



**ADDING NOVICHOK NERVE
AGENTS TO THE CWC
ANNEX ON CHEMICALS:
A TECHNICAL FIX AND ITS IMPLICATIONS
FOR THE CHEMICAL WEAPONS PROHIBITION REGIME**

ALEXANDER KELLE

ACKNOWLEDGEMENTS

Support from UNIDIR core funders provides the foundation for all the Institute's activities. This project is supported by the Government of Norway.

The Institute thanks Cheng Tang, Dr. Stefano Costanzi and Dr. Ralf Trapp for their comments and suggestions on earlier versions of this report. UNIDIR's Cécile Aptel, James Revill, María Garzón Maceda, Maliha Khan and Yuanhu Yuin provided valuable support throughout. Design and layout are by Kathleen Morf.

While the majority of events analysed in this report took place over the course of the final two years of the author's tenure as a Senior Policy Officer (2013–2019) at the Organisation for the Prohibition of Chemical Weapons (OPCW), this study is based on numerous documents in the public domain. In addition, preparation of the manuscript during the second half of 2021 has benefitted from regular exchanges with several knowledgeable individuals from diverse and multidisciplinary backgrounds. In particular, the author would like to thank Dr. Jonathan Forman for helping him to develop many of the perspectives and understandings on which this paper, especially its more scientifically informed, technical sections, is based, and for many critical and constructive comments provided during its drafting. All remaining errors are, of course, the author's own.

Dr. Kelle has also benefitted greatly from the work of the OPCW Scientific Advisory Board (SAB) and the substantive reports produced by the Board when Dr. Forman served as its secretary. These reports, many of which are available on the OPCW website, are rich in citations to papers and events that shaped the OPCW's evolution, especially for the period discussed in this paper. The SAB reports are a unique record and contain a wealth of scholarly information that this report was able to draw upon.

Preparation of this report benefitted from a grant from the German Foundation for Peace Research (DSF) to the Institute for Peace Research and Security Policy at the University of Hamburg (IFSH), grant number SP03/05/2020. This support is gratefully acknowledged.

ABOUT UNIDIR

UNIDIR is a voluntarily funded, autonomous institute within the United Nations. One of the few policy institutes worldwide focusing on disarmament, UNIDIR generates knowledge and promotes dialogue and action on disarmament and security. Based in Geneva, UNIDIR assists the international community to develop the practical, innovative ideas needed to find solutions to critical security problems.

NOTE

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. The views expressed in the publication are the sole responsibility of the individual authors. They do not necessarily reflect the views or opinions of the United Nations, UNIDIR, its staff members or sponsors.

CITATION

A. Kelle, Adding Novichok Nerve Agents to the CWC Annex on Chemicals: a technical fix and its implications for the chemical weapons prohibition regime, Geneva, Switzerland: UNIDIR, 2022, <https://doi.org/10.37559/WMD/22/WMDCE/01>.

TABLE OF CONTENTS

| | |
|----------------------------------------------------------------------------------------------------------------------------------|-----------|
| SUMMARY | 1 |
| 1. INTRODUCTION | 2 |
| 2. NOVICHOK USE IN THE UNITED KINGDOM AND THE POLITICAL PROCESS AT THE OPCW | 4 |
| 3. NOVICHOK NERVE AGENTS AND THEIR INCLUSION IN THE CWC ANNEX ON CHEMICALS: FROM SPECULATION TO SCIENTIFIC FACT | 8 |
| 4. IMPLICATIONS FOR THE CHEMICAL WEAPONS PROHIBITION REGIME | 16 |

ABOUT THE AUTHOR

ALEXANDER KELLE is a Senior Researcher at the Berlin Office of the Institute for Peace Research and Security Policy at the University of Hamburg (IFSH), Germany. He served as a Senior Policy Officer at the Organisation for the Prohibition of Chemical Weapons (OPCW) from February 2013 to December 2019. Prior to this, he taught and conducted research at the universities of Bradford, Belfast and Bath, United Kingdom. Dr. Kelle's research has received funding from the European Union, the British Academy, the MacArthur Foundation, the North Atlantic Treaty Organization (NATO) and the German Foundation for Peace Research (DSF), among others. He received his PhD in political science from Goethe University Frankfurt.

His research focuses on the proliferation and prohibition of chemical and biological weapons. He is particularly interested in the evolution of the international regimes to prohibit these weapons and their institutional foundation as well as the effects of scientific and technological developments on proliferation risks and their prevention. Dr. Kelle's research has been published in numerous outlets, such as *The Non-proliferation Review*, *Contemporary Security Policy*, *International Affairs*, *Science and Engineering Ethics*, *Medicine, Conflict and Survival* and *Bulletin of the Atomic Scientists*. He has published seven books, including *Prohibiting Chemical and Biological Weapons: Multilateral Regimes and Their Evolution* (Lynne Rienner, 2014).

The views expressed in this report are those of the author and should not be attributed to any current or past employer.

ABBREVIATIONS AND ACRONYMS

| | |
|-------------|------------------------------------------------------|
| ABEO | Advisory Board on Education and Outreach |
| CAS | Chemical Abstracts Service |
| CSP | Conference of the States Parties to the CWC |
| CW | Chemical weapons |
| CWC | Chemical Weapons Convention |
| OPCW | Organisation for the Prohibition of Chemical Weapons |
| SAB | Scientific Advisory Board |



SUMMARY

In November 2019, the states parties to the Chemical Weapons Convention (CWC) adopted proposals to add novichok nerve agents to the CWC's Annex on Chemicals. This represented an important manifestation of cooperation in a CWC-implementation environment that is largely characterized by concerns about compliance and outright accusations of non-compliance. Yet, the question remains whether this technical amendment of the CWC has actually solved or only temporarily masked more fundamental CWC compliance and accountability issues.

This report discusses and analyses the use of a novichok nerve agent in the United Kingdom in March 2018. This triggered a political process at the Organisation for the Prohibition of Chemical Weapons (OPCW) that led to the amendment of the CWC schedules. It provides a factual overview of the scientific discussion around the novichok class of chemical agents, and how this has changed since the amendment of the CWC schedules was adopted. Against the background of the cases where nerve agents have been used for political assassination, the report concludes with a discussion of implications of the schedule amendments for compliance with, and implementation of, the chemical weapons prohibition regime.

In particular, it highlights the limitations inherent in list-based approaches for the operationalisation of a generic prohibition, such as the one contained in the CWC. The report also recommends that CWC states parties consider a re-affirmation and clarification of the CWC's general-purpose criterion in the context of the Fifth CWC Review Conference in May 2023. In addition, this report suggests that in order to continue to ensure compliance with the treaty's object and purpose, it may be useful to broaden the view and discuss, among other topics,

- Under which circumstances states parties would be willing to make use of tools foreseen in the CWC to ascertain compliance with its provisions;
- How new initiatives and mechanisms developed in recent years – such as the Fact-Finding Mission, Declaration Assessment Team, and Investigation and Identification Team – could be streamlined into the regular operation of the OPCW;
- Whether there is a willingness among OPCW member states to develop new tools for addressing the use of chemical warfare agents against individuals;
- How new and innovative ideas generated by key stakeholders in the chemical industry and the scientific community could be better used for improving compliance with the CWC; and
- What lessons we can learn from the biological weapons prohibition regime or the implementation of other relevant treaties for strengthening compliance with the CWC.

1 INTRODUCTION

Implementation of the Chemical Weapons Convention (CWC) is based on an elaborate verification regime of which the Convention's Annex on Chemicals forms a central element.¹ The Annex consists of three lists, so-called Schedules of Chemicals, with Schedule 1 containing the most toxic chemicals known to have been developed, produced, stockpiled or used as chemical warfare agents, as well as key final-stage precursors to these agents. These schedules, which entered into force with the CWC in April 1997, remained unchanged until June 2020, despite some accusations in the open literature that so-called "novichoks", potent "fourth-generation" nerve agents (henceforth referred to simply as novichoks) with greater toxicity than the nerve agents listed in CWC Schedule 1 had been investigated by scientists in the former Soviet Union.²

The issue was ultimately brought onto the agenda of the Organisation for the Prohibition of Chemical Weapons (OPCW), the CWC's implementing agency, only after the confirmation of the poisoning of a former Russian spy and his daughter by a chemical reported to be a novichok nerve agent in the United Kingdom in March 2018.³ This was followed by a second incident involving the same chemical (and this time resulting in a fatality) in June of that year.⁴ These incidents precipitated a flurry of activities involving extraordinary meetings of the OPCW Executive Council, and proposals for amendments to the Schedules being drafted, assessed and subsequently revised, along with a steep chemistry learning curve for diplomats in The Hague, the seat of the OPCW. The net result was the inclusion of families of chemicals, under the umbrella that covers the agent used in the 2018 incidents, within the CWC's Annex on Chemicals in June 2020.

¹ Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction, Organisation for the Prohibition of Chemical Weapons, 1993, <https://www.opcw.org/chemical-weapons-convention>; and Annex on Chemicals, <https://www.opcw.org/chemical-weapons-convention/annexes/annex-chemicals/annex-chemicals>.

² OPCW, "Report of the Scientific Advisory Board on Developments in Science and Technology for the Third Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention", RC-3/DG.1, 29 October 2012, https://www.opcw.org/sites/default/files/documents/CSP/RC-3/en/rc3dg01_e.pdf, paragraphs 9 and 82; and J. P. Perry Robinson, "Novichok Nerve Agents", Sussex Harvard Information Bank (SHIB), O-list Item 502, 2019.

³ OPCW, "Summary of the Report on Activities Carried Out in Support of a Request for Technical Assistance by the United Kingdom of Great Britain and Northern Ireland (Technical Assistance Visit TAV/02/18)", Note by the Technical Secretariat, S/1612/2018, 12 April 2018, https://www.opcw.org/sites/default/files/documents/S_series/2018/en/s-1612-2018_e_1.pdf; and M. Peplow, "Nerve Agent Attack on Spy Used 'Novichok' Poison", Chemical and Engineering News, vol. 96, no. 12 (19 March 2018), <https://cen.acs.org/articles/96/i12/Nerve-agent-attack-on-spy-used-Novichok-poison.html>.

⁴ OPCW, "Summary of the Report on Activities Carried Out in Support of a Request for Technical Assistance by the United Kingdom of Great Britain and Northern Ireland (Technical Assistance Visit TAV/03/18 and TAV/03B/18, 'Amesbury Incident')", S/1671/2018, 4 September 2018, <https://www.opcw.org/sites/default/files/documents/2018/09/s-1671-2018%28e%29.pdf>.

The identification of these chemicals as novichok, however, is acknowledged in neither the Annex on Chemicals nor other OPCW documents that define structures, scientific information or declaration-relevant information to support implementation of the amended Annex (such as the *Handbook on Chemicals* and decisions by the Executive Council that have added these chemicals to the OPCW Central Analytical Database⁵). The association of the terminology novichok with these chemicals appears primarily in open literature (including scientific publications) and in statements from some CWC states parties.

These events took place in an environment of CWC implementation that was largely characterized by concerns about compliance as well as outright accusations of non-compliance with the Convention by the Syrian Arab Republic.⁶ In the light of high levels of contestation of a key norm of the CW prohibition regime – that is, the norm against the use of CW – the agreement among the states parties and subsequent adoption of the amendment to Schedule 1 appears as a temporary island of cooperation in a sea of political gridlock and conflict over norm compliance.

This report continues (in chapter 2) with a discussion of the use of a novichok nerve agent in the United Kingdom in March 2018 and analyses the political processes that this triggered at the OPCW. These processes resulted in adoption of the Schedule amendment during the 24th Session of the OPCW Conference of the States Parties (CSP) to the CWC in November 2019. Following this overview, the report provides (in chapter 3) a factual look at the scientific discussion around the novichok class of chemical agents and how this has changed since the CSP adopted the CWC Schedule amendment. Against the backdrop of the novichok poisoning of Russian opposition leader Alexei Navalny in August 2020, it concludes (in chapter 4) with a discussion of the broader implications for compliance with and implementation of the CW prohibition regime. Relevant issues in this context comprise the scope of the verification regime in the light of the general-purpose criterion, the various utilities of chemical weapons, limitations in the current CWC compliance and verification architecture, and possible measures to address such limitations.⁷

⁵ OPCW, *Handbook on Chemicals*, Appendix 2 of the Declarations Handbook, 2022, <https://www.opcw.org/resources/declarations/handbook-chemicals>; and OPCW Executive Council, “Lists of Newly Validated Data on Scheduled Chemicals for Approval by the Executive Council for Inclusion in the OPCW Central Analytical Database”, Decision, EC-96/DEC.1, 9 March 2021, <https://www.opcw.org/sites/default/files/documents/2021/03/ec96dec01%28e%29.pdf>; and OPCW, Executive Council, “Lists of Newly Validated Data on Scheduled Chemicals for approval by the Executive Council for inclusion in the OPCW Central Analytical Database”, Decision, EC-99/DEC.1, 8 March 2022, <https://www.opcw.org/sites/default/files/documents/2022/03/ec99dec01%28e%29.pdf>.

⁶ OPCW, “Syria and the OPCW”, <https://www.opcw.org/media-centre/featured-topics/syria-and-opcw>.

⁷ On the general-purpose criterion see paragraphs 1–2 of Article II of the Chemical Weapons Convention, <https://www.opcw.org/chemical-weapons-convention/articles/article-ii-definitions-and-criteria>.

2 NOVICHOK USE IN THE UNITED KINGDOM AND THE POLITICAL PROCESS AT THE OPCW

Allegations of the use of a novichok nerve agent in the city of Salisbury, United Kingdom, on 4 March 2018 against a former Russian spy, Sergey Skripal, and his daughter burst onto the international scene just over a week later. Following a statement by the British Prime Minister, Theresa May, on 12 March 2018,⁸ the United Kingdom told the OPCW Executive Council that, based on preliminary findings, it had concluded that it was

*highly likely that the Russian Federation, a fellow State Party to the Chemical Weapons Convention and fellow member of this Executive Council is implicated in chemical weapons use, whether by failure to control its own materials or by design. And in whichever scenario, the Russian Federation has failed, for many years, to declare chemical weapons development programmes dating from the 1970s.*⁹

The Russian Federation, in turn, rejected all accusations levelled against it, describing the British authorities' accusations of Russia's "involvement in using poisonous agents on their territory" as "unfounded" and "absolutely unacceptable" and suggested that the United Kingdom "immediately avail itself of the [clarification] procedures provided for by paragraph 2 of Article IX of the CWC".¹⁰ The United Kingdom did not pursue this bilateral course of action. Instead, it raised the matter at the OPCW without invoking the formal clarification procedures foreseen in CWC Article IX, including those involving the Executive Council.

Following that session of the Executive Council, the United Kingdom requested a Technical Assistance Visit, during which an OPCW team independently collected both biomedical and environmental samples. The sample analysis performed, independently, by a number of OPCW designated laboratories confirmed the identity of the chemical and that it matched what the United Kingdom had previously reported.¹¹ However, the OPCW report did not identify this chemical as a novichok nerve agent, only as a toxic chemical. The assessment that it was a match with the chemical reported by the United Kingdom was based on molecular structure (which the OPCW report noted as "allegedly a nerve agent"), not chemical name. In the light of these findings, the OPCW Director-General requested the OPCW Scientific Advisory Board (SAB) to conduct a detailed review and prepare a report on new types of nerve agent¹². In its response, the SAB recommended, among other things, "considering whether any changes to the Schedules of Chemicals involving new nerve agents and their precursors would be warranted in order to

⁸ T. May, "PM Commons statement on Salisbury incident", 12 March 2018, <https://www.gov.uk/government/speeches/pm-commons-statement-on-salisbury-incident-12-march-2018>.

⁹ United Kingdom of Great Britain and Northern Ireland, "Statement by H.E. Ambassador Peter Wilson, Permanent Representative of the United Kingdom of Great Britain and Northern Ireland to the OPCW at the Eighty-Seventh Session of the Executive Council", EC-87/NAT.5, 13 March 2018, https://www.opcw.org/sites/default/files/documents/EC/87/en/ec87nat05_e.pdf.

¹⁰ Russian Federation, "Statement by H.E. Ambassador A.V. Shulgin Permanent Representative of the Russian Federation to the OPCW at the Eighty-Seventh Session of the Executive Council (on the Chemical Incident in Salisbury)", EC-87/NAT.9, 13 March 2018, https://www.opcw.org/sites/default/files/documents/EC/87/en/ec87nat09_e.pdf.

¹¹ OPCW, S/1612/2018.

¹² OPCW, "Request for Information from States Parties on New Types of Nerve Agents", Note by the Director-General, S/1621/2018, 2 May 2018, https://www.opcw.org/sites/default/files/documents/S_series/2018/en/s-1621-2018_e.pdf.

ensure that appropriate restrictions and monitoring are implemented”.¹³ Furthermore, reinforcing additional points raised by the SAB regarding the lack of available information on these new types of nerve agent, a second novichok incident took place in the United Kingdom, in Amesbury on 30 June 2018, just three days before the Board’s report was published.¹⁴

Shortly after the March 2018 regular session of the Executive Council, Russia requested an additional meeting of the Council to discuss the allegations directed against it.¹⁵ At this meeting, which took place on 4 April, there was a wide-ranging exchange of views on the poisoning in the United Kingdom and how it should be dealt with. Notably, Guatemala asked

*the Technical Secretariat, through the Director-General, to inform the States Parties in a timely manner as to whether this incident – which involves the use of a substance not included in the Annex on Chemicals – might drive us to use the procedure specified in Article XV, paragraphs 1, 4 and 5 directed at minimising the possibility of it being used again.*¹⁶

This marked the first mention of a possible amendment of the CWC Schedules by a state party, without actually triggering the process foreseen in CWC Article XV.¹⁷

An additional meeting of the Executive Council was convened shortly afterwards at the request of the United Kingdom in order to discuss the findings of the report of the Technical Assistance Visit issued by the OPCW Technical Secretariat.¹⁸ During this meeting Italy noted that the

*identification of a new family of non-scheduled nerve agent is a major concern and a worrying challenge to the OPCW’s verification regime: The Technical Secretariat in cooperation with the industry cluster and the Scientific Advisory Board should quickly be involved so as to reach conclusions on a scientific basis proposing the necessary measures to be adopted.*¹⁹

¹³ OPCW, Scientific Advisory Board, “Report of the Scientific Advisory Board at its Twenty-Eighth Session, 10–14 June 2019”, SAB-28/1, 14 June 2019, https://www.opcw.org/sites/default/files/documents/2019/09/sab-28-01%28e%29_0.pdf, p. 18; and OPCW, Scientific Advisory Board, “Response to the Director-General’s Request to the Scientific Advisory Board to Provide Advice on New Types of Nerve Agents”, SAB-28/WP.1, 3 July 2019.

¹⁴ OPCW, S/1671/2018.

¹⁵ OPCW, “Request by the Russian Federation to Convene a Meeting of the Executive Council”, Note by the Director-General, EC-M-57/1, 30 March 2018, https://www.opcw.org/sites/default/files/documents/EC/M-57/en/ecm5701_e_s.pdf.

¹⁶ Guatemala, “Statement by the Delegation of Guatemala at the Fifty-Seventh Meeting of the Executive Council”, EC-M-57/NAT.13, 4 April 2018, https://www.opcw.org/sites/default/files/documents/EC/M-57/en/ecm57nat13_e_.pdf, p.1.

¹⁷ Coincidentally, during that same time period the SAB was also expressing views on reviewing and possibly amending Schedules for unrelated reasons. See OPCW, Scientific Advisory Board, “Report of the Scientific Advisory Board on Developments in Science and Technology for the Fourth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention”, RC-4/DG.1, 30 April 2018, https://www.opcw.org/sites/default/files/documents/CSP/RC-4/en/rc4dg01_e_.pdf, paragraph 24.

¹⁸ OPCW, “Request by the United Kingdom of Great Britain and Northern Ireland to Convene a Meeting of the Executive Council”, Note by the Director-General, EC-M-59/1, 12 April 2018, https://www.opcw.org/sites/default/files/documents/EC/M-59/en/ecm5901_e_.pdf.

¹⁹ Italy, “Statement by H.E. Ambassador Andrea Perugini Permanent Representative of Italy to the OPCW at the Fifty-Ninth Meeting of the Executive Council”, EC-M-59/NAT.13, 18 April 2018, https://www.opcw.org/sites/default/files/documents/EC/M-59/en/ecm59nat13_e_.pdf, p. 2.

At the same Executive Council meeting, Russia recommended that “the Director-General of the OPCW Technical Secretariat should prepare and introduce at the soonest OPCW Executive Council meeting, in accordance with the paragraph 5 of the Article XV of the Convention, a draft decision providing for the development of changes to the Annex on the schedules of chemicals”.²⁰ Thus, while calls for the Technical Secretariat to prepare a Schedule amendment were put forward already in April 2018, those making the calls did not fully appreciate that this would require a formal request by one or more CWC states parties.

This changed on 16 October 2018, when the United States of America, Canada and the Netherlands jointly submitted a formal proposal to amend the Schedule of Chemicals according to CWC Article XV. Following the procedure foreseen in paragraph 5 of that article, the Director-General provided an evaluation of the proposal in mid-December.²¹ On 14 January 2019, the Executive Council held its 62nd meeting and adopted the joint US–Canadian–Netherlands proposal by consensus, with Russia disassociating itself from the consensus without opposing the decision.²² While this process played out, Russia submitted its own set of proposals to amend CWC Schedule 1 on 30 November, which the Director-General in turn evaluated.²³ At a meeting on 25 February 2019, the Executive Council decided by vote to reject the Russian proposals, which consisted of a set of five individual elements submitted as a package, largely because the Technical Secretariat assessed that one of the five elements did not meet the requirements for inclusion in Schedule 1.²⁴

The procedure contained in paragraph 5 of Article XV foresees a silence period of 90 days after any Executive Council decision on a Schedule amendment, which allows the states parties an opportunity to change the course of events. On 9 April 2019 Russia objected to the approval of the joint proposal, and Burundi objected to the rejection of the Russian proposal.²⁵ As a result, the next available session of the Conference of the States Parties had to address both proposals as a matter of substance. Russia modified its proposal in the intervening period, and put forward suggestions under which the complete set of proposals might be consolidated into a single amendment.²⁶ While agreement on developing a consolidated amendment could not be reached

²⁰ Russian Federation, “Aide Memoire of the Russian Federation on Enhancement of the Chemical Weapons Convention”, EC-M-59/NAT.4, 18 April 2018, https://www.opcw.org/sites/default/files/documents/EC/M-59/en/ecm59nat04_e.pdf, p. 6.

²¹ OPCW, “Evaluation of the Proposal Submitted by Canada, the Netherlands, and the United States of America for a Change to the Annex on Chemicals of the Chemical Weapons Convention”, Note by the Director-General, EC-M-62/DG.2, 14 December 2018.

²² OPCW, “Report of the Sixty-Second Meeting of the Executive Council”, EC-M-62/2, 14 January 2019, <https://www.opcw.org/sites/default/files/documents/2019/01/ecm6202%28e%29.pdf>.

²³ OPCW, Executive Council, “Evaluation of the Proposals Submitted by the Russian Federation for a Change to the Annex on Chemicals of the Chemical Weapons Convention”, EC-M-63/DG.2, Corr.1 and Corr.2, 29 January 2019.

²⁴ OPCW, EC-M-63/DG.2, Corr.1 and Corr.2; and see, for example, the British statement at the 63rd meeting of the OPCW Executive Council, 25 February 2019, <https://www.opcw.org/sites/default/files/documents/2019/02/Statement%20by%20Nicola%20Stewart%2C%20Deputy%20Permanent%20Representative%20of%20the%20UK%20at%20EC-M-63.pdf>.

²⁵ Burundi, “Request for Circulation of a Document”, EC-M-63/NAT.4, 9 April 2019.

²⁶ OPCW, “Note Verbale 1035 (Dated 7 June 2019) from the Permanent Representation of the Russian Federation on the Circulation of Notes Verbales 771 and 775 Regarding Proposed Technical Changes to the Annex on Chemicals to the Chemical Weapons Convention”, Note by the Director-General, S/1765/2019, 14 June 2019; OPCW, “Joint Diplomatic Note 02-Ca/NL/US-2019, Dated 3 June 2019, from the Permanent Representations of Canada, the Netherlands, and the United States of America in Response to the Diplomatic Note from the Russian Federation Dated 30 April 2019, Regarding Proposed Technical Changes to the Annex on Chemicals to the Chemical Weapons Convention”, Note by the Director-General, S/1758/2019, 3 June 2019; and OPCW, “Note Verbale 1868 from the Permanent Representation of the Russian Federation to the OPCW Regarding a Consolidated List of Chemicals for the Introduction of Changes to Schedule 1 of the Annex on Chemicals to the Chemical Weapons Convention Dated 27 September 2019”, Note by the Director-General, S/1797/2019, 27 September 2019.

by the states, in the end the joint proposal and the modified Russian proposal were adopted by consensus under a single gavel stroke by the CSP in November 2019.²⁷ The OPCW Technical Secretariat subsequently issued a consolidated text of both proposals to be inserted into Schedule 1 of the CWC Annex on Chemicals, which entered into force on 20 June 2020.²⁸

In preparation for the entry into force of the Schedule amendment, the Technical Secretariat issued guidance concerning changes resulting from the decisions to help states parties ensure their continued compliance with Article VI. The guidance distinguishes four scenarios in which a state party might find itself, depending on whether or not it has declared a Schedule 1 facility and whether or not activities related to the newly added chemicals are undertaken at such a facility. For each of the four scenarios, the Secretariat outlined implications for initial declarations under Article VI, facility agreements and inspections of relevant facilities.²⁹ It is unclear how many states parties have been affected by these changes. However, the fact that some states are affected can be inferred from the inclusion of a number of these new types of chemical substance in the OPCW's *Handbook on Chemicals*, the validation of related analytical data by the OPCW Validation Group³⁰ and the inclusion of validated analytical data in the OPCW Central Analytical Database.³¹ Addition of these chemicals to the database is noteworthy, as the SAB had recommended making such data available to ensure that the Technical Secretariat and the designated laboratories had adequate knowledge and information to aid in the analysis of new types of nerve agent and their analogues.³² It is also noteworthy that the analysis of biomedical samples collected during a Technical Assistance Visit requested by Germany in response to the 2020 poisoning of Russian opposition leader Alexey Navalny reported a new nerve agent analogue that was unscheduled (i.e., it appeared in none of the CWC Schedules).³³ The unscheduled chemical was reported as having a molecular structure that combined features characteristic of several of the chemicals added to Schedule 1 in June 2020.³⁴

²⁷ OPCW, "Changes to the Annex on Chemicals to the Chemical Weapons Convention", 2019, <https://www.opcw.org/changes-annex-chemicals>; and OPCW, Conference of the States Parties, "Technical Change to Schedule 1(A) of the Annex on Chemicals to the Chemical Weapons Convention", Decision, C-24/DEC.4; and "Changes to Schedule 1 of the Annex on Chemicals to the Chemical Weapons Convention", C-24/DEC.5, 27 November 2019, <https://www.opcw.org/resources/documents/conference-states-parties/twenty-fourth-session-conference-states-parties>.

²⁸ OPCW, "Consolidated Text of Adopted Changes to Schedule 1 of the Annex on Chemicals to the Chemical Weapons Convention", Note by the Technical Secretariat, S/1820/2019, 23 December 2020, <https://www.opcw.org/sites/default/files/documents/2019/12/s-1820-2019%28e%29.pdf>.

²⁹ OPCW, "Guidance for States Parties on Article VI Declaration Obligations and Inspections Following Entry into Force of Changes to Schedule 1 of the Annex on Chemicals to the Chemical Weapons Convention", Note by the Technical Secretariat, S/1821/2019/Rev.1, 14 January 2020, <https://www.opcw.org/sites/default/files/documents/2020/01/s-1821-2019r1%28e%29.pdf>.

³⁰ OPCW, "Report of the Fiftieth Meeting of the Validation Group for the Updating of the OPCW Central Analytical Database, 16 September 2020", Note by the Technical Secretariat, S/1914/202/Rev.1, 16 December 2020, <https://www.opcw.org/sites/default/files/documents/2020/12/s-1914-2020r1%28e%29.pdf>; and OPCW, "Report of the Fifty-Second Meeting of the Validation Group for the Updating of the OPCW Central Analytical Database, 22 September 2021", Note by the Technical Secretariat, S/2001/2021, 5 November 2021, <https://www.opcw.org/sites/default/files/documents/2021/11/s-2001-2021%28e%29.pdf>.

³¹ OPCW, EC-96/DEC.1; and OPCW, EC-99/DEC.1.

³² OPCW, SAB-28/1; and OPCW, SAB-28/WP.1.

³³ OPCW, "Summary of the Report on Activities Carried out in Support of a Request for Technical Assistance by Germany (Technical Assistance Visit – TAV/01/20)", Note by the Technical Secretariat, S/1906/2020, 6 October 2020, <https://www.opcw.org/sites/default/files/documents/2020/10/s-1906-2020%28e%29.pdf>.

³⁴ OPCW, S/1906/2020.

3 NOVICHOK NERVE AGENTS AND THEIR INCLUSION IN THE CWC ANNEX ON CHEMICALS: FROM SPECULATION TO SCIENTIFIC FACT

Speculation and discussion in open literature as well as scientific and technical publications on the existence of new types of nerve agent called novichoks long predated the Skripal incident.³⁵ The SAB had actually considered the topic in 2011 as part of its scientific review for the Board's report on developments in science and technology to the Third CWC Review Conference, in 2013.³⁶ At that time, as well as at the time of the Director-General's request in 2018, there was no information available that could scientifically confirm or verifiably attribute any of the speculation about the origin and properties of these "new" nerve agents. While some technical publications did provide chemical structures, there were inconsistencies between publications and no information was available that could independently verify that any of these structures were the novichok nerve agents allegedly investigated in the Soviet Union.

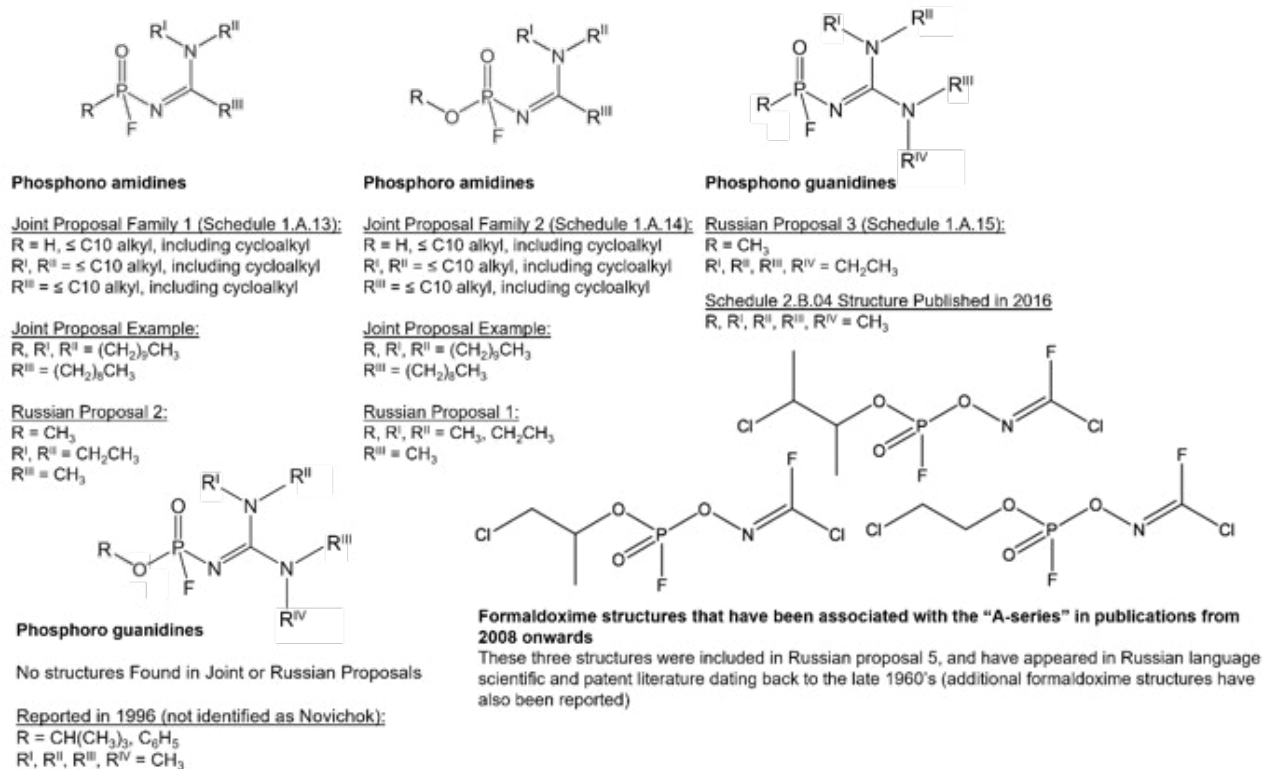
The published structures encompassed a diversity of molecules, some of which resembled phosphonofluoridate-type G-series nerve agents (e.g., chemicals found within CWC Schedule 1.A.01) with either amidine, guanidine or formaldoxime moieties substituted for the alkoxy group, and also included analogous phosphorofluoridate chemical structures (figure 1).³⁷ These publications often assigned the structures to a set of nerve agents referred to as the "A-series". For many of these molecular structures there was no assigned Chemical Abstracts Service (CAS) registry number and no available scientific literature with associated experimental data. The primary exceptions to the absence of experimental information and CAS numbers had appeared in Russian-language chemistry publications and patents dating back to the late 1960s and early 1970s for some of the formaldoxime structures.³⁸

³⁵ For an example in the open literature, see V. S. Mirzayanov, *State Secrets: An Insider's Chronicle of the Russian Chemical Weapons Program*, 2008, pp. 142–149. Scientific and technical publications include V. Pitschmann, "Overall View of Chemical and Biochemical Weapons", *Toxins*, vol. 6, no. 6 (2014), pp. 1761–1784, <https://doi.org/10.3390/toxins6061761>; E. Halánek and Z. Koblíha, "Potential Chemical Warfare Agents", *Chemicke Listy*, vol. 105, no. 5 (2011), pp. 323–333 (in Czech); M. Guidotti and F. Trifirò, "Chemical Risk and Chemical Warfare Agents: Science and Technology Against Humankind", *Toxicological & Environmental Chemistry*, vol. 98, no. 9 (2015), pp. 1018–1025, <https://doi.org/10.1080/0277248.2014.996153>; H. D. Ellison, *Chemical and Biological Warfare Agents*, 2nd edn., 2008; and S. L. Hoenig, *Compendium of Chemical Warfare Agents*, 2007. See also A. E. Smithson et al., *Chemical Weapons Disarmament in Russia: Problems and Prospects*, Henry L. Stimson Center, October 1995, https://www.stimson.org/sites/default/files/file-attachments/Report17_1.pdf.

³⁶ OPCW, RC-3/DG.1; and OPCW, Scientific Advisory Board, "Report of the Sixteenth Session of the Scientific Advisory Board", SAB-16/1, 6 April 2011, https://www.opcw.org/sites/default/files/documents/SAB/en/sab-16-01_e.pdf, paragraphs 11.1–11.2.

³⁷ OPCW, RC-3/DG.1; and S. Costanzi, J.-H. Machado and M. Mitchell, "Nerve Agents: What They Are, How They Work, How to Counter Them", *ACS Chemical Neuroscience*, vol. 9, no. 5 (2018), pp. 873–885, <https://doi.org/10.1021/acschemneuro.8b00148>.

³⁸ S. I. Malekin et al., "Mechanism of Reactions of Gem-chloronitrosoalkanes with Tervalent Phosphorus Compounds", *Journal of General Chemistry of the USSR (English translation)*, vol. 42, no. 4 (1972), pp. 799–802, *Zhurnal Obshchei Khimi*, vol. 42, no. 4, pp. 807–811; S. I. Malekin et al., "Phosphorylated Oximes. X. Reactions of 2-alkoxy-1,3,2-oxazaphospholidines with Gem-chloronitrosoalkanes", *Journal of General Chemistry of the USSR (English translation)*, vol. 42, no. 2 (1972), pp. 293–295, *Zhurnal Obshchei Khimi*, vol. 42, no. 2, pp. 302–305; Y. L. Kruglyak, S. I. Malekin and I. V. Martynov, "Phosphorylated Oximes. XII. Reactions of 2-halophospholanes with Dichlorofluoronitrosomethane", *Zhurnal Obshchei Khimi*, vol. 42, no. 4 (1972), pp. 811–814; I. V. Martynov, Y. L. Kruglyak and S. I. Malekin, "Carbonyl Halide Oxime b-chloroalkyl Fluorophosphates", Soviet Patent SU 241433 19690418, 1969 (in Russian); and I. V. Martynov, Y. L. Kruglyak and S. I. Malekin, Soviet Patent SU 245097 19690614, 1969 (in Russian).

Figure 1: Chemical structures associated with the terminology novichok in open, scientific or patent literature


Notes: For further information on phosphono- and phosphoroamidines and phosphoguanidines included in proposals and Schedule amendments, see OPCW, "Consolidated Text of Adopted Changes to Schedule 1 of the Annex on Chemicals to the Chemical Weapons Convention", Note by the Technical Secretariat, S/1820/2019, 23 December 2020, <https://www.opcw.org/sites/default/files/documents/2019/12/s-1820-2019%28e%29.pdf>. For further information on phosphono- and phosphoroguanidine compounds reported in scientific literature that were not included in any Schedule amendments, see S. E. Hosseini et al., "Fragmentation Pathways and Structural Characterization of Organophosphorus Compounds Related to the Chemical Weapons Convention by Electron Ionization and Electrospray Ionization Tandem Mass Spectrometry", *Rapid Communications in Mass Spectrometry*, vol. 30 (2016), pp. 2585–2593, <https://doi.org/10.1002/rcm.7757>; and J. Münchenberg et al., "Synthesis of Organophosphorous-N-(N',N'',N''',N''-tetramethyl) Guanidinide Fluorides and Their Reaction with Chalcogens and Triphenylmethyl Azide; Synthesis and Characterization of Organochalcogeno- and Phenyltriphenylmethylirino-phosphonic-N-(N',N'',N''',N''-tetramethyl)guanidinide Fluorides", *Zeitschrift für Naturforschung B*, vol. 51 (1996), pp. 1150–1160. For further information on formaldoximes in Russian scientific and patent literature, see S. I. Malekin et al., "Mechanism of Reactions of Gem-chloronitrosoalkanes with Tervalent Phosphorus Compounds", *Journal of General Chemistry of the USSR (English translation)*, vol. 42, no. 4 (1972), pp. 799–802, *Zhurnal Obshchei Khimi*, vol. 42, no. 4, pp. 807–811; S. I. Malekin et al., "Phosphorylated Oximes. X. Reactions of 2-alkoxy-1,3,2-oxazaphospholidines with Gem-chloronitrosoalkanes", *Journal of General Chemistry of the USSR (English translation)*, vol. 42, no. 2 (1972), pp. 293–295, *Zhurnal Obshchei Khimi*, vol. 42, no. 2, pp. 302–305; Y. L. Kruglyak, S. I. Malekin and I. V. Martynov, "Phosphorylated Oximes. XII. Reactions of 2-halophospholanes with Dichlorofluoronitrosomethane", *Zhurnal Obshchei Khimi*, vol. 42, no. 4 (1972), pp. 811–814; I. V. Martynov, Y. L. Kruglyak and S. I. Malekin, "Carbonyl Halide Oxime b-chloroalkyl Fluorophosphates", *Soviet Patent SU 241433 19690418*, 1969 (in Russian); and I. V. Martynov, Y. L. Kruglyak and S. I. Malekin, *Soviet Patent SU 245097 19690614*, 1969 (in Russian). For further information on formaldoxime compounds associated with novichok terminology, see H. D. Ellison, *Chemical and Biological Warfare Agents*, 2nd edn., 2008; S. L. Hoening, *Compendium of Chemical Warfare Agents*, 2007; V. Pitschmann, "Overall View of Chemical and Biochemical Weapons", *Toxins*, vol. 6, no. 6 (2014), pp. 1761–1784, <https://doi.org/10.3390/toxins6061761>; E. Halánek and Z. Koblíha, "Potential Chemical Warfare Agents", *Chemicke Listy*, vol. 105, no. 5 (2011), pp. 323–333 (in Czech); M. Guidotti and F. Trifirò, "Chemical Risk and Chemical Warfare Agents: Science and Technology Against Humankind", *Toxicological & Environmental Chemistry*, vol. 98, no. 9 (2015), pp. 1018–1025, <https://doi.org/10.1080/02772248.2014.996153>; and E. X. Albuquerque, M. Adler and E.F.R. Pereira, "Method of Treating Organophosphorous Poisoning", *US Patent US9132135B2*, 2015.

The Russian publications did not identify any of the chemicals as novichok or as having any association to chemical warfare agents. In general, the papers provided sparse information on any uses of these chemicals beyond several (primarily indirect) mentions of pesticides. The association of the formaldoxime structures with the term novichok began to appear in the late 2000s in non-Russian publications (including in patents related to the treatment of organophosphate poisoning).³⁹ However, these publications provided no information that could verify those associations.

At the time of the Director-General's request to the SAB, information found within the open and scientific literature was limited to speculation that novichoks were nerve agents, that there were structural variants, and that both unitary and binary versions had been developed, with inconsistencies on what the actual molecular structures were.⁴⁰ No documents could be found with verifiable information or data on toxicity, physical properties (beyond those reported in Russian chemistry literature on formaldoxime compounds⁴¹), medical treatment, and suitable protective equipment or detection methods. A notable exception to the lack of experimental information was a 2016 study published by scientists at one of the OPCW designated laboratories. The paper reported mass spectral data on a phosphonofluoridate structure that contained a guanidine moiety and met the criteria for a chemical structure that falls under Schedule 2.B.04 of the CWC.⁴² The substance was prepared by microsynthesis (i.e., generating a quantity of material suitable for mass spectral analysis and not isolated or purified). The specific chemical was referred to as a novichok in the published work (its structure is defined in figure 1); however, there was no information to independently verify that claim. The phosphoroguanidine structures illustrated in figure 1 had also been reported in open literature as possible novichok agents, but chemicals with these structures did not actually appear in any of the Schedule amendment proposals.⁴³ However, two chemicals meeting the general description of the phosphorofluoridate family of figure 1 had been published in scientific literature in 1996 as part of a study looking at rotation of phosphorus–nitrogen bonds in conjugated systems. The paper made no association of these chemicals with the term novichok or with any use as a chemical warfare agent.⁴⁴

The inclusion of novichok terminology in patent literature deserves further mention. The relevant patents primarily concern medical treatments for (or countermeasures against) nerve agents or neurological disorders, with a smaller number of documents pertaining to physical protection, sampling and analysis, decontamination and destruction, or other applications. None of these

³⁹ Ellison, *Chemical and Biological Warfare Agents*; Hoenig, *Compendium of Chemical Warfare Agents*; Pitschmann, "Overall View of Chemical and Biochemical Weapons"; Halánek and Koblíha, "Potential Chemical Warfare Agents"; Guidotti and Trifirò, "Chemical Risk and Chemical Warfare Agents"; and E. X. Albuquerque, M. Adler and E. F. R. Pereira, "Method of Treating Organophosphorous Poisoning", US Patent US9132135B2, 2015.

⁴⁰ OPCW, SAB-28/1; and OPCW, SAB-28/WP.1

⁴¹ Malekin et al., "Mechanism of Reactions of Gem-chloronitrosoalkanes with Tervalent Phosphorus Compounds"; Malekin et al., "Phosphorylated Oximes. X. Reactions of 2-alkoxy-1,3,2-oxazaphospholidines with Gem-chloronitrosoalkanes"; Kruglyak et al., "Phosphorylated Oximes. XII. Reactions of 2-halophospholanes with Dichlorofluoronitrosomethane"; Martynov et al., "Carbonyl Halide Oxime b-chloroalkyl Fluorophosphates"; and Martynov et al., Soviet Patent SU 245097 19690614.

⁴² S. E. Hosseini et al., "Fragmentation Pathways and Structural Characterization of Organophosphorus Compounds Related to the Chemical Weapons Convention by Electron Ionization and Electrospray Ionization Tandem Mass Spectrometry", *Rapid Communications in Mass Spectrometry*, vol. 30 (2016), pp. 2585–2593, <https://doi.org/10.1002/rcm.7757>.

⁴³ OPCW, SAB-28/WP.1; and Mirzayanov, *State Secrets*.

⁴⁴ J. Münchenberg et al., "Synthesis of Organophosphonous-N-(N',N',N',N"-tetramethyl) Guanidinide Fluorides and Their Reaction with Chalcogens and Triphenylmethyl Azide; Synthesis and Characterization of Organochalcogeno- and Phenyltriphenylmethylirino-phosphonic-N-(N',N',N',N"-tetramethyl)-guanidinide Fluorides", *Zeitschrift für Naturforschung B*, vol. 51 (1996), pp. 1150–1160.

patents, however, are for inventions of nerve agents or nerve agent-production processes.⁴⁵ The context in which the term novichok appears in these patents is limited to general lists of chemical names that could be considered nerve agents for which the patent might be relevant. Likewise, these patents contain no experimental information on the preparation or properties of these chemicals (the patents are not about novichok) and many of the descriptions and claims within these patents also include non-nerve agent chemicals among the toxic chemical substances listed.⁴⁶

The SAB reviewed all of this available information for its response to the Director-General.⁴⁷ A set of potentially relevant families of chemical structures (including structures defined in figure 1 and others) were identified. Yet, as noted above, there was insufficient information for verification of any claims about the substances (and whether or not they represented novichok agents). The SAB could also find no examples of commercial sources, current uses or applications for any of the families of chemicals reviewed.

The Board did provide recommendations, including the consideration of amending the Annex on Chemicals as described above. Other recommendations focused on needs and approaches for developing knowledge and capabilities about the new types of agent in order to equip the Technical Secretariat and the designated laboratories to respond to further incidents with these chemicals (especially for detection and assistance and protection purposes).⁴⁸ With insufficient information available to implement those recommendations, the SAB report urged states parties to share information with the Technical Secretariat in a manner that minimized any potential proliferation risk (proliferation concerns were frequently raised during the discussions on the SAB report and the Schedule changes proposed by states parties).⁴⁹ It is noteworthy that the scientific and patent literature that refers to novichok found its way into some of the public and political debate related to the Schedule change proposals. In some instances, these documents were cited as evidence that states other than the former Soviet Union had invented novichok.⁵⁰ (This featured in many of the counter narratives to what had been stated by British authorities.⁵¹) The information in these publications, however, could not support (or provide any insight into) any such allegations. To aid the SAB in its review of new types of nerve agent, the Director-

⁴⁵ OPCW, SAB-28/WP.1.

⁴⁶ See, for example, J. T. Hupp et al., "Metal Organic Frameworks for the Catalytic Detoxification of Chemical Warfare Nerve Agents", US Patent 9623404B2, 2018, which lists numerous chemical agents that the invention is claimed to be able to detoxify. Many of the listed chemicals are not actually nerve agents.

⁴⁷ OPCW, S/1621/2018; OPCW, SAB-28/1; and OPCW, SAB-28/WP.1.

⁴⁸ OPCW, SAB-28/1; and OPCW, SAB-28/WP.1.

⁴⁹ See, for example, the British statement at the 63rd meeting of the OPCW Executive Council, 25 February 2019, <https://www.opcw.org/sites/default/files/documents/2019/02/Statement%20by%20Nicola%20Stewart%2C%20Deputy%20Permanent%20Representative%20of%20the%20UK%20at%20EC-M-63.pdf>

⁵⁰ Russian Federation, EC-M-59/NAT.4; Russian Federation, "Statement by G.V. Kalamonov Deputy Minister of Industry and Trade of the Russian Federation and I.V. Rybalchenko Professor, Doctor of Chemical Sciences, Expert of the Ministry of Defence of the Russian Federation", EC-M-57/NAT.4, 4 April 2018, https://www.opcw.org/sites/default/files/documents/EC/M-57/en/ecm57nat04_e.pdf; Russian Federation, "Statement by H.E. Ambassador A.V. Shulgin, Permanent Representative of the Russian Federation to the OPCW, at the Fifty-Ninth Meeting of the OPCW Executive Council", EC-M-59/NAT.3, 18 April 2018, https://www.opcw.org/sites/default/files/documents/EC/M-59/en/ecm59nat03_e.pdf; Russian Federation, "Request for Information from States Parties on New Types of Nerve Agents", SAB-28/INF.1, 28 September 2018; and Russian Federation, "Considerations Regarding the Schedules of Chemicals of the Annex on Chemicals to the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction", RC-4/NAT.35, 5 December 2018.

⁵¹ G. Ramsay and S. Robertshaw, "Weaponising News: RT, Sputnik and Targeted Disinformation", King's College London, Centre for the Study of Media, Communication & Power, 2019, <https://www.kcl.ac.uk/policy-institute/research-analysis/weaponising-news>.

General requested states parties to also provide information.⁵² Only Russia publicly acknowledged responding to this request, providing the SAB with copies of a number of the scientific publications and patents that had been cited in political statements alleging that Western states may have invented or produced novichok.⁵³

More information has become available since the publication of the SAB report. This encompasses information for emergency responders,⁵⁴ scientific papers reviewing the previous literature and providing new insights into the variety of chemical structures speculated to have been associated with the novichok terminology,⁵⁵ computational studies,⁵⁶ and new papers reporting experimental work related to structural characterization, detection, hydrolysis or decontamination.⁵⁷

The technical considerations described here provide the backdrop against which the proposals for amending the CWC Annex on Chemicals have to be seen. The United States, Canada and the Netherlands jointly submitted the first such proposal.⁵⁸ It presented two families of amidine structures (these were the phosphono and phosphoro analogues illustrated in figure 1). Each family was defined by molecular structures having four variable groups of alkyl or cycloalkyl substituents with up to 10 carbon atoms each, as well as their protonated and alkylated salt variations. The example chemicals that were ultimately included in the Annex on Chemicals in June 2020 based on the joint proposal had three of these four variable groups defined as linear chains of 10 carbon atoms with the fourth variable group (the alkyl chain attached to the methyldene carbon of the amidine moiety) defined as a linear chain of 9 carbon atoms (in effect a 10-carbon alkylidene structure; these molecular structures are illustrated in figure 1). However,

⁵² OPCW, S/1621/2018.

⁵³ Russian Federation, SAB-28/INF.1.

⁵⁴ United States Department of Health and Human Services, "Fourth Generation Agents", 19 January 2019, <https://chemm.hhs.gov/nerveagents/FGAReferenceGuide.htm>; S. McGhee et al., "Nerve Agents: A Guide for Emergency Nurses, Part 1", *Emergency Nurse*, vol. 29, no. 3 (2021), <https://doi.org/10.7748/en.2019.e1896>; and Public Health England, "Briefing Note for Emergency Departments—Management of Suspected Novichok Poisonings", July 2018, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/738497/ED_briefing_note_nerve_agents.pdf.

⁵⁵ E. Nepovimova and K. Kuca, "Chemical Warfare Agent NOVICHOK – Mini-Review of Available Data", *Food and Chemical Toxicology*, vol. 121 (2018), pp. 343–350, <https://doi.org/10.1016/j.fct.2018.09.015>; M. Kloske and Z. Witkiewicz, "Novichoks – The A group of Organophosphorus Chemical Warfare Agents", *Chemosphere*, vol. 221 (2019), pp. 672–682, <https://doi.org/10.1016/j.chemosphere.2019.01.054>; and L. M. de Fonseca Carvalho, "Novichok(s): A Challenge to the Chemical Weapons Convention", *Revista de Ciências Militares*, vol. 9, no. 2 (2021), pp. 39–62, https://www.ium.pt/?page_id=6461.

⁵⁶ Y. A. Imrit et al., "Theoretical Study of the Hydrolysis Mechanism of A-234; The Suspected Novichok Agent in the Skripal Attack", *RSC Advances*, vol. 10, no. 47 (2020), pp. 27,884–27,893, <https://doi.org/10.1039/D0RA05086E>; I. Lyagin and E. Efremenko, "Theoretical Evaluation of Suspected Enzymatic Hydrolysis of Novichok Agents", *Catalysis Communications*, vol. 120 (2019), pp. 91–94, <https://doi.org/10.1016/j.catcom.2018.11.019>; K. Jeong and J. Choi, "Theoretical Study on the Toxicity of 'Novichok' Agent Candidates", *Royal Society Open Science*, vol. 6, no. 8 (2019), 190414, <https://doi.org/10.1098/rsos.190414>; and K. Jeong et al., "Vapor Pressure and Toxicity Prediction for Novichok Agent Candidates Using Machine Learning Model: Preparation for Unascertained Nerve Agents after Chemical Weapons Convention Schedule 1 Update", *Chemical Research in Toxicology*, 2022, <https://doi.org/10.1021/acs.chemrestox.1c00410>.

⁵⁷ S. M. Bester et al., "Crystal Structure of Recombinant Human Acetylcholinesterase Inhibited by A-234", *RCSB Protein Data Bank*, 1 July 2020, <https://doi.org/10.2210/pdb6NTL/pdb>; D. Noort et al., "Verification of Exposure to Novichok Nerve Agents Utilizing a Semitargeted Human Butyrylcholinesterase Nonapeptide Assay", *Chemical Research in Toxicology*, vol. 34, no. 8 (2021), pp. 1926–1932, <https://doi.org/10.1021/acs.chemrestox.1c00198>; J. Y. Lee, K. C. Lim and H. S. Kim, "Characterization and Study on Fragmentation Pathways of a Novel Nerve Agent, 'Novichok (A234)', in Aqueous Solution by Liquid Chromatography–Tandem Mass Spectrometry", *Molecules*, vol. 26, no. 4 (2021), p. 1059, <https://doi.org/10.3390/molecules26041059>; S. P. Harvey, L. R. McMahon and F. J. Berg, "Hydrolysis and Enzymatic Degradation of Novichok Nerve Agents", *Heliyon* vol. 6, no. 1 (2020), e03153, <https://doi.org/10.1016/j.heliyon.2019.e03153>; and P. Jacquet et al., "Enzymatic Decontamination of G-Type, V-Type and Novichok Nerve Agents", *International Journal of Molecular Sciences*, vol. 22, no. 15 (2021), p. 8152, <https://doi.org/10.3390/ijms22158152>.

⁵⁸ OPCW, Executive Council, "Recommendation for a Change to Schedule 1 of the Annex on Chemicals to the Chemical Weapons Convention", Decision, EC-M-62/DEC.1, 14 January 2019, <https://www.opcw.org/sites/default/files/documents/2019/01/ecm62dec01%2B%28e%29.pdf>.

these specific structures of example chemicals from the joint proposal had not been previously found in open or scientific literature associated with novichok agents. The family descriptions of the joint proposal did, however, capture amidine-containing structures that had been associated with novichok agents in unverified open literature. The direct association of the families within the proposal with novichok agents was found in statements by diplomats in support of the proposal, rather than the proposal itself.⁵⁹ These statements also indicated that the chemical used in Salisbury was found within one of the proposed families.⁶⁰ The family descriptions were very broad, with an estimated 3×10^{11} theoretically possible molecular structures based on the total number of possible non-cycloalkyl variations alone.⁶¹ Indeed, if cycloalkyl variations and the possibility of salts for which alkyl groups and associated anions are not constrained are factored in, then there is no theoretical limit for molecular structures. This approach provides a means to encompass all potentially toxic analogues of these types of chemical. Criticism of the proposal pointed to the possibility that some of the chemicals falling under this broad umbrella of molecular structures (with emphasis on the chemicals containing the 9- and 10-carbon linear alkyl chains used as examples) might include substances with relatively low toxicity and, additionally, that adding only two families of chemicals might not be comprehensive enough.⁶² While some of this criticism came from states parties debating the merits of the proposal (in particular, Russia⁶³), the issue of coverage of types of new agents had also been raised by academic researchers, whose criticism applied to both the joint and the Russian proposals for Schedule amendment.⁶⁴

The Russian schedule amendment proposal took a different approach, providing five individual proposals (these underwent several updates to provide greater clarity on the nature of the chemicals being considered for inclusion).⁶⁵ The final proposals included phosphono- and phosphoramidine structures like those in the joint proposal, but allowing only one or two carbon atoms for each of the four variable groups (resulting in a total coverage of six phosphoro analogues and a single phosphono analogue under the descriptions provided; see figure 1). These families also included example chemicals falling within the defined limits of the carbon chains. The three additional proposals included a single phosphonoguanidine structure, a group

⁵⁹ Canada, "Statement by H.E. Ambassador Sabine Nölke Permanent Representative of Canada to the OPCW at the Ninetieth Session of the Executive Council", EC-90/NAT.14, 12 March 2019, <https://www.opcw.org/sites/default/files/documents/2019/03/ec90nat14%28e%29.pdf>; United States of America, "Statement by H.E. Ambassador Kenneth D. Ward Permanent Representative of the United States of America to the OPCW at the Ninetieth Session of the Executive Council", EC-90/NAT.7, 12 March 2019, <https://www.opcw.org/sites/default/files/documents/2019/03/ec90nat07%28e%29.pdf>; and Netherlands, "Statement by H.E. Ambassador Paul van den IJssel Permanent Representative of the Kingdom of the Netherlands to the OPCW at the Sixty-Second Meeting of the Executive Council", EC-M-62/NAT.3, 14 January 2019, <https://www.opcw.org/sites/default/files/documents/2019/01/ecm62nat03%28e%29.pdf>.

⁶⁰ Canada, EC-90/NAT.14; United States of America, EC-90/NAT.7; and Netherlands, EC-M-62/NAT.3.

⁶¹ There are 879 possible (non-cyclo)alkyl side chains possible with 1–10 carbon atoms. Of the 4 substituents, 2 can also have R = H (figure 1), and the other 2 are found in a dialkylamino group (for which there are a combined total of asymmetric and symmetric configurations. This gives a total number of possibilities not accounting for cycloalkyl groups of $880 \times 880 \times 386,760 = 2.995 \times 10^{11}$.

⁶² Russian Federation, "Statement by H.E. Ambassador A.V. Shulgin Permanent Representative of the Russian Federation to the OPCW at the Sixty-Second Meeting of the Executive Council", EC-M-62/NAT.4, 14 January 2019, <https://www.opcw.org/sites/default/files/documents/2019/02/ecm62nat04%28e%29.pdf>.

⁶³ Russian Federation, EC-M-62/NAT.4.

⁶⁴ S. Costanzi and G. D. Koblenz, "Novichok Agents: Further Amending the Chemical Weapons Convention Schedules and the Australia Group Precursors List after the Navalny Incident", Presentation at ACS National Meeting Spring 2021, 9 April 2021, <https://www.morressier.com/article/novichok-agents-further-amending-chemical-weapons-convention-schedules-australia-group-precursors-list-navalny-incident/609136926e987178c2dc73e9>.

⁶⁵ OPCW, Executive Council, "Recommendation for a Change to Schedule 1 of the Annex on Chemicals to the Chemical Weapons Convention", Draft Decision, EC-M-63/DEC/CRP.1, 19 February 2019.

of 14 formaldoxime structures, and two families of bisquaternary ammonium carbamate compounds that had been reported in a series of United States patents issued to the US Army in the 1980s.⁶⁶ The carbamates are mentioned here for completeness in describing the schedule amendment proposals, but are not elaborated on as they are not organophosphorus-based substances and they have not been associated with novichok terminology.

Additionally, the collective set of chemical structures that were proposed was actually not exclusively unscheduled. Like the guanidine-containing phosphonofluoridate compound reported in 2016 (figure 1), all the phosphonoamidine and phosphonoguanidine structures in the Russian proposal, and compounds that fell under the joint proposal's phosphonoamidine family with the carbon chain attached directly to the phosphorus atom limited to one, two or three carbons (e.g., methyl, ethyl, n-propyl and iso-propyl) already fell under the description of Schedule 2.B.04. However, the joint proposal went beyond the structures of Schedule 2.B.04 by allowing all the variable groups attached to the phosphorus atom to be larger than three carbon atoms. None of this could be considered a hindrance to updating the Schedules as proposed: Schedule 2.B.04 specifies that when chemicals meeting the criteria of 2.B.04 are also covered under Schedule 1, they are to be considered Schedule 1 chemicals.⁶⁷

The Director-General's evaluation of the joint proposal identified no impediments to inclusion of the two proposed families in Schedule 1.⁶⁸ As noted above, the proposal was recommended for adoption by the Executive Council in January 2019. However, the Director-General's evaluation of the Russian proposals found the group of formaldoximes to be inconsistent with the criteria for inclusion in Schedule 1.⁶⁹ While the Executive Council saw no impediments for the inclusion of the remaining Russian proposals within Schedule 1, it did not approve the overall package of proposals for adoption due to the Council members being unable to reach a consensus on the inclusion of the formaldoxime structures.

From a technical perspective, the formaldoxime compounds were believed to be unlikely to have been used in the Skripal poisoning. These substances are expected to be readily prone to hydrolysis and would not be consistent with the environmental stability observed with the chemical used in Salisbury (supporting this view, slow rates of hydrolysis for phosphono- and phosphoroamidines, including the chemical reportedly used in Salisbury, has recently been experimentally observed and reported in scientific literature).⁷⁰

⁶⁶ The content of the patents is reviewed in J. C. Ball, "Binding of Quaternary Ammonium Salts to Acetylcholine Receptors: Possible Chemical Warfare Nerve Agents", *Military Medical Science Letters*, vol. 82, no. 1 (2013), pp. 2–24, <https://doi.org/10.31482/mmsl.2013.001>.

⁶⁷ See Chemical Weapons Convention, Annex on Chemicals, Schedule 2, <https://www.opcw.org/chemical-weapons-convention/annexes/annex-chemicals/schedule-2>.

⁶⁸ OPCW, EC-M-62/DG.2.

⁶⁹ OPCW, EC-M-63/DG.2, Corr.1 and Corr.2; and Guidelines for inclusion in Schedules are contained in the Chemical Weapons Convention, Annex on Chemicals, <https://www.opcw.org/chemical-weapons-convention/annexes/annex-chemicals/annex-chemicals>.

⁷⁰ Harvey et al., "Hydrolysis and Enzymatic Degradation of Novichok Nerve Agents".

In the lead up to the 24th Conference of the States Parties, where the joint and Russian proposals were scheduled to be voted on, the Russian delegation drafted a compromise proposal to combine their five groups with the joint proposal.⁷¹ However, the sponsors of the joint proposal did not accept this.⁷² Ultimately, Russia agreed to remove the formaldoxime proposal from further consideration, while continuing to suggest approaches to combine the joint proposal and the four remaining Russian proposals into a single amendment.⁷³ As noted above, ultimately the joint proposal along with the four remaining Russian proposals were adopted under two separate decisions by consensus.⁷⁴

After adoption, the Technical Secretariat provided text for an updated Schedule 1.⁷⁵ As the Russian phosphono- and phosphoroamidine proposals contained molecular structures that fell under the molecular family descriptions of the joint proposal, these were considered to be included within the coverage of the joint proposal. The combined groups were assigned as Schedules 1.A.13 (phosphonoamidines) and 1.A.14 (phosphoroamidines). The example chemicals from the Russian proposals 1 and 2 were included alongside the joint proposal example chemicals in the new families 1.A.13 and 1.A.14. The remaining Russian proposals (3 and 4) were added to the Annex as the new Schedule 1.A.15, which comprises a single phosphonoguanidine structure; and the new Schedule 1.A.16, which comprises two families of bisquaternary ammonium carbamate compounds that, as noted above, are not associated with novichok.

It is noteworthy that official OPCW publications in the period leading up to the Schedule amendment generally avoided use of the term novichok, yet publications in scientific and open literature refer to the chemicals added to the Schedules as novichoks, A-series agents or fourth-generation nerve agents.⁷⁶

⁷¹ OPCW, S/1765/2019.

⁷² OPCW, S/1758/2019.

⁷³ OPCW, C-24/DEC.4 and C-24/DEC.5; and OPCW, S/1797/2019.

⁷⁴ OPCW, "Changes to the Annex on Chemicals to the Chemical Weapons Convention"; and OPCW, C-24/DEC.4 and C-24/DEC.5.

⁷⁵ OPCW, S/1820/2019.

⁷⁶ US Department of Health and Human Services, "Fourth Generation Agents; McGhee et al., "Nerve Agents: A Guide for Emergency Nurses, Part 1"; Public Health England, "Briefing Note for Emergency Departments—Management of Suspected Novichok Poisonings"; Nepovimova and Kuca, "Chemical Warfare Agent NOVICHOK"; Kloske and Witkiewicz, "Novichoks"; de Fonseca Carvalho, "Novichok(s)"; Imrit et al., "Theoretical Study of the Hydrolysis Mechanism of A-234"; Lyagin and Efremenko, "Theoretical Evaluation of Suspected Enzymatic Hydrolysis of Novichok Agents"; Jeong and Choi, "Theoretical Study on the Toxicity of 'Novichok' Agent Candidates"; Jeong et al., "Vapor Pressure and Toxicity Prediction for Novichok Agent Candidates Using Machine Learning Model"; Bester et al., "Crystal Structure of Recombinant Human Acetylcholinesterase Inhibited by A-234"; Noort et al., "Verification of Exposure to Novichok Nerve Agents Utilizing a Semitargeted Human Butyrylcholinesterase Nonapeptide Assay"; Lee et al., "Characterization and Study on Fragmentation Pathways of a Novel Nerve Agent, 'Novichok (A234)"; Harvey et al., "Hydrolysis and Enzymatic Degradation of Novichok Nerve Agents"; and Jacquet et al., "Enzymatic Decontamination of G-Type, V-Type and Novichok Nerve Agents".

4 IMPLICATIONS FOR THE CHEMICAL WEAPONS PROHIBITION REGIME

What the amendment of Schedule 1 has accomplished – beyond the fact that states parties were able to find a compromise solution – is the expansion of the list of chemicals annexed to the CWC for verification purposes. However, the poisoning of Alexei Navalny with yet another, unscheduled chemical of the novichok-group has demonstrated that no list, no matter how long and sophisticated, will ever be complete.⁷⁷ This is not to deny the usefulness of the Schedules as a verification tool. Rather, it is to point out that they are not sufficient to address comprehensively the threat of chemical weapons (CW).

The descriptions used in some of the CWC Schedules to capture specific types of nerve agent or their precursors define families of molecular structures that have variable numbers of atoms – these give rise to unlimited numbers of related chemical substances (e.g., Schedules 1.A.03, 1.A.13, 1.A.14 and 2.B.04 in particular). Other schedules define a specific chemical (or chemicals), which limits coverage to those specific molecular structures (this would include Schedule 1.A.15).⁷⁸ Thus, it is difficult at best to develop a defined “list” of actual scheduled chemicals, independent of the issue of trying to identify and list unscheduled chemicals. Hence, while further amending the CWC Schedules might help the CWC verification toolbox to catch up with a newly identified CW agent, it cannot solve the underlying reality, captured in the CWC, that any toxic chemical used to harm people or animals is considered a chemical weapon, not only those covered by the schedules.⁷⁹

The poisoning of Alexei Navalny took place less than two months after the Schedule amendments came into effect. The OPCW reported that the chemical agent was unscheduled yet contained structural elements of both Schedules 1.A.14 and 1.A.15.⁸⁰ These facts clearly demonstrate the limitations of list-based approaches.⁸¹ In the aftermath of the Navalny poisoning, Russia first proposed an OPCW Technical Assistance Visit to help clarify the circumstances of the Navalny poisoning. Yet, even though the Director-General repeatedly confirmed that a team to conduct such a visit was ready to be dispatched, the Technical Assistance Visit never took place.⁸² Against this background, on 5 October 2021 the United Kingdom and 44 co-sponsoring CWC states parties used the procedure of CWC Article IX, paragraph 2, to ask Russia for four specific points

⁷⁷ OPCW, S/1906/2020; and D. Steindl et al., “Novichok Nerve Agent Poisoning”, *The Lancet*, 16 January 2021, pp. 249–252, [https://doi.org/10.1016/S0140-6736\(20\)32644-1](https://doi.org/10.1016/S0140-6736(20)32644-1).

⁷⁸ G. Pontes et al., “Nomenclature, Chemical Abstracts Service Numbers, Isomer Enumeration, Ring Strain, and Stereochemistry: What Does Any of This Have to Do with an International Chemical Disarmament and Nonproliferation Treaty?”, *Journal of Chemical Education*, vol. 97, no. 7 (2020), pp. 1715–1730, <https://doi.org/10.1021/acs.jchemed.0c00547>. See also C. M. Timperley and J. E. Forman, “Reply to ‘Comment on “Nomenclature Chemical Abstracts Service Numbers, Isomer Enumeration, Ring Strain and Stereochemistry: What Does Any of This Have to Do with an International Chemical Disarmament and Nonproliferation Treaty?”’”, *Journal of Chemical Education*, vol. 98, no. 4 (2021), <https://doi.org/10.1021/acs.jchemed.1c00134>; and S. Costanzi et al., “Lists of Chemical Warfare Agents and Precursors from International Nonproliferation Frameworks: Structural Annotation and Chemical Fingerprint Analysis”, *Journal of Chemical Information Modeling*, vol. 60, no. 10 (2020), pp. 4804–4816, <https://doi.org/10.1021/acs.jcim.0c00896>.

⁷⁹ Costanzi and Koblenz, “Novichok Agents”.

⁸⁰ OPCW, S/1906/2020.

⁸¹ OPCW, S/1906/2020.

⁸² OPCW, “Featured Topic: Case of Mr Alexei Navalny”, <https://www.opcw.org/media-centre/featured-topics/case-mr-alexei-navalny>.

of clarification.⁸³ In response, Russia quickly issued a lengthy compilation of documents that did not address these concerns, and accused France, Germany, Sweden and the United Kingdom of misusing the provisions of the CWC for political ends.⁸⁴ After Russia thus “shut the door to the least confrontational solution to the dispute”,⁸⁵ even more CWC states parties – a total of 55 – reiterated the request during the CSP in November 2021.⁸⁶ For the time being, they seem to have decided not to escalate their quest for clarification. In addition to formally involving the OPCW Executive Council, this could involve a challenge inspection or an investigation of alleged use invoked under CWC Article IX. While the potential of these procedures to attribute the use of a novichok nerve agent against Alexei Navalny beyond circumstantial evidence is questionable, it is certain that such additional steps would bring further political polarization among CWC states parties.

Going beyond the specifics of the three instances of novichok poisoning, there are more fundamental compliance and accountability concerns. The first is related to a practical implementation issue concerning the broad scope of the CW prohibition regime. The general-purpose criterion, as contained in the CWC’s definition of a chemical weapon in Article II, subparagraph 1(a), defines all toxic chemicals as CW whenever they are used to cause harm to humans or animals, “except where intended for purposes not prohibited under this Convention, as long as the types and quantities are consistent with such purposes”. Yet, this raises the question of how anyone tasked with compliance-related activities under the CWC can know whether or not a chemical is scheduled or if it is intended to be used as a CW? In principle, understanding the molecular structure and comparing that to a family or molecular description as defined in the Schedules should be sufficient to determine whether a chemical is contained in the Annex on Chemicals. Unfortunately, while this may be straightforward to a chemist, it is likely to be impractical for those tasked with more general implementation and oversight activities (e.g., where list-based approaches are favoured). Solutions to this issue through informatics-based approaches have been described,⁸⁷ but these still require the development of tools that can be routinely used by non-chemists. Likewise, even if such tools were readily available, there are open questions on what is required to suitably evaluate and accept these tools for adoption by CWC states parties.

⁸³ United Kingdom of Great Britain and Northern Ireland, “Request for Circulation of a Document at the Ninety-Eighth Session of the Executive Council”, EC-98/NAT.7, 5 October 2021, <https://www.opcw.org/sites/default/files/documents/2021/10/ec98nat07%28e%29.pdf>. United Kingdom of Great Britain and Northern Ireland, “Request for Circulation of a Document at the Ninety-Eighth Session of the Executive Council”, EC-98/NAT.11, 11 October 2021, <https://www.opcw.org/sites/default/files/documents/2021/10/ec98nat11%28e%29.pdf>.

⁸⁴ Russian Federation, “Request for Circulation of a Document at the Ninety-Eighth Session of the Executive Council”, EC-98/NAT.8, 7 October 2021, <https://www.opcw.org/sites/default/files/documents/2021/10/ec98nat08%28e%29.pdf>.

⁸⁵ O. Meier and A. Kelle, “The Navalny poisoning: Moscow Evades Accountability and Mocks the Chemical Weapons Convention”, *Bulletin of the Atomic Scientists*, 19 October 2021, <https://thebulletin.org/2021/10/the-navalny-poisoning-moscow-evades-accountability-and-mocks-the-chemical-weapons-convention>.

⁸⁶ Bulgaria, “Joint Statement on Behalf of 55 States Parties Delivered by H.E. Ambassador Krassimir Kostov, Permanent Representative of Bulgaria to the OPCW at the Twenty-Sixth Session of the Conference of the States Parties under Agenda Item 9(d)”, 29 November 2021, https://www.opcw.org/sites/default/files/documents/2021/11/BG_on_behalf_of_55_on_Navalny_CSP-26_Item_9d.pdf.

⁸⁷ Costanzi et al., “Lists of Chemical Warfare Agents and Precursors from International Nonproliferation Frameworks”; A. Kelle and J. E. Forman, “Verifying the Prohibition of Chemical Weapons in a Digitalized World”, in T. Reinhold, N. Schörnig (eds.), *Armament, Arms Control and Artificial Intelligence: The Impact of Software, Machine Learning and Artificial Intelligence on Armament and Arms Control*, in press; and V. Borrett et al., *Science and Technology for WMD Compliance Monitoring and Investigations*, UNIDIR, 2020, <https://doi.org/10.37559/WMD/20/WMDCE11>.

Even though the CWC contains a comprehensive prohibition on CW use, the use of novichok agents against individuals for assassination purposes raises a further, potentially thorny, compliance issue of a political nature, concerning the various utilities of chemical weapons. When states negotiated the bulk of the CWC during the 1980s, their primary goal was to restrain inter-state armed conflict through the prohibition of CW possession and use. Clearly, as both terrorist use of toxic chemicals and the use of nerve agents for assassination purposes discussed here have demonstrated, the contexts in which toxic chemicals are regarded as useful weapons have evolved. If toxic chemicals are repeatedly assigned sufficient utility as a weapon for political assassination purposes, in the end this might undermine the norms against CW possession and use, and the CW prohibition regime more broadly. Considering the potential for terrorist use of CW after the unconventional attacks on the United States on 11 September 2001 and the mailing of anthrax spores through the US postal system, CWC states parties acted swiftly by creating an Open-Ended Working Group on Terrorism at a December 2001 meeting of the Executive Council. The text of the CWC does not even mention the possibility of use of CW by a non-state or terrorist actor. Yet, states parties saw the need and had the political will to address the issue through the lens of CWC implementation more broadly, even though none of the core norms of the CW prohibition regime was directly at stake. The Technical Secretariat has also provided discussion papers addressing how the implementation of the Convention contributes to counter-terrorism.⁸⁸ This has set a precedent enabling the OPCW to address issues that some might argue are peripheral to the CWC's original objective. This is not to argue for the creation of an open-ended working group on the general-purpose criterion. However, CWC states parties should re-affirm and clarify the general-purpose criterion as going beyond inter-state use of toxic chemicals as weapons. In practical terms, such a re-affirmation and clarification could be discussed during the run-up to the Fifth CWC Review Conference, in May 2023, and either inserted into the political declaration of the Review Conference or issued as a stand-alone declaration.

The amendment of the CWC Schedule points to issues of broader limitations in the current CWC compliance and verification architecture. It also highlights possible measures to address such limitations. In a nutshell, the question that arises is whether "business as usual" is sustainable given the issues that have come up in the context of the Schedule amendment. To be clear, this is not to argue that the Convention is in need of amending. On the contrary, the Convention has been written in a suitably open-ended form that allows states parties to change policies when there is reason to do so in order to maintain compliance with the treaty's object, purpose and resultant obligations. Several areas for consideration come to mind:

- The Convention foresees the challenge inspection process as the ultimate tool to ascertain compliance with the CWC. In the light of the ongoing debates on the use of new nerve agents for political assassination, the question arises, under which circumstances states parties are willing to make use of this tool, and whether the fallout of such use would accomplish more than intensifying existing tensions.

⁸⁸ OPCW, "Status of the OPCW's Contribution to Global Anti-Terrorism Efforts", Note by the Director-General, EC-90/DG.8, 12 February 2019, <https://www.opcw.org/sites/default/files/documents/2019/02/ec90dg08%28e%29.pdf>; and OPCW, "The Implementation of Article VI as a Contribution to Countering Chemical Terrorism: Discussion Paper", Note by the Technical Secretariat, S/1622/2018, 8 May 2018, https://www.opcw.org/sites/default/files/documents/S_series/2018/en/s-1622-2018_e.pdf.

- The OPCW's activities in Syria have included new initiatives and missions that are not explicitly defined within the Convention. Yet they have provided a path forward in addressing challenges to the object and purpose of the CWC while keeping within the treaty's framework and mandate. These initiatives, for which there are different levels of acceptance among CWC states parties, include the Fact-Finding Mission, the Declarations Assessment Team, and the Investigation and Identification Team, as well as the Rapid Response and Assistance Mission.⁸⁹ These new approaches have emerged in response to circumstances and needs that were not considered at the time of the treaty negotiation. In the light of the Skripal and Navalny poisonings and their impact within the OPCW policymaking organs, how could the experiences with these new mechanisms be streamlined into the regular operation of the OPCW? Are there other new approaches that might be considered? Is there a will among OPCW member states to explore further developing new types of mission suitable for addressing the use of chemical warfare agents targeted at individuals by states? Likewise, just as there exist tools under the CWC that can be drawn upon for countering chemical terrorism, are there tools that remain to be explored for addressing state-sponsored chemical attacks?
- The chemical industry (as demonstrated by the OPCW's ties with industry organizations⁹⁰) and the scientific community (as demonstrated by OPCW's ties with the International Union of Pure and Applied Chemistry⁹¹) are key stakeholders in the CWC and have long participated in and supported its implementation. While there often appear to be clear boundaries between these stakeholders and the diplomatic world, these communities (and civil society at large) represent a source of new and innovative ideas. Are there opportunities coming from outside the OPCW through these non-governmental stakeholders that might be explored? In this context, the existing efforts of the CWC Coalition, the OPCW's industry engagement efforts, and the OPCW's Advisory Board on Education and Outreach (ABEO, which is composed of independent experts nominated by states parties) are already facilitating relevant engagement and discussion, and the ABEO and Chemical Industry Coordination Group provide mechanisms that can bring forward recommendations in a more formal manner.⁹²

⁸⁹ OPCW, Fact Finding Mission, <https://www.opcw.org/fact-finding-mission>; OPCW, Declaration Assessment Team, <https://www.opcw.org/declaration-assessment-team>; OPCW, Investigation and Identification Team, <https://www.opcw.org/iit>; and OPCW, "Establishment of a Rapid Response Assistance Team", Note by the Technical Secretariat, S/1381/2016, 10 May 2016, https://www.opcw.org/sites/default/files/documents/S_series/2016/en/s1381-2016_e_.pdf; and OPCW, "Guidelines for States Parties Requesting a Rapid Response and Assistance Mission", Note by the Technical Secretariat, S/1429/2016, 17 October 2016, https://www.opcw.org/sites/default/files/documents/S_series/2016/en/s-1429-2016_e_.pdf.

⁹⁰ OPCW, "Engaging the Chemical Industry Associations", Note by the Director-General, C-26/DG.15, 5 November 2021, <https://www.opcw.org/sites/default/files/documents/2021/12/c26dg15%28e%29.pdf>.

⁹¹ J. Forman and M. Cesa, "A Partnership of Science and Diplomacy to Eliminate Chemical Weapons", IUPAC Stories, 18 September 2019, <https://iupac.org/100/stories/a-partnership-of-science-and-diplomacy-to-eliminate-chemical-weapons>; and R. M. Hartshorn and J. E. Forman, "Building Broader and Deeper Links Between OPCW and IUPAC", Chemistry International, vol. 41, no. 2 (2019), pp. 30–33, <https://doi.org/10.1515/ci-2019-0210>.

⁹² CWC Coalition, "The Chemical Weapons Convention Coalition", <https://www.cwccoalition.org/>; OPCW, C-26/DG.15; and OPCW, "Advisory Board on Education and Outreach: Supporting the OPCW's Engagement with External Partners", <https://www.opcw.org/about/subsidiary-bodies/advisory-board-education-and-outreach>.

- Looking towards new approaches for stakeholder engagement, the OPCW's SAB has recently initiated a "crowdsource challenge" allowing it to reach out more broadly across scientific communities and stakeholders for the discussion of new ideas.⁹³ Lessons learned from that initiative could inform similar approaches that look towards engaging stakeholders in the broader civil society.
- Are there lessons to be learned from the biological weapons prohibition regime or the implementation of other treaties?⁹⁴ For instance, could confidence-building visits – such as the one conducted in 2018 at the Lugar Center for Public Health Research, Tbilisi, Georgia after it was accused of non-compliance by Russia⁹⁵ – be a useful tool to address compliance concerns around novichok agents and other non-traditional types of toxic chemicals used as weapons?
- Finally, CWC Article VIII, paragraph 6, mandates the Technical Secretariat to take into consideration advances in science and technology for verification purposes. To what extent are states parties supporting the adoption of both existing capability-enhancing technologies and emerging technologies to aid verification? This is especially pertinent in regard to developing approaches to meet the challenges of unfamiliar chemicals that do not rely on having a readily available "list" of known substances. Are there opportunities for finding new tools for building greater confidence? The SAB has provided substantive input on potential opportunities offered by available and emerging science and technology for treaty implementation.⁹⁶ The OPCW's Centre for Chemistry and Technology could provide a multilateral forum through which scientists from across the states parties might collaborate and explore SAB recommendations.⁹⁷

⁹³ OPCW, "The OPCW Plant Biomarker Challenge", 2020, <https://www.opcw.org/biomarker>.

⁹⁴ J. Revill et al., "Compliance and Enforcement: Lessons from Across WMD-Related Regimes", UNIDIR, 2019, <https://doi.org/10.37559/WMD/19/WMDCE6>; and C. Wunderlich, H. Müller and U. Jakob, WMD Compliance and Enforcement in a Changing Global Context, UNIDIR, 2021, <https://doi.org/10.37559/WMD/21/WMDCE02>.

⁹⁵ BWC, Meeting of Experts on Strengthening National Implementation, "Building Confidence in Compliance: Peer Review Transparency Exercise at the Richard Lugar Center for Public Health Research (CPHR) of the National Center for Disease Control and Public Health (NCDC) in Tbilisi, Georgia", Submitted by Georgia and co-sponsored by Germany, BWC/MSP/2018/MX.3/WP.2, 19 July 2018, <https://undocs.org/en/BWC/MSP/2018/MX.3/WP.2>; and BWC, Meeting of States Parties, "Transparency Visit to the Lugar Center, Georgia: An Independent Report", Submitted by Georgia, BWC/MSP/2018/WP.11, 7 December 2018, <https://undocs.org/en/BWC/MSP/2018/WP.11>.

⁹⁶ OPCW, Scientific Advisory Board, "Report of the Scientific Advisory Board on Developments in Science and Technology for the Fourth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention", RC-4 /DG.1, 30 April 2018, https://www.opcw.org/sites/default/files/documents/CSP/RC-4/en/rc4dg01_e.pdf; and OPCW, Scientific Advisory Board, "Investigative Science and Technology Report of the Scientific Advisory Board's Temporary Working Group", SAB/REP/1/19, December 2019, <https://www.opcw.org/sites/default/files/documents/2020/11/TWG%20Investigative%20Science%20Final%20Report%20-%20January%202020%20%281%29.pdf>.

⁹⁷ OPCW, "Centre for Chemistry and Technology Project", <https://www.opcw.org/media-centre/featured-topics/chemtech-centre>.

C h e m T e c



WMD COMPLIANCE & ENFORCEMENT SERIES

Compliance and Enforcement
in WMD-related Treaties

IAEA Mechanisms to Ensure Compliance
with NPT Safeguards

Compliance Management under the
Chemical Weapons Convention

Compliance and Enforcement in the
Biological Weapons Regime

Monitoring, verification, and compliance
resolution in U.S.-Russian Arms Control

Compliance and Enforcement:
Lessons from across WMD-related Regimes

Exploring the Future of WMD Compliance
and Enforcement: Workshop Report

Science and Technology for Monitoring
and Investigation of WMD Compliance

The Role of International Organizations
in WMD Compliance and Enforcement:
Autonomy, Agency and Influence

Tools for Compliance and Enforcement
from Beyond WMD Regimes

WMD Compliance and Enforcement
in a Changing Global Context

Enhancing the Management and Enforcement
of Compliance in the Regime Prohibiting
Chemical Weapons

**Adding Novichok Nerve Agents to the CWC Annex
on Chemicals: A Technical Fix and its Implications
for the Chemical Weapons Prohibition Regime**

WWW.UNIDIR.ORG
@UNIDIR