    - Encourage SMEs to document knowledge in training materials (such as in instructor guides, which is a typical SAT requirement) so that new instructors have a base of SME knowledge to work from
- Encourage mentoring
    - Establish formal mentor and mentee relationships
    - Encourage informal relationships as well
- Stress the importance of conferences
    - American Nuclear Society (ANS), INMM, etc.
    - Huge value to allow for cross pollination across the lab complex
    - Provide great opportunities for informal knowledge transfer
- Distribute a comprehensive list of tools, trainings, websites that are available for information
    - Include a comprehensive list of who is involved in safeguards to include contact information (must keep current and communicate changes)
- Utilize communities of practice (intralab and interlab)

<u>Other Thoughts Related to This Objective</u>

- For these to have the greatest effect many of these activities require debriefing
    - What were the challenges
    - What was the most difficult
    - Use the debrief to identify additional knowledge which may need to be captured and shared
- Make extensive use of videos – capture different lectures or at a conference
    - After have an active conversation to have active dialogue
- IT infrastructure is critical for the transfer portion

Objective 4: Encourage the use and integrate of knowledge
How do we encourage the use and integration/implementation of knowledge?

- Need to encourage from the top down:
    - Internal lab management
    - HQ down to labs

    - Incorporate knowledge management words into the lab operational contract to create a top down message
- Get funding (always gets lab management attention)
- Incorporating the capture and transfer into its workforce processes and management
    - Succession planning
    - Exit interviews
    - Needs assessment (critical skill gaps)
- Give staff opportunities to expand portfolios
- Incorporate in performance appraisals
- Have lab management encourage staff to take pride in their work as part of pushing the importance of KM
- Encourage staff to transfer and share knowledge with junior staff and mentoring (start as soon as a staff member is ten years from retirement)
- Have a planned staff transition to the next staff member
    - Especially important for critical missions to allow for smooth transfer and continuity of operations
- Encourage staff to be invested in the success of the organization mission space.
    - Include KM in performance goals/reviews and in training
- Require project documentation to capture the results of the activity (part of the tasking or statement of work)
    - HQ requirement to include lessons learned
- Incentivize pay award for extracurricular activities in the area of safeguards
    - Provide a talk at INMM
    - Be on a board
- Have a champion (KM Officer) at each lab to facilitate, provide awareness, make knowledge management easier
    - Have person become KM certified
    - Maybe tie it into the Quality Management department
    - They should champion all the KM tools such as nonproliferation portal, and repository (when stood up)
- Give awards out for activities aligned with knowledge management activities (maybe during Knowvember)
- Change culture to value KM
- Increase utilization of and contributions to the nonproliferation portal
    - Use for providing read-aheads
    - Apply for trainings through portal
    - Every lab has skin in the game
    - Include a board of directors (early/mid-career person nominated from each lab) to suggest improvements, encourage utilization, etc.
- Provide notification of/reports on updates from the KM repository or any infrastructure
    - Newsletter
    - INMM communicator
    - Automatic emails

Other Thoughts Related to This Objective

- Each lab should share good practices from their knowledge management strategy and implementation as part of our goal of fostering a U.S. safeguards "community of practice" that allows us to both recognize that our separate organizations have elements of competition, but that our shared goal is to maintain the overall quality and contribution of the U.S. safeguards community.

10. APPENDIX B: SURVEY RESULTS

10.1. Survey Summary – Focus Areas

Infrastructure
Challenge: Access to safeguards information, documents, and knowledge experts
Recommendation: Develop a user friendly shared platform repository where relevant project materials, training, curriculum, presentations, etc. can be accessed.

Incentive and Resources
Challenge: Limited time, funding, and resources to document work, transfer knowledge to next generation, and mentoring.
Recommendation: Incentivize staff to engage in knowledge transfer and mentoring.

Training
Challenge: Training, mentoring & transferring of knowledge to the next generation
Recommendation: Evaluate effectiveness of training: right people, correct mode and execution and make adjustments where necessary.

Processes and Procedures
Challenge: Implementation of knowledge management and knowledge retention varies across the lab complex but typically no formal process has been identified and has a lower priority.
Challenge: Responsibility of knowledge management and knowledge retention varies throughout the lab complex.
Recommendation: Identify and recommend best practices for transition planning, succession planning, workforce planning, exit interviews, and knowledge transfer

10.1.1. CHALLENGES

Infrastructure
Access to safeguards information, documents, and knowledge experts.

The ability to search or peruse archived department-wide network drives for previous work (i.e., presentations, reports, proposals, etc.) allows for continued reference to safeguards-related scope at LAB I. Uploads of safeguards-related university engagement curricula, presentations, and lectures to eRoom and similar online database efforts extrapolate this idea out to a DOE-wide effort and there is optimism for this system if it continues to be utilized.

While LAB G uses a variety of information technology tools for knowledge retention such as SharePoint and a records management system, the laboratory overall does not have explicit knowledge management objectives or metrics.

Organizing information in a database that is accessible by future users.

Most safeguards staff members work independently rather than on teams and there are no requirements for archiving project information. Thus information about individual projects may not be shared with colleagues and once projects are complete, the results may be lost.

Information so that it can be shared effectively with future users, and transferring information and knowledge from experts to new staff through mentoring and training.

Cataloging information to pass to newer staff;

LAB H also utilizes shared drives and SharePoint to archive project information which can be used for knowledge retention activities.

Safeguards KR is also not a high priority within LAB A management and practices are informal. Those responsible for safeguards KR and KM include managers, who transition work of departing staff to new PIs, project managers, who are responsible for documenting their projects, and staff, who are responsible for ensuring that project documents are kept on shared platforms such as eRoom and Box. These platforms are very useful for retaining past work and ensuring it is available to new staff. LAB A does not have explicit KR or KM objectives.

Retaining and transferring tacit knowledge can be difficult.

Incentive and Resources

Limited time, funding, and resources to document work, transfer knowledge to next generation, and mentoring.

Lack of time and funding creates a disincentive for safeguards staff members to document their work throughout their career. Moreover, without appropriate resources safeguards knowledge and experience will not be captured and/or transferred.

The challenge affecting safeguards knowledge retention at LAB E is funding. For example, safeguards funding has decreased by 35 percent overall as compared to FY11 levels, which complicates recruitment and retention efforts. As such, the safeguards program is very small which limits the number of safeguards projects the lab can commit to as well as the availability of staff to facilitate effective knowledge retention.

The biggest challenge to safeguards KR at LAB D is lack of time and funding.

The biggest challenge is sustained funding to hire new staff and retain them within the safeguards arena.

LAB I's continuation of all safeguards-related expertise is proportionately dependent to safeguards-related work scope. There is no safeguards-dedicated department at LAB I, and safeguards expertise is strewn across several departments. Without steady safeguards-specific funding, continuation of knowledge is more difficult.

Lack of support from sponsors to fund the overlap necessary to transfer knowledge to the next generation;

Workload does not allow time for KR.

Lack of resources for senior staff to teach and document knowledge for younger staff;

Insufficient investment of resources to hire staff early enough to allow successful mentoring and knowledge transfer from one generation to the next

The biggest challenge for safeguards KR at LAB A is the size of its program which is small and allows for minimal overhead and infrastructure for KR.

Training

Training, mentoring & transferring of knowledge to the next generation

When a safeguards staff member leaves to join another organization, there is a disincentive to share their knowledge because it will make them less competitive in the future. Whereas retirees are more likely to share their knowledge.

Concern over job security has also been observed for knowledge retention in that existing personnel do not want to become expendable – if all knowledge is transferred among a group of professionals or easily to new-hires, there could be a concern for job security.

LAB I considers its amount of retirees as the largest barrier/challenge to knowledge retention. LAB I added that outgoing staff have to juggle mentoring new hires with current work execution. LAB I's attrition is compounded by professional poaching and targeted hires from other organizations.

With regard to safeguards KR priorities, the nonproliferation division management places strong emphasis on mentoring students as the most organic form of KR. Departing staff are also encouraged to return as guest scientists or contractors where they can continue to support new staff.

LAB I management recognizes when risks in losing important skills and mission-critical knowledge arise, as in single-point failure areas, and the organization works to mentor new-hires to replace and retain outgoing capacity. This demonstrates an active commitment to safeguards knowledge retention when high-priority potential losses are identified. Yet, the ability to execute recognized mid- to long-term knowledge retention responsibilities is limited by the need to meet immediate work scope demands. At a higher organizational level, competing priorities often mean that the main driver is the program with the largest amount of funding, and smaller programs receive less priority. Therefore, LAB I assesses its current state of safeguards knowledge retention to medium, citing retirement and lack of new scope as threats to the retention of expertise.

It is also difficult for outgoing employees to coordinate and cooperate with new hires on transferring safeguards expertise when there is a lack of safeguards-specific scope to execute.

Apathy, time, and funding for mentors and protégés;

Basic safeguards policy and technical information has often been transferred or reinforced at the same time as University Engagement and Next Generation Safeguards Initiative events. When such workshops are held, select new hires, interns, and interested mid-career professionals sit in on safeguards presentations and lectures. Briefing packages have been created in limited instances that include narrated PowerPoints for knowledge preservation. Yet these materials cannot substitute actual turnover time between professionals and on-the-job training and expertise.

Processes and Procedures

Implementation of knowledge management and knowledge retention varies across the lab complex but typically no formal process has been identified and has a lower priority.

The lack of an institutionalized knowledge retention mechanism from management or sponsors was identified by LAB H as the biggest challenge to knowledge retention.

The lack of an organized methodology to manage knowledge retention in preparation for attrition or retirements is also a challenge for LAB H. Therefore, the current practice of safeguards KR for LAB H remains an informal one based on a case-by-case basis.

Regarding the priority given to safeguards knowledge retention by management, LAB H considers this a low priority. On rare occasions, retiring staff plan in advance to mentor early- and mid-career staff and transfer critical information and knowledge to those who will inherit their portfolios. More often, however, once people decide to retire or leave the laboratory, they do not give much notice and then are so consumed by out-processing that they do not have time to do explicit knowledge transfer.

Due to the small size of LAB B's safeguards R&D program, there are no formal procedures for safeguards knowledge retention and management has placed little priority/importance on this.

Given the above mentioned challenges, it is interesting to note that minimal importance is placed on safeguards KR and there is no formal structure for safeguards KR.

Not demonstrating KR value to the organization; and

In terms of explicit knowledge management and retention objectives, LAB D places emphasis on identifying and capturing essential safeguards information, organizing and storing safeguards

Processes and Procedures

Responsibility of knowledge management and knowledge retention varies throughout the lab complex.

Safeguards knowledge retention is managed by the nonproliferation division Chief of Staff, and group managers. In addition, each nonproliferation division group is responsible for identifying knowledge/roles that are at risk of leaving the group and determining how to transfer the knowledge and continue the role through transfer of responsibilities or hiring new staff.

No explicit knowledge management objectives exist at this time at LAB I. Once a retiring position or otherwise outgoing professional is identified, dependent on time remaining at current responsibility, care is taken to reassign active projects and brief new point of contacts. Many LAB I employees move across departmental organizations over the course of their career, and contact between legacy and current staff for clarification, assistance, or even take on responsibilities across different departments is commonplace. This pathway for knowledge continuation is obviously limited by retirement and remains an issue for LAB I.

Knowledge management is considered an important responsibility across LAB G for both staff and management. For example, principal Investigators are responsible for project documentation while line managers must assist their staff with knowledge transfer, training opportunities, and professional development. Business/Sector Managers identify business opportunities to engage younger staff in new work.

Responsibility for KR at LAB E rests with its Global Security Program. At the working level, PI's initiate and implement informal practices and procedures relevant to KR and knowledge transfer.

The International Safeguards Department at LAB H does not have explicit knowledge management objectives. However, there are robust knowledge management efforts within the weapons program that have been ongoing for several decades. The 'Knowledge Preservation for the Nuclear Weapons Enterprise' collects, organizes, and archives interviews with past weapons engineers and SME's, and video, tapes, digital media, and photographs in order to track the history of the program and to educate incoming, early-career SME's. There is also a larger, laboratory-wide KM effort led by LAB H's Technical and Compliance Training Department.

No one employee has the explicit responsibility of knowledge management. However, managers are responsible for transitioning the work of departing staff to new principal investigators. Project managers are responsible for documenting their projects, including scope of work, progress, milestones, and deliverables.

LAB I identified project managers as those responsible for safeguards knowledge retention as they oversee the safeguards projects themselves.

10.1.2. RECOMMENDATIONS

Infrastructure
Develop a user friendly shared platform repository where relevant project materials, training, curriculum, presentations, etc. can be accessed.

Develop user-friendly records management systems.

Establish a common user platform for project documents, e.g. SharePoint, shared drives.

Ensure project documents are kept on shared platforms such as eRoom and Box and these platforms are easily accessible and regularly updated.

PI's need to document projects in a shared platform.

PI's need to document projects.

Establish user friendly shared platforms to allow for documentation of relevant project materials, training, curriculum, presentations, etc.

Established a shared platform or filing system to facilitate teamwork and knowledge transfer if necessary.

Incentivize and Resources

Incentivize staff to engage in knowledge transfer and mentoring

Secure funding to formalize mentoring.

Fund mentoring of early-career staff and interns/fellows by mid-career staff.

Fund mentoring of early- mid-career staff by senior staff.

Mentoring programs wherein late-career staff are paired with early-to mid-career staff 3- 5 years prior to retirement to create a mentor/mentee project team. These mentors contribute to projects led by the mentee, co-author papers, and provide expertise and input on proposals.

Require (and fund) mentoring.

Utilize overhead or program development funds to support authoring of program history by individuals with extensive experience who are nearing retirement or other separation. Such documentation is meant to capture important details, insights and lessons learned to ensure these are retained.

Training

Evaluate effectiveness of training: right people, correct mode and execution and make adjustments where necessary.

Advertise safeguards training courses to a wide laboratory audience to encourage non-safeguards staff to participate and potentially get involved in the field.

Offer retired staff the opportunity to return as guest scientists or fellows and continue to mentor early-career staff and students.

Retirees should be able to come back as unpaid (or nominally paid) visiting scientists to facilitate knowledge transfer.

Establish requirements for staff to present work at seminars or annual program reviews.

Encourage and fund professional development via engagement with professional societies (INMM, ANS, IEEE, Nonproliferation and Arms Control Community of Interest Network [NAC COIN])

Secure or request funding to develop reference documents and training materials, such as PowerPoint presentations with audio narration that could be used to provide briefings for new talent in the field. Funding should cover training for a minimum of 6 months, up to one year of new hires or early-career staff.

Managers should work with new staff for 6 months to one year to ensure they are up to speed on processes and procedures.

Processes and Procedures

Identify and recommend best practices for transition planning, succession planning, workforce planning, exit interviews, and knowledge transfer.

Establish a systematic approach to succession and workforce planning that assesses required knowledge, skills, and abilities necessary to meet current and evolving commitments.

- Identify key positions/critical roles that may become vacant in the near future. Potential successors should be identified and assessed against core competencies along with a strategy to support potential successor development.

Establish robust succession plans.

Conduct exit interviews.

Ensure that management communicates safeguards KR expectations clearly to staff.

Safeguards groups or departments should identify knowledge/roles that are at risk of leaving the laboratory and determine how to transfer the knowledge laterally or to newly hired staff.

Transfer portfolios to early- and mid- career staff prior to departure.

Manager should ensure departing staff transition their work to new PI's.

Assuming funding is available, e.g. projects have enough resources or funding is available outside of direct projects (HCD intern funding), SME's should hire undergraduate- and graduate-level interns to grow expertise and create professional development opportunities.

Leverage existing knowledge management programs to gain lessons learned.

Capture lessons learned.

Establish requirements in the goal and performance planning process that call for senior staff to share lessons learned with less experience staff.

11. APPENDIX C: AGENDA

Workshop on Safeguards Knowledge Management and Retention

August 29-30, 2017

Security Notice - The Center for Global Security and Cooperation is a "Property Protection Area (PPA)" and as such, the following items are allowed in the building: electronic devices, including cell phones (e.g., BlackBerry, iPhone, Android, etc.), laptop computers, 2-way pagers, USB drives, Apple devices (e.g., iPod, iPad, iWatch, etc.), e-readers (e.g., Kindle, Nook, etc.), and Bluetooth. The above noted items are not allowed elsewhere on Sandia premises unless otherwise noted. The following items are prohibited on all Sandia controlled premises: intoxicants, illegal drugs, drug paraphernalia, firearms, and explosive materials.

Objective: The purpose of this workshop is to clearly identify challenges related to safeguards knowledge retention at the U.S. Department of Energy, National Nuclear Security Administration's (DOE/NNSA) National Laboratory Complex, and to develop recommendations and practical steps to mitigate those challenges.

Day 1: Tuesday, August 29

Center for Global Security and Cooperation (CGSC)/1149
10600 Research Rd., SW
Albuquerque, NM 87185

7:30a Meet at CGSC, Sandia National Laboratories

8:00a Welcome and Introductions .....Becky Jones, PNNL

8:10a Opening remarks (via phone) .....Kathryn Glynn
HCD Program Director, NA-241

8:20a What is Knowledge Management and Retention? .....Bridget Bersell, PNNL

9:00a Overview of FY17 Knowledge Retention Project .....Risa Haddal, SNL; Becky Jones, PNNL

9:10a Overview of Succession Planning Methodology .....Bernie Kirk, ORNL

9:30a Break

9:45a Overview of Workforce Planning and Agility .....Rebecca Stevens, LANL

10:15a Knowledge Retention Survey Results .....Risa Haddal, SNL; Becky Jones, PNNL

10:30a Participants Breakout into Groups .....All

11:45a Lunch

12:45p Continue Breakout Group Sessions and Reporting .....All

4:30p Adjourn

6:00pm-10:00pm Welcome Reception or dinner .....National Museum of Nuclear Science & History

Day 2: Wednesday, August 30

Center for Global Security and Cooperation (CGSC)/1149

8:00a Welcome Back, Answer Questions .....Becky Jones, Bridget Bursell, PNNL

8:10a Demonstrate Succession Planning Methodology.....Bernie Kirk, ORNL

8:40a INITIAL .....Alexis Trehan, LANL

9:10a Continue Breakout Group Sessions and Reporting .....All

11:45a Lunch

1:00p Guest Speakers
During this time period, scribe/facilitator summarizing the results of working groups)

1:00p Sandia's ASK Expert Finder Demo .....Dann Barnes, SNL

1:10p Sandia Personalized Information Retrieve Environment.....Pengchu Zhang, SNL

1:20p Knowledge Management Engagement for Safeguards Organizations .....Justin Reed, ANL

1:40p Knowledge Management for the SNL NW Program .....Diane Miller, Angie VanArsdale, SNL

2:10p Overview of Safeguards Knowledge Repository.....Justin Reed, ANL
(During this time period, scribe/facilitator summarizing the results of working groups)

2:30p Break

2:45p Facilitator Summarize Results .....All

3:45p Workshop Summary.....Becky Jones, Bridget Bursell, PNNL

4:00p Adjourn

12. APPENDIX D: WORKSHOP PARTICIPANTS

Safeguards Knowledge Management and Retention Workshop Participants, Agenda, and Notes

August 29-30, 2017

Participants

Participant Name	Participant Lab
Justin Reed	Argonne National Laboratory
Susan Pepper	Brookhaven National Laboratory
Amanda Rynes	Idaho National Laboratory
George Anzelon	Lawrence Livermore National Laboratory
Alexis Trehan	Los Alamos National Laboratory
Hannah Hale	Oak Ridge National Laboratory
Amanda Sayre	Pacific Northwest National Laboratory
Justin Rizzi	Savannah River National Laboratory
Karen Hogue	Y-12
KR&M Team	
Rebecca Stevens	Los Alamos National Laboratory
Bernie Kirk	Oak Ridge National Laboratory
Becky Jones	Pacific Northwest National Laboratory
Roberta Burbank	Pacific Northwest National Laboratory
Bridget Bersell	Pacific Northwest National Laboratory
Jacqueline Hoswell	Sandia National Laboratories
Shannon Abbott	Sandia National Laboratories

DISTRIBUTION

1	MS0899	Technical Library	9536 (electronic copy)
1	MS1371	Tina Hernandez	6832 (electronic copy)
1	MS1371	Risa Haddal	6832 (electronic copy)
1	MS1371	Jacqueline Hoswell	6832 (electronic copy)


Sandia National Laboratories