CNS

OCCASIONAL PAPER

#39 · OCTOBER 2018

Safeguards and Verification in Inaccessible Territories

Chen Kane, PhD

Middlebury Institute *of* International Studies at Monterey

James Martin Center for Nonproliferation Studies

The views, assessments, judgments, and conclusions in this report are the sole representations of the authors and do not necessarily represent either the official position or policy or bear the endorsement of the James Martin Center for Nonproliferation Studies, the Middlebury Institute of International Studies at Monterey, the President and Trustees of Middlebury College, US Government, or Ploughshares Fund.

We would like to acknowledge Ms. Michelle Dover as an advisor on this project. One of the original designers of this project while at CNS, she provided valuable advice and help in data collection after joining the Ploughshares Fund, who graciously allowed her to continue her participation in the project. While Middlebury Institute of International Studies receives funding from Ploughshares Fund for other projects, this specific project received no funding from Ploughshares Fund, and views, assessments, judgments, and conclusions in this report are the sole representations of the author and do not necessarily represent either the official position or policy or bear the endorsement of Ploughshares Fund.

James Martin Center For Nonproliferation Studies
www.nonproliferation.org

The James Martin Center for Nonproliferation Studies (CNS) strives to combat the spread of weapons of mass destruction by training the next generation of nonproliferation specialists and disseminating timely information and analysis. CNS at the Middlebury Institute of International Studies at Monterey is the largest nongovernmental organization in the United States devoted exclusively to research and training on nonproliferation issues.

Middlebury Institute of International Studies at Monterey
www.miis.edu

The Middlebury Institute of International Studies at Monterey, a graduate school of Middlebury College, provides international professional education in areas of critical importance to a rapidly changing global community, including international policy and management, translation and interpretation, language teaching, sustainable development, and nonproliferation. We prepare students from all over the world to make a meaningful impact in their chosen fields through degree programs characterized by immersive and collaborative learning and opportunities to acquire and apply practical professional skills. Our students are emerging leaders capable of bridging cultural, organizational, and language divides to produce sustainable, equitable solutions to a variety of global challenges.

James Martin Center for Nonproliferation Studies
Middlebury Institute of International Studies at Monterey
460 Pierce St., Monterey, CA 93940, U.S.A.
Tel: +1 (831) 647-4154
Fax: +1 (831) 647-3519

Front cover photo: "A fresh / spent fuel area in al-Tuwaitha, Iraq," © US Department of State and the Multi-National Force – Iraq.

CONTENTS

TABLE OF FIGURES

Glossary

AP	Additional Protocol
BOG	Board of Governors
CCB	cask custody building
CNS	Center for Nonproliferation Studies
C/S	containment/surveillance
CSA	Comprehensive Safeguards Agreement
CSFS	common spent fuel storage
CW	chemical weapons
CWC	Chemical Weapons Convention
CWPF	chemical weapons production facilities
DAT	Declaration Assessment Team
FFM	Fact-Finding Mission
GPS	Global Positioning System
HEU	highly enriched uranium
IAEA	International Atomic Energy Agency
ICR	inventory change report
IO	international organization
ISIL	Islamic State of Iraq and the Levant (aka ISIS)
ISIS	Islamic State of Iraq and Syria (aka ISIL)
JIM	joint investigative mechanism
LEU	low-enriched uranium
LOF	location outside facilities
MBR	material balance reports
MNSR	miniature neutron source reactor
NNWS	Non-Nuclear-Weapon State
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
OCPF	other chemical production facility
OPCW	Organisation for the Prohibition of Chemical Weapons
PIL	physical inventory listings
R&D	Research and Development
RR	research reactor
SIR	safeguards implementation report
SNOS	short notice operational support
SQ	Significant Quantity
SQP	Small Quantities Protocol
UN	United Nations
UNDSS	United Nations Department of Safety and Security
UNGA	United Nations General Assembly
UNSC	United Nations Security Council
UNSCOM	United Nations Special Commission
UNSCR	United Nations Security Council Resolution
US	United States
USG	United States Government
WMD	weapons of mass destruction

Executive Summary

The paper aims to assist the international community and international organizations (IOs), such as the International Atomic Energy Agency (IAEA) and the Organisation for the Prohibition of Chemical Weapons (OPCW), to better prepare for challenges related to verification and safeguards of nuclear materials, chemical weapons, and facilities in inaccessible territories. The paper identifies lessons from past and ongoing cases (Iraq, Libya, Syria, Fukushima/Japan, and Crimea/Ukraine) and presents policy, legal, and technical recommendations to the IAEA, OPCW, and their member states to overcome some of these challenges.

The challenges in verifying and safeguarding nuclear materials in inaccessible sites have existed for decades. Past cases include Chernobyl, Three Mile Island, and Serbia during the Balkan Wars of the 1990s. Nevertheless, the number of cases in which international organizations such as the IAEA and the OPCW had to verify the status of declared materials in territories they could not access increased significantly since 2010.

This report discusses three categories of situations from which the IAEA and the OPCW have been barred from accessing sensitive materials or facilities. One category consists of locations that are insecure or unsafe and thus involve high risk to IO staff such as in Libya, Iraq, and Fukushima (Japan). The other two categories involve territory over which the state responsible for securing access does not have de facto control. This occurs when the site is controlled by either nonstate actors, such as some sites in Iraq and Syria, or by another state, as in Crimea, Ukraine. In many of these instances, securing access involves a range of political sensitivities, such as civil war, occupation, or natural disaster, which has broader implications and complexities beyond nuclear or chemical nonproliferation, further complicating an IO's ability to gain access to the site or use other means to gather required information. Each of these situations poses different political, legal, and technical challenges and limitations, but they also offer potential novel solutions.

This paper draws a distinction between nuclear and chemical analyses because the Chemical Weapons Convention (CWC) and the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) impart distinct obligations on authorities and their corresponding IO. The IAEA and the OPCW, the IOs mandated to implement the safeguards and verification provisions of their respective treaties, have fundamentally different mandates: they differ in what they verify, methods of verification, and relevant legal authorities. The CWC mandates that the OPCW verifies that no prohibited chemicals are used or developed while the NPT mandates that IAEA inspects all declared nuclear materials and applies material accountancy to verify no diversion. The OPCW traditionally spent about half of its inspection time verifying the destruction of chemical weapons stockpiles while the IAEA monitors first and foremost that no diversion of nuclear materials took place and that no undeclared nuclear materials or facilities exist in the country. In addition, the IAEA issues an annual safeguards conclusion evaluating the compliance of all NPT member states that signed comprehensive safeguards agreements (CSAs) and appraising the correctness and completeness of each state's declarations. The OPCW does not have a mandate to make CWC compliance determinations regarding state parties' activities and therefore does not issue compliance reports for any states except Syria. For Syria, the

OPCW issues compliance reports based on the 2013 Executive Council decision and UN Security Council (UNSC) resolution (UNSCR) 2118.[1]

These differences not only warrant a distinct analysis of both nuclear and chemical weapons scenarios but also of the distinct organizational cultures developed within the two respective organizations. At the same time, the way each of these organizations has dealt with the challenges of safeguards and verification in inaccessible territories and beyond can assist the other organization in their future planning and strategies. For example, as the OPCW moves from verifying disarmament towards greater verification of industry, which relies more on material accountancy, the IAEA experience in verifying declaration correctness and completeness and development of a comprehensive systems-based approach for verification, could be useful as the OPCW transitions. On the other hand, the way the OPCW exercised legal and technical creativity and flexibility in destroying Libya's and Syria's CW programs could assist some of the IAEA challenges in verifying inaccessible materials.

Because of specific events in the last two decades, the nuclear materials in the case studies discussed in this paper cannot be used directly to make nuclear weapons, and chemical weapons have been mostly destroyed or secured in Iraq and partially in Syria.[2] This existing reality is certainly fortunate, but pure luck is not a sustainable strategy. A situation in which significant amounts of declared nuclear materials or chemical weapons are inaccessible to the IAEA or OPCW is certainly foreseeable, and the outcomes of such future circumstances may be shaped by the methods with which the IAEA and OPCW conduct safeguards and verification today. The particular conditions of the case studies discussed in this paper are unlikely to be repeated in the future, but the IAEA and OPCW are likely to become involved again in similarly demanding undertakings, using similar methods and principles. Strategic planning could thus be highly beneficial.

When the NPT and CWC were negotiated and the accompanying safeguards/verification procedures were adopted, parties did not necessarily envisage many present-day circumstances. These new realities as related to inaccessibility required the IAEA and OPCW to adopt ad hoc solutions that do not always live up to their own standards of verifying compliance. In the future, these organizations will have to demonstrate flexibility to meet their respective mandates while relying on consistent principles and safeguards/verification methodologies. The paper concludes each of the nuclear and chemical sections with recommendations for the adoption of such methods.

1 The OPCW is required by the Executive Council 2013 decision and UN Security Council (UNSC) resolution (UNSCR) 2118 to report to the UNSC about progress in implementing the destruction of Syria's chemical weapons (CW) stockpile and Syria's implementation of the CWC. See Organisation for the Prohibition of Chemical Weapons (OPCW) Decision Destruction of Syrian Chemical Weapons, EC-M-33/DEC.1, September 27, 2013, <https://www.opcw.org/fileadmin/OPCW/EC/M-33/ecm33dec01_e_.pdf>, and United Nations Security Council (UNSC) Resolution 2118 (2013), S/RES/2118, September 27, 2013, <https://undocs.org/S/RES/2118(2013)>.

2 "Direct-use" nuclear material can be used for the manufacture of nuclear explosives components without transmutation or further enrichment. For safeguards purposes, all plutonium is defined by the IAEA as "direct use material," but if the plutonium is contained in irradiated fuel (such as in the facilities discussed in the Ukrainian and Japanese cases), it cannot be used directly in weapons unless it is separated by reprocessing.

The project was conducted between March 2016 and August 2018. The project team conducted in-depth consultations with more than forty serving and former government and IO officials, as well as experts in Vienna, The Hague, US national labs, and Washington, DC. The final product may not reflect their positions or opinions, and any mistakes in the document should not be attributed to them.

Nuclear Section

Risks associated with nuclear materials

There are two types of risks—proliferation and security—associated with nuclear material and facilities. Proliferation risks derive from the danger that a state could establish a nuclear-weapons program using declared and/or undeclared materials and facilities. Proliferation risks are addressed by the IAEA's safeguards, which are designed to detect and deter the diversion of nuclear material by a state.

Security risks relate to the possibility that a nonstate actor could obtain and misuse nuclear material. Measures that prohibit unauthorized access to nuclear facilities and to nuclear materials address nuclear-security risks. Such access could involve theft or acquisition of nuclear material to construct a nuclear weapon. However, these risks more commonly include the use of nuclear material to produce a rudimentary nuclear device (an improvised nuclear device) or use of radioactive material (nuclear or otherwise) to produce a radiological dispersal device.[3] Even before 9/11, allegations and indications that various terrorist and nonstate groups were trying to acquire nuclear and other radioactive materials frequently surfaced.[4] Indictments in criminal prosecutions of several alleged members of terrorist groups have included such charges. Threats to use radioactive sources for malicious purposes have been rare but not unknown. Sabotage of, threats of attack on, and materialized attacks on nuclear facilities have also occurred in the past, but none of these reported events have yet resulted in the dispersal of radioactive material.[5] At the same time, nonstate actors with the ability to seize control over large territories, people, and strategic assets have grown more prominent.[6] The Islamic State of Iraq and the Levant (ISIL, also known as Daesh or ISIS) seized uranium compounds from Iraq's Mosul University in 2014, and the Free Syrian Army gained control over the former Syrian nuclear reactor site at al-Kibar. Fortunately, the uranium compounds at Mosul University did not pose a significant proliferation or security risk, and ISIL did not use the cobalt-60 (Co-60) within the radiotherapy machines at the university.[7] The reactor at al-Kibar was destroyed before the civil war. However, similar fortune may not exist in the future. Additionally, other radioactive sources—such as those in medical facilities, oil and gas, and other industrial settings— exist in parts of Iraq, Syria, and Libya that these groups currently or previously controlled. Whether these groups have attempted to misuse the materials thus far remains unclear.

3 Generally, a radiological dispersal device made with nuclear materials is not as potentially lethal as those using other radioactive materials because nuclear materials are not highly radioactive. However, the psychological and economic consequences of a nuclear-material-fueled radiological dispersal device, such as a "Dirty Bomb," could be severe.

4 These include groups such as Al Qaeda, Chechnya-based separatists, Lashkar-e-Taiba, and Aum Shinrikyo, whom all have demonstrated interest in acquiring a nuclear weapon.

5 "Nuclear Terrorism: threats, risks and vulnerabilities," IAEA, <http://www-ns.iaea.org/security/threats.asp?s=4>.

6 ISIL control of oil resources like wells and refineries served as an important factor in funding and sustaining its operations.

7 Joby Warrick and Loveday Morris, "How ISIS nearly stumbled on the ingredients for a 'dirty bomb,'" *Washington Post,* July 22, 2017, <https://www.washingtonpost.com/world/national-security/how-isis-nearly-stumbled-on-the-ingredients-for-a-dirty-bomb/2017/07/22/6a966746-6e31-11e7-b9e2-2056e768a7e5_story.html?utm_term=.40961d3c50aa>.

Unlike in the case of safeguards, the IAEA has been granted no legal authority by its member states to verify or enforce on-site nuclear-security measures, which are the sole responsibility of the state. Nevertheless, the IAEA plays an important role by recommending nuclear-security guidelines. When requested to do so, the IAEA has also helped member states assess and enhance their nuclear-security measures.[8]

Although the IAEA has no legal mandate to enforce nuclear security, threats to security are intertwined with nonproliferation threats in that both require effective control over materials and facilities. By examining how to ensure the continuation of safeguards of nuclear materials, the IAEA can provide early warning in the event of attempts to illegally acquire materials, thereby significantly reducing the proliferation and security threats posed by both state and nonstate actors.

IAEA's legal authorities

Under the NPT, non-nuclear-weapon states (NNWS) commit to not produce or otherwise acquire nuclear weapons, to place all nuclear material under IAEA safeguards, and to allow the IAEA to verify that no such material is used for prohibited purposes.[9] The IAEA applies safeguards to independently verify that nuclear material is not used for nuclear weapons or other nuclear-explosive devices. The IAEA has no legal authority to guarantee the security of nuclear materials or prevent their diversion. Rather, safeguards are designed to ensure early detection of a "significant quantity" (SQ) of nuclear material being diverted from peaceful uses to nuclear weapons production and to deter such diversion.[10]

The IAEA implements safeguards at facilities where states have declared the existence of nuclear materials.[11] Safeguard measures include nuclear accountancy, on-site inspections, and other technical means.[12] The IAEA also implements safeguards in locations outside facilities (LOFs), defined as any non-facility locations in which less than one effective kilogram (kg) of nuclear material is customarily used.

States accept these measures through the conclusion of safeguards agreements with the IAEA. Most agreements are CSAs, concluded by the IAEA with NNWS party to the NPT.

---

8 See IAEA, "Nuclear Safety & Security, Services for Member States," <http://www-ns.iaea.org/reviews/default.asp?s=7&l=57>.

9 IAEA, "IAEA Safeguards," June 2015, <https://www.iaea.org/sites/default/files/safeguards_web_june_2015.pdf>.

10 The IAEA defines SQ as "the approximate amount of nuclear material for which the possibility of manufacturing a nuclear explosive device cannot be excluded…. Significant quantities are used in establishing the quantity component of the IAEA inspection goal." The significant quantities are, respectively, 25 kg of U-235 contained in HEU, and 8 kg of plutonium. See IAEA, "IAEA Safeguards Glossary," *International Nuclear Verification Series,* No. 3, 2001 Edition, <https://www.iaea.org/sites/default/files/iaea_safeguards_glossary.pdf>.

11 Facility is defined by the IAEA as "a reactor, a critical facility, a conversion plant, a fabrication plant, a reprocessing plant, an isotope separation plant or a separate storage installation; or any location where nuclear material in amounts greater than one effective kilogram is customarily used." See IAEA, The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on The Non-Proliferation of Nuclear Weapons, INFCRIC/153 (corrected), para. 106.

12 Trevor Findlay, "Unleashing the Nuclear Watchdog: Strengthening and Reform of the IAEA," *Centre for International Governance Innovation*, June 2012, p. 59.

Safeguards require all NNWS to report and allow the IAEA to conduct safeguards on all source and special fissionable material, collectively referred to as "nuclear material." The IAEA Statute and its safeguards agreements define "special fissionable" as material from which nuclear weapons or other nuclear-explosive devices could readily be made (e.g. plutonium-239; uranium-233; and uranium-235). Special fissionable material does not include source material (e.g. natural uranium, depleted uranium, or thorium).[13] Radioactive sources that do not contain uranium, plutonium, or thorium are not subject to safeguards and do not need to be reported to the IAEA under a CSA.

In the 1990s, the discovery of a clandestine nuclear-weapon program in Iraq revealed shortcomings in the safeguards system, leading to a strengthening of IAEA safeguards. In 1997, after years of negotiations, the IAEA's Board of Governors (BOG) agreed to supplement the CSA with the text of the Model Additional Protocol. The Additional Protocol (AP) provides the IAEA with broader access to information about their nuclear programs and increased physical access to sites. APs augment the IAEA's ability to improve the effectiveness and efficiency of safeguards, particularly with respect to ascertaining the absence of undeclared nuclear material and activities in a state.

Since 1999, following the adoption of APs by many states, the IAEA has provided three types of safeguards conclusions. For states with only a CSA in place, the IAEA can conclude that all "declared nuclear material remained in peaceful activities," if no evidence for diversion was detected. Of the cases analyzed in this paper, the IAEA has been drawing this conclusion for Syria.[14] For states with both a CSA and an AP, the IAEA can either conclude that all "declared nuclear material remained in peaceful activities,"—the conclusion drawn for Iraq since 2005[15]—*or* it can conclude that "all nuclear material remained in peaceful activities." This latter conclusion is also known as "the broader conclusion." Of the cases analyzed in this paper, the IAEA concluded this for Japan since 2003, for Libya since 2008, and for Ukraine since 2010.[16]

Broader conclusions are drawn after the IAEA conducts a thorough investigation of the country as a whole, using an approach based on the State-Level Concept.[17] Once a country obtains the broader conclusion, the IAEA can reduce the frequency of its inspections and some of its timeliness goals related to the parts of the nuclear fuel cycle that are less proliferation-sensitive. For example, if the agency

13 See IAEA, "IAEA Safeguards Glossary," *International Nuclear Verification Series*, No. 3, 2001 Edition, <https://www.iaea.org/sites/default/files/iaea_safeguards_glossary.pdf>.

14 The IAEA drew this conclusion from at least 2000, the date the IAEA started to publish portion of their Safeguards Implementation Report. See IAEA Safeguards Statements, available at <https://www.iaea.org/publications/reports>.

15 See IAEA Safeguards Statements, available at <https://www.iaea.org/publications/reports>.

16 See IAEA, "The Safeguards Implementation Report for 2017," GOV/2018/19, May 3, 2018, <https://armscontrollaw.files.wordpress.com/2018/05/iaea-2017-sir.pdf>. For earlier conclusion see the case studies section.

17 The State-Level Concept refers to implementing safeguards in a manner that considers a state's nuclear and nuclear-related activities and capabilities as a whole and within the scope of the state's safeguards agreement. See IAEA, "The Conceptualization and Development of Safeguards Implementation at the State Level," GOV/2013/38, August 12, 2013; Yukiya Amano, "Introductory Statement to the Board of Governors," September 9, 2013, <http://www.iaea.org/newscenter/statements/2013/amsp2013n17.html>, IAEA, "Supplementary Document to the Report on the Conceptualization and Development of Safeguards Implementation at the State Level," GOV/2014/41.

ascertained that a state did not engage in any undeclared reprocessing, it could reduce the frequency of inspections at a power reactor using low-enriched uranium from four times per year to one.[18]

To implement this concept, the IAEA adopted an Integrated Safeguards approach specifically for states that satisfy the broader conclusion. The IAEA accounted for state-specific characteristics, features, and all other safeguards-relevant information available about each state and, in consultation with the state, developed a customized "state-level integrated safeguards approach."[19]

An additional agreement—the small quantities protocol (SQP)—affects IAEA access to facilities. Many states with minimal to no nuclear activities have concluded SQPs with the IAEA, which holds in abeyance certain safeguards procedures provided that certain criteria are met. In the 1974 original SQP standard text, states that concluded an SQP could be immune to certain key inspection measures. In 2005, however, the BOG approved a modified text, known as the modified SQP, which closed this loophole. As of December 2016, Syria—one of the case studies in this report—still has an unmodified SQP.[20]

This paper analyzes past cases in which the IAEA encountered an access impediment to implement its safeguards activities. At times, the IAEA has found other technical means to compensate for lack of access; in other cases, it has not. Further, this paper will address Agency practices so far and, when necessary, suggest improved measures that the Agency and its members can adopt to address inaccessibility challenges now and in the future. Notably, the IAEA determines whether it can safely access a site for inspection based on the UN Department of Safety and Security's (UNDSS) assessment, which is confidential. In fact, security clearance by UNDSS is required for all IAEA staff on official travel.[21]

With regards to nuclear-security challenges, the IAEA plays an increasingly important role in nuclear security although the security of nuclear materials is a state responsibility.[22] The Agency issues nuclear-security guidelines (INFCIRC/225/rev.5), and upon request, trains experts (including police and border guards) in nuclear security, helps to return highly enriched uranium (HEU) to countries of origin when asked, supplies radiation detection instruments, and carries out advisory missions to help states improve their nuclear-security frameworks.[23] The IAEA's nuclear-security role will likely continue to expand in light of the recent entry into force of the 2005 Amendment to the Convention

18 Laura Rockwood, "The IAEA's State-Level Concept and the Law of Unintended Consequences," *Arms Control Today*, August 28, 2014, <https://www.armscontrol.org/act/2014_09/Features/The-IAEAs-State-Level-Concept-and-the-Law-of-Unintended-Consequences>.

19 Ibid.

20 IAEA, "Status of Small Quantities Protocols," October 7, 2016, <https://www.iaea.org/safeguards/safeguards-legal-framework/safeguards-agreements/status-small-quantities-protocols>.

21 IAEA, "The Safeguards Implementation Report for 2017," GOV/2018/19, May 3, 2018, <https://armscontrollaw.files.wordpress.com/2018/05/iaea-2017-sir.pdf>.

22 States that have adopted the 2005 Amendment of the Convention on the Physical Protection of Nuclear Material will be implementing practices that draw significantly on the long-standing INFCIRC 225 (currently Rev. 5) that is published as part of the Agency's Nuclear Security Series.

23 Statement by Yukiya Amano, IAEA Director General, to the Nuclear Security Summit, Washington DC, April 1, 2016, <https://www.iaea.org/newscenter/statements/statement-at-nuclear-security-summit>.

on the Physical Protection of Nuclear Material and the adoption of the Nuclear Security Summit 2016 Action Plan in Support of the IAEA.

Case Studies

The paper examines five nuclear case studies in which the IAEA's ability to access nuclear materials to conduct safeguards activities was limited: Iraq, Fukushima/Japan, Libya, Syria, and Crimea/Ukraine. These five cases fall under one or more of three categories—constraints on IAEA access due to security risks, territory controlled by a nonstate actor, or territory controlled by another country. In all case studies, the relevant facilities are located in NNWS countries with CSAs. Some of them also have APs in place. Table 1 summarizes the names of the discussed facilities under IAEA safeguards based on the three types of inaccessibility listed above.

Table 1: Typology of Nuclear Case Studies

	Reason for inaccessibility and relevant facilities		
State	**Deterioration of security**	**Controlled by another state**	**Controlled by nonstate**
Iraq	» Tuwaitha Location C		
Japan/ Fukushima	» Fukushima Daiichi Power Station Units 1–6 » Common Spent Fuel Storage (CSFS) » Cask Custody Building (CCB)		
Libya	» IRT-Tajura research reactor (RR) » Tajura uranium R&D facility		
Syria	» Miniature Neutron Source Reactor (MNSR) » al-Kibar (not a declared site)		» al-Kibar (not a declared site)
Ukraine/ Crimea		» IR-100 Research Reactor » Sevastopol Subcritical Assembly	

Table 2 summarizes these cases based on the safeguards implemented and the IAEA safeguards conclusions drawn as reflected in the IAEA's Safeguards Implementation Report (SIR) for 2017.[24] With the exception of the first two sections of the SIR, which are publicly available since 2003, the SIR is a restricted document for member states.[25]

24 IAEA, "Safeguards Statement for 2017," <https://armscontrollaw.files.wordpress.com/2018/05/iaea-2017-sir.pdf>.
25 See IAEA Safeguards Statements, available at <https://www.iaea.org/publications/reports>.

Nevertheless, the SIRs for 2013 through 2015 and for 2017 are publicly available after being leaked to a nongovernment expert who posted them online.[26]

Table 2: IAEA Safeguards Status and Safeguards Conclusions[27]

State	Facility under safeguards	Last known IAEA visit	Safeguards agreement	Safeguards Conclusion: "declared nuclear materials…"	Safeguards Conclusion: "all nuclear materials…" (first year broader conclusion was granted)
Iraq	» Tuwaitha, Location C, Storage Facility	2017	CSA & AP	✓	–
Japan	» Fukushima Daiichi Power Station Units 1–6 » CSFS » CCB	Regularly to some of the facilities on site; others cannot be accessed since March 2011	CSA & AP	–	✓ (2003)
Libya	» IRT-Tajura RR » Tajura Uranium R&D Facility	2017	CSA & AP	–	✓ (2008)
Syria	» MNSR	2017	CSA[28]	✓	–
Ukraine	» IR-100 RR » Sevastopol Subcritical Assembly	2014	CSA&AP	–	✓ (2010)

Fortunately, Fukushima is the only nuclear site that contains significant proliferation-sensitive material, so these sites constitute a security risk more than a proliferation risk. Neither Libya nor Iraq has significant nuclear material due to their removal during 1990s and the 2000s. Furthermore, the reactor in Syria was destroyed, access to Fukushima is limited due to radiation levels, and nuclear materials in Crimea are currently controlled by a nuclear-weapon state.

26 IAEA, "The Safeguards Implementation Report for 2013," GOV/2014/27, April 23, 2014, <https://armscontrollaw.files.wordpress.com/2014/06/iaea-2013-sir.pdf>; IAEA, "The Safeguards Implementation Report for 2014," GOV/2015/30, June 10, 2015, <https://armscontrollaw.files.wordpress.com/2015/07/sir-2014.pdf>; and IAEA, "The Safeguards Implementation Report for 2015," GOV/2016/22, May 3, 2016, <https://armscontrollaw.files.wordpress.com/2016/10/iaea-2015-sir.pdf>, and IAEA, "The Safeguards Implementation Report for 2017," GOV/2018/19, May 3, 2018, <https://armscontrollaw.files.wordpress.com/2018/05/iaea-2017-sir.pdf>.

27 IAEA, "Safeguards Statement for 2017," <https://armscontrollaw.files.wordpress.com/2018/05/iaea-2017-sir.pdf>.

28 While Syria concluded an original SQP and have not updated it, therefore it is still appended to the text of its CSA, since Syria introduced nuclear material to nuclear facility, its SQP was terminated. Syria is subject to the full range of IAEA safeguards activities and reporting obligations under its CSA. See Russell Leslie, John Carlson, and Annette Berriman, "Ensuring Effective Safeguards Coverage of States with Small Quantities Protocols," presented at the INMM 47th Annual Meeting, Nashville, Tennessee, July 16–20, 2006, <https://dfat.gov.au/international-relations/security/asno/Documents/ensuring_effective_safeguards_coverage_state_small_quantities_protocols.pdf>, and Kalman A. Robertson, Jaime Vidaurre-Henry, and Mizuki Hirai, "The Capacity-Building Support Needs of States with Small Quantities Protocols," presented at the INMM 58th Annual Meeting, July 2017, <https://apsn-safeguards.org/sites/default/files/a301_1%20SQP.pdf>.

Nevertheless, the IAEA's approach to access challenges and safeguards conclusions in these five cases may have bearing on future cases. In addition, even small quantities of material—whether in special nuclear materials or Category 3 radioactive sources—can create significant economic and psychological disruption.[29]

Each of the case studies covered below review four areas: the status of the state's nuclear program, the status of nuclear material under safeguards in that state, the IAEA's safeguards conclusions for that state during the relevant period, and issues related to nuclear security that involve the nuclear (and, at times, radiological) materials discussed.

Iraq

Status of the nuclear program and IAEA safeguards: From 1991 to 2007, Iraq was subject to the most intrusive inspections in history as mandated by UN Security Council (UNSC) resolutions (UNSCR) following the 1991 Gulf War. These resolutions mandated the IAEA to uncover and dismantle Iraq's clandestine nuclear-weapons program and to implement an Ongoing Monitoring and Verification (OMV) Plan to ensure Iraq did not reinstitute it. After the UNSC lifted the resolutions in 2007, Iraq signed an AP to its CSA in 2008 and implemented it provisionally until its entry into force in 2012.[30] In 2010, the UNSC lifted the last two restrictions on Iraq's nuclear civilian activities, including the pursuit of nuclear power.[31]

Status of nuclear material under IAEA safeguards: In 2004, the Iraqi government requested the IAEA's assistance in cleaning and decommissioning the country's former nuclear complex, where many sites had been subject to physical damage and looting after the 2003 war.[32] The IAEA included eleven nuclear sites in the decommissioning program.[33] The largest and most complex site was the al-Tuwaitha Nuclear Centre, which is located about twenty kilometers from Baghdad.[34] Two of

29 The categories for radioactive sources are defined by the IAEA's Code of Conduct to help ensure that radioactive sources are used within an appropriate framework of radiation safety and security. Category 3 sources, if not safely managed or securely protected, could cause permanent injury to a person who handled them or was otherwise in contact with them for some hours. See, IAEA, "Code of Conduct on the Safety and Security of Radioactive Sources," January 2004, <http://www-pub.iaea.org/MTCD/publications/PDF/Code-2004_web.pdf>.

30 IAEA, "Status of the Additional Protocol," <https://www.iaea.org/safeguards/safeguards-legal-framework/additional-protocol/status-of-additional-protocol>.

31 UN, "Security Council Takes Action to End Iraq Sanctions, Terminate Oil-For-Food Programme as Members Recognize 'Major Changes' Since 1990," December 15, 2010, <http://www.un.org/press/en/2010/sc10118.doc.htm>.

32 IAEA, "Iraq decommissioning project," 2014, <http://www-ns.iaea.org/projects/iraq/>.

33 The majority of Iraq's former nuclear facilities are in the al-Tuwaitha Nuclear Research Center. These facilities include bombed and partially destroyed research reactors, a fuel fabrication facility, and radioisotope production facilities. Within these facilities are large numbers of silos, approximately 30 process or waste storage tanks, and thousands of drums of uncharacterized radioactive waste. There are also former nuclear facilities/sites that are outside of al-Tuwaitha, and these include the former uranium processing and waste storage facility at Jesira, the dump site near Adaya, the former centrifuge facility at Rashdiya, and the former enrichment plant at Tarmiya. See Fouad al-Musawi et al, "Radioactive Waste Management and Nuclear Facility Decommissioning Progress in Iraq," 2013 Waste Management Symposia, February 24 –28, 2013, Phoenix, Arizona, <http://www.wmsym.org/archives/2013/papers/13216.pdf>.

34 IAEA, "Iraq decommissioning project," 2014, <http://www-ns.iaea.org/projects/iraq/>.

the other ten nuclear sites, including Wardiya/Location C (a radioactive materials storage area), are adjacent to the Centre and linked to its activities. The IAEA project to support Iraq efforts in decommissioning its former nuclear complex ended in 2013.

Currently, Location C is Iraq's only declared nuclear facility under IAEA safeguards, and according to the IAEA, it is guarded at all times. Location C hosts two categories of materials—"inventory," which is material that could be used or sold (including yellowcake), and waste, which are materials that cannot be used or sold.[35] The bunker that contains the waste consists of a large number of plastic containers full of uranium compounds mixed with sand and fine stones. These containers were brought from the al-Jesira site and contain an estimated three tons of material. Eleven large containers full of low-level radioactive wastes sit outside of the bunker along with another one that contains filters contaminated by UCl4.[36] Location C is a highly contaminated area both within the buildings and in the surrounding open areas.[37] Iraq also declared one LOF, a hospital in Baghdad that likely houses depleted uranium shielding contained in a Co-60 teletherapy machine.

Based on the IAEA Safeguards Criteria and the relatively low amount of nuclear materials in Location C and the LOF, the Agency should conduct inspections once a year.[38] Based on the SIR, the IAEA last visited Location C in 2017. It did not visit the site in 2013, 2014, and 2016. See Annex 1 for a summary of the IAEA safeguards activities in Iraq from 2013–17. While the 2016 SIR is not publicly available, the author understands that the IAEA did not visit Iraq in 2016.

Nuclear safeguards conclusion: In the 2000 and 2003 SIRs—the only two that were partly available publicly prior to the 2003 war—the IAEA concluded that it had found no indications of the diversion of declared nuclear material in Iraq.[39] The SIR indicated that the Agency implemented its UNSCR-related mandate until March 17, 2003, and as of that time, the IAEA had not found any evidence or plausible indication of the revival of a nuclear program. It also noted that under Iraq's CSA, the Agency verified in June 2003 that the amount of uranium likely dispersed through looting in April 2003 was not of proliferation concern. In the 2004 SIR, the IAEA affirmed that it had physically inventoried the remaining nuclear material in Iraq, located at Tuwaitha, and placed it under Agency seal.

Since returning to Iraq in 2005, the IAEA has found no indications of diversion of declared nuclear material and concluded in subsequent SIRs that all declared nuclear material remained in peaceful

35 The latest publicly available information from the IAEA is from December 2014.

36 IAEA, "Location C (al-Wardia)," <http://www-ns.iaea.org/projects/iraq/locationc.asp?s=8&l=66>.

37 Ibid.

38 Safeguards expert (name and organization withheld by request), personal interviews with author.

39 IAEA, "The Safeguards Statement for 2003," <https://www.iaea.org/sites/default/files/es2003.pdf>. In the 2000 report, the IAEA noted that since December 1998, the Agency has not been in a position to implement its mandate under the UNSCR and, therefore, cannot provide any assurance that Iraq is in compliance with its obligations under those resolutions. However, it was able to conduct a physical inventory verification of the nuclear material under safeguards located at the Tuwaitha storage facility in January 2000 and was able to verify the presence of the nuclear material in question. See "IAEA Board Reviews Record of Safeguards Implementation," Vienna, June 18, 2001, <https://www.iaea.org/newscenter/pressreleases/iaea-board-reviews-record-safeguards-implementation>.

nuclear activities.[40] Although Iraq brought into force an AP to its CSA, the IAEA has not drawn a broader conclusion for Iraq thus far.[41] Iraq's past nuclear-weapons program and the ongoing unrest have made it difficult to ensure that all nuclear materials are declared, and the Agency is unable to guarantee the absence of undeclared nuclear materials. In addition, the IAEA may be withholding its broader conclusion to avoid the political complexities that often arise in states where the security situation makes continuous access for verification purposes uncertain.[42]

Nuclear-security risks: Recent reports of ISIL activities in Iraq highlight the risks associated with nonstate actors' access to nuclear and radioactive materials and heighten concerns about the security of these materials in Iraq. In July 2014, the Iraqi government reported to the IAEA that ISIL seized control of nearly 40 kg (88 pounds) of uranium compounds when the group took over Mosul. The IAEA noted that, on the basis of initial information, they assessed "the material involved is low grade and would not present a significant safety, security, or nuclear proliferation risk….Nevertheless, any loss of regulatory control over nuclear and other radioactive materials is a cause for concern."[43] Furthermore, in 2015, a radioactive source (iridium-192, used for nondestructive radiographic inspection of oil and gas pipelines) was stolen, purportedly by ISIL, from a storage depot of an Iraqi oil facility. The sources were found three months later in an abandoned car.[44]

More concerning was that ISIL also controlled territory in Mosul that contained two teletherapy machines carrying sources of Co-60. ISIL may or may not have been aware of these sources and their potential to be used in a radiological dispersal device. In comparison, at least one of the Co-60 sources in Mosul had a dose rate roughly 20 times greater than the aforementioned missing iridium source. The sources could have produced a fatal dose within 2–4 hours to an individual within a meter from the source.[45] The sources were recovered in 2017 after ISIL was defeated in Mosul.

---

40 See IAEA, Safeguards Statements 2005-2017 <https://www.iaea.org/publications/reports>.

41 In all of the publicly available portions of the IAEA SIRs from 2008–2017, the IAEA states: "because the evaluation process described in paragraph 12 had not yet been completed for 57 (55) States, the conclusion drawn for these States relates only to declared nuclear material in peaceful activities." See for example, IAEA, "The Safeguards Statement for 2017," <https://armscontrollaw.files.wordpress.com/2018/05/iaea-2017-sir.pdf>.

42 Thirteen years have passed since the IAEA resumed verification activities in Iraq. In comparison, the Agency took thirteen years to issue South Africa a broader conclusion. However, South Africa had nuclear weapons, a significant amount of material unaccounted for, and was left with an extensive nuclear-energy program. In Iraq, the Agency dismantled its nuclear-weapon program, leaving behind no nuclear civilian program, and most, if not all, of its nuclear materials were removed.

43 Fredrik Dahl, "UPDATE 4-Seized nuclear material in Iraq 'low grade' - UN agency," *Reuters*, July 10, 2014, <http://uk.reuters.com/article/iraq-security-iaea/update-4-seized-nuclear-material-in-iraq-low-grade-un-agency-idUK-L6N0PL1RM20140710 >.

44 "Radioactive device feared stolen by ISIS found outside petrol station in Iraq," *RT News,* Feb. 21, 2016, <https://www.rt.com/news/333198-radioactive-iridium-iraq-isis/>.

45 For additional information, see "Cobalt 60 Sources in Mosul: Recovery and Lessons for the Future," Statement by the Institute for Science and International Security, July 22, 2017, <http://isis-online.org/uploads/isis-reports/documents/Mosul_Source_Fact_Sheet_22Jul2017_Final.pdf>.

Japan/Fukushima

Status of the nuclear program and IAEA safeguards: Japan has an extensive civilian nuclear program with 125 facilities containing nuclear materials under IAEA safeguards.[46] Given the size of the program and nuclear facilities under safeguards, the IAEA conducts about 300 inspections in Japan annually with almost 2,800 calendar days in field verification.[47]

On March 11, 2011, a devastating earthquake and subsequent tsunami hit the Fukushima Daiichi nuclear site. The site hosts six nuclear power units, a cask custody building (CCB), and a common spent fuel storage facility (CSFS). As a result of the earthquake and tsunami, the reactor cores in Units 1–3 overheated, and the nuclear fuel melted, breaching the three containment vessels. Subsequent explosions inside the reactor buildings in Units 1, 3, and 4 damaged structures and equipment and injured personnel.[48] After the reactors were stabilized, plans to decommission the site began.[49]

The incident posed a significant challenge for the continuation of IAEA safeguards on the site. Structural damage and radiation prevented the Japanese operators and the IAEA from accessing some of the facilities. After the incident, only half of the eight buildings on site were accessible. In the other half, nuclear fuel in Units 1–3 and spent-fuel ponds in Unit 4 were inaccessible. While Unit 4 did not contain any fuel assemblies, the spent-fuel pond has inaccessible nuclear material.[50]

To address this challenge, the IAEA created a task force composed of representatives of the Japanese government, the site operator, TEPCO —the Japanese power company responsible for its maintenance—and the IAEA. The group developed a holistic approach to safeguards implementation for the Fukushima Daiichi site, monitoring the recovery of safeguards at the Fukushima Daiichi and Daini nuclear power plants, and it considered possible approaches to longer-term safeguards challenges arising from the March 2011 accident.[51]

Increasingly safeguards measures have been implemented for all nuclear materials on site except for those in Units 1–3, which remain unsafe and inaccessible.[52] As of 2017, the IAEA successfully reveri-

46 Japan's nuclear program includes 125 facilities under IAEA safeguards—sixty-three nuclear reactors, twenty research reactors and critical assemblies, two conversion plants, eight fuel-fabrication plants, six reprocessing plants, three enrichment plants, eight separate storage facilities, and fifteen other facilities where nuclear materials were present. See IAEA, "IAEA Annual Report 2016 Additional Annex Information," GC(61)/3/Annex, Table A32(a), <https://www.iaea.org/About/Policy/GC/GC61/GC61Documents/English/gc61-3-att1_en.pdf>.

47 See IAEA, "SIR 2014," <https://armscontrollaw.files.wordpress.com/2015/07/sir-2014.pdf>, and IAEA, "SIR 2015," <https://armscontrollaw.files.wordpress.com/2015/07/sir-2014.pdf>.

48 IAEA, "The Fukushima Daiichi Accident: Report by The Director General," GC(59)/14, 2015, <http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1710-ReportByTheDG-Web.pdf>.

49 Ibid.

50 Ibid.

51 Hirokazu Kumekawa et al, "Cooperation in the Implementation of Safeguards at Fukushima Daiichi Site," paper delivered at the IAEA Symposium on International Safeguards, Vienna, Austria, October 23, 2014, <https://www.iaea.org/safeguards/symposium/2014/home/eproceedings/sg2014-papers/000143.pdf>.

52 "Safeguards," *Nuclear Regulatory Authority of Japan*, 2014, <https://www.nsr.go.jp/data/000142853.pdf>.

fied approximately 80 percent of the nuclear material present at the Fukushima Daiichi site at the time of the accident.[53] Nuclear material inaccessible for verification continues to remain at only the three damaged reactors (Units 1-3). Transfers of fuel assemblies from the spent fuel ponds of these reactors are scheduled to begin at the end of 2018, at which time the material will be re-verified.

Since regular safeguard measures cannot be applied to Units 1–3, the IAEA has been implementing special monitoring arrangements, including the installation of surveillance systems and neutron-gamma monitoring systems to ensure that nuclear material cannot be removed from the damaged reactors without the IAEA's knowledge.[54] The data from these systems are being transmitted remotely to the Agency's offices in Tokyo.[55]

On-site, the IAEA also carries out specially designed in-field activities, named Short Notice Operational Support (SNOS) activities, in addition to inspection, design information verification, and complimentary access. The SNOS activities aim to confirm that declared material is not diverted; that no movements of nuclear material are undeclared; and that the operator's declaration on the decommissioning status and related operations is consistent with the reality on the ground.[56]

Table 3: Safeguards status at the Fukushima Daiichi site at the end of 2015[57]

Unit	Declared Nuclear Material	
	Core	Spent Fuel Pond
1–3	Inaccessible, but independently monitored by the IAEA	Inaccessible, but independently monitored by the IAEA
4	No fuel assemblies	All fuel assemblies were transferred to CSFS or Unit 6 and reverified at the destinations.
5	After successful in on-site verification, all the fuel assemblies were transferred to the spent fuel pond of Unit 5. Current status: No fuel assemblies.	Reverified and under containment/ surveillance (C/S)
6	All the fuel assemblies were transferred to spent fuel pond of Unit 6. Current status: No fuel assemblies.	Reverified and under C/S
CSFS		Reverified and under C/S
TCCA		Under Dual C/S

53 IAEA, "The Safeguards Implementation Report for 2017".
54 "Safeguards," *Nuclear Regulatory Authority of Japan*, October 2016, <http://www.nsr.go.jp/data/000142853.pdf>.
55 Ibid; IAEA, "Strengthening the Effectiveness and Improving the Efficiency of Agency Safeguards," Report by the Director General (GC(61)/1 and Add.1), July 26, 2017, <https://www.iaea.org/About/Policy/GC/GC61/GC61Documents/English/gc61-16_en.pdf>.
56 Ibid.
57 "Safeguards," *Nuclear Regulatory Authority of Japan,* October 2016, <http://www.nsr.go.jp/data/000142853.pdf>. The green border covers areas where IAEA safeguards apply at the Fukushima Daiichi site, solid green where IAEA has physical access, and yellow for areas still physically inaccessible to the IAEA.

The IAEA has been using the inaccessible units as test sites for a new IAEA detection system. The Agency developed a rapid environmental radioactivity mapping system using unmanned aerial vehicles on a customized hexacopter.[58] This detection system could be used by the IAEA in the future for other inaccessible facilities. See Annex 1 for a summary of the IAEA safeguards activities in Japan as a whole in 2013–17.

Status of nuclear material under safeguards: Japan brought its AP into force in 1999, and the IAEA drew its first broader conclusion for Japan in 2003. The IAEA started the implementation of Integrated Safeguards in Japan in September 2004. Given the number of nuclear facilities in Japan, this implementation was gradual and reached full coverage of all nuclear facilities and LOFs in January 2011.[59] The IAEA has drawn a broader conclusion for Japan each year since 2003 and continued to do so through 2012–14 despite not being able to physically verify the nuclear-material inventory at some of the facilities at Fukushima Daiichi. Although the IAEA could not access all nuclear materials at the site, it noted it could continue to credibly draw a broader conclusion because Japan cooperated in creating a new acceptable safeguards approach to address the physical access problems at the site and established safeguards measures to ensure that nuclear material cannot be removed from the site without the Agency knowledge, and the IAEA has normal access to all remaining materials at other Japanese facilities.

Nuclear-security risks: Widespread and long-lasting disruptions to security infrastructure, systems, and staffing took place as a result of the immediate extreme events at the Fukushima Daiichi plant. However, despite the disruption of security measures, no apparent significant security incidents occurred at the Fukushima Daiichi plant during or after the accident.[60] In the context of the strong security measures implemented at the site and given the nuclear material's high radioactivity, the inaccessible nuclear materials at Units 1–3 are not considered a major threat for theft or misuse.

Libya

Status of the nuclear program and IAEA safeguards: In December 2003, Libya renounced its decades-old WMD programs and admitted the extent of its nuclear-weapon program, including its previously undeclared efforts to acquire uranium-enrichment capabilities.[61] The United States responded by removing Libya's nuclear weaponization documentation, enrichment-related equipment, and uranium hexafluoride as well as repatriated unirradiated HEU fuel to Russia.[62]

58 IAEA, "Annual Report 2015," GC(60)/9 (Corrected), <https://www.iaea.org/About/Policy/GC/GC60/GC60Documents/English/gc60-9_en.pdf>.

59 "Safeguards," *Nuclear Regulatory Authority of Japan*, October 2016, <http://www.nsr.go.jp/data/000142853.pdf>.

60 Committee on Lessons Learned from the Fukushima Nuclear Accident for Improving Safety and Security of US Nuclear Plants, "Phase 2, National Academies of Sciences, Engineering, and Medicine," *Lessons Learned from the Fukushima Nuclear Accident for Improving Safety and Security of US Nuclear Plants: Phase 2* (Washington, DC: National Academies Press, May 6, 2016), <https://www.ncbi.nlm.nih.gov/books/n/nap21874/pdf/>.

61 IAEA, "The Safeguards Statement for 2003," <https://www.iaea.org/sites/default/files/es2003.pdf>.

62 "Was Libyan WMD Disarmament a Significant Success for Nonproliferation?," Nuclear Threat Initiative, September 1, 2004, <http://www.nti.org/analysis/articles/was-libyan-wmd-disarmament-success/>.

Throughout 2004, the IAEA carried out an intensive investigation into Libya's past and present nuclear activities, conducting numerous inspections of twelve previously undeclared locations that had been involved in Libya's undeclared nuclear program since the beginning of the 1980s, along with eighteen locations that could have, from a technical standpoint, provided support to a nuclear weapons research and development program.[63] In 2006, the Tajura IRT RR (research reactor) core was converted to use low-enriched uranium (LEU) instead of HEU. The conversion was completed in 2009, and the remaining HEU was shipped to Russia.[64]

Status of nuclear material under IAEA safeguards: Libya's nuclear program consists of a 10 MW(th) IRT research reactor in operation since 1980 and a critical assembly facility (100 W), both of which are located at the Tajura Nuclear Research Centre (TNRC). The two facilities at Tajura have been subject to IAEA safeguards since 1980.

Prior to December 2003, the total quantity of declared nuclear material under safeguards in Libya amounted to 20 kg of U-235 in HEU fuel and 1,000 tonnes of uranium ore concentrate (UOC). Some of Libya's undeclared activities took place at TNRC,[65] which was renamed the Renewable Energies and Water Desalination Research Centre in mid-2004.[66] Libya also has one LOF at the Tripoli Central Hospital, which contains a radiotherapy machine for cancer treatment.

The IAEA carried out inspections in Libya since in 2014 and 2017; it did not carry out an inspection between these years. See Annex 1 for a summary of the IAEA safeguards activities in Libya in 2013–15.

Nuclear safeguards conclusion: In the 2004 SIR (the first SIR after Libya dismantled its nuclear program), the IAEA noted that Libya's declaration of its uranium-conversion program, enrichment program, and other past nuclear-related activities appeared to be consistent with the information available to and verified by the Agency. At that time, the verification of the correctness and completeness of Libya's declarations was ongoing.[67] In the 2005 SIR, the IAEA noted that it had found no indications of the diversion of declared nuclear material and concluded that all declared nuclear material remained in peaceful activities.[68]

63 IAEA, "Implementation of the NPT Safeguards Agreement of the Socialist People's Libyan Arab Jamahiriya," GOV/2004/12, February 20, 2004, <https://fas.org/nuke/guide/libya/iaea0204.pdf>.
64 IAEA, "Support of Research Reactor HEU to LEU Fuel Conversion," June 14, 2016, <https://www.iaea.org/OurWork/ST/NE/NEFW/Technical-Areas/RRS/conversion-libya.html>.
65 IAEA, "Implementation of the NPT Safeguards Agreement of the Socialist People's Libyan Arab Jamahiriya," GOV/2004/12, February 20, 2004, <https://fas.org/nuke/guide/libya/iaea0204.pdf>.
66 IAEA, "Additional Annex Information," GC(55)/2, "Annual Report for 2010," <https://www.iaea.org/sites/default/files/annexinfo_3.pdf>; IAEA, "Implementation of the NPT Safeguards Agreement in the Socialist People's Libyan Arab Jamahiriya," GOV/2008/39, September 12, 2008, <http://isis-online.org/uploads/isis-reports/documents/IAEA_Libya_Report_12September2008.pdf>.
67 IAEA, "Safeguards Statement for 2004," <https://www.iaea.org/sites/default/files/es2004.pdf>.
68 IAEA, "Safeguards Statement for 2005," <https://www.iaea.org/sites/default/files/es2005.pdf>.

Libya signed an AP to its CSA in 2004 and implemented it on a provisional basis until its entry into force in 2006.[69] The IAEA drew a broader conclusion with respect to Libya in 2008 and announced that the noncompliance issues previously reported and subsequently monitored after 2003 were resolved.[70] Since Libya's 2011 civil war and ensuing political turmoil, the IAEA has struggled to verify Libya's nuclear activities. It has, however, maintained the country's 2008 broader conclusion despite not conducting safeguards inspections for several years.[71]

Nuclear-security risks: The security of Libya's remaining nuclear and radioactive materials came under the scrutiny of the UN Support Mission in Libya following the February 26, 2011, UNSCR 1970, which imposed sanctions on Libya.

Libya declared a storage facility with 6,400 barrels containing more than 1,100 kg of yellowcake at a former military facility near Sabha, an area considered to be the heart of the country's expansive smuggling and human trafficking network.[72] The site appears to be guarded.[73] Under CSAs, yellowcake is subject to minimal reporting requirements and is not routinely subject to IAEA routine safeguards. However, under certain circumstances, the IAEA can request access to verify yellowcake in countries that adopted an AP. After the deterioration of Libya's security situation in 2011, the Agency requested access to Libya's yellowcake. Concerned about accidents or seizure due to security and safety vulnerabilities at the Sabha facility as well as the gradual breakdown of the yellowcake's storage containers, the IAEA called for the material to be sold and shipped abroad.[74] However, the international community missed an opportunity to remove the yellowcake and any other nuclear materials from Libya when its last chemical weapons were shipped abroad in September 2016.

69 IAEA, "Safeguards Statement for 2006," <https://www.iaea.org/sites/default/files/es2006.pdf>.

70 IAEA, "Safeguards Statement for 2008," <https://www.iaea.org/sites/default/files/es2008.pdf>.

71 See IAEA, "The Safeguards Implementation Report for 2014"; IAEA, "The Safeguards Implementation Report for 2015", and IAEA, "The Safeguards Implementation Report for 2017." While the 2016 SIR is not publicly available, the authors understand that these figures are consistent with no visit during 2016.

72 "UN Envoy Says 6,400 Barrels of Yellowcake Is Stored in Libya," *BBC News*, December 10, 2013, <http://www.bbc.com/news/av/world-africa-25312416/un-envoy-says-6400-barrels-of-yellowcake-is-stored-in-libya>; Anthony Loyd, "al-Qa'ida Eyes Gaddafi's Missiles and Uranium," *The Australian*, October 23, 2013, <https://www.theaustralian.com.au/news/world/al-qaida-eyes-gaddafis-missiles-and-uranium/news-story/f2be42d9a563a3a01b883f9d76577678?sv=790eba64515b210cfa491a37a3192bdc>; Callum Paton, "Libya: Inside Sabha the heart of Libya's smuggling and human trafficking network," *International Business Times*, July 24, 2015, <http://www.ibtimes.co.uk/libya-inside-sabha-heart-libyas-smuggling-human-trafficking-network-1512459>.

73 "UN Envoy Says 6,400 Barrels of Yellowcake Is Stored in Libya"; Loyd, "al-Qa'ida Eyes Gaddafi's Missiles and Uranium,"; "Libya's Security Situation Still Precarious amid Civilian Protests Demanding Withdrawal of Armed Groups, Top Official Tells Security Council," UN Meetings Coverage and Press Releases, December 2013, <http://www.un.org/press/en/2013/sc11205.doc.htm>.

74 UNSC, "Report of the Secretary-General on the United Nations Support Mission in Libya," S/2012/129, March 1, 2012, para. 38; "Libya Should Ship Away Uranium Holdings: IAEA," *NTI*, December 23, 2011, <http://www.nti.org/gsn/article/libya-should-ship-away-uranium-holdings-iaea/>.

Syria

Status of nuclear materials under IAEA safeguards: The only facility under IAEA safeguards in Syria is the Miniature Neutron Source Reactor (MNSR) located southeast of Damascus. The reactor was supplied by China and uses HEU for fuel.[75] The MNSR's HEU inventory is about 1 kg, the equivalent of about 1/25 SQ, which is too small of an amount to produce significant amounts of plutonium.

The IAEA could not visit MNSR for several years (estimated July 2012 to September 2015) due to the ongoing civil war. In 2013 and again in 2014, the IAEA decided after consultation with the UNDSS to postpone the inspection until security conditions improved. Instead, the Agency monitored the reactor using satellite imagery, which has limited utility without physical access but can detect attempts to remove the reactor core.[76] The IAEA last visited the MNSR in 2015 and 2017.[77] While the 2016 SIR is not publicly available, the authors understand that the IAEA did not conduct inspections in Syria during 2016. See Annex 1 for a summary of the IAEA safeguards activities in Syria 2013–15.

In June 2015, Syria requested that the reactor core be converted from using HEU fuel to LEU. China, the supplier of the reactor, is currently converting other MNSR reactors to LEU.[78] However, considering Syria's security situation, the conversion process will likely not move forward.

Status of past undeclared nuclear activities and IAEA safeguards: After the IAEA concluded that the facility at Dair Alzour—allegedly destroyed by Israel in 2007—had most likely been an undeclared gas-cooled graphite-moderated plutonium-production reactor under construction, the IAEA BOG found in 2011 Syria to be in noncompliance with its CSA.[79] The IAEA visited the remains of Dair Alzour once in 2008 and later asked to visit the site again along with three other sites alleged to be functionally related to Dair Alzour. Syria declined the Agency's requests for access to these locations. The 2011 IAEA BOG resolution urged Syria to come into compliance with its NPT safeguards agreement; provide the IAEA with updated reporting and access to all information, sites, material, and persons necessary; and resolve all outstanding questions.

---

75 George Anzelon, "Selected safeguards case studies from the 2000s," presented for the International Safeguards Policy and Information Analysis Course, Middlebury Institute of International Studies at Monterey, June 2015.

76 IAEA, "Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic: Report by the Director General," GOV/2013/41, August 28, 2013.

77 IAEA, "Safeguards Statement for 2015," <https://www.iaea.org/sites/default/files/16/08/statement_sir_2015.pdf>, and IAEA, "The Safeguards Implementation Report for 2017".

78 The conversion of the MNSR in Ghana was completed in 2017, and the HEU was repatriated to China. See Sandor Tozser, "Supporting Nuclear Non-Proliferation: Ghana Converts Research Reactor from HEU to LEU Fuel," August 29, 2017, <https://www.iaea.org/newscenter/news/supporting-nuclear-non-proliferation-ghana-converts-research-reactor-from-heu-to-leu-fuel>.

79 In its resolution GOV/2011/41 of June 2011 (adopted by a vote), The IAEA Board of Governors had, inter alia, called on Syria to urgently remedy its noncompliance with its NPT safeguards agreement and, in particular, to provide the Agency with updated reporting under its safeguards agreement and access to all information, sites, material, and persons necessary for the Agency to verify such reporting and resolve all outstanding questions so that the Agency could provide the necessary assurance as to the exclusively peaceful nature of Syria's nuclear programme.

In 2012, Syria offered the Agency access to the Dair Alzour site under certain conditions. After careful review, the Agency concluded that the proposal was not acceptable given the conditions placed by Syria on Agency verification activities and Syria's unwillingness to discuss the three other locations. The Agency proposed to hold further discussions. Syria indicated in February 2012 that it would provide a detailed response at a later time, noting the difficult prevailing security situation in the country, but it has not yet provided these details.[80]

In the mid-1980s, the IAEA helped Syria acquire the Uranium Recovery Plant in Homs, a small plant for extracting uranium from phosphoric acid.[81] During routine MNSR safeguards visits in 2008 and 2009, the IAEA found particles of a type of anthropogenic uranium not included in Syria's reported inventory at the MNSR. The IAEA subsequently concluded that Syria had chemically processed raw uranium oxide at a phosphate plant in Homs— previously an undeclared location—and had not declared that activity to the IAEA. The Agency reported in 2010 that Syria had conducted undeclared activities at the reactor, obtaining yellowcake from its Uranium Recovery Plant in Homs to process uranyl nitrate.[82] The IAEA analyzed open-source scientific publications and Syria's explanations and concluded that Syria may have carried out still more undeclared nuclear processing activities.[83]

According to a safeguards expert, the output of the Homs extraction plant was far too small to support the fueling requirements of the al-Kibar reactor. The first core, at least, was presumably supplied by North Korea.[84] However, the amount of fuel Syria possessed at Dair Alzour and its current location, if there was any, remains unknown. A large stock of natural uranium, possibly exceeding 50,000 kg, was needed for the reactor's first load.[85] If it exists, such a large stock of uranium fuel would pose a relatively low proliferation and security risk given Syria's current declared materials.

How much uranium was extracted or yellowcake was produced at Homs remains unclear. Syria rejected the IAEA's request to visit the Homs facility on the grounds that the pilot plant was "not subject to Syria's Safeguards Agreement with the Agency."[86] Nonetheless, in April 2011, the IAEA visited the site in Homs and took environmental and destructive analysis samples from the

80 IAEA, "Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic: Report by the Director General," GOV/2013/41, August 28, 2013.
81 George Anzelon, "Selected safeguards case studies from the 2000s," presented for the International Safeguards Policy and Information Analysis Course, Middlebury Institute of International Studies at Monterey, June 2015.
82 IAEA, "Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic: Report by the Director General," GOV/2010/11, February 18, 2010.
83 Mark Hibbs, "Syria and the IAEA," March 6, 2011, <http://carnegieendowment.org/2011/03/06/syria-and-iaea>.
84 Safeguards expert (name and organization withheld by request), personal interviews with author.
85 David Albright, Serena Kelleher-Vergantini, and Sarah Burkhard, "Syria's Unresolved Nuclear Issues Reemerge in Wake of ISIL Advance and Ongoing Civil War," June 30, 2015, <http://isis-online.org/uploads/isis-reports/documents/Syria_June_30_2015_Final.pdf>.
86 IAEA, "Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic: Report by the Director General," GOV/2010/47, September 6, 2010.

yellowcake, which were "not inconsistent" with the uranium particles found at the MNSR. The Agency said it monitors the Homs site using satellite imagery.[87]

Nuclear safeguards conclusion: The 2009 SIR report was based on limited access to the Dair Alzour site and indicated that the IAEA was unable to confirm that the site had been non-nuclear. The IAEA also stated that it was attempting to resolve questions regarding the MNSR and the presence of particles from an undeclared uranium source found there.[88] With regards to Syrian undeclared activities in its sole declared site, the MNSR, the IAEA found no indication of the diversion of declared nuclear material and so concluded that all declared nuclear material remained in peaceful activities.[89]

In 2010, the SIR reported that Syria had not been cooperative with the IAEA's attempted investigations into the destroyed site at Dair Alzour, but it had agreed to a plan of action for resolving the issues related to the uranium particles at the MNSR.[90]

In June 2011, the IAEA confirmed that the destroyed Dair Alzour site was most likely an undeclared nuclear reactor and reported Syria's noncompliance to the UNSC. In the following months, Syria cooperated with IAEA efforts to resolve outstanding issues: the previously unreported conversion activities at the MNSR and the source of the uranium particles. The IAEA decided that the MNSR would be addressed further in the routine implementation of safeguards.[91]

During all this period, the IAEA continued to draw the conclusion that all declared nuclear material remained in peaceful activities.[92] Despite not visiting MNSR from about July 2012 to September 2015, the IAEA drew the same conclusion for Syria during that period.[93] In addition, despite finding that Syria extracted yellowcake at the Homs site to conduct undeclared activities in the MNSR, the IAEA has not concluded at any point that the introduction of undeclared activities to a declared facility constitute noncompliance.[94]

Nuclear-security risks: Although Syria is no longer believed to have an active secret nuclear program, it could have hidden assets associated with its past undeclared nuclear efforts. These concerns, coupled with the deteriorating security situation in Syria, continue to raise questions about the security of nuclear material, such as the stocks of yellowcake and a possible large undeclared stock

87 IAEA, "Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic: Report by the Director General," GOV/2013/41, August 28, 2013.
88 IAEA, "Safeguards Statement for 2009," <https://www.iaea.org/sites/default/files/es2009.pdf>.
89 IAEA, "Safeguards Statement for 2005," <https://www.iaea.org/sites/default/files/es2005.pdf>.
90 IAEA, "Safeguards Statement for 2010," <https://www.iaea.org/sites/default/files/es2010.pdf>.
91 IAEA, "Safeguards Statement for 2011," <https://www.iaea.org/sites/default/files/es2011.pdf>.
92 IAEA, "Safeguards Statement for 2012," <https://www.iaea.org/sites/default/files/es2012.pdf>.
93 IAEA, "Safeguards Statement for 2013," <https://www.iaea.org/sites/default/files/statement_for_sir_2013_gov_2014_27.pdf>; IAEA, "Safeguards Statement for 2014," <https://www.iaea.org/sites/default/files/sir_2014_statement.pdf>.
94 The IAEA Board of Governors found Syria in noncompliance with its CSA based on its undeclared construction of a nuclear reactor at Dair Alzour and failure to provide design information for the facility in accordance with Code 3.1 of Syria's Subsidiary Arrangements. See IAEA, Implementation of the NPT safeguards agreement in the Syrian Arab Republic," GOV/2011/41, June 9, 2011, <https://www.iaea.org/sites/default/files/gov2011-41.pdf>.

of natural-uranium fuel.[95] For example, in February 2013, the Free Syrian Army took control of the Dair Alzour site; one year later, the Islamic State reportedly gained control of it. As of November 2017, the Syrian Army gained full control on the Dair Alzour area. As of mid-2018, it seems that the uranium-extraction plant in Homs and the three other locations that the IAEA had previously sought access to verify suspicious undeclared nuclear activities, namely Marj as-Sultan, Masyaf, and Iskandariyah, are under the Syrian regime's control.[96]

Ukraine/Crimea

Status of nuclear materials under IAEA safeguards: Ukraine has extensive nuclear research and nuclear-energy programs. In 1998, the country concluded a CSA with the IAEA, adding an AP to its CSA in 2006.[97]

In March 2014, Russia invaded the Ukrainian territory of Crimea. Crimea had two locations under IAEA safeguards at the time of invasion: an IR-100 training reactor (200 kilowatts) at the Naval Engineering School in the Sevastopol National University of Nuclear Energy and Industry and a subcritical assembly at the Kharkov Institute of Physics and Technology.[98] Since March 2014, the practical operation of the research reactor is under Russian control, and Ukraine has neither regulatory control over the facility nor the ability to facilitate IAEA inspection activities.

In 2014, Russia placed the two Crimea locations on its list of facilities eligible for safeguards under its Voluntary Offer Agreement and invited the IAEA to visit them. The Ukrainian government has no physical control over the nuclear material at those locations, and the IAEA has not visited the sites since Ukraine lost control of them in March 2014. See Annex 1 for a summary of the IAEA safeguards activities in Ukraine 2013–17.

The United States and other member states encouraged the Agency not to visit those sites under Russian auspices because "any effort to take action that could be interpreted as acknowledging an alteration in Crimea's status as part of Ukraine," which "would be contrary to the call in United Nations General Assembly (UNGA) Resolution 68/262, and outside the purview of the IAEA's

95 David Albright, Serena Kelleher-Vergantini, and Sarah Burkhard, "Syria's Unresolved Nuclear Issues Reemerge in Wake of ISIL Advance and Ongoing Civil War."

96 Nuclear Threat Initiative, "Syria," August 2014, <http://www.nti.org/learn/countries/syria/nuclear/>; For the most up to date areas of control in Syria, check the Omran Center for Strategic Studies, "Territorial Control Map – Syria," and Muraselon, "Syria War Maps," https://en.muraselon.com/.

97 IAEA, "Safeguards Statement for 2006," <https://www.iaea.org/sites/default/files/es2006.pdf>.

98 While not a nuclear facility, the subcritical assembly falls under INFCIRC/153, 106(b): "any location where nuclear material in amounts greater than 1 effective kg is used." This facility was constructed based on an agreement with the US on technical and financial assistance to Ukraine, signed during the Nuclear Security Summit in Washington, DC, in April 2010. The US invested $73 million in the project in exchange for Ukraine's decision to dispose of its entire stockpile of highly enriched uranium. See Dmytro Chumak, "The Implications of The Ukraine Conflict for National Nuclear Security Policy," *EU NonProliferation Papers,* No. 53, November 2016, <http://www.nonproliferation.eu/web/documents/nonproliferationpapers/the-implications-of-the-ukraine-conflict-for-natio-54.pdf>.

mandate and expertise."[99] The UNGA resolution calls upon states, IOs, and specialized agencies not to recognize any change in the status of Crimea or the Black Sea port city of Sevastopol and to refrain from actions or dealings that might be interpreted as such.[100]

Nuclear safeguards conclusion: Ukraine's AP to its CSA came into force in 2006.[101] Until 2009, the IAEA concluded that all declared nuclear material remained in peaceful activities.[102] The IAEA drew the broader conclusion for Ukraine for the first time in 2010 and continued to draw a broader conclusion for Ukraine in 2014–2017 despite not having visited the Sevastopol nuclear sites since Ukraine lost control over the facilities in March 2014.[103] The IAEA stated in its SIR since 2014:

> "In 2017, one planned in-field verification activity was not conducted at the IR-100 research reactor and subcritical uranium-water assembly located at the Sevastopol National University of Nuclear Energy and Industry of Ukraine, where declared nuclear material was located. Nevertheless, based on the evaluation of all safeguards relevant information for Ukraine in 2017, including safeguards relevant communications from Ukraine, the Agency did not find any indication that, in its judgment, gave rise to a proliferation concern. Consequently, the Secretariat was able to draw the broader conclusion for Ukraine that all nuclear material remained in peaceful activities."[104]

Nuclear and radiological-security risks: Although the Russian Federation—a nuclear-weapon state—currently controls the two nuclear sites in Crimea, there remains a risk that nonstate actors could access on-site materials and radioactive materials in Russia-controlled Ukrainian territory. With the occupation of Crimea, the Ukrainian government reported a loss of access to and regulatory control over all nuclear and radioactive materials located in the occupied territories. These include more than 1,200 radioactive sources ranging from category 1 to 5; sixty-five facilities using radioactive sources, including eight institutions with high activity sealed radioactive sources; three repositories of radioactive waste; sources of ionizing radiation kept in two storage facilities; and 142 radiation sources in two coal-mining facilities.[105]

---

99 US Statement at the IAEA Board of Governors Meeting, Vienna, Austria, June 6-10, 2016, <https://vienna.usmission.gov/statement-on-ukraine/>.

100 UN General Assembly Resolution, "Territorial integrity of Ukraine," 68/262, March 27, 2014, <http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/68/262>.

101 See IAEA Safeguards Statements 2006–2009, <https://www.iaea.org/Publications/Reports>.

102 IAEA, "Safeguards Statement for 2005."

103 Safeguards expert (name and organization withheld by request), personal interviews with author.

104 See IAEA, "The Safeguards Implementation Report for 2014," GOV/2015/30, June 10, 2015, <https://armscontrollaw.files.wordpress.com/2015/07/sir-2014.pdf>; and IAEA, "The Safeguards Implementation Report for 2015," GOV/2016/22, May 3, 2016, <https://armscontrollaw.files.wordpress.com/2016/10/iaea-2015-sir.pdf>, and IAEA, "The Safeguards Implementation Report for 2017," GOV/2018/19, May 3, 2018, <https://armscontrollaw.files.wordpress.com/2018/05/iaea-2017-sir.pdf>.

105 "National Progress Report: Ukraine," *NSS 2016*, March 31, 2016, <http://www.nss2016.org/document-center-docs/2016/3/31/national-progress-report-ukraine>; Dmytro Chumak, "The Implications of The Ukraine Conflict for National Nuclear Security Policy."

In January 2014, Ukraine's state system of physical protection was switched to high alert to address emerging threats to "prevent provocations, mass disorders, incidents with unpredictable consequences, illegal actions towards nuclear facilities, nuclear material, radioactive waste and other sources of ionizing radiation."[106] The Ukrainian government implemented multiple security measures since 2014 to strengthen the physical protection of nuclear and radiation facilities still under their control. The remaining security measures in place in the facilities currently under Russian control are unclear. Risks are significant especially given Ukraine's lack of effective regulatory control over these sites, the state of lawlessness in some of these regions, and the risk of illicit trafficking, sabotage, and malicious use. For example, in July 2015, the Security Service of Ukraine discovered several ionizing radiation sources in a coal mine in the Luhansk region that had been moved there from the Donetsk region.[107] In March 2016, the Security Service of Ukraine intercepted three radiation sources in the Zaporizhia region that allegedly had arrived in Ukraine through uncontrolled sections of the Ukraine-Russia border.[108]

Observations and Conclusions from the Case Studies

Based on the five case studies, we observed that the practices the IAEA has used to conduct safeguards and draw its safeguards conclusions in cases where it had limited or no access to declared or suspected nuclear materials. The analysis shows that, in most of these cases, the IAEA utilized other technologies to compensate for lack of physical access and drew safeguards conclusions on a case-by-case basis, leading in some cases to apparent inconsistencies. If this practice continues, it could damage the credibility of the IAEA safeguards conclusions. Based on the five case studies we observed that:

- The IAEA has always reaffirmed previously drawn broader conclusions.
- Except in cases of noncompliance, the IAEA does not have a category in the SIR for states in which it is unable to draw either no diversion of declared materials or the broader conclusion.
- The IAEA has not reported to the BOG that it was unable to verify the non-diversion of nuclear material——even if it cannot prove or disprove that diversion has taken place. In practice, the Agency has reported an inability to verify non-diversion only when also reporting noncompliance.
- Due to the IAEA's practice above in drawing its safeguards conclusion, not drawing a safeguards conclusion has been equated with noncompliance.
- The IAEA apparently does not have contingency plans to ensure continuity of safeguards for nuclear materials or facilities and, as such, does not have an early-warning mechanism or planning tool to address loss of access.
- The IAEA appears to take a case-by-case approach to drawing safeguards conclusions in situations that limit or eliminate the Agency's ability to visit facilities and LOFs under safeguards.
- The Agency sometimes reaffirmed its broader conclusion, despite being unable to perform planned inspection-related safeguards activities for years.

106 Ibid.
107 "National Statement: Ukraine," *NSS 2016.*
108 Ibid.

- » It is unclear whether the IAEA updates its acquisition path analysis following loss of access to evaluate if there is a need to adapt its safeguards activities to restore effective coverage of all plausible acquisition paths for the state.
- » The IAEA sometimes could have used technical measures other than direct physical access to allow for ongoing safeguards. Although technical means cannot completely replace access for a long period, they are better than no information at all.
- » In some cases, the IAEA tacitly drew broader conclusions based on their access to only part of the state's territory covered by the safeguards agreement (in Japan, Libya, and Ukraine). In some of these cases, the IAEA may not have had sufficient technical information to establish that "all nuclear material remained in peaceful activities."[109] This practice, over time and across several cases, could damage the credibility of the IAEA safeguards conclusions.
- » In at least one case (Syria), the IAEA has not labeled undeclared activities in a declared site as noncompliance.

Recommended Measures

The following section describes political, technical, and legal measures the IAEA and its member states may consider adopting to address ongoing and future challenges related to safeguards in inaccessible territories. Some of the suggested measures may be politically controversial but could assist the IAEA in enhancing its credibility by reducing inconsistencies and political influence on its safeguards conclusions.

Policy Tools

- » The IAEA should develop a strategy to decouple the perception of its decision not to draw any conclusion nor reaffirm a broader conclusion with noncompliance or an inevitable increase of safeguards efforts. To that end, the Agency should explain that inability to draw any safeguards conclusion or not reaffirming a broader conclusion is not a punishment but rather a reflection of what the Agency could or could not do. The Agency should also reassure member states that just because the Agency could not reaffirm a broader conclusion, the Agency would not increase its safeguards efforts automatically. Rather, it will determine the level of safeguards activities based on the quantity and type of nuclear material, the facility type, operating status, the country nuclear-fuel cycle, and other related factors.[110] Politically noncontroversial cases where not reaffirming a broader conclusion clearly was not related to noncompliance, such as in Libya and Japan, could have been used by the Agency to

109 For example, at Sevastapol, there is much less than 1 SQ of declared material, and the Agency believes there little or no plausibility that Russia, a nuclear-weapon state, would divert the material for weapons use and no reason to imagine that Ukraine could use Crimea or rebel-held areas for undeclared activities, the Agency felt it can reaffirm Ukraine's broader conclusion without physical access to the site since 2014. Which technical measures the Agency sought in the Libya case remain unclear.

110 For a discussion of how non-affirmation of broader conclusion may affect the Agency safeguards effort in a country, see George Anzelon et al, "Adjusting Safeguards Implementation when the IAEA is Unable to Reaffirm a Previously Drawn Safeguards Conclusion," presented at 57th Annual Meeting of the Institute of Nuclear Materials Management, Atlanta, Georgia, July 2016, <https://e-reports-ext.llnl.gov/pdf/826628.pdf>.

demonstrate this principle. Instead, the Agency chose to maintain broader conclusions in these countries so as not to "punish" them for events outside of their control.

» Member states should avoid using the process of drawing safeguards conclusions for political gains because doing so will jeopardize the credibility of the Agency to draw safeguards conclusions based on technical findings. The politicization of drawing safeguards conclusions has evolved in large part due to dynamics within the BOG. Ever since the debate emerged about how the IAEA applies the State-Level Concept, a few states (especially Russia) have pressured the IAEA to share the details of its evaluation process and methods for drawing conclusions with the ostensible purpose of allowing states to have an increased say in the technical application of safeguards.[111] The question over Ukraine has sharpened this discussion: Russia continues to seek the International community's recognition for its annexation of Crimea, while the US maintains that the IAEA should not visit these sites as it would confirm Russia's control over Crimea. A purely technical question—can the IAEA assure the international community that there was no diversion and all materials remained in peaceful use—became hostage to a broader political struggle.

» When the IAEA cannot verify the status of declared nuclear materials in a country, the Agency should report it to the Board. The safeguards conclusion should accurately reflect the Agency's capability to verify the peaceful uses of materials in the country. Article 19 of CSAs anticipates this possibility and does not require the Board to report the matter to the UNSC if it is not a noncompliance case.

» The IAEA should develop a systematic approach to drawing its safeguards conclusions, particularly with regards to member states that are either unwilling or unable to provide access to necessary information or locations. Among the issues the Agency should consider is what constitutes "sufficient safeguards measures." The review should also consider under which circumstances the Agency should conduct an updated acquisition path analysis.

» The IAEA should make the entire SIR public and increase transparency of the principles, procedures, and practices used to draw its safeguards conclusions. In some cases, this means highlighting principles and procedures already outlined in reports to the Board and applying them in a consistent manner.

» The IAEA should develop a generic contingency plan for facilitating safeguards continuity that can be fielded quickly in cases involving lost access to declared nuclear materials. The Standing Advisory Group on Safeguards Implementation, an advisory group to the IAEA director general, could discuss principles and guidelines for such plans.[112] Early planning will allow for coordination with multiple relevant stakeholders and, more importantly, enable the relevant member state to employ, if willing, its own technical means if physical access is lost.[113]

---

111 Mark Hibbs, "IAEA Safeguards Development and Russia's National Interest," *Carnegie Endowment for International Peace*, November 22, 2014, <http://carnegieendowment.org/2014/11/22/iaea-safeguards-development-and-russia-s-national-interest-pub-57429>; Mark Hibbs, "Russia's Safeguards Problem," Arms Control Wonk, December 3, 2012, <http://www.armscontrolwonk.com/archive/1101196/russias-safeguards-problem/>.

112 The authors are aware this has been a controversial issue, and at times, various State Members, including the US, opposed the IAEA conducting such an assessment. See, for example, Fredrik Dahl, "U.S., Russia clash over Syria reactor at U.N. nuclear meeting," *Reuters*, Sep. 9, 2013, <http://www.reuters.com/article/us-syria-crisis-russia-nuclear/u-s-russia-clash-over-syria-reactor-at-u-n-nuclear-meeting-idUSBRE9880J520130909>.

113 For more on this issue, see the Technical Tools section.

» With regard to radiological-materials security, states should maintain a radioactive source registry. This will allow the authorities to know in some detail what materials may be out of their control if a state lost control of specific territory.

Legal Tools

The IAEA should adopt a more systemic approach based on consistent principles and procedures for drawing safeguards conclusions:

» If the IAEA cannot draw any conclusion, it should both report it to the BOG and mention it in the SIR. For this purpose, the Agency should add another level to its safeguards conclusion—"unable to draw safeguards conclusion"—to cover cases in which it cannot verify the status of declared nuclear materials in the country.

» If the Agency plans to continue to reaffirm a broader conclusion when it does not have physical access to a site for years, it should explain the means in which it used to compensate for the lack of physical access and hold that no diversion or undeclared activities took place.

» The IAEA should treat introduction of and activities with undeclared materials at a declared facility as a noncompliance to a CSA.

» When the IAEA does not conduct visits required by its safeguards criteria, it should clearly state so in the SIR and include the reasons for it. For example, in the case of Iraq, the Agency should inspect the declared sites according to its safeguards criteria once per year. The IAEA may have decided not to do that in 2013, 2014, and 2016 due to security reasons and relatively low nuclear material inventory, but this was not stated in the relevant SIRs. The same is true in the case of Libya and Syria.

If a state cannot provide physical access to safeguarded material, the state and the IAEA may take several measures, depending on the circumstances:

» In some instances, the state itself can invoke paragraph 76(d) of INFCIRC/153, working with the Agency to find alternative technical means to meet its safeguards responsibilities. Japan sought this kind of path after Fukushima without directly invoking paragraph 76(d).

» The original possessor state might, in some instances, wish to issue a statement that, although it claims rightful ownership of the lost territory, it does not currently control it or cannot provide IAEA access.

When the state does not control the materials, the operator or entity that does control the materials may be eager to demonstrate compliance. For example, the operators in the Sevastopol nuclear reactor may be eager to cooperate. Similarly, future cases could occur where a nonstate actor that found itself controlling a nuclear facility may want to demonstrate it has no intention to use the materials.

In these cases:

- The state in question or the state that supplied the materials can ask the IAEA or other parties, such as the United States or the United Nations, to remove the safeguarded materials (depending on the supply agreement provisions and security on the ground).
- If the IAEA provided materials or equipment under a technical cooperation, the Agency could request that the materials or equipment be returned.
- The Agency could request a special inspection or "visit" from the entity that operates the site.

The OPCW experience with Syria, where access was negotiated through the UN and directly with whoever controlled the territory, proved that gaining access and conducting verification activities do not equate recognizing the legitimacy of that entity to control the territory. In contrast to the IAEA's (and the US) stand on Crimea, the UN and the OPCW negotiations for access with the opposition groups in Syria were not politicized. In Syria, negotiations were not perceived to challenge the Syrian regime's sovereignty over territories no longer under state control, nor as acknowledgment of the legitimacy of the opposition's control.[114]

Technical Tools

Technical tools can be used in two distinct circumstances. The first instance is if the IAEA or the country that controls the facility assesses it may soon lose control and access to a site. In that case, the state or the facility operator may be willing to cooperate with the IAEA. If the IAEA and member states anticipate lost access with sufficient lead-time, the Agency can ask a state to implement certain measures to ensure continuity of safeguards in case of loss of physical access to the site, such as transmission of safeguards information. Regardless of who controls access—the original owner, another state, or a nonstate actor—that party may be interested in maintaining safeguards by continuing to transmit data to the IAEA, thereby providing assurance that nuclear materials have not been diverted and that nuclear facilities are not being misused. Although such information may be hard to authenticate and should not be the sole source for determining compliance, this option is better than having no information available at all. Information gathering will assist the IAEA in assessing whether it can implement sufficient safeguards measures and whether it needs to revise the country safeguards conclusions and/or the safeguards efforts in the country.

In such scenarios, the IAEA can use some of the following tools:

- Electronic tamper-proof seals that can be interrogated remotely or transmit data.
- Cameras that can be interrogated remotely or transmit data for ongoing monitoring.
- Further incorporation of remote monitoring systems such as Reactor Power monitor, Data Link, and Gamma Detection Network for future contingencies.
- Solar-powered backups may mitigate the risk of losing electricity and data transmission, particularly under turbulent conditions at a site or if access is prevented for an extended period.

114 For more information, see the Syrian case study in the Chemical Section.

- Supporting technologies and black box safeguards kits may be employed by individuals other than inspectors. IAEA members should consider these alternatives in safeguards technologies development.
- Unattended environmental monitoring equipment may be installed by the Agency prior to losing access. Additional measures can subsequently be taken by the entity that holds the facility, which comes with challenges related to authentication and the chain of custody. The method by which environmental samplings were taken from Parchin in Iran, both problematic and controversial, could be used as a reference based on the lessons learned for an operator taking environmental samples.
- Drones and video cameras may assist with collecting radiation measurements. The IAEA used drones in Japan, and the OPCW used video cameras with Global Positioning System (GPS) on local military vehicles in Syria.

Second, if the IAEA has no access to the site or cooperation from the entity that controls the site, tools are more limited. The following recommendations can provide some reassurances or information on the status of the nuclear materials in the facility but cannot replace inspections and access on the ground:

- Satellite imagery: The Agency currently uses satellite imagery primarily to monitor noncompliance cases. While the utility of satellite imagery is limited to detecting structural changes and movement in and out of the facility, it can assist in determining the facility's past or present operational history and detecting core removal.
- Wide-area environmental sampling: This technology has yet to be approved by the IAEA BOG, but it is identified in the Additional Protocol and, once approved, could be used to identify undeclared facilities. Its usefulness may be limited to larger facilities that produce or use at least 1 SQ of nuclear material and tied to site-specific information such as atmospheric conditions, standoff distances, interference issues, and other factors.
- Open-source information: The IAEA conducts open-source, technological, and trade analyses. Using a broad set of media sources and nuclear-trade publications, the Agency reviews scientific and technical publications and performs focused information collection and research on any critical topics identified in acquisition path analysis. The required extent and depth of this activity is greater for states with extensive nuclear and nuclear-related capabilities or where inconsistencies or indications of undeclared activities already exist.[115] Such research may need to be enhanced in instances where no access exists and can include targeted information collection and information requests to the occupying state or entity as well as other third parties.
- Intelligence: The IAEA occasionally receives intelligence information from member states, which it tries to corroborate independently. Such cooperation may be necessary in cases of no or reduced physical access.

115 J. B. Sanborn et al, "Performance Targets for IAEA Detection of Undeclared Nuclear Activities," presented at the Institute of Nuclear Materials Management 55th Annual Meeting, LLNL-CONF-656848, Atlanta, GA, July 9, 2014, <https://e-reports-ext.llnl.gov/pdf/777659.pdf>.

Chemical Section

Risks associated with chemical weapons

The norm against chemical weapons (CW) is considered universal as only four countries have not ratified the CWC.[116] However, events taking place in the Middle East, especially since 2012, pose serious challenges to nonproliferation in general and the CWC and the norm against CW use, in particular. Since the eruption of civil war in Syria and the rise of ISIL in Syria and Iraq, we have witnessed the repeated use of CW by both the Bashar al-Assad regime and nonstate actors. The destruction of the Assad regime's declared CW stockpiles eliminated the strategic threat posed by the most dangerous chemicals weapons in the region.[117] Nevertheless, the norm against CW use as well as the broader nonproliferation regime continues to be challenged by the repeated use of chlorine, sarin, and mustard gas against innocent civilians, along with evidence that Syria has not declared all of its CW stockpiles.

The OPCW legal authorities

The Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (CWC) aims to eliminate an entire category of WMD by prohibiting the development, production, acquisition, stockpiling, retention, transfer, or use of CW by states parties.[118] Under the convention, states parties are required to:

- Take steps necessary to enforce the prohibition within their jurisdiction by adopting national implementation legislation;[119]
- Declare past and existing CW stockpiles;
- Eliminate stockpiles of CW under the OPCW supervision;
- Ensure certain toxic chemicals and their precursors (listed in schedules 1, 2 and 3 in the CWC) are used only for nonprohibited purposes.[120]

116 The CWC defines chemical weapons as any toxic chemical or its precursor that can cause death, injury, temporary incapacitation, or sensory irritation through its chemical action. Munitions or other delivery devices designed to deliver chemical weapons, whether filled or unfilled, are also considered weapons. See OPCW, "Brief Description of Chemical Weapons," <https://www.opcw.org/about-chemical-weapons/what-is-a-chemical-weapon/>. The four holdout states include Egypt, Israel, North Korea, and South Sudan.

117 The Syrian chemical-weapons program was based primarily on binary weapons, two toxic substances brought together to create a highly toxic chemical warfare agent. The less toxic substances comprised the large bulk of the chemicals that were removed from Syria along with a smaller quantity of ready-to-use sulfur mustard. See OPCW, "Frequently Asked Questions," <https://www.opcw.org/special-sections/syria/frequently-asked-questions/>.

118 Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction, Geneva, September 3, 1992, <https://www.opcw.org/fileadmin/OPCW/CWC/CWC_en.pdf>.

119 In 2016, out of 192 state parties, 150 have adopted national implementing legislation while 42 have yet to adopt their implementing legislation, see <https://www.opcw.org/fileadmin/OPCW/EC/85/en/ec8517_c22crp01_e_.pdf>.

120 Chemicals covered by the CWC are divided into three "schedules" based on their possible utility in developing chemical weapons: Schedule 1 covers known CW agents and their immediate precursors. These have very limited industrial and medical applications. Schedule 2 covers chemicals and precursors that have some industrial uses, and Schedule 3 covers chemicals and precursors with broader commercial applications.

While the OPCW was charged with implementing the CWC, its authorities do not completely cover the CWC obligations. In fact, the prohibitions in the treaty extend more broadly than OPCW's authorities and verification process. The OPCW authorities cover three main aspects: declarations, destruction, and monitoring.

Declarations: The OPCW is responsible for verifying both the correctness and completeness of state parties' declarations of CW stockpiles as well as destruction or conversion of facilities involved in the production of chemical weapons and specified activities that take place in their chemical industries. However, in practice, the OPCW mostly verifies declared information (correctness, rather than completeness), and it has insisted only in selective instances on states to revise their declarations.[121] While revising declarations is normal practice, especially when submitted for the first time or if circumstances change, the OPCW was selective in which cases it required revision due to incomplete or false information. For example, the OPCW negotiated back and forth with some states that submitted false or incomplete declarations (e.g. Iran and Syria), but it did not do so in other cases.[122] For example, Burma and South Africa both declared they did not have chemical programs in the past despite publicly available information to the contrary. In addition, Libya declared it did not receive any munition from outside sources despite proof that contradicts that information.

Destruction: The OPCW verifies the irreversible destruction of declared chemical weapons stockpiles and the destruction or conversion of chemical weapons production facilities (CWPF). The OPCW accomplishes this with inspectors on the ground observing destruction, verifying records, and sampling residue.

Monitoring: The OPCW verifies two kinds of facilities: CW-related facilities and industrial facilities. In CW-related facilities, inspections are conducted at regular intervals and at relatively short notice to confirm that production of CW has ceased, chemical weapons are not removed from their declared storage locations (except for destruction), and that equipment is not diverted. OPCW inspectors maintain a continuous on-site presence during destruction operations to confirm CW destruction, but remote monitoring could also confirm the non-operation of CWPF.[123] The destruction of Syrian chemicals in Syria, for example, was apparently video monitored.

---

121 Verification of correctness ensures whether what has been declared has been correctly declared. Verification of completeness verifies also whether all that should have been declared has indeed been declared. The OPCW Scientific Advisory Board's Temporary Working Group recommended the OPCW expanding its verification activities to also determine completeness, noting that "without supplementing the information from verification activities with relevant data from open sources on completeness of declarations, any analysis of the effectiveness of the implementation of the verification regime of the Convention cannot be described as comprehensive." See OPCW, "Verification Report of the Scientific Advisory Board's Temporary Working Group," SAB/REP/1/15, June 2015, <https://www.opcw.org/fileadmin/OPCW/SAB/en/Final_Report_of_SAB_TWG_on_Verification_-_as_presented_to_SAB.pdf>.

122 Iran's initial declarations were submitted and revised in June 1998, January 1999, and March 1999.

123 OPCW, "Three Types of Inspections," *Fact Sheet no. 5*, October 10, 2014, <https://www.acs.org/content/dam/acsorg/events/program-in-a-box/documents/2016-global-security/cw-inspections.pdf>.

Table 4: OPCW Routine Inspections of Chemical Weapons Facilities[124]

	Production Facilities	Storage Facilities	Destruction Facilities
Annual Inspection Rate	Maximum 4 per year	Determined by Secretariat after initial inspection	Determined by Secretariat after initial inspection
Notification Prior to Inspection	At least 24 hours	At least 24 hours	At least 24 hours
Duration of Inspection	Determined by Secretariat	Determined by Secretariat	Determined by Secretariat
Inspector Access	Unimpeded	Unimpeded	Unimpeded

The nature of inspections at chemical industry facilities depends on the chemicals those facilities produce, i.e. Schedule 2, Schedule 3, or unscheduled "discrete organic chemicals."

Table 5: OPCW Routine Inspections of Chemical Production Facilities[125]

	Schedule 1 Facilites	Schedule 2 Facilities	Schedule 3 Facilities	Other Chemical Production Facilities
Annual Inspection Rate	Single Small-Scale Facility: twice per year on average; Other Facilities: on average once a year	Based on risk assessment after intial inspection and facility agreement; not more than two per year per site	Based on random selection, equitable geographical distribution and information available to the Secretriat; no more than two per year at any one site	Based on random selection, equitable geographical distribution, information available to the Secretariat and proposals by states parties; no more than two per year at any one site
			Combined number of Schedule 3 and other chemical production facility inspections in any state party per year not to exceed three plus 5% of total number of declared Schedule 3 and other chemical production sites in the State Party, or 20, whichever is lower	
Notification Prior to Inspection	At least 24 hours	At least 48 hours	At least 120 hours	At least 120 hours
Duration of Inspection	Determined by Secretariat	6 hours (extension possible)	24 hours (extension possible)	24 hours (extension possible)
Inspector Access	Unimpeded to plant and unit but no access to wider site	Unimpeded to plant and within plant site; access to other plant areas guided by clarification and facility agreement rules or, if no facility agreement, managed access rules	Unimpeded to plant and within plant site; access to other plant areas guided by clarification rule	Unimpeded to plant and within plant site; ISP can apply managed access to protect confidential information; for other plant areas, request for access based on ambiguity rule or granted by ISP

124 Ibid.
125 Ibid.

Since this paper covers both the IAEA and OPCW, several important differences between these two organizations not covered previously are worth mentioning. The OPCW's technical secretariat is transitioning away from verifying the destruction of existing CW stockpiles to focusing inspection efforts on monitoring peaceful uses of toxic chemicals. Meanwhile, the IAEA is concentrating almost exclusively on verifying the peaceful uses of nuclear materials. As a result, while the OPCW has developed elaborate mechanisms to verify CW dismantlement, the tools needed to verify legitimate activities are less developed (especially in the case of trade) and rarely implemented (in the case of industry) compared to those for overseeing weapons destruction. For comparison, in 2017, the IAEA conducted about 2,800 site visits compared to 321 OPCW inspections of industrial facilities.[126] Due to the nature of material accountancy, the IAEA verifies all declared nuclear materials in a state, but the OPCW cannot realistically verify all chemicals in a state.

In addition, as opposed to the IAEA, the OPCW does not make compliance decisions or judgments, and it does not produce an annual compliance report. If a member state is suspicious of noncompliance, it can request a challenge inspection. Since the OPCW does not make noncompliance decisions, the Executive Council can in cases "of particular gravity and urgency" bring the issue or matter, including relevant information and conclusions, directly to the attention of the UNGA and the UNSC.[127] No such referral has taken place so far.

Case Studies

The project examines four case studies—Iraq, Libya, Syria, and Ukraine/Crimea—relevant to the chemical field. In some of these cases, the OPCW lacks access to declared CW that have yet to be destroyed or access to verify destroyed stockpiles. In other cases, the OPCW lacks access to a declared facility to verify chemicals' peaceful purposes.

Iraq

Iraq had an extensive CW program that was dismantled by the UN Special Commission (UNSCOM) in the 1990s.

Declaration to the OPCW: Iraq joined the CWC in 2009 and submitted its initial declaration to the OPCW in March 2009. Given the security situation in the country and the methods of CW stockpile destruction in the 1990s and 2000s, the Iraqi government struggled to assess its CW stockpile and draw destruction plans, relying mainly on UNSCOM documentation when submitting its initial

126 IAEA, Safeguards Implementation in 2017," <https://www.iaea.org/sites/default/files/18/04/sg-implementation-2017.pdf>, and OPCW, "Draft Report of the OPCW on the Implementation of the Convention on the Prohibition of The Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction in 2017," EC-88/3, C-23/CRP.1, July 12, 2018, <https://www.opcw.org/fileadmin/OPCW/EC/88/en/ec8803_c23crp01_e_.pdf>.
127 CWC, January 13, 1993, "Article VIII: The Organization."

declaration.[128] In addition, the OPCW relied on US and UK documentation on CW-related recovery and destruction activities between 2003 and 2008.[129]

Iraq declared five former CWPFs and two storage bunkers (bunkers 13 and 41 in al-Muthanna Chemical Weapons Complex).[130] The two bunkers at al-Muthanna are located sixty miles north of Baghdad, near the town of Samarra. Given the hazardous conditions within the bunkers, Iraq stated it could not conduct a detailed on-site inventory. In 2013, Iraq reported that it had photomapped the interiors of bunkers 13 and 41 and felt that it had a good sense of their contents. Iraq declared that bunker 13 contained 2,500 sarin-filled 122mm chemical rockets produced and filled before 1991 and about 180 tonnes of sodium cyanide, a very toxic chemical and a precursor for the warfare agent tabun. According to the Iraqi statement, bunker 41 contains over 2,000 empty contaminated artillery shells, containers, and incinerator equipment.[131]

Status of verification of Destruction: In May 2011, the OPCW made helicopter overflight inspections of some of the declared CWPFs and the CWSFs. It visited the Al Rashad CWPF in 2012 to assess Iraq's request to convert the facility.[132] In April 2014, Iraq submitted detailed facility information for the al-Muthanna destruction plans to the OPCW and committed $55 million for the destruction of its CW and CWPFs.[133] al-Rashad, one of the five declared CWPFs, was certified by the OPCW as converted on December 4, 2013. Additionally, the Iraqi Monitoring Directorate visited India to discuss how to treat polymerized mustard gas in bunker 41 containers, and Germany delivered a mobile laboratory in support of the destruction project.[134]

In June 2014, ISIL overran and held the al-Muthanna site, halting CW destruction operations and looting equipment.[135] In 2015, after the Iraqi government retook al-Muthanna, engineers removed mines and explosive devices.[136] Upon Iraq's request in 2016, the OPCW procured training courses in medical response, safety, decontamination, detection, and handling of chemically contaminated

128 US State Department, "Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction Condition 10(C) Report," April 2016, <http://www.state.gov/t/avc/rls/rpt/2016/255563.htm>.

129 OPCW, "Reports of The Technical Secretariat For The Purpose of Reviewing Documentation Related to The Recovery and Destruction of Iraqi Chemical Weapons," November 19, 2014, S/1224/2014, <https://www.opcw.org/fileadmin/OPCW/S_series/2014/en/s-1224-2014_e_.pdf>.

130 Ibid.

131 Jean Pascal Zanders, "What's He Building in There?," CBRNe World, August 2014, <http://www.cbrneworld.com/_uploads/download_magazines/Zanders.pdf>.

132 US State Department, "Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction Condition 10(C) Report," January 2013, <https://www.state.gov/documents/organization/212108.pdf>.

133 US State Department, "Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction Condition 10(C) Report," April 2016.

134 Ibid.

135 UNSC, Letter dated 30 June 2014 from the Permanent Representative of Iraq to the United Nations addressed to the Secretary-General, July 1, 2014, S/2014/457, <http://repository.un.org/bitstream/handle/11176/32921/S_2014_457-EN.pdf?sequence=3&isAllowed=y>.

136 US State Department, "Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction Condition 10(C) Report," April 2016.

items for Iraqi workers assigned to destruction sites.[137] In 2017, the encapsulation of bunker 13 was completed while encapsulation work for bunker 41 proceeded.[138] Since the bunkers are sealed and security is still unstable, the OPCW has not conducted ground inspections but did fly over the site several years ago. The destruction (i.e. neutralization and encapsulation) of Iraq's CW remnants is being monitored through videos made by the Iraqi government. Additionally, four former CWPFs declared by Iraq have been completely destroyed, which was verified by the OPCW during inspections conducted in December 2017 and February 2018. The Secretariat also verified that one former CWPF had been converted for peaceful purposes.[139]

Nonstate actor use: CW have allegedly been used in Iraq since 2004 sporadically in Improvised Explosive Devices that contained pre-1990 chemical munitions and then in 2006–2007 by al-Qaida in Iraq (AQI), the ISIL predecessor, which attempted to use chlorine tanks in vehicle-borne improvised explosive devices. In August 2015, Iraq requested technical assistance from the OPCW to investigate allegations that sulfur mustard was used against Peshmerga fighters near Irbil. Drawing from analyses of biomedical samples from victims and environmental samples, the OPCW concluded that sulfur mustard had probably been used by ISIL.[140] How the group acquired the weapons remains unclear. ISIL may have produced them indigenously or acquired them from undeclared Syrian stockpiles. According to Defense Intelligence Agency Director James Clapper, ISIL produced the gas.[141] ISIL also notably controlled the Mosul University chemistry lab from June 2014 to October 2017 and has allegedly used it to produce explosives.[142] Whether it also used this location for mustard production remains unclear.

Libya

Declaration: Libya became a CWC state party in February 2004, declaring a CW stockpile, CWPFs, and other chemical production facilities (OCPFs). It also submitted and started to implement a destruction plan. In October 2011, a few months after the fall of Muammar Qaddafi's regime, Libya's National Transitional Council announced that it had discovered an undeclared cache of CW, which was later confirmed by the OPCW to be mustard gas and associated artillery shells. The CW

137 Ibid.
138 OPCW, Note by The Technical Secretariat Review of the Operation of the Chemical Weapons Convention since the Third Review Conference, WGRC-4/S/1, May 29, 2018, <https://www.opcw.org/fileadmin/OPCW/CSP/RC-4/en/wgrc4s01_e_.pdf>.
139 OPCW, Opening Statement by the Director-General to the Executive Council at its Eighty-Seventh Session, EC-87/DG.22, March 13, 2018, <https://www.opcw.org/fileadmin/OPCW/EC/87/en/ec87dg21_e_.pdf>.
140 OPCW, "Director-General expresses concern over alleged recent chemical attacks in Iraq," March 23, 2016, <https://webcache.googleusercontent.com/search?q=cache:EwdhGiGBVhUJ:https://www.opcw.org/news/article/director-general-expresses-concern-over-alleged-recent-chemical-attacks-in-iraq/+&cd=1&hl=en&ct=clnk&gl=us>..
141 Statement by The Honorable James R. Clapper, Director of National Intelligence, to the Senate Select Committee on Intelligence – IC's Worldwide Threat Assessment Opening Statement, Feb 9, 2016, <https://www.dni.gov/files/documents/2016-02-09SSCI_open_threat_hearing_transcript.pdf>.
142 Margaret Coker and Ben Kesling, "Islamic State Hijacks Mosul University Chemistry Lab for Making Bombs," *Wall Street Journal*, April 1, 2016, <http://www.wsj.com/articles/ islamic-state-hijacks-mosul-university-chemistry-lab-for-making-bombs-1459503003 >.

munitions were declared to the OPCW in November 2011 and February 2012.[143] However, these declarations lacked information on the origin of the munitions. Despite the munition being in wooden cases with Persian script, Libya stated in its declaration that it did not receive any munition from outside sources.[144] The OPCW did not follow up on the origin of the munitions nor demand that Libya correct its declaration.

Destruction: Due to the armed revolution that began in February 2011, CW destruction halted at times. However, by May 2014, Libya completed destruction of its declared Category 1 and Category 3 CW.[145] Libya and others considered various options for the destruction of its remaining 850 tons of category 2 chemical precursors. In July 2014, Libya reported that it had suspended destruction efforts due to serious political, security, and budgetary issues, but it proposed destruction options for the future.[146]

In February 2016, Libya asked the OPCW to explore other options, such as shipping the category 2 stockpile overseas to be destroyed. At the same time, Libya completed the destruction of about 114 metric tonnes of isopropanol at the Ruwagha site and of about 19 metric tonnes of pinacolyl alcohol at the Bir al-Osta Milad site. The destruction of those two chemicals has been verified by the OPCW.[147] In March 2016, Libya completed decanting the remaining chemicals in Ruwagha in leak-proof containers, importantly maintaining the physical and general integrity of the stockpile due to incidents of evaporation, leakage, and spillage of chemicals. The process also improved the conditions of the stockpile for handling before shipping. The OPCW confirmed the transfer of the remaining chemicals using video recordings.[148]

The United States and others were reluctant to support the removal of Libya's remaining stockpile for destruction outside the country, and many CWC member states were concerned about pursuing yet another UNSCR authorizing the removal of CW for destruction purposes. The 2013 UNSCR adopted in the Syria case was justified by the extraordinary circumstances required to safely destroy Syria's CW, but it also stated that the resolution should not set a precedent. The US was furthermore

143 Kelsey Davenport, "Last CW Materials Removed from Libya," *Arms Control Today*, October 2016, <https://www.armscontrol.org/print/7705>.
144 R. Jeffrey Smith, Joby Warrick, and Colum Lynch, "Iran may have sent Libya shells for chemical weapons," *Washington Post*, November 20, 2011, <https://www.washingtonpost.com/world/national-security/iran-may-have-sent-libya-shells-for-chemical-weapons/2011/11/18/gIQA7RPifN_story.html?utm_term=.5774f053ffd8>.
145 Chemical weapons are formally divided in the CWC into three categories. Category 1 refers to Schedule 1 chemical agents and munitions filled with Schedule 1 agents. Category 2 covers munitions filled with other toxic chemicals and any other weaponized chemical agents other than those in Schedule 1. Unfilled munitions and devices and any other equipment specifically designed to aid in the deployment of chemical weapons fall into Category 3. Destruction timelines are set by the CWC for the destruction of all three categories. See OPCW, "Brief Description of Chemical Weapons."
146 US Department of State, "Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction Condition 10(C) Report," April 15, 2015, <https://www.state.gov/t/avc/rls/rpt/2015/243245.htm>.
147 Libya Annual Report to the Conference of the States Parties at Its Twenty-Second Session on Progress Achieved Towards Complete Destruction of The Remaining Stockpile of Chemical Weapons as at 31 October 2017," C-22/NAT.2, Nov. 16, 2017, <https://www.opcw.org/fileadmin/OPCW/CSP/C-22/national_statements/c22nat02_e_.pdf>.
148 OPCW, "Draft Report of the OPCW on the Implementation of the Convention on the Prohibition of The Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction in 2016."

concerned by Russia's dissatisfaction with the results of the Libyan 2011 UNSCR 1973 and the potential politicization of a new resolution.[149]

While Libya's category 2 material did not constitute a proliferation or security risk, even if it were to fall out of the Libyan government's control, the United States and others were concerned with news headlines that terrorists had seized CW. This calculation tipped the scales in favor of seeking another UNSCR. In July 2016, the UNSC adopted a resolution that authorized member states to "acquire, control, transport, transfer and destroy chemical weapons" identified by the OPCW in Libya "to ensure that the country's stockpile was eliminated in the 'soonest and safest' manner."[150] In August 2016, Libya's remaining CW were removed to be destroyed in Germany. Samples were taken by the Libyan government and shipped by the OPCW to the United Kingdom for analysis. In addition, OPCW inspectors verified the delivery of the tanks and their corresponding OPCW seal numbers at a port in Germany, and they verified the destruction process along with Libyan observers every two months.[151] By December 2017, all of Libya's declared chemical weapons that were shipped to Germany were destroyed.[152]

During the removal of the material from the Ruwagha Tank Farm, one tank experienced an exothermic reaction during reloading. The OPCW reported that the tank was destroyed in August 2017, and it reported that it was able to verify the destruction remotely through video recording.[153] The Ruwagha Tank Farm still hosts 350 metric tonnes of highly acidic mustard hydrolysate stored in corroded and leaking containers along with other remnants from the CW program. These still must be addressed through costly cleanup operations.[154]

As Libya approaches the end of its CW program destruction, the OPCW must verify the completion of destruction by obtaining soil samples. However, the UNDSS informed the OPCW at the end of 2017 that the Ruwagha chemical facility is located in a "no-fly zone" and that the UN has not been able to obtain clearance for a flight into the area until Dec. 2017. During 2018, the UNDSS informed the OPCW that the restriction on travel to Tripoli has been lifted; however, since travel to Ruwagha is still unsafe, the OPCW trained four Libyans on soil sample collection and live video streaming. The plan is for the Libyans to conduct soil sampling, which will be observed by the OPCW inspectors in real time via video link.[155]

---

149 UNSCR 1973 formed the legal basis for military intervention in the Libyan Civil War, demanding "an immediate ceasefire," authorizing the international community to establish a no-fly zone and to use all means necessary short of foreign occupation to protect civilians.

150 "Adopting Resolution 2298, Security Council Authorizes Member States to Control, Destroy Libya's Chemical Weapons," *UN Meetings Coverage and Press Releases*, July 22, 2016, <http://www.un.org/press/en/2016/sc12455.doc.htm>.

151 OPCW, "Report by the Director-General: Status of the Implementation of the Plan for the Destruction of Libya's Remaining Category 2 Chemical Weapons Outside the Territory of Libya," EC-87/DG.6, December 22, 2017, <https://www.opcw.org/fileadmin/OPCW/EC/87/en/ec87dg06_e_.pdf>.

152 Ibid.

153 Ibid.

154 Ibid.

155 Ibid and, OPCW, Opening Statement by the Director-General to the Executive Council at its Eighty-Seventh Session, EC-87/DG.22, March 13, 2018, <https://www.opcw.org/fileadmin/OPCW/EC/87/en/ec87dg21_e_.pdf>.

However, the OPCW also developed an alternative plan if the security conditions on the ground continue to prevent it from physically accessing the site. The plan includes using GPS and date/time-enabled sealed OPCW cameras, which will conduct a review of the former storage area via a live satellite feed. Using the live video feed, trained Libyan representatives will collect and seal the soil samples under the monitoring of OPCW inspectors. The soil samples will be evaluated at the OPCW Laboratory.[156]

Nonstate actors: The Libyan government is responsible for maintaining the security of stockpiles until they are destroyed. The OPCW could verify these materials while waiting for destruction. These tasks have been particularly challenging in the context of ISIL, which established its most developed branch outside of Syria and Iraq in Libya. Conditions have become too dangerous for the OPCW to physically access the site, so it resorted to remote verification.

Syria

The continued use of CW in Syria during the ongoing civil war has been a major foreign-policy challenge. The following section will address only the aspects related to challenges facing the OPCW in verifying Syria's initial declaration, CW use, destruction, and peaceful application in Syria.

Following the August 21, 2013, Ghouta attack, the UNSC and the OPCW Executive Council endorsed a framework arrangement negotiated by the United States and Russia.[157] The OPCW 2013 Executive Council decision and UNSCR 2118 mandated the complete "elimination of all (of Syria's) CW material and equipment in the first half of 2014." The resolution and decision established strict deadlines and stipulated special procedures for the expeditious and verifiable destruction of Syria's CW program, confirmed Syria's accession to the CWC, and authorized experts from the OPCW and the United Nations to supervise the removal and destruction of its declared CW stockpile. The UNSCR also noted that in the event of noncompliance, it would impose Chapter VII measures.[158]

When it acceded to the CWC, Syria declared approximately 1,308 metric tonnes of CW, including sulfur mustard agents, precursors for the sarin nerve agent, and other chemicals.

Notably, several parallel missions took place in Syria with the participation of the OPCW, each led by a different organization, objective, and mandate.

» The allegations of chemical-weapon use prior to and in Ghouta were investigated under the UN Secretary-General's Mechanism for the Investigation of Alleged Chemical and Biological

156 OPCW, "Opening Statement by the Director-General to the Executive Council at its Eighty-Sixth Session".
157 OPCW, Decision Destruction of Syrian Chemical Weapons, EC-M-33/DEC.1, September 27, 2013, <https://www.opcw.org/fileadmin/OPCW/EC/M-33/ecm33dec01_e_.pdf>; United Nations Security Council (UNSC), Resolution 2118 (2013), S/RES/2118, September 27, 2013, <https://undocs.org/S/RES/2118(2013)>.
158 Chapter VII of the United Nations Charter grants the UN Security Council's powers to maintain peace. It allows the Council to "determine the existence of any threat to the peace, breach of the peace, or act of aggression" and to take military and nonmilitary action to "restore international peace and security."

Weapons Use. It took place based on Syria's request and its membership in the 1925 Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare (the Geneva Protocol). The investigation found "clear and convincing evidence that surface-to-surface rockets containing the nerve agent sarin were used" in the 2013 Ghouta attack, which took place while the team was investigating previous allegations. The report purposely did not identify the attack's perpetrator because it was excluded from the investigation's official mandate. This mission was completed in September 2014.

» The verification of the destruction of Syria's CW was mandated by the OPCW Executive Council decision, UNSCR 2118, and the CWC (after Syria's accession). It was jointly conducted by the United Nations and the OPCW until September 2014.

» The ongoing verification of Syrian compliance with the CWC (verification of Syria's initial declaration, complete destruction of the entire Syrian CW program, as well as continued allegations of CW use) is conducted by the OPCW under the CWC.

» In April 2014, the director general of the OPCW established a fact-finding mission (FFM) mechanism to investigate allegations of CW use in Syria. The FFM mandate did not include attribution for the alleged use.[159] The first report mentioned 116 alleged incidents of CW use in Syria over the course of 2014 and 2015, 23 of which it confidently determined involved exposure to a chemical substance.[160] The FFMs concluded for these 23 incidences "with a high degree of confidence" and at least four more in 2017—2018 that sarin and chlorine gas had been used in Syria.[161] The OPCW continues to employ FFMs to investigate ongoing allegations of the continued use of chemical weapons in Syria.[162]

» The UN-OPCW Joint Investigative Mechanism (JIM) was established by the UNSC in August 2015 and renewed in November 2016. It was tasked to conduct an investigation to identify "to the greatest extent feasible" those involved in the use of chemical weapons, following a determination by the FFM findings that specific incidents involved or likely involved the use of chemicals as weapons in Syria. The JIM September 2015 mandate included access to all locations, individuals, and materials in Syria that the JIM deemed relevant.[163] The JIM investigated multiple incidents of CW use that took place between April 2014 and November 2017. It identified that some attacks, in which sarin and chlorine were used, were conducted by the Assad regime while other attacks, in which sulfur mustard was used, were conducted by ISIL.[164] In November 2017, Russia blocked the renewal of the

159 OPCW, "Third Report of The OPCW Fact-Finding Mission in Syria," S/1230/2014, December 18, 2014, <http://photos.state.gov/libraries/netherlands/328666/pdfs/THIRDREPORTOFTHEOPCWFACTFINDINGMISSIONINSYRIA.pdf>.

160 UNSC, "First report of the Organization for the Prohibition of Chemical Weapons-United Nations Joint Investigative Mechanism," S/2016/142, February 12, 2016, <https://undocs.org/S/2016/142>.

161 Ibid, and OPCW, Opening Statement by the Director-General to the Executive Council at its Eighty-Seventh Session, EC-87/DG.22, March 13, 2018, <https://www.opcw.org/fileadmin/OPCW/EC/87/en/ec87dg21_e_.pdf>.

162 For the lists of FFMs reports, see <https://www.opcw.org/special-sections/syria/fact-finding-mission-reports/>.

163 UNSC, Resolution 2235 (2015), S/RES/2235 (2015), August 7, 2015, <https://www.un.org/en/ga/search/view_doc.asp?symbol=S/RES/2235(2015)>.

164 UNSC, "Letter dated 21 October 2016 from the Secretary-General addressed to the President of the Security Council," S/2016/888, October 21, 2016, <http://www.un.org/ga/search/view_doc.asp?symbol=s/2016/888>; UNSC, "Letter dated 26 October 2017 from the Secretary-General addressed to the President of the Security Council," S/2017/904, October 26, 2017, <https://reliefweb.int/sites/reliefweb.int/files/resources/N1734930.pdf>.

> JIM mandate. To rectify the lack of attribution body after the JIM dissolvent, in June 2018 the CWC Fourth Special Session of the Conference of the States Parties adopted a decision giving the OPCW the mandate to identify those responsible for chemical weapons attacks in Syria, and beyond.[165]

The Syria case set many precedents. It was the first OPCW international disarmament mission in a conflict zone with a parallel investigation into the alleged use of CW, and it required the simultaneous verification of declaration, dismantlement, destruction, and compliance within a very short time. The 2013 Executive Council decision and the UNSCR 2118 mandate of eliminating Syria's declared stockpile are broader than that of the CWC, requiring the destruction of the program and the weapons and allowing access to any facility related to the program, which included research and development facilities. As such, the Executive Council decision and UNSCR required broader obligations for declaration and destruction and granted greater verification authorities to the OPCW in comparison with those mandated under the CWC or regularly exercised by the OPCW.

Declarations: Syria submitted its initial declaration when it acceded to the CWC in October 2013, which was followed by at least ten subsequent amendments in which the Syrian government revealed, among other information, previously undisclosed CW-related facilities. In April 2014, the OPCW established a declaration assessment team (DAT) to clarify Syria's declaration accuracy and completeness. In total, Syria declared an approximate 1,308 metric tonnes of CW, including sulfur mustard agents, precursors for the sarin nerve agent, and other chemicals. It also declared 27 CWPFs and one OCPF. The OPCW holds, despite many amendments, that the Syrian declaration is still incomplete with gaps, discrepancies, and omissions.[166]

Notably, until November 2017, Syria did not provide the OPCW with any of the original documents related to its CW program and denied OPCW access to interview personnel affiliated with the program in violation of the Executive Council decision and UNSCRs. In November 2017, Syria provided the OPCW with 19 documents, totaling approximately 450 pages. The documents provide details of some research and development activities that reportedly took place in the declared laboratories of the Scientific Studies and Research Centre (SSRC) between 1995 and 2010. As of August 2018, the OPCW could not conclude that Syria had submitted an accurate and complete declaration. In fact, the OPCW reported that it is unable to resolve all identified gaps, inconsistencies, and discrepancies in the Syrian declaration, and there has been an increase in the number of unresolved issues.[167]

Destruction: the OPCW confirmed that all of Syria's declared Category 1 and Category 2 CW have been destroyed. In 2016, the OPCW conducted five CWPF inspections to verify the destroyed

165 OPCW, "Decision Addressing the Threat from Chemical Weapons Use," C-SS-4/DEC.3, June 27, 2018, <https://www.opcw.org/fileadmin/OPCW/CSP/C-SS-4/en/css4dec3_e_.doc.pdf>.
166 OPCW Executive Council, "Note by The Director-General Progress in The Elimination of The Syrian Chemical Weapons Programme," EC-84/DG.1, October 25, 2016, <https://www.opcw.org/fileadmin/OPCW/EC/84/en/ec84dg01_e_.pdf>, and OPCW, "Progress in the Elimination of the Syrian Chemical Weapons Programme," EC-89/DG.1, July 24, 2018, <https://www.opcw.org/fileadmin/OPCW/EC/89/en/ec89dg01_e_.pdf>.
167 OPCW, "Opening Statement by the Director-General to the Executive Council at its Eighty-Sixth Session."

CWPFs and to monitor the integrity of the interior plugs.[168] A contracted company fulfilled routine annual maintenance of the remote monitoring systems installed at the destroyed underground structures.[169] As of August 2018, all the 27 declared CWPFs had been destroyed.[170]

Use: Mustard, sarin, and toxic chemicals have been used in Syria after the destruction phase both by the Assad regime and by ISIL. The OPCW FFMs and the JIM conducted several investigations related to allegations of toxic chemical use. The FFMs concluded for at least 23 incidences "with a high degree of confidence" and at least four more in 2017—2018 that sarin and chlorine gas had been used in Syria.[171] In November 2016, the OPCW Executive Council adopted a decision calling on all parties identified by the JIM reports as responsible for CW use to desist immediately and authorized additional inspections at selected sites and facilities of concern in Syria.[172] The OPCW conducted several inspections at SSRC, specifically at the Barzah and Jamrayah facilities, which are suspected to be connected to the continued use of CW by the Assad regime. The OPCW did not find in the samples collected any indication of the presence of scheduled chemicals.[173]

Ukraine/Crimea

Ukraine signed the CWC in 1993 and became a state party in 1998. Ukraine does not have declared CW, but according to the latest available OPCW 2016 Annual Report, there are six declared chemical facilities in Ukraine: one declared schedule 2, one declared and inspectable schedule 3, and four declared and inspectable OCPFs.[174] As far as we know, none of these facilities are located in Crimea. In 2014, Russia threatened to file a complaint with the OPCW claiming that the Ukrainian armed forces used white phosphorus and chloropicrin against its supporters.[175] However, Russia ultimately decided not to file the complaint.[176]

168 OPCW, "Draft Report of the OPCW on the Implementation of the Convention on The Prohibition of The Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction in 2016."
169 OPCW Executive Council, "Note by the Director-General Progress in The Elimination of The Syrian Chemical Weapons Programme," EC-84/DG.1, March 23, 2017.
170 OPCW, "Progress in the Elimination of the Syrian Chemical Weapons Programme," EC-89/DG.1, July 24, 2018, <https://www.opcw.org/fileadmin/OPCW/EC/89/en/ec89dg01_e_.pdf>.
171 Ibid, and OPCW, Opening Statement by the Director-General to the Executive Council at its Eighty-Seventh Session, EC-87/DG.22, March 13, 2018, <https://www.opcw.org/fileadmin/OPCW/EC/87/en/ec87dg21_e_.pdf>.
172 OPCW, "Decision: OPCW-United Nations Joint Investigative Mechanism Reports on Chemical Weapons Use in the Syrian Arab Republic," EC-83/DEC.5, Nov. 11, 2016, <https://www.opcw.org/fileadmin/OPCW/EC/83/en/ec83dec05_e_.pdf>.
173 OPCW, "Progress in the Elimination of the Syrian Chemical Weapons Programme," EC-89/DG.1, July 24, 2018, <https://www.opcw.org/fileadmin/OPCW/EC/89/en/ec89dg01_e_.pdf>.
174 OPCW, "Report of The OPCW on the Implementation of The Convention on The Prohibition of The Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction in 2015," C-21/4, November 30, 2016, <https://www.opcw.org/fileadmin/OPCW/CSP/C-21/en/c2104_e_.pdf>.
175 Sara Malm and Will Stewart, "Russia demands investigation into claims chemical weapons were used in Ukraine amid frantic efforts to secure fresh ceasefire," *MailOnline*, June 30, 2014, <http://www.dailymail.co.uk/news/article-2675422/Russia-demands-investigation-claims-chemical-weapons-used-Ukraine-amid-frantic-efforts-secure-fresh-ceasefire.html#ixzz4UAZcQl1b>.
176 "Russia has decided to postpone the filing of the application in the OPCW for the proceeding events in Odessa," RIN.RU, June 30, 2016, <http://news.rin.ru/eng/news///40896/1//>.

Observations

The OPCW demonstrated considerable creativity in accessing disputed territories as well as verifying the status of declared facilities and CW use in inaccessible territories in Libya and Syria.

- Despite the security situation, the OPCW DAT has visited Syria multiple times since April 2014 to discuss Syria's revisions to its initial declaration.[177]
- Once the Joint Mission ceased in September 2014, the UN Office for Project Services was authorized to provide subsequent logistical, administrative, and security support to the OPCW teams in Syria.[178] Cooperation between the two organizations allows the OPCW to continue to conduct verification missions in Syria.
- Despite the imposed no-fly zone and the ongoing war in Libya, the OPCW developed technical alternatives to verify the destruction of some of Libya's declared CW.
- The OPCW hired a contractor to install and maintain remote monitoring systems in Syria's CW-related facilities.
- As part of the joint UN-OPCW investigation of CW use, as well as for the later verification of destruction, the OPCW negotiated with both the Assad government and the opposition for access to roads controlled by the opposition and sometimes to sites within the opposition-held territory. Notably, in contrast to the IAEA's (and the US) stand on Crimea, the UN/OPCW negotiations for access with the opposition were not politicized. The negotiations were not perceived to challenge the Assad regime's sovereignty over the territories no longer under his control nor as acknowledgment of the legitimacy of the opposition's control.
  - At one of the declared CWPF facilities in Syria, which was under government control but connected by a road under opposition control, the OPCW mounted sealed video cameras with GPS on trucks to obtain visual confirmation that there was no material or production in the facility.
  - In another instance, the OPCW was unable to access storage tunnels in the opposition-controlled territory. The tunnels were too expansive to destroy and were therefore blocked in several places. The OPCW used remote monitoring—fiber optic seals and commercial satellites imagery— to verify that the tunnels were not reopened.

The OPCW has notably been very transparent in its reporting. Many OPCW documents related to the Executive Council decisions, director general reports, as well as documents related to its verification activities and findings are available online.

177 Ralf Trapp, "Report: Lessons Learned from the OPCW Mission in Syria," submitted to the Director-General of the Technical Secretariat of the OPCW, December 16, 2015, <http://www.the-trench.org/wp-content/uploads/2016/01/Trapp-20151216-OPCW-Syria-lessons-learned.pdf>.
178 Ibid.

Recommended Measures

Completeness and correctness

The OPCW has the authority to verify both the completeness and correctness of state declarations. It has exercised this authority inconsistently as evidenced by instances in which the OPCW allowed declarations to remain not only incomplete but incorrect (e.g., Libya, Burma, and South Africa). To rectify this inconsistency in the future:

- The OPCW needs to understand and evaluate the full scope of a state's chemical activities to be able to credibly assess the implementation of the CWC. The OPCW should assess the completeness of all declarations and receive the resources—including intelligence, open-source information and analysis tools, satellite imagery, manpower, and political backing—needed to make that assessment. A similar recommendation was noted by the OPCW Scientific Advisory Board's Temporary Working Group, which recommended taking into account all relevant data points pertaining to a state party by conducting a comprehensive systems-based approach where all separate elements of information are combined and analyzed systematically.[179] This will be especially important as the OPCW transitions from focusing on destruction to verification of industry. The IAEA experience in developing the State-Level Concept and broader conclusion could be useful in this regard.
- The DAT established for Syria should be given this task permanently. The DAT experience will be tremendously important for the verification of declaration of any of the three CWC hold-out states.
- The OPCW needs to access existing data sets to validate verification-related information. Other organizations (e.g., customs organizations, industry, shipments) maintain data sets that would be very useful for the OPCW. The OPCW should identify these entities and sign cooperation agreements with them as it recently did with the World Customs Union.
- State members should consider how to strengthen OPCW verification capabilities through technological development—especially the development of verification technologies, analytical tools, and open-source analysis.

Mandate full implementation and expansion

Like the IAEA, the OPCW has been operating in some cases under circumstances the CWC negotiators did not design or predict. The OPCW has been challenged by the use of CW by nonstate actors in fragile or failed states that cannot exercise their sovereignty, noncompliance, and the use of commercial chemicals as weapons. It increasingly has been using the CWC as a framework that can be adapted to face new challenges. The OPCW has also been preparing for an increase in tasks related to the post-destruction phase, especially the prevention of CW re-emergence and the assurance of

179 For a broader discussion on correctness and completeness in the OPCW verification work, see OPCW, "Verification Report of the Scientific Advisory Board's Temporary Working Group," SAB/REP/1/15, June 2015, <https://www.opcw.org/fileadmin/OPCW/SAB/en/Final_Report_of_SAB_TWG_on_Verification_-_as_presented_to_SAB.pdf>.

chemical safety and security. To strengthen the OPCW mandate and practices, the OPCW and its member states should consider the following:

- The OPCW should make public its judgment both of compliance and noncompliance. While the OPCW does not make a public determination regarding compliance with the CWC (aside from the decision on Syria, which was based on the Executive Council decision and UNSCRs), the OPCW should make its verification implementation report public. An annual report by the international organization responsible for the implementation of the CWC will serve both as an assurance measure that states parties live up to their treaty obligations as well as a transparency measure to assure that those that do not live up to their treaty obligations are reported as such. Such a report will not detract from each state party's right to continue to make national compliance determinations; it can also inform it and help in gathering international support to rectify noncompliance instances. The report should include:
  - Names of CWC states parties that the OPCW could and could not verify the correctness of their declarations;
  - Names of CWC states parties that the OPCW could and could not verify the completeness of their declarations;
  - Names of CWC states parties that have and have not adopted national implementation legislation, the lack of which could jeopardize the ability to identify, attribute, investigate, and prosecute those who violate the treaty, as well as an assessment of the effectiveness of such legislation;[180]
  - The names of all declarable and inspectable facilities; and
  - In case planned inspections were not conducted, the OPCW should include the reason and explain how it expects to gather the information necessary to ensure treaty implementation.
- The international community and states parties will benefit if the Technical Secretariat, Director General, and the Executive Council fully exercise their CWC mandate and report noncompliance issues. The current reporting is confined to Syria based on the 2013 Executive Council decision and UNSCRs, but the CWC itself authorizes these three bodies to handle concerns about compliance and cases of noncompliance as well as reporting these to the UNSC and UNGA.[181] For that purpose, the OPCW should operationalize the authorities it is given within the CWC to report suspected noncompliance and to resolve inconsistencies or incompleteness in declarations when it cannot do so. The Technical Secretariat will report such cases to the Director General who informs the Executive Council, which then decides whether to bring the issue to the attention of the UNSC and UNGA.

180 Notably, only states parties, not nonstate actors that include individuals living within state party, can violate the CWC. The existence of national legislation could assist states themselves with identifying, attributing, investigating, and prosecuting any party that violates the Convention.

181 Paragraphs 35 and 36 of Article VII and paragraph 40 of Article VIII of the CWC authorize the Technical Secretariat, Director General, and Executive Council to consider issues affecting the convention and its implementation, including concerns regarding compliance, and in cases of noncompliance, they can inform states parties and bring the issue to the Conference. In cases of grave and urgent noncompliance, the Executive Council can bring the issue to the attention of the UNGA and UNSC.

- » Member states should support the OPCW in exploring the legal, political, and technological tools it may need to address new threats such as the use of chemicals as CW, nonstate actors, noncompliance, and post-destruction verification.[182] It may approach this challenge with a method similar to the process conducted by the IAEA during the 1990s: identify areas in which the OPCW could expand its practices without requiring any new legal authority and those in which it is necessary to expand legal authority.
- » The OPCW needs to be supported by its members in activities that include the development of a viable industry verification regime, preparedness for nonroutine inspections, and collaboration with other IOs, industries, and entities.

Nonstate Actors: The OPCW has been creative in addressing the use of CW by nonstate actors by establishing FFMs in Syria, partnering with the JIM and investigating suspected CW use based on member state invitations. The OPCW will need the additional support of member states to develop tools that further the OPCW's capabilities and mandate in this regard. Specifically, they must provide access to information and intelligence and collaborate with other entities that may have information on material flows, movement, and transfers. The OPCW Road Map decision and the July 2018 Conference of the States Parties decision are important steps in this direction.[183]

Technology: The Libya and Syria cases provided the OPCW with opportunities to use, for the first time, new technologies such as mobile (portable) infrared Raman spectrometry, analysis of authentic samples at designated laboratories, remote monitoring systems, GPS-controlled tamper-proof video cameras on drones or host country vehicles, and satellite imagery. Innovation and flexibility with technology to address new challenges, including cases of no access, will continue to be important. While no remote technology can completely substitute for inspectors on the ground, it can ameliorate difficult situations, especially when the alternative is to acquire no information at all.

The OPCW should develop a long-term plan for how it will retain disarmament expertise, personnel, and technologies for the long run. This could prove difficult, especially after the destruction of all CW in the US and Russia.[184] In addition, the OPCW needs to develop a plan on how to address its transition from verifying destruction to verifying industry where it will have to employ more material accountancy methods.

Funding: The OPCW-established special fund for the operations in Syria should continue as a fund for special missions and contingency operations. States parties should continue to support it financially and politically, and the OPCW should develop contingency plans and operation procedures for such cases in the future.

182 The OPCW Executive Council October 2017 decision for a Road Map to address the nonstate actor threat is a positive step in that direction.

183 OPCW, "Addressing the Threat Posed by the use of Chemical Weapons by Non-State Actors," EC-86/DEC.9, October 13, 2017, <https://www.opcw.org/fileadmin/OPCW/EC/86/en/ec86dec09_e_.pdf>, and OPCW, "Decision Addressing the Threat from Chemical Weapons Use," C-SS-4/DEC.3, June 27, 2018, <https://www.opcw.org/fileadmin/OPCW/CSP/C-SS-4/en/css4dec3_e_.doc.pdf>.

184 For important discussions and recommended measures, see Christine Parthemore, "Technology in Context: Lessons from the Elimination of Weapons of Mass Destruction," *The Nonproliferation Review*, Vol. 23, 2016, Issue 1, pp. 83–99.

Annex 1 – IAEA Safeguards activities in the five case studies (2013–2017)[185]

Year	Facilities under safeguards	Material balance areas containing LOFs under safeguards	Number of facilities and LOFs inspected	Total number of inspections	Number of design information verifications	Number of complementary accesses	Person-days of inspection	Calendar days in the field for verification	Number of accounting reports received in the year	Percent of accounting reports late	Number of AP declarations received in the year	Percent of AP declarations late	Number of ICR received	Numbers of PIL received	Number of MBR units received
Iraq															
2013	1	1	0	0	0	0	0	0	12	0	16	0	–	–	–
2014	1	1	0	0	0	0	0	0	–	–	16	–	18	3	3
2015	1	1	0	0	0	0	2	7	–	–	16	–	30	2	2
2017	1	1	1	1	1	0	2	12	–	–	16	–	7	3	3
Japan/Fukushima															
2013	125	214	105	314	73	14	1498	2958	30690	<1	219	0	–	–	–
2014	125	202	102	315	62	19	1467	2745	–	–	222	–	27527	333	333
2015	125	200	103	299	55	16	1537	2836	–	–	220	–	21969	321	321
2017	125	201	98	269	61	22	1337	2768	–	–	219	–	14781	317	317
Libya															
2013	2	1	0	0	0	0	0	0	4	100	19	100	–	–	–
2014	2	1	2	2	2	1	4	8	–	–	23	–	0	4	4
2015	2	1	0	0	0	0	0	0	–	–	22	–	0	0	0
2017	2	1	2	2	2	0	4	10	–	–	19	–	0	0	0
Syria															
2013	1	1	0	0	0	Not app	0	0	2	50	Not app	Not app	–	–	–
2014	1	1	0	0	0	Not app	0	0	–	–	Not app	Not app	0	1	1
2015	1	1	1	1	1	Not app	2	5	–	–	Not app	Not app	0	2	2
2017	1	1	1	1	1	Not app	2	10	–	–	Not app	Not app	0	1	1
Ukraine/Crimea															
2013	34	8	28	62	28	5	157	336	12578	3	42	0	–	–	–
2014	34	8	27	67	24	0	210	303.5	–	–	22	–	3933	38	38
2015	37	8	28	74	27	3	203	348.5	–	–	19	–	5114	38	38
2017	37	8	25	43	20	7	166	330	–	–	31	–	4427	34	34

Not app	Not applicable, the country does not have an AP in force
–	Information not available due to changes in the SIR reporting categories
ICR	Inventory Change Reports
MBR	Material Balance Reports
PIL	Physical Inventory Listings

185 Based on publicly available SIRs for 2013–2017. See IAEA, SIR 2013, <https://armscontrollaw.files.wordpress.com/2014/06/iaea-2013-sir.pdf>; IAEA, SIR 2014, <https://armscontrollaw.files.wordpress.com/2015/07/sir-2014.pdf>; IAEA, SIR 2015, <https://armscontrollaw.files.wordpress.com/2015/07/sir-2014.pdf>, and SIR 2017, <https://armscontrollaw.files.wordpress.com/2018/05/iaea-2017-sir.pdf>. Since both Japan and Ukraine have multiple facilities under inspection, the absence of verification activities in one site will be hard to depict in this table.

About the Author

Dr. Chen Kane is the Middle East Nonproliferation Program director at the James Martin Center for Nonproliferation Studies at the Middlebury Institute for International Studies at Monterey. She focuses on projects related to reducing the proliferation of weapons of mass destruction and the projected expansion of nuclear energy with a particular focus on the Middle East. Dr. Kane also serves as an advisor to the National Nuclear Security Administration. Kane is the founder of the Middle East Next Generation Arms Control Network.

Prior to joining CNS, Dr. Kane served as a fellow in the nonproliferation program at the Center for Strategic and International Studies and worked for the Israel Atomic Energy Commission, eventually becoming the director of external relations. Dr. Kane has held research positions at the Belfer Center for Science and International Affairs at Harvard University, as well as the Washington Institute for Near East Policy.

Dr. Kane was an adviser to both the Jebsen Center for Counter-Terrorism at Tufts University and the Crown Center for Middle East Studies at Brandeis University, as well as an adjunct professor with the National Defense University. She holds a PhD and MALD from Tufts University's Fletcher School of Law and Diplomacy and an MA and BA from Tel Aviv University.

OCCASIONAL PAPERS AVAILABLE FROM CNS

online at https://nonproliferation.org/category/topics/cns_papers

#39 • Safeguards and Verification in Inaccessible Territories

#38 • Geo4Nonpro 2.0

#37 • All the World is Staged: An Analysis of Social Media Influence Operations against US Counterproliferation Efforts in Syria

#36 • North Korea's Information Technology Networks

#35 • Countering North Korean Procurement Networks Through Financial Measures: The Role of Southeast Asia

#34 • Open-Source Monitoring of Uranium Mining and Milling for Nuclear Nonproliferation Applications

#33 • WMD Proliferation Risks at the Nexus of 3D Printing and DIY Communities

#32 • Taiwan's Export Control System: Overview and Recommendations

#31 • Revisiting Compliance in the Biological Weapons Convention

#30 • Crowdsourcing Systems and Potential Applications in Nonproliferation

#29 • The Verification Clearinghouse: Debunking Websites and the Potential for Public Nonproliferation Monitoring

#28 • Geo4nonpro.org: A Geospatial Crowd- Sourcing Platform for WMD Verification

#27 • Searching for Illicit Dual Use Items in Online Marketplaces: A Semi-Automated Approach

#26 • 2016 Symposium Findings on Export Control of Emerging Biotechnologies

#25 • Outlawing State-Sponsored Nuclear Procurement Programs & Recovery of Misappropriated Nuclear Goods

#24 • Strengthening the ROK-US Nuclear Partnership

#23 • Replacing High-Risk Radiological Materials

#22 • A Blueprint to a Middle East WMD Free Zone

#21 • Biotechnology E-commerce: A Disruptive Challenge to Biological Arms Control

#20 • Countering Nuclear Commodity Smuggling: A System of Systems

#19 • Alternatives to High-Risk Radiological Sources

#18 • Stories of the Soviet Anti-Plague System

#17 • Ugly Truths: Saddam Hussein and Other Insiders on Iraq's Covert Bioweapons

#16 • Rethinking Spent Fuel Management in South Korea

#15 • Engaging China and Russia on Nuclear Disarmament

#14 • Nuclear Challenges and Policy Options for the Next US Administration

#13 • Trafficking Networks for Chemical Weapons Precursors: Lessons from the 1980s Iran-Iraq War

#12 • New Challenges in Missile Proliferation, Missile Defense, and Space Security

#11 • Commercial Radioactive Sources: Surveying the Security Risks

#10 • Future Security in Space: Commercial, Military, and Arms Control Trade-Offs

#09 • The 1971 Smallpox Epidemic in Aralsk, Kazakhstan, and the Soviet Biological Warfare Program

#08 • After 9/11: Preventing Mass-Destruction Terrorism and Weapons Proliferation

#07 • Missile Proliferation and Defences: Problems and Prospects

#06 • WMD Threats 2001: Critical Choices for the Bush Administration

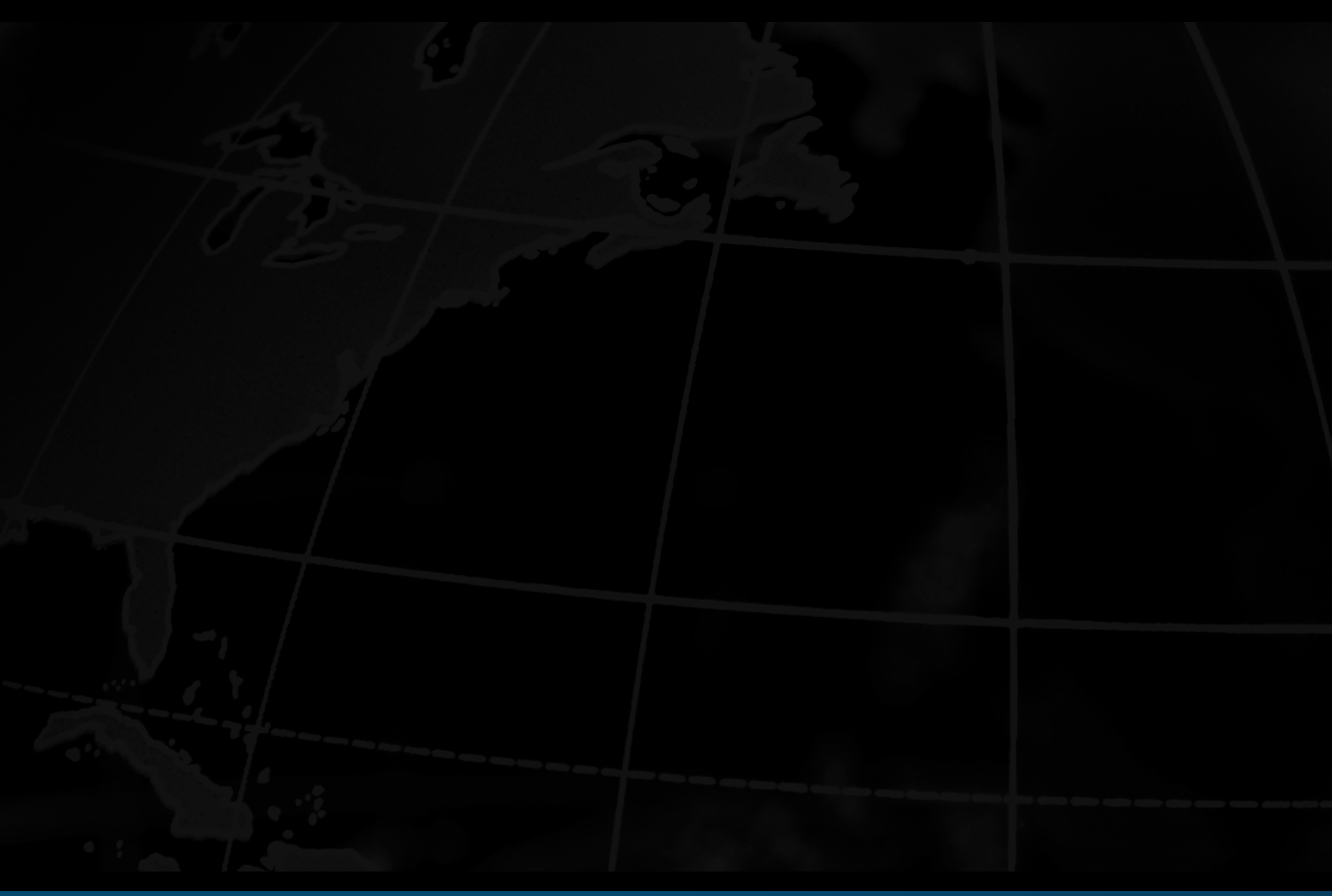
#05 • International Perspectives on Ballistic Missile Proliferation & Defenses

#04 • Proliferation Challenges and Nonproliferation Opportunities for New Administrations

#03 • Nonproliferation Regimes at Risk

#02 • A History of Ballistic Missile Development in the DPRK

#01 • Former Soviet Biological Weapons Facilities in Kazakhstan: Past, Present, and Future



nonproliferation.org

Middlebury Institute *of*
International Studies at Monterey
James Martin Center for Nonproliferation Studies