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LLNL-MIIS International Nuclear Safeguards Policy Summer Course

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LLNL-MIIS International Nuclear Safeguards Policy Summer Course

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Abstract

The Lawrence Livermore National Laboratory (LLNL) and the James Martin Center for Nonproliferation Studies (CNS) at the Middlebury Institute of International Studies (MIIS) at Monterey actively support U.S. Department of Energy National Nuclear Security Administration (NNSA) Next Generation Safeguards Initiative (NGSI) efforts to recruit and train the next generation of nuclear safeguards experts. Together, with support from the NGSI Human Capital Development (HCD) program, LLNL and CNS/MIIS co-host the International Nuclear Safeguards Policy Summer Course. The week-long, tuition free course held at MIIS examines the historical evolution of the legal and institutional foundations of international safeguards, approaches and technologies for safeguards implementation, and current and recent challenges to the international safeguards systems through the use of case studies. The course also features an exercise, focusing in the last several years on safeguards issues in Iran, that aims to elucidate from a technical safeguards standpoint the numerous safeguards issues the Iran cases illustrates, as well as how these issues were dealt with by the non-proliferation regime at a policy level. The paper reviews the evolution of the course since its launch in 2008, the current goals and content of the course, lessons learned, and its continuing role in training the next generation of safeguards experts.

Introduction

The Lawrence Livermore National Laboratory (LLNL) and the James Martin Center for Nonproliferation Studies (CNS) at the Middlebury Institute of International Studies at Monterey (MIIS) actively support U.S. Department of Energy (DOE) National Nuclear Security Administration (NNSA) Next Generation Safeguards Initiative (NGSI) efforts to recruit and train the next generation of nuclear safeguards experts. Together, with support from the NGSI Human Capital Development (HCD) program, LLNL and CNS/MIIS have co-hosted the International Nuclear Safeguards Policy and Information Analysis Summer Course every year since 2008 [1].

The tuition-free, week-long course held at MIIS examines the historical evolution of the legal and institutional foundations of international safeguards, describes the approaches and technologies for safeguards implementation, and explores, through the use of case studies, current and recent challenges to the international safeguards systems. The course draws on the expertise of former and current safeguards policy experts from LLNL and other DOE national laboratories, and the IAEA. The course features a hands-on exercise to evaluate the students' understanding of the material by engaging them in working through various safeguards issues from technical, legal and policy perspectives. The exercises typically change every year to ensure they reflect the most relevant safeguards issues of the day.

The course is aimed at graduate-level students and young professionals with policy backgrounds as well as those from more technically-oriented fields, such as nuclear engineering, nuclear physics and analytical chemistry. The student audience for the course is diverse, coming from universities and DOE national laboratories from across the country, and with a quarter to a third coming from abroad.

As part of the NGS program, each year four to six U.S. citizens who attend the course are selected for a 10-week paid internship at LLNL, which starts the week after the course. Working with LLNL staff the interns are able to do further research on specific safeguards issues.

LLNL and CNS/MIIS both bring unique expertise to deliver a substantive, robust content to educate the next generation of safeguards experts. CNS, internationally recognized as a leader in nonproliferation education, ensures that the course meets high academic standards, incorporates the most promising tools in nonproliferation education—including assessment exercises and online learning modules—and places emphasis on understanding the international context, while LLNL draws on its practical experience in nuclear safeguards implementation to help design the agenda, deliver the content and bridge the technology-policy gap, a critical challenge for international safeguards education [1].

Pre-course module

Students selected for the course are required to complete a mandatory online pre-course module to ensure that all course participants have the minimum tools and knowledge necessary to participate properly in the course [2]. The course consists of the following six topics:

Topic 1: Energy, Weapons & Technology

Topic 2: The NPT Regime

Topic 3: CTBT

Topic 4: The IAEA and Safeguards

Topic 5: Nuclear Possessor States: Capabilities and Doctrines

Topic 6: Case Studies (Iran, DPRK, Syria, Argentina, Brazil).

Each module contains an introductory presentation developed and delivered by a MIIS staff member who is an expert in the topic at hand; a list of required readings relevant to the topic, as well as some additional resources are made available. Each module (except for Topic 5) has an associated quiz which the students have to pass successfully in order to register completion of the module.

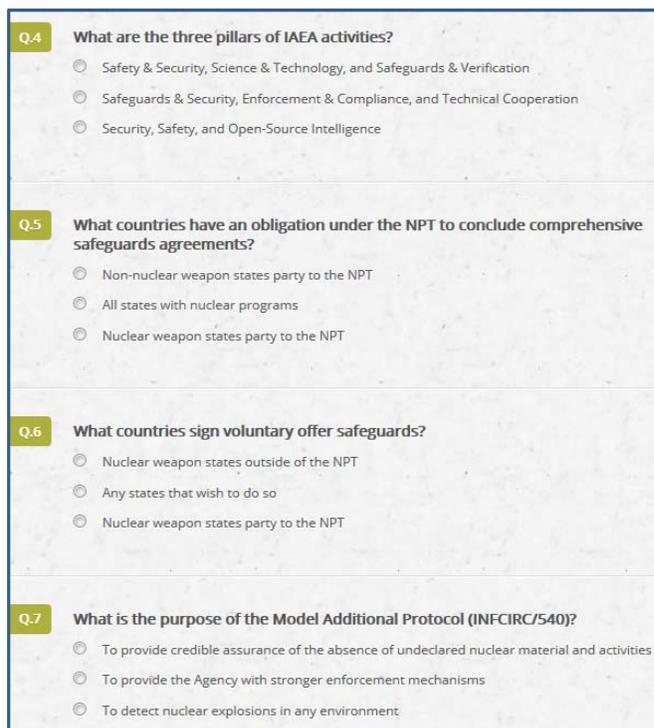


Figure 1: Excerpt from the quiz for Topic 4 of the pre-course module

Course content and exercises

The course focuses on providing the participants with a solid foundation for understanding the policy facet of international safeguards and how the policy dimension interplays with the legal and technical dimensions underpinning the safeguards work of the IAEA. While the agenda is not static, and is updated every year to make sure the content remains relevant and up-to-date, the presentations generally are organized around the following themes: the origins of international nuclear safeguards; the evolution of international safeguards implementation and compliance issues; safeguards activities, tools and evaluation methodologies (in the field and at headquarters); State evaluation and the State level concept; specific topics and case studies in international safeguards. *(Please refer to Annex I for the list of course speakers and presentations for the June 2016 course.)*

An important element of the course curriculum is a hands-on exercise designed to test and evaluate the participants' understanding of the material. During the exercises the students, typically working in groups of three to five, examine various safeguards issues from technical, legal and policy perspectives. The exercises are designed to simulate what it is like to be an IAEA safeguards inspector or analyst, or a representative of a state confronted with a safeguards issue, e.g. a case of a potential noncompliance. The exercises typically change each year to ensure they reflect the most relevant current safeguards issues. Some examples of past exercises are:

- Prepare a State Evaluation Report: The exercise involves drafting a State Evaluation Report for one of a number of select States to enhance the participants' understanding of the information analysis processes that are performed in the course of safeguards State evaluation. The deliverable is a presentation summarizing the analysis of all factors relevant for drawing safeguards conclusions and for prioritizing recommended follow-up actions. The presentation is to include a brief profile of the State and its nuclear development, a consistency analysis of all information available on the State's Nuclear Fuel Cycle Activities and Facilities and other factors relevant to the State as a whole, analysis of the potential proliferation pathways, and conclusions and recommendations.
- Simulate a debate within the IAEA Board of Governors to consider a resolution seeking to enhance a State's cooperation with the IAEA: The exercise revolves around a simulation of a regular session of the IAEA Board of Governors, during which time an IAEA Member State requests the Board Chairperson to submit before the Board for consideration a draft resolution calling on a particular State to enhance its cooperation with the IAEA regarding the Agency's investigation of outstanding safeguards issues in that State. During the course of the week, the students' representing various Board Member States are expected to develop and establish their delegations' goals and positions with respect to the proposed text of the resolution, seek alliances for their position, draft and/or amend the resolution text, and ultimately debate the resolution.
- Develop a State-level Approach: The exercise centers on one of the key safeguards implementation activities – developing a State-level approach for one of four fictional states, spanning a range of fuel cycle characteristics and technical development. Working in smaller groups and drawing on comprehensive State evaluation, the students are

expected to identify and analyze technically plausible acquisition paths by which a State may acquire nuclear material suitable for use in a nuclear explosive device, specify and prioritize specific technical objectives for covering acquisition paths, and identify applicable safeguards measures to address the technical objectives. The final presentation by each group includes an overview of plausible acquisition pathways, key technical objectives for safeguards coverage, and a list of safeguards measures needed to achieve the technical objectives.

- **Safeguards Issues in Iran**: This exercise focuses on a case study of Iranian safeguards issues, and involves the students working in small groups to study a body of IAEA reporting published since 2003, as well as relevant UN Security Council and IAEA Board of Governors resolutions, to gain a greater understanding of the Iran case from a safeguards standpoint. The case study focuses on two sets of questions: a set of general questions about the factual conditions of the Iran safeguards case, and a set of debate-style questions intended to make students understand and evaluate the merits of arguments on two sides of a particular issue. As their deliverables, the students prepare written responses to the first, general set of questions and, discuss them in a group setting, each question led by an assigned group. Each question from the second set is debated by two groups assigned to study that issue in advance.

Each year an extensive survey of the participants' experience with the course is conducted. The results are reviewed to improve the course on an ongoing basis. As an example, based on responses from previous iterations of the course, in 2016 several new hands-on modules were included: practical use of IAEA inspection tools and an environmental sampling taking activity. Both were received very well, as they served to augment the intense lectures and course discussions, and to provide a largely information analysis, policy-oriented audience with an inside look into how some of the safeguards activities that take place in the field are carried out.

Course participation and career progression

Recruitment

The course is advertised widely by CNS/MIIS, which assures dissemination within the U.S. nonproliferation community, and, considering CNS's extensive international network, to academic and government entities working on nonproliferation and international security issues overseas. Information about the course is also shared with other DOE national laboratories targeting young professionals interested in (re)directing their work towards supporting international safeguards activities.

Participants

The course is aimed at graduate-level students and young professionals with policy backgrounds as well as those from more technically-oriented fields. Between a quarter and a third of the students typically have scientific or technical backgrounds, e.g. in nuclear engineering, nuclear physics and analytical chemistry. The student audience for the course is diverse, coming from universities and DOE national laboratories from across the country. The number of course participants has steadily increased, as seen in Figure 2 below.

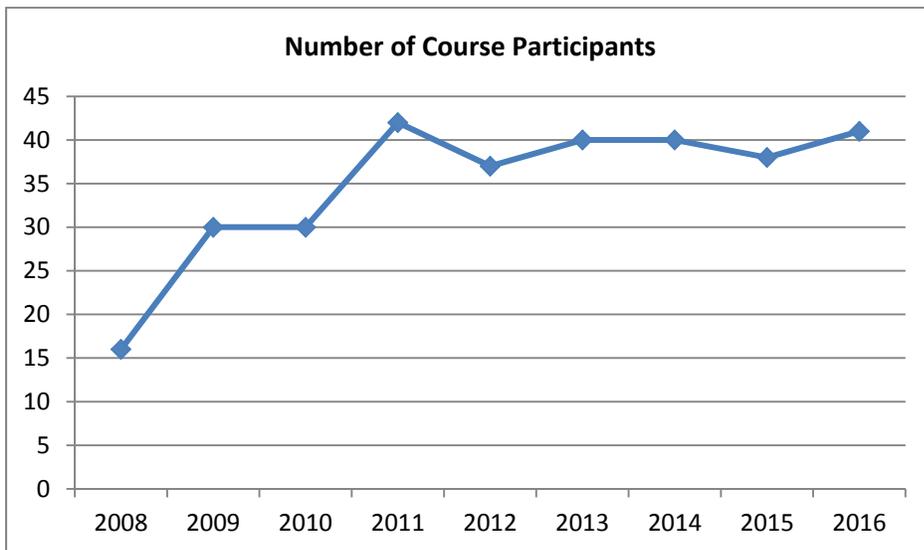


Figure 2: Number of Course Participants

The course draws a number of participants from abroad, typically from government regulatory authorities and foreign ministries. Over the years, countries represented among participants included: Austria, Azerbaijan, Belgium, Burkina Faso, Canada, Egypt, France, Ghana, India, Italy, Moldova, Netherlands, Nigeria, Norway, Pakistan, Poland, Romania, Russia, Slovenia, South Africa, Turkey, and the UK. Please see table 1 for the breakdown of participants.

2012	37 participants (17 male, 20 female) from six countries Schools included: Jawaharlal Nehru University New Delhi (India), George Washington University, Georgetown, MIIS, MIT, Novouralsk State Institute of Technology (Russia), Old Dominion University, Pennsylvania State University, UC Berkeley, University of Tennessee, Yale Organizations represented: CTBTO, LANL, LLNL, Nigeria Atomic Energy Commission, PNNL
2013	40 participants (19 male, 21 female) from six countries Schools included: American University in Cairo (Egypt), Carleton University, George Washington University, Georgia Institute of Technology, Kings College London, Medical University of Vienna, MIIS, Pennsylvania State University, Rensselaer Polytechnic Institute, UC Berkeley, University of Bern (Switzerland), University of Georgia, University of Ghana, University of Maryland, University of Michigan, University of Tennessee, University of Uyo (Nigeria), Virginia Polytechnic Institute Organizations represented: ANL, LANL, LLNL, NNSA, ORNL, Pakistan Nuclear Regulatory Authority, PNNL
2014	40 participants (23 male, 17 female) from eight countries Schools included: Boston University, George Washington University, Hillsdale College, King's College London, MIIS, Missouri State University, Nigerian Defense Academy, Sciences Po (France), Texas A&M, UC Berkeley, University of Georgia, University of Tennessee, University of Wisconsin Madison Organizations represented: Belgian Federal Agency for Nuclear Control, DOE HQ, DTRA, INL, LLNL, Ministry of Foreign Affairs & Regional Cooperation (Burkina Faso), Nigerian Nuclear Regulatory Commission, SNL

2015	<p>38 participants (25 male, 13 female) from nine countries Schools included: George Washington University, Georgetown, Harvard University (JFK School), Jagiellonian University Krakow (Poland), Jawahial Nehru University (India), Johns Hopkins, King's College London, MIIS, National Defense University (Pakistan), Vienna Technical University (Austria), Sciences Po (France), UC Berkeley, University College London, University of Florence, University of Georgia, University of Oslo, University of Utah, Virginia Tech Organizations represented: IAEA, Nigerian Nuclear Regulatory Commission</p>
2016	<p>41 participants (17 male, 24 female) from nine countries Schools included: American University, MIIS, North Carolina State University, UC Berkeley, University of Chicago, University of Pittsburgh, University of Tennessee Knoxville Organizations represented: ANL, Department of Foreign Affairs, Trade and Development (Canada), IAEA, LANL, LLNL, Ministry of Foreign Affairs (Egypt), National Agency for Regulation of Nuclear and Radiological Activities (Moldova), NRC, SNL, South African Nuclear Energy Corporation, State Agency on Nuclear and Radiological Activity Regulation of the Ministry of Emergency Situations (Azerbaijan)</p>

Table 1: Participants by the numbers

Career progression

While the course is useful to anyone interested in pursuing a career in international safeguards, it is most relevant to those participants who seek to pursue a career in policy and information analysis. It provides excellent pre-professional training for recent graduates and early career professionals interested in careers where they can understand, shape and implement U.S. safeguards policy, e.g. in the NNSA's Office of Defense Nuclear Nonproliferation, the State Department's Bureau of International Security and Nonproliferation, Nuclear Regulatory Commission, and elsewhere. Considering the course content's focus on information analysis, state evaluation and investigation of indicators of potential noncompliance, the course is well suited for those interested in pursuing analytical positions within national laboratories and in the IAEA's Department of Safeguards.

Many of the participants continue with their graduate studies, now with a more nuanced understanding of and interest in the various issues surrounding international safeguards policy. For those who had graduated prior to participating in the course and who look to start their careers, one opportunity has been the NNSA Nonproliferation Graduate Fellowship Program (NGFP), which places fellows in a year-long assignment with an NNSA office whose mission focuses on nonproliferation efforts, including R&D, international security and fissile materials disposition, as well as other national security areas. Over the years, the graduates of the course, either directly or following an NGFP assignment, found positions at DOE national labs, e.g. BNL, LANL LLNL, federal agencies, e.g. DOE's NA-24 office, Department of State's Comprehensive Threat Reduction program, Department of Defense's Office of Nuclear, Chemical and Biological Defense Programs, as well as international agencies, such as the International Atomic Energy Agency's Department of Safeguards and the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO).

Student evaluations and reactions

The students are asked to fill out a 27-question online course evaluation survey that provides feedback to measure satisfaction with the course, the individual lectures and exercises to help the organizers to continue improving the course. By setting aside dedicated time during the course for participants to fill out the survey, the organizers ensure high response rate, e.g. in 2016 a nearly 100% response rate for multiple choice questions and almost 80% for those questions that required an open-ended response were achieved.

For 2016, the participants gave the course an overall satisfaction rating of 4.64 on a scale of 1 (poor) to 5 (excellent), with over 70% rating it as excellent. The participants universally reported that the course contributed overall to their learning about the subject matter (ranking it “excellent” or “very good”). Overwhelming majorities consider the length (83%) and the difficulty (95%) of the course to be “about right”. The instructional team’s overall performance is consistently ranked as high. The instructors are considered knowledgeable, engaged and interested in the subject matter, well prepared, respectful of students’ opinions and responsive to students’ questions (the ranking for instructors’ overall performance was 4.6 on a scale of 1 (poor) to 5 (excellent)).

Open-ended questions offered a wide range of suggestions for further refinement to the course, in particular in the area of in-class exercises and on better engaging participants with more technical backgrounds. Some of the respondents felt that the exercises were geared toward those with policy backgrounds. While the course was intentionally designed to focus on the policy element of international safeguards, integrating the policy and technical sides is critically important for understanding and implementing safeguards effectively. The students seemed to welcome the sidebar of technical details of the nuclear fuel cycle included in some of the facility-based safeguards presentations. The task for next year will be to use the lectures and to design the exercises in such a way that they take advantage of the technical expertise offered by the students themselves and engaging all the participants via in-class exercises so they benefit from each other’s past experiences and backgrounds.

Conclusion

The International Nuclear Safeguards Policy Summer Course organized jointly by LLNL and CNS/MIIS actively support U.S. DOE NNSA Next Generation Safeguards Initiative efforts to recruit and train the next generation of nuclear safeguards experts. Through the use of lectures by active and retired subject matter experts from DOE national laboratories, the IAEA and MIIS, tailored case study exercises and hands-on modules, the course examines the historical evolution of the legal and institutional foundations of international safeguards, approaches and technologies for safeguards implementation, and current and recent challenges to the international safeguards systems. The paper reviewed the history of the course since its launch in 2008, the current goals and content of the course, and highlighted its continuing role in training the next generation of safeguards experts.

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References

1. Justin Reed, Sean Dunlop and Fred Wehling, “LLNL-CNS International Safeguards Policy and Information Analysis Summer Course,” presented at the 51st INMM Annual Meeting, July 2010, Baltimore, Maryland USA.
2. <https://safeguardscourse.wordpress.com/>

Appendix: List of 2016 Course Speakers and Presentations

Overview and Course Objectives

George Moore, Center for Nonproliferation Studies (CNS)

Foundations of Nuclear Nonproliferation Treaty Safeguards

Jean-Maurice Crété, International Atomic Energy Agency (IAEA)

IAEA and the Department of Safeguards

Jean-Maurice Crété, IAEA

Introduction to the exercises and organization of case study groups

Yana Feldman, Lawrence Livermore National Laboratory (LLNL)

Safeguards Case Studies of the 1990s; DPRK Safeguards Issues

George Anzelon, LLNL

Strengthened Safeguards: Program 93+2 and the Additional Protocol

Jill Cooley, Y-12 National Security Complex

New and Evolving Challenges to the NPT Regime

Bill Potter, CNS

State Evaluation Process and Information Analysis

Yana Feldman, LLNL

Facility-Level Safeguards Implementation

Mark Schanfein, Pacific Northwest National Laboratory (PNNL)

Introduction to IAEA Inspection Tools (hands-on activity)

Mark Schanfein, PNNL

Japan: Safeguarding High-Throughput Bulk-Handling Facilities

Shirley Johnson, Tucker Creek Consulting LLC

State-level Concept

Jill Cooley, Y-12

Collecting, Processing and Communicating Safeguards-Relevant information at the IAEA:

Techniques and Human Resources

Jean-Maurice Crété, IAEA

Select Safeguards Cases of the 2000s

George Anzelon, LLNL

Life of a Nuclear Safeguards Inspector

Ruth Kips, LLNL

Environmental Sampling Overview

Ruth Kips, Yana Feldman and George Anzelon, LLNL

Environmental Sampling Hands-On Activity

Iran: Safeguards Issues

Celia Reynolds, LLNL
Iran and JCPOA
Kyle Chand, LLNL
Discussion: Careers in Safeguards and Nonproliferation
Moderator: All Instructors
Legal Authorities, Noncompliance and Challenges to the Safeguards System
Laura Rockwood, Vienna Center for Disarmament and Non-Proliferation
Small Quantities Protocol: The Case of Myanmar
William Moore, LLNL
Relationship between Nuclear Security and Safeguards, post-Nuclear Security Summit reality
George Moore, CNS