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## Contemporary Chemical Weapons Use in Syria and Iraq by the Assad Regime and the Islamic State

Robert J. Bunker Dr.

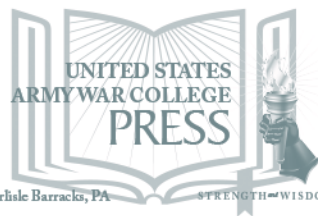
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Robert J. Bunker Dr., *Contemporary Chemical Weapons Use in Syria and Iraq by the Assad Regime and the Islamic State* ( US Army War College Press, 2019),  
<https://press.armywarcollege.edu/monographs/383>

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STRENGTH \* WISDOM

# CONTEMPORARY CHEMICAL WEAPONS USE IN SYRIA AND IRAQ BY THE ASSAD REGIME AND THE ISLAMIC STATE

Robert J. Bunker





# The United States Army War College

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IN SYRIA AND IRAQ BY THE ASSAD REGIME  
AND THE ISLAMIC STATE**

**Robert J. Bunker**

**February 2019**

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ISBN 1-58487-800-2

## FOREWORD

The subject of chemical weapons and their contemporary use is an understudied one—especially at the strategic level of analysis. Within the last few decades, the Strategic Studies Institute (SSI), and indeed the U.S. Army War College (USAWC) itself, has produced relatively few works on these weapons, their battlefield use, and what this may mean to Landpower projection. Provided by Dr. Robert J. Bunker, a past Minerva Chair at our institution, this monograph, which focuses on the chemical weapons programs of the Assad regime and the Islamic State (IS) and their subsequent use of these weapons on the battlefield, can therefore be considered a very unique and timely contribution related to this topical area.

The monograph contains an introduction into the subject matter, provides an overview of the chemical warfare capabilities of the Assad regime and the IS, addresses their contemporary use of chemical weapons in Syria and Iraq, and highlights the ensuing lessons learned. It then offers nine U.S. Army policy and planning considerations for those instances when the Landpower force may be engaging in operations against actors armed with chemical weapons or subsequently operating in environments contaminated by chemical weapons. It does so by providing interlinking inferences that span the tactical through the operational into the strategic levels of analysis related to a subject fraught with missing and partial information and ongoing disinformation campaigns by the perpetrators and their allies of said chemical weapons use.

This targeted work, devoid of theoretical musings, can be considered an applied counter-chemical warfare policy document. By seeking to bridge the immediate

past—focused on Assad regime and IS chemical weapons activities—with a recognition of the future threat potentials that exist—specifically that of the chemical weapons capabilities of the Democratic People’s Republic of Korea and Islamic Republic of Iran—the U.S. Army policy and planning guidance proposed will be of immense interest to U.S. Army and Department of Defense leaders as well as senior U.S. Government policymakers tasked with managing weapons of mass destruction arms control, mitigation, and elimination activities.

A handwritten signature in black ink, reading "Douglas C. Lovelace, Jr." in a cursive script.

DOUGLAS C. LOVELACE, JR.  
Director  
Strategic Studies Institute and  
U.S. Army War College Press

## ABOUT THE AUTHOR

ROBERT J. BUNKER is an international security and counterterrorism professional and is presently an adjunct research professor at the Strategic Studies Institute (SSI) of the U.S. Army War College (USAWC) and an instructor with the Safe Communities Institute, University of Southern California. Past associations include Futurist in Residence, Behavioral Research and Instruction Unit at the Federal Bureau of Investigation Academy in Quantico, VA, and Distinguished Visiting Professor and Minerva Chair at SSI, USAWC. Dr. Bunker has delivered numerous presentations—including U.S. congressional testimony—and has hundreds of publications including dozens of books, booklets, reports, papers, articles, response guidance, and research notes. Radical Islamist-focused publications and activities include co-editorship of a recent five-volume *Small Wars Journal* anthology series on this topical area as well as earlier works ranging from the weaponization of unmanned aerial systems, use of teleoperated sniper rifles and machine guns, and suicide bombers (including internal body cavity), along with related efforts extending back to pre-September 11, 2001, research on al-Qaeda doctrine, later published for U.S. law enforcement counterterrorism purposes, as well as pre- and post-September 11, 2001, Los Angeles Terrorism Early Warning Group (LA TEW) activities. Dr. Bunker holds university degrees in political science, government, social science, anthropology-geography, behavioral science, and history, and has undertaken extensive specialized counterterrorism and counternarcotics training.



## SUMMARY

Chemical weapons remain a component of the 21st-century battlefield even though the international community has attempted to ban them from the arsenals of both state and nonstate actors. They have been referred to as the poor man's atomic bomb, as have biological weapons, another form of nonnuclear weapons of mass destruction. While chemical weapons do not have the destructive power of strategic—or even tactical—nuclear warheads, they are far easier to acquire or produce and are able to generate a terror factor even when their use is merely threatened.

Chemical weapons also possess inherent military functions in that they can be used to kill and degrade opposing troop formations and for area- and materiel-denial purposes (e.g., persistent agents), have anti-materiel uses (e.g., corrosive agents), and can even cause aircrews to be grounded due to the effects of myopia (e.g., nerve agents). The ongoing threat of chemical agent attacks can also have psychological effects on military units and potentially force military personnel to operate in mission-oriented protective posture gear and/or buttoned up in armored fighting vehicles (relying upon their filtration units) for extended periods of time, inhibiting battlefield performance.

Concerns related to the chemical targeting of U.S. military forces are not without recent incident precedent. On September 21, 2016, a shell containing sulfur mustard landed in the Qayara West Air Base in Northern Iraq, which housed hundreds of U.S. troops, with no injuries reported. Then, on April 16, 2017, U.S. advisors in an Iraqi outpost in Western Mosul, Iraq, were subjected to an Islamic State (IS) sulfur mustard

munitions attack in which 25 Iraqi soldiers required medical attention. Thus, the known North Korean and suspected Iranian arsenals, as well as Hezbollah weapons transfer and use potentials, a Syrian wildcard use scenario, and recent IS incidents directed at U.S. military forces, together suggest that chemical weapons represent a very real battlefield threat. As a result, the U.S. Army must – at a minimum – be prepared to operate in environments contaminated by chemical weapons, as well as be involved in related activities such as mitigating their effects on friendly forces and civilian populations, deterring their initial use, and facilitating the elimination of agent stockpiles and production capabilities in coordination with the Joint Force and the National Command Authority.

To address these concerns related to U.S. Army operations, this monograph focuses on two case studies related to contemporary chemical weapons use in Syria and Iraq by the Assad regime and the IS. The document provides an overview of the chemical warfare capabilities of these two entities; discusses selected incidents of chemical weapons use each has perpetrated; provides analysis and lessons learned concerning these chemical weapons incidents, their programs, and the capabilities of the Assad regime and the IS; and presents U.S. Army policy and planning considerations on this topical area of focus.

The two case studies provide quite a few valuable insights for U.S. Army operational planning as well as higher-level ancillary strategic considerations. Lessons learned concerning the Assad regime's program and use of chemical agents in Syria are:

- The Assad regime has and will continue to view chemical weapons as a strategic resource.

- Assad regime survival is more important than its chemical weapons program or engaging in chemical warfare.
- To protect the Assad regime's chemical weapons program and ability to use chemical weapons, deception and outright lies have been actively utilized by the regime on an ongoing basis.
- The Assad regime continues to engage in brinkmanship when utilizing chemical warfare attacks on its enemies within Syria.
- Some chemical weapons are more favored than others for battlefield use by the Assad regime.

Lessons learned concerning the IS's program and their use of chemical agents in Iraq and Syria are:

- The IS approached chemical weapons use with an operationally and tactically focused thought process.
- The IS weaponized chemical agents as it could and utilized them as soon as feasible.
- The chemical weapons sophistication achieved by the IS never matured past a moderate level of chemistry with a weaker form of sulfur mustard being the deadliest agent produced.
- The development of the IS's chemical weapons program was hindered by ongoing U.S. and coalition subject matter expert and facilities targeting operations.
- The IS's chemical weapons program never developed to the point that it supported combined arms operations or was integrated with the IS's unmanned aerial systems or armored vehicle-borne improvised explosive device (VBIED) programs.



The U.S. Army counter-chemical warfare policy and planning guidance proposed in this monograph, decoupled from the present Department of Defense countering weapons of mass destruction approach, is:

- Support joint and interagency intelligence collection and analysis of the state or nonstate chemical warfare program of concern.
- Recognize the context within which the state or nonstate chemical warfare program exists.
- Support the Joint Force in implementing National Command Authority guidance concerning preconflict removal and elimination of the state or nonstate chemical warfare program.
- Prepare to support the Joint Force to implement National Command Authority guidance related to deterrence and chemical warfare use response protocols.
- Support the Joint Force to implement National Command Authority guidance concerning preemptive strike options against the state or nonstate chemical warfare program.
- Train, equip, and organize the force for operations in the projected environment contaminated by chemical weapons that may emerge.
- Extend chemical warfare defense planning to rear area basing, coalition force, and civilian populations in the areas of responsibility of the Army Landpower force.
- Prepare for the trans-conflict targeting of the state or nonstate chemical warfare program.
- Develop a strategic counternarrative plan against the expected propaganda campaign that will be utilized by the state or nonstate entity possessing the chemical warfare program.

Additional considerations in support of the above focus on a number of elements. First, red teaming and wargaming should be utilized in support of the guidance discussed above. Such analytic techniques offer a cost-effective and proven method of validating potential counter-chemical warfare policies. Second, leadership development in counter-chemical weapons expertise beyond the operational level should be fostered. Chemical weapons have strategic impact potentials—especially when ballistic missiles with nerve agent payloads are pointed at U.S. allies. Finally, research and writing pertaining to Army chemical weapons defense policy should be encouraged at the War College level. This area is very much an understudied field at the strategic Landpower studies level, with little to no work being carried out on it. Given the very real 21st-century threat potentials chemical weapons use represents, more professional consideration by Army strategic leaders will be required.



## CONTEMPORARY CHEMICAL WEAPONS USE IN SYRIA AND IRAQ BY THE ASSAD REGIME AND THE ISLAMIC STATE

Chemical weapons remain a component of the 21st-century battlefield even though the international community has attempted to ban their utilization, if not outright existence, in the arsenals of both state and nonstate actors alike. They have been referred to in the past as the poor man's atomic bomb, as have biological weapons which are representative of another form of nonnuclear weapons of mass destruction (WMD).<sup>1</sup> While chemical weapons do not have the destructive power equivalence of strategic—or, for that matter, even tactical—nuclear warheads, they are far easier to acquire or produce and are able to generate a terror factor even when just their use is threatened. This later characteristic was evident during the January 1991 Iraqi Scud missile attacks on Tel Aviv and Haifa, Israel, which were initially thought to be carrying nerve agent payloads. Quite literally, “the airwaves deteriorated into near pandemonium” as reporters were forced nervously to don gas masks while the ambiguity of the missile strikes being or not being only conventional in nature played on the fears of the news crews.<sup>2</sup>

Chemical weapons also possess inherent military functions in that they can be used to kill and degrade opposing troop formations, be used for area- and materiel-denial purposes (in the case of persistent agents), have anti-materiel uses (in the case of corrosive agents), and can even cause aircrews to be grounded due to the effects of myopia (in the case of nerve agents). The ongoing threat of chemical agent attacks can also have psychological effects on military units and, under certain conditions, force military

personnel to operate in mission-oriented protective posture gear and/or buttoned up in armored fighting vehicles (relying upon their filtration units) for extended periods of time, which inhibits their battlefield performance.

While chemical weapons have existed for well over 2,000 years (their use was chronicled by the ancient Greeks during the Peloponnesian War in which sulfur smoke was utilized as a choking agent for incapacitation purposes), such weapons have seen their greatest battlefield employment during periods of the early and later 20th century. During the first period—from 1915 to 1918, during World War I—the allies and central powers used chlorine, and later, phosgene and sulfur mustard agents. Some 90,000 fatalities and roughly 1 million casualties occurred during the conflict as a result of the use of chemical weapons.<sup>3</sup> During the second period—from 1983 to 1988, during the Iran-Iraq War—sulfur mustard, tabun, and possibly sarin were fielded by Iraqi forces, with Iranian forces at the end of the war retaliating with phosgene, cyanogen chloride, and sulfur mustard (likely) used.<sup>4</sup> A 1991 declassified Central Intelligence Agency report estimated that over 50,000 Iranian chemical warfare casualties took place.<sup>5</sup> Since the 1990s, chemical weapons have been employed on the battlefield or in terrorist incidents in Japan, Iraq, Syria, and Afghanistan.<sup>6</sup> Derived from this weapons use pedigree, concerns over both small- and large-scale chemical weapons use against deployed, forward garrisoned, and rear area U.S. Army forces overseas naturally exist.<sup>7</sup> These concerns, especially as they relate to larger scale use, are primarily reserved for the chemical warfare capabilities of North Korea and Iran.

North Korea has extensive chemical artillery capabilities as a complement to its nuclear deterrent. Since its 1961 "Declaration of Chemicalization," it has gone on to produce hundreds of tons of sulfur mustard as well as thousands of tons of sarin and VX. One recent estimate is that the massed North Korean artillery could now blanket enough sarin in the Seoul, South Korea, region to achieve a rate of agent dispersal of "about 100 kilograms per square kilometer every 15 minutes." By this delivery method, about 240 tons of sarin could be distributed throughout Seoul in a number of hours, resulting in approximately a 25-percent causality rate.<sup>8</sup>

Iran developed an active chemical weapons program in 1983 during its war with Iraq. Blister, blood, choking, and likely nerve agents have been produced by this program that at its height had a yearly production capacity of 1,000 tons. While Iran ratified the Chemical Weapons Convention (CWC) in 1997, the present state of its chemical agent stockpiles and delivery systems is unclear, although the expectation is that it still has secret caches of chemical weapons under Iranian Revolutionary Guard Corps control. Further, given Iran's robust chemical production capacity, it is projected that chemical weapons could be readily produced from preexisting and newly created precursor agents if hostilities were to break out with the United States.<sup>9</sup>

Consternation also exists that, if a military conflict began between Iran and the United States, Iran would likely provide chemical agents to Hezbollah that would fight as its proxy. Hezbollah currently retains an arsenal of possibly over 100,000 missiles in Southern Lebanon, with long-range systems able to carry chemical warheads that could be launched against

U.S. and allied forces in the region.<sup>10</sup> The Assad regime in Syria and the Islamic State (IS) have also had, until recently, very active chemical weapons programs and have been engaged in the ongoing battlefield use of these agents, although in the case of the Syrian Arab Republic, no present expectation of its directly attacking U.S. forces with such munitions exists.<sup>11</sup>

Overall, concerns related to the chemical targeting of U.S. military forces are not without recent incident precedent. On September 21, 2016, a shell containing sulfur mustard landed in the Qayara West air base in Northern Iraq that housed hundreds of U.S. troops, with no injuries reported from the incident.<sup>12</sup> Then, on April 16, 2017, U.S. advisors in an Iraqi outpost in western Mosul, Iraq, were subjected to an IS sulfur mustard munitions attack in which 25 Iraqi soldiers required medical attention.<sup>13</sup> Thus, the known North Korean and suspected Iranian arsenals, as well as Hezbollah weapons transfer and use potentials, a Syrian wildcard use scenario, and recent IS incidents of use directed at U.S. military forces, together suggest that chemical weapons represent a very real battlefield threat. As a result, the U.S. Army must—at a minimum—be prepared to operate in environments contaminated by chemical weapons. In addition, the Army must be involved in related activities such as mitigating the effects of chemical weapons on friendly forces and civilian populations, deterring their use in the first place, and ultimately facilitating the elimination of chemical agent stockpiles and production capabilities in coordination with the Joint Force and the National Command Authority.

To address the abovementioned concerns related to U.S. Army operations in environments contaminated by chemical weapons and ancillary mitigation, deterrence, and elimination (e.g., arms control) issues,

this monograph will focus on two case studies related to contemporary chemical weapons use in Syria and Iraq by the Assad regime and the IS. Initially, this monograph provides an overview of the chemical warfare capabilities of these two entities. Then it discusses selected incidents of chemical weapons use each has perpetrated. Next, it provides analysis and lessons learned concerning these chemical weapons incidents, their programs, and the capabilities of the Assad regime and the IS. Lastly, it presents U.S. Army policy and planning considerations on this topical area of focus.

## **CHEMICAL WARFARE CAPABILITIES OF THE ASSAD REGIME AND THE ISLAMIC STATE (IS)**

This section provides an overview of Assad regime and IS chemical warfare capabilities. Such capabilities, at a bare minimum, are derived from the utilization of “weaponized agents” on the battlefield.<sup>14</sup> Such weaponization occurs from a process of taking chemical agents and merging them with delivery systems. In order for a state (e.g., the Assad regime) or nonstate group (e.g., the IS) to do this, the acquisition and/or production of both agents and their delivery systems is required. Some components of this activity can be either domestic or foreign in nature but are typically blended, at least initially in the case of states who are creating the infrastructure to produce chemical weapons.

Chemical agents can be acquired from domestic sources, as in the case of the IS raiding a Syrian Government chemical weapons depot, or from foreign sources, as in the case of Syria receiving them from an allied state such as Russia. Such acquired agents may already be in weaponized form and loaded in a delivery system; however, this is very rare in the case



of nonbinary munitions due to transportation safety issues and are highly uncommon even for such binary munitions themselves. If the intent is to create a chemical agent production capability, domestic research and production facilities need to be created, and a scientific workforce would need to be educated. Since chemical agents require precursor agents in their manufacture, these precursors also need to either be manufactured domestically, requiring their own production facilities and educated personnel, or purchased overseas. Once chemical warfare agents have been produced, they then need to be safely stockpiled and protected.

From a chemical agent acquisition and production standpoint, this is only half the endeavor since delivery systems also need to be acquired or produced in order to eventually merge a chemical agent and a delivery system for weaponization purposes. Such chemical weapons produced will typically be collocated with or near bulk chemical agent stockpiles for safety and security purposes. Once a bare minimum chemical warfare capability exists, some sort of basic doctrine needs to be developed in order to utilize it, along with the creation of defensive protocols for decontamination and medical response in case of accidents and other mishaps related to the weaponized chemical agents. Chemical warfare personnel will also need to be assigned to specialized units and equipped and trained in offensive and defensive doctrine to gain proficiency; although, in the case of the IS, chemical warfare doctrine, equipment, and training may be exceedingly minimal.<sup>15</sup>

## **THE ASSAD REGIME**

Given the sensitive nature of this subject matter related to the Syrian Arab Republic – it exists within a

highly classified state program—its chemical warfare capabilities are opaque at best. The Assad regime, then under the rule of Hafez al-Assad, initially acquired chemical weapons, most certainly sulfur mustard (a blister agent) and possibly sarin (a nerve agent), as early as 1972 from Egypt prior to the start of the Yom Kippur War. Russia, during the same period, provided defensive equipment for Syrian military personnel that would be fielding these chemical weapons.<sup>16</sup> As a result of the Yom Kippur defeat, the subsequent defeat in June 1982 in Lebanon by Israel, and ongoing regional security concerns with Iraq, the Assad regime continued to develop its chemical warfare program primarily with Russian support.

Sporadic, limited glimpses of, and at times contradictory information related to the Syrian chemical weapons program have since been reported on for more than 4 decades. An overview of this information can be found in the Syrian Chemical Chronology spanning December 1968 through March 2008.<sup>17</sup> When more authoritative program information was provided (such as a declassified Top Secret Central Intelligence Agency intelligence assessment published in November 1985 on this subject and released in November 2011), it was so heavily redacted as to be of marginal use only, although it did confirm that Syrian chemical warfare units were fully configured around Soviet military doctrine.<sup>18</sup>

More substantive chemical weapons program clarity related to the Assad regime has only emerged over the last 5 years. This is a direct result of the infamous August 21, 2013, Ghouta, Syria, chemical attack. Due to subsequent international fallout with the Western liberal democracies, the Assad regime was forced to accept a deal brokered by Russia, a long-term ally and

regime patron. Failure to do so would have meant a certain widening of the Syrian conflict with Western coalition countries (spearheaded by the United States and France) engaging in direct air strikes. As a result of multiparty negotiations, United Nations (UN) Security Council Resolution 2118 was adopted on September 27, 2013, that set the terms of the agreement with the Syrian Arab Republic and guaranteed that coalition air strikes would be averted.<sup>19</sup> As a result of that deal, Syria both hastily acceded to the 1992 CWC on October 14, 2013, and accepted the fast track destruction of its chemical weapons program, or at least those components of the program that it openly declared.<sup>20</sup>

A confidential chemical weapons program declaration provided by the Assad regime to the Organisation for the Prohibition of Chemical Weapons of the UN subsequently took place on October 24, 2013.<sup>21</sup> A listing of the chemical agents (and precursor agents), chemical sites, and chemical weapons (i.e., delivery systems) were declared and then cataloged by the Organisation for the Prohibition of Chemical Weapons personnel to facilitate their destruction either on site, as in the case of production equipment and unfilled munitions, or for overseas transport, in the case of agents; this list can be viewed in table 1. It was created by Al Mauroni, a Department of Defense (DoD) counter-WMD expert, who assembled it from various sources including the Organisation for the Prohibition of Chemical Weapons documents. This table provides some transparency related to the confidential declaration, none of which has been made public. It also incorporates the October 2014 Assad regime disclosure to the UN Security Council concerning the existence of three additional chemical weapons research facilities one additional chemical weapons production facility somehow not disclosed the previous year.<sup>22</sup>

<b>CHEMICAL AGENTS</b>	580 metric tons of methylphosphonyl difluoride (DF, a precursor for sarin) 20 metric tons of mustard agent 130 metric tons of isopropyl alcohol 310 metric tons of 4 "other category 1 industrial chemicals" 260 metric tons of 13 different "category 2 industrial chemicals" including chloroethylamine, phosphorus, trichloride, phosphorus oxychloride, hexamine, hydrogen chloride, and hydrogen fluoride
<b>CHEMICAL SITES</b>	1 research and development, 10 production (including 27 production facilities), and 12 storage sites
<b>CHEMICAL WEAPONS</b>	1,230 unfilled munitions (aerial bombs, missile warheads)

**Table 1. Assad Regime Chemical Weapons Program – Declared<sup>23</sup>**

The information provided in table 1 can be compared to intelligence estimates of Assad regime chemical warfare capabilities compiled in table 2. This table principally relies on a declassified and translated French intelligence assessment published on September 3, 2013, with the addition of a few other chemical weaponry estimates. This assessment estimated that over 1,000 metric tons of chemical agents and precursor chemicals exist in the Syrian program. It is impossible to reconcile the table 1 Assad regime declaration and Organisation for the Prohibition of Chemical Weapons audits with the table 2 intelligence estimates due to their different emphases, finite data provided, and limited reliability of the information even when provided. Further, the listing of 130 metric tons of isopropyl alcohol attributed to the Assad regime declaration in table 1, while a required reactant to DF (methylphosphonyl difluoride, 580 metric tons listed) in the production of sarin, is problematic. This

common chemical utilized in industrial and other processes thus represents 10 percent of the Syrian chemical agents and precursors with it being given equal weight to CWC schedule 1 and 2 chemicals.<sup>24</sup> Many other issues with the chemical weapons program figures, such as the low amount of sulfur mustard tonnage and low number of munitions declared, also exist.<sup>25</sup>

AGENT	TYPE; PERSISTENCY	STOCKPILE; METRIC TONS	DELIVERY METHOD
Sulfur Mustard (H/HD)	Blister Agent; Very High	>200 Tons	Scud C (500 km) M600 (<300 km) SS21 (70 km) Artillery Rockets (<50 km)
<i>Nitrogen Mustard (HN)</i>	<i>Blister Agent; High</i>	<i>Unknown; Experimental Development Potentials</i>	<i>Assume same as Sulfur Mustard</i>
Sarin (GB)	Nerve Agent; Low	>200 Tons (Bulk of the Arsenal)	Scud D (600 km) Scud C (500 km) Scud B (300 km) M600 (<300 km) SS21 (70 km) Artillery Rockets (<50 km) Tactical Munitions (<50 km) 250kg & 500kg Bomb (via aircraft)
<i>Soman (GD)</i>	<i>Nerve Agent; Moderate</i>	<i>Unknown; Experimental Development Potentials</i>	<i>Assume same as Sarin (GB)</i>
VX	Nerve Agent; Very High	>20 Tons	Scud D (600 km) Scud C (500 km) Scud B (300 km) M600 (<300 km) SS21 (70 km) Artillery Rockets (<50 km); BM-14, Volcano
Chlorine (Cl); Pure & Mixed	Choking Agent; Low	Industrial Production Capability	Barrel Bomb, Gas Cylinder (via helicopter)
Italics = Unconfirmed and speculative agents and/or stockpiles.			

**Table 2. Assad Regime Chemical Warfare Capabilities – Estimated<sup>26</sup>**

Suffice it to say, the Syrian Arab Republic had, until acceding to the CWC and allowing for its declared chemical weapons program components to be destroyed and whose removal out of the country for subsequent elimination took place between October 6, 2013, and June 23, 2014,<sup>27</sup> well developed capabilities to deliver sulfur mustard, sarin, and VX agents in weaponized munitions against both external and internal enemies. It is unknown what percentage of the existing chemical weapons program and munitions the Assad regime allowed to be sacrificed in order to stave off Western airstrikes in the fall of 2013. What is known is, post-Ghouta, is the regime initially kept a low profile in its chemical weapons use and followed a dual track of reconstituting some of the lost components of its chemical weapons production capabilities. These measures likely included the rebuilding of a fleet of mobile sarin production labs in the back of large nondescript trucks<sup>28</sup> and the acceptance of shipments of North Korean delivery systems,<sup>29</sup> as well as exploiting dual-purpose chemicals (e.g., chlorine) as low-tech chemical weapons in a new round of attacks against the enemies of the regime.<sup>30</sup> This reconstitution was carried out by the Syrian Scientific Studies and Research Center (the producer of chemical agents for the Assad regime) in coordination with the little known Syrian air force organization termed Unit 450 that controls the regime's chemical weapons stockpiles.<sup>31</sup> Some speculation also exists concerning the fate of 2,000 chemical agent aerial-type bombs that existed in the regime arsenal prior to it acceding to the CWC. While the regime said it converted them over to conventional weapons use, some, if not the majority, of these nerve agent dispersal munitions could have been secretly retained.<sup>32</sup> As time passed, the Assad regime then took a calculated risk and attempted

to revert openly to the use of the more deadly nerve agent sarin once again in the April 4, 2017, Khan Sheikhoun attack.<sup>33</sup> This blatant CWC violation immediately resulted in a military response by the United States in which 59 Tomahawk cruise missiles targeted Al Shayrat Airfield from which the Syrian aircraft engaging in the chemical attack originated.<sup>34</sup>

## **THE ISLAMIC STATE (IS)**

The IS chemical weapons program completely pales in comparison to the Assad regime program in duration, size, and expertise. Information on this relatively nascent and small-scale program, which followed both chemical agent acquisition and production strategies, is, however, extremely difficult to obtain. As a result, only glimpses of this program appear in newspaper publications and online media reports from time to time.

As background, the IS predecessor al-Qaeda in Iraq (also known by other names over time) was, sometime prior to 2003, linked via its leader Abu Musab al-Zarqawi to the Khurmil facility in northern Iraq. This facility was operated by Ansar al-Islam and was involved in cyanide experimentation and weaponization attempts. Further, in January 2004, a small block of cyanide salt was discovered in a safe house in Baghdad, a laboratory in Fallujah in November 2004 was seized, and a chemical facility was discovered in Mosul in August 2005; together, they were either directly or indirectly linked to al-Qaeda in Iraq. Additionally, in April 2004, a chemical bomb plot undertaken under the direction of al-Zarqawi targeting major intelligence and political facilities in Amman, Jordan, was interdicted. Some 20 tons of chemical agents (mostly

pesticides, potassium cyanide, and what appeared to be crude TATP [triacetone triperoxide] bombmaking precursors) were to be utilized in the creation of chemically boosted vehicle-borne improvised explosive devices (VBIEDs).<sup>35</sup> After the death of al-Zarqawi in June 2006, during the latter 2006 to mid-2007 period, the IS predecessor then began to use chlorine VBIEDs in a number of attacks in the Ramadi area of Iraq. These attacks were facilitated by the development of a small chlorine weapons program. They only ceased after local access to chlorine was blocked, al-Qaeda in Iraq leadership targeted, and the program itself dismantled by Iraqi and U.S. forces.<sup>36</sup>

The IS program focused on in this monograph appears to have been built from scratch beginning in the summer of 2014 on the heels of the failure of an earlier al-Qaeda in Iraq chemical weapons plot foiled in Baghdad in June 2013.<sup>37</sup> The new program was facilitated by Abu Malik, also known as Salih Jasim Muhammed Falah al-Sabawi. Abu Malik had been affiliated with al-Qaeda in Iraq since 2005, remained with the group as it evolved, and would go on to initially provide direction to the IS concerning the creation of its chemicals program. Years ago, he had been an engineer at the Al Muthanna State Establishment.<sup>38</sup> Al Muthanna (formerly known as Project 922) housed a massive facility that was the center of the Saddam Hussein regime's old chemical weapons program. The facility existed about 140 kilometers northwest of Baghdad in the Saladin Governorate. Under Abu Malik's guidance, IS chemical agent acquisition began in full force with the seizure of the defunct and largely destroyed facility in June 2014. The group had an opportunity over approximately 5 months to loot its



contents until Al Muthanna was retaken by the Iraqi Army in late November 2014:

Many chemical weapons incidents clustered around the ruins of the Muthanna State Establishment, the center of Iraqi chemical agent production in the 1980s.

Since June, the compound has been held by the IS, the world's most radical and violent jihadist group. In a letter sent to the United Nations this summer, the Iraqi government said that about 2,500 corroded chemical rockets remained on the grounds, and that Iraqi officials had witnessed intruders looting equipment before militants shut down the surveillance cameras.

The United States government says the abandoned weapons no longer pose a threat. But nearly a decade of wartime experience showed that old Iraqi chemical munitions often remained dangerous when repurposed for local attacks in makeshift bombs, as insurgents did starting by 2004.<sup>39</sup>

After the Iraqi Army recovered the facility, one of their government officials said that IS militants were unable to penetrate the storage facility:

Islamic State [IS] militants, who had seized the area during a lightning offensive last June, were not able to penetrate the fortified bunkers, Mohammad Jawad Al-Doraky told delegates at a chemical weapons conference in The Hague.

He said Iraqi government forces had now managed to oust [the] Islamic State [IS] from the compound, where two sealed bunkers contain stockpiles of old chemicals, rockets and equipment.<sup>40</sup>

This statement is incorrect, as some level of IS looting did take place; just as is the earlier U.S. statement about the benign nature of the facilities' chemical

contents are in error. In fact, a Central Intelligence Agency report on the facility written in 2004 as a component of the Saddam regime's chemical warfare program portrays the dangerous chemical agents associated with it as well as mentioning some of the past looting of equipment and munitions due to earlier facility breaches.<sup>41</sup>

The massive site appears to represent a vast and deadly chemical agent and precursor smorgasbord of rusted and leaking munitions, containers, and barrels of sulfur mustard, sarin, and other highly toxic substances. The question is not whether the IS could penetrate some of the sealed cruciform-shaped earth covered storage bunkers within 5 months, but rather once they did, under Malik's leadership, what types and amounts of chemical agents were still contained within them, were they still viable, could IS personnel safely recover and transport them, and could those agents then be repurposed and weaponized for future utilization? Such important questions still remain unanswered. Abu Malik was subsequently targeted and killed in a U.S. drone strike specifically directed against him in the vicinity of Mosul, Iraq, on January 24, 2015. According to a statement released by U.S. Central Command, "His death is expected to temporarily degrade and disrupt the terrorist network and diminish [the IS] ability to potentially produce chemical weapons against innocent people."<sup>42</sup>

A small IS chemical weapons research cell was then mentioned in September 2015 by an anonymous U.S. official and quoted in news reports. It relates to the utilization of powdered sulfur mustard in at least four attacks on both sides of the Syria-Iraq border, one in which 120 millimeter (mm) chemical-tipped mortar shells were employed. The prevailing thought was that this cell was producing the powdered agent

and weaponizing it as part of ongoing field experiments as opposed to seized Iraqi or Syrian sulfur mustard stockpiles being utilized.<sup>43</sup> This was followed by the reported capture of Sleiman Daoud al-Afari (a former Saddam regime chemical weapons expert who was working for the IS) in Badoosh (also known as Badush), Iraq, in February 2016.<sup>44</sup> He provided actionable intelligence: “Under interrogation by the U.S. military, al-Afari has reportedly provided valuable information regarding ISIS chemical weapons and operations.”<sup>45</sup> This subsequently resulted in airstrikes against a production plant in Mosul and a deployed chemical weapons “tactical unit” in the vicinity of that city.<sup>46</sup> In May 2016, Abu Sufyan, “a senior [IS] chemical expert who staged chemical attacks in the Euphrates River Valley,” was targeted and killed by U.S. forces.<sup>47</sup>

It was then reported in August 2016, via an interview with Abu Ahmad (also an IS operative), that the group had much earlier acquired a large quantity of sarin, sulfur mustard, and chlorine agents (the equivalent of up to 10 large cargo trucks worth of stocks) from the base of Syrian Army Regiment 111 near Darat Izza, Syria, in mid-August 2013. The almost 500-acre fortified base had originally been overrun in December 2012 by the Al-Nusra Front (a component of al-Qaeda), many of whose members, including those who had seized the Assad regime’s chemical agents, went over to the Syrian factions merging with the Iraqi jihadists in the process of forming the IS. While the report remains unsubstantiated, it raises the possibility of at least some Assad regime chemical warfare agents falling into the hands of the IS is not totally implausible.<sup>48</sup>

On September 14, 2016, in Iraq “near Al Huwayjah, two strikes [conducted by U.S. coalition forces]

engaged an ISIL [Islamic State in Iraq and the Levant] chemical weapons storage facility and destroyed a rocket system, a rocket rail, and a mortar system.”<sup>49</sup> This was followed by U.S. air strikes on September 23, 2016, on a converted pharmaceutical factory complex in the Mosul area turned into an IS local headquarters and chemical weapons production plant—the types of warfare agents being produced were thought to be either chlorine or sulfur mustard.<sup>50</sup> Concerning the quality of the chemical agents produced:

The ISIS-made mustard agent is typically in a crude form, a powder mixed with oil in makeshift containers strapped to conventional munitions. ISIS has shown no evidence of producing mustard in its gas state, which would be a far more lethal form.

The IS group makes the mustard agent in laboratories inside its territory in Iraq and Syria and there’s no evidence the group has imported it from other countries, military officials said.<sup>51</sup>

An IS chemical-tipped missiles project as well as chemical weapons production (specifically, sulfur mustard) in Mosul University was then revealed in January and February 2017, respectively, as the facilities were overrun by Iraqi and other coalition troops.<sup>52</sup> With the increasing loss of key research and production sites, which include the Mosul facilities, and with Raqqa increasingly under pressure, the IS attempted by May 2017 to reconstitute a new chemical weapons cell in the Mayadin region of Syria.<sup>53</sup> In response, the United States designated two of the surviving IS chemical weapons program leaders, Attallah Salman ‘Abd Kafi al-Jaburi and Marwan Ibrahim Hussayn Tah al-Azawi, in June for immediate capture or elimination.<sup>54</sup> The IS has since been unable to restart its

chemical weapons production capabilities effectively and has seen its program degraded to the point where it might be able to create small batches of impure sulfur mustard or chlorine agents. This production is also becoming increasingly difficult for the group to even undertake.<sup>55</sup> Ongoing U.S. collation strikes (air and artillery fires) on the dwindling components of this program since June 2017 are as follows:

July 27: Near Rawah [Iraq], one strike destroyed an ISIS chemical storage site.<sup>56</sup>

July 31: Near Dayr Az Zawr [Syria], three strikes destroyed 13 ISIS oil stills, an oil storage barrel, and an ISIS chemical weapons factory.<sup>57</sup>

August 28: Near Dayr Az Zawr, Syria, one strike engaged an ISIS tactical unit and destroyed an IS in Iraq and Syria chemical weapons cache.<sup>58</sup>

September 24: Near Huwajah, Iraq, three strikes engaged three IS in Iraq and Syria tactical units and destroyed two chemical factories.<sup>59</sup>

An estimate of IS chemical warfare capabilities can be viewed in table 3. Chemical agents confirmed to be in the possession of the IS are sulfur mustard, chlorine, and some pesticides. No nerve agent weaponization or use on the battlefield by this organization can be confirmed. Further, no confirmation of IS possession of nerve agents exists, with this being a speculative capability at best.

AGENT	TYPE; PERSISTENCY	STOCKPILE; METRIC TONS	DELIVERY METHOD
Sulfur Mustard (H/HD)	Blister Agent; Very High	Low-quality production in converted facilities in Iraq and Syria  <i>Looting of al-Muthanna Facility, Iraq (Unknown amounts in corroded artillery shells); Seized Regiment 111, Syria Stockpile</i>	Powered form – 120 mm Mortars, Artillery Shells, 122 mm Grad Rockets (20 km), Improvised Rockets
<i>Sarin (GB); Unknown if Cyclosarin (GF) is included</i>	<i>Nerve Agent; Low</i>	<i>Looting of al-Muthanna Facility, Iraq (Up to 15,000 liters of GB may have existed in corroded rockets – approximately 16 metric tons)</i>	<i>No Confirmed Battlefield Use – Not Repurposed or Weaponized</i>
VX	<i>Nerve Agent; Very High</i>	<i>Looting of al-Muthanna Facility, Iraq (Potentials); Seized Regiment 111, Syria Stockpile</i>	<i>No Confirmed Battlefield Use – Not Repurposed or Weaponized</i>
Pesticides  <i>Hazardous Industrial Chemicals – Includes Hydrogen Cyanide (AC) precursors; H/HD, GB, GF, GA (Tabun), VX precursors may also exist</i>	Phosphine (PH <sub>3</sub> ); Other Undisclosed Agents  Precursor Agents; Unknown	Seized Stockpiles and Production Facilities  <i>Looting of al-Muthanna Facility, Iraq (Unknown amounts)</i>	IEDs, Shells
Chlorine (Cl)	Choking Agent; Low	Seized and Improvised Industrial Production Facilities in Syria and Iraq  <i>Seized Regiment 111, Syria Stockpile</i>	Roadside Bombs, Mortar Shells, Rockets, AVBIEDs
Italics = Unconfirmed and speculative agents and/or stockpiles			

**Table 3. IS Chemical Warfare Capabilities – Estimated<sup>60</sup>**

## CONTEMPORARY USE OF CHEMICAL WEAPONS IN SYRIA AND IRAQ

A number of maps have been produced that provide visual overviews of alleged and actual chemical weapons incidents taking place in Syria by the Assad regime and in Iraq and Syria by the IS. A sampling of these maps range from an ongoing crowd-sourced wiki creation that integrates lists of individual wiki incident entries for Syria,<sup>61</sup> through an early International Institute for Counter-Terrorism report that included an Assad regime incident specific map,<sup>62</sup> and a later *Jane's* map focused on allegations of IS use incidents in Iraq and Syria.<sup>63</sup> Quite a bit of incident variability exists between these maps and some of the others not mentioned. Thus, no collective data set of the actual incidents taking place can be determined within the parameters of this monograph. Rather, a small number of illustrative incidents involving the Assad regime and IS to convey chemical weapons use patterns will be discussed.

### The Assad Regime

The earliest allegation of Assad regime chemical weapons use was reported on December 23, 2012. It relates to a Homs, Syria, poison gas attack in which at least six people in a rebel-held area were reported to have been killed.<sup>64</sup> While chlorine was initially suspected in the attack, 3-quinuclidinyl benzilate (BZ) use was also suspected and thought to be more probable, although this has since been met with skepticism and repudiated – with weaponized commercial pesticide now suggested as being used.<sup>65</sup> However, this pesticide and sarin may manifest similar victim symptomology. A month prior to the attack, an indications and

warnings event took place in which Israel reportedly shared satellite intelligence with the United States: “Syrian troops appeared to be mixing chemicals at two storage sites, probably the deadly nerve gas sarin, and filling dozens of 500-pound bombs that could be loaded on airplanes.”<sup>66</sup> An international diplomatic effort of diverse interests (composed of the United States, Arab states, Russia, China, Iraq, and Turkey) put political pressure on the Assad regime, ending the preparation of the sarin-filled bombs. While an international crisis was thought to have been averted, especially given the Barack Obama administration’s earlier Assad regime “red-line” chemical weapons use stance on August 20, 2012, the Homs attack a month later and follow-on ones would prove otherwise.<sup>67</sup>

Since that first use incident, at least half-a-dozen incidents related to nerve agents and a dozen related to the less deadly choking agent chlorine have taken place. Chlorine agent use is likely well into the low dozens of incidents, with eight incidents identified as taking place between November 17 and December 13, 2016, and another eight identified as taking place between January 8 and April 7, 2017.<sup>68</sup> Even such conservative estimates do not go unchallenged. Ongoing disinformation campaigns conducted by the Assad regime and their Russian allies, as well as some of the jihadi opposition groups, related to chemical warfare incidents exist. This has helped to obscure who the actual perpetrators are, with finger-pointing on both sides and even at U.S.-backed forces taking place.<sup>69</sup> Additionally, even U.S. determinations of Assad regime chemical weapons use are also occasionally in variance with UN fact-finding mission reports. The reason is that UN teams, at times, will have to conduct their investigations remotely because of the dangers inherent in making entry into contested urban areas.



Further, due to political considerations, the UN is allowed to state that chemical weapons were utilized in an incident, but they do not have the mandate to name the perpetrator of the criminal act.<sup>70</sup> Still, incidents of Assad regime chemical weapons use can be identified and are provided in table 4 to highlight some of the agents utilized, their patterns of deployment, and effect.

DATE	LOCATION	AGENT; DELIVERY METHOD	TARGET; DEATHS and CASUALTIES
March 19, 2013	Khan Al Asal, Aleppo, Syria	Insecticide or nerve agent (sarin probable); overflying aircraft dropping barrel bomb; a rocket or missile was also suggested	Assad regime soldiers and civilians; 20 deaths and 124 casualties
April 13, 2013	Sheik Maqsood, Aleppo, Syria	Sarin; helicopter or aircraft munitions drop	Free Syrian Army (FSA); 1 death and 21 casualties
April 29, 2013	Saraqeb, Syria	Sarin; helicopter dropping three improvised munitions (trailing white smoke)	Free Syrian Army (FSA) area; 1 death and 10 casualties
August 21, 2013	Ghoutha area of Damascus, Syria	Sarin; surface-to-surface rockets with chemical payload capability	Insurgent fighters and civilians; 281 to 1,429 deaths and low 1,000s casualties
April 11 and 18, 2014	Keferzita (Kafr Zita), Syria	Chlorine; helicopters dropping barrel bombs	Civilians; 2 deaths and 200 casualties
December 9, 2016	Kallaseh, Aleppo, Syria	Chlorine; helicopter dropping yellow gas cylinder	+50 civilian casualties at al-Hayat clinic
January 8-9, 2017	Basimah, Damascus, Syria	Chlorine; unknown delivery system	46 casualties
April 4, 2017	Khan Sheikhoun, Syria	Sarin; warplane dropping KhAB-250 kg or KhAB-500 kg bombs	92 deaths and +200 casualties

**Table 4. Chemical Weapons Use in Syria by the Assad Regime – Selected<sup>71</sup>**

*Khan Al Asal, Aleppo, Syria (March 19, 2013)*

This chemical weapons incident took place in the Khan Al Asal area of Aleppo in the early morning hours. It appears to have been a case of Assad regime on Assad regime chemical fratricide. It resulted in organophosphate poisoning—in all likelihood, sarin gas—resulting in 20 deaths and 124 injuries to regime soldiers and civilians. A barrel bomb type device, a commonly used improvised explosive device (IED), was dropped from a regime helicopter on its own controlled part of the city, although alternative reports of a rocket or missile being utilized have also been made. As part of an active propaganda campaign, the Assad regime and the Russian Government claimed that a rocket containing sarin had been fired by rebel forces at the Assad regime position and called in a UN team to investigate the incident. This was a rather bold gambit, given that the Aleppo rebels did have the technical capacity to either produce or utilize binary-type sarin munitions.<sup>72</sup>

*Sheik Maqsood, Aleppo, Syria (April 13, 2013)*

In the Sheik Maqsood neighborhood of Aleppo, a Free Syrian Army fighter was killed and 23 injured by an Assad regime sarin gas attack. A bomb of some sort was dropped by either a helicopter or an aircraft on the rebel position. Atropine was utilized to treat those injured.<sup>73</sup>

*Saraqueb, Syria (April 29, 2013)*

Free Syrian Army controlled territory was attacked in Saraqueb by an Assad regime helicopter that dropped multiple bombs containing sarin on its forces

and on civilians. A trail of white smoke was seen, associated with the dropping of the three munitions. One civilian death and 10 injuries subsequently took place. Atropine was provided to those injured to relieve miosis and other nerve agent symptoms. A newer investigative report provides images of the sarin canisters dropped in this incident and brings together discrete pieces of information related to it.<sup>74</sup>

*Ghouta, Damascus, Syria (August 21, 2013)*

This incident represents the largest Assad regime chemical weapons attack that took place during the Syrian civil war. The earlier incidents were in some ways precursors leading up to it, as the regime became emboldened for not being more forcefully sanctioned for its chemical warfare activities. In this attack, the Assad regime released a barrage of surface-to-surface rockets containing sarin into the rebel-held areas of East and West Ghouta, Damascus. The estimated death toll for this incident ranges from no less than 281, provided by French intelligence, to 1,429, based on a U.S. Government figure. Causality estimates are projected to be in the low thousands.<sup>75</sup> Of note is the White House assessment that “the Syrian regime has used chemical weapons over the last year primarily to gain the upper hand or break a stalemate in areas where it has struggled to seize and hold strategically valuable territory.”<sup>76</sup> Given the criticality of the Ghouta district to the future integrity of Damascus (its capital city), it is of little wonder that this was the focal point of the Assad regime’s large chemical weapons attack. After the attack, the Assad regime and their Russian allies (and even the Iranians) attempted, to no avail, to place the blame for it on rebel groups. This disinformation

narrative is consistent with the ongoing Assad regime propaganda campaign.<sup>77</sup>

*Keferzita (Kafr Zita), Syria (April 11 and 18, 2014)*

This post-Ghouta incident begins the Assad regime's use of chlorine against opposing rebel fighters and civilians. In two attacks that killed 2 and injured 200 in Keferzita, barrel bombs containing chlorine were dropped by regime helicopters, primarily against civilians. The chemical agents utilized in the attacks originated from overseas:

The canisters contain markings with the code 'CL2' [the symbol for chlorine gas] and 'NORINCO' [indicating that the cylinders were manufactured in China by the state-owned company NORINCO]. Yellow is the standard industrial gas color code for chlorine.<sup>78</sup>

*Kallaseh, Aleppo, Syria (December 9, 2016)*

An Assad regime helicopter dropped a yellow gas cylinder near the al-Hayat clinic in the Kallaseh area of Aleppo in this evening incident. Over 50 casualties resulted from the attack. Numerous chlorine attacks had been taking place since April 2014 by the Assad regime in an attempt to sidestep the CWC to which it had acceded.<sup>79</sup>

*Basimah, Damascus, Syria (January 8-9, 2017)*

This chlorine use incident was conducted over 2 days in three separate attacks by the Assad regime. It took place in the Basimah section of Damascus and resulted in 46 casualties. The type of delivery method was not specified; however, for regime chlorine-based agents, typically barrel bombs and gas cylinders are

utilized for dispersal. The incident is representative of a large number of other such regime chlorine attacks that have occurred in that many individuals were injured, but few, if any, immediate deaths took place.<sup>80</sup>

*Khan Sheikhoun, Syria (April 4, 2017)*

The Khan Sheikhoun incident represents the second largest chemical weapons attack carried out by the Assad regime during the Syrian civil war. It was an attempt once again to push the envelope against the Western coalition with respect to conducting large-scale nerve agent attacks rather than utilizing less effective chlorine munitions, as it had been doing post-Ghouta. In this incident, a Syrian aircraft dropped either KhAB 250 kilogram (kg) or 500 kg bombs containing sarin on rebel-held territory. The early morning attack caused 92 fatalities and over 200 casualties and, as was mentioned earlier, was met with a large-scale U.S. cruise missile attack against the Assad regime base where the attacking Sukhoi SU-22 aircraft originated. Once again, Russia attempted to deflect blame from the Assad regime by stating that the nerve agent release was due to Syrian aircraft hitting a rebel chemical weapons stockpile.<sup>81</sup>

### **The Islamic State (IS)**

After a roughly 7-year hiatus from the al-Qaeda in Iraq use of chlorine-based VBIEDs in mid-2007, a successful IS chlorine attack was launched in July 2014:

IS is believed to have first used CW in July 2014, during a battle to capture the village of Avdiko, in north east Syria. Very few details are available, but three Kurdish YPG fighters were reported to have been killed by the CW. This attack was part of a broader assault on the village,

and whilst it contributed to the IS victory, it was unlikely to have been a decisive factor in the battle given the small number of casualties it caused.<sup>82</sup>

This incident marked the beginning of numerous IS follow-on chemical weapons attacks with primarily chlorine and sulfur mustard agents utilized, although some early use of pesticides is also noted. A *Jane's* report alleged that at least 52 incidents took place in Syria and Iraq through mid-November 2016,<sup>83</sup> and a later report alleged 30 incidents took place in Syria, and 41 incidents took place in Iraq through the end of June 2017.<sup>84</sup> The initial report identified 19 of the 52 alleged chemical attacks as having taken place in the Mosul area, reflecting the centrality of that region as the basis of much of the IS's chemical weapons program.<sup>85</sup> A well-crafted tactical and operational analysis of IS chemical weapons use identifies its utilization for the harassment of enemy forces, defensive military operations (especially as a chemical IED mine to cover retreats along roadways), and as terror weapons used against civilian populations.<sup>86</sup> A sampling of the IS chemical weapons attacks have been identified in table 5 and are discussed herein.

DATE	LOCATION	AGENT; DELIVERY METHOD	TARGET; DEATHS AND CASUALTIES
October 21, 2014	Kobane, Syria	Unknown – sulfur mustard, riot control, or phosphine	Kurdish fighters; 0 deaths and 25 casualties
January 23, 2015	Highway between Mosul and Syrian Border, Iraq	Chlorine; 1 VBIED (or AVBIED)	Peshmerga fighters; 0 deaths and 12 casualties
March 12, 2015	Tikrit area, Iraq	Chlorine; 1 road- side bomb	Iraqi Forces; 0 deaths and 0 casualties
August 21 and September 1, 2015	Marea, Syria	Sulfur mustard; <52 artillery and Gvozdika missiles (122 mm) and 18 artillery and Gvozdika missiles (122 mm)	Militia and civilians; 0 deaths and 113 casualties
February 11 and 25, 2016	Dumise and Sinjar, Iraq	Chlorine and sulfur mustard; 30 120 mm mortar shells/ chlorine; 19 rockets	Militia and civilians; 0 deaths and ~285 casualties
March 9 and 12, 2016	Taza, Iraq	Sulfur mustard; <40 rockets	Militia and civilians; 1 death and ~600 casualties
April 5, 2016	Deir-e-Zor, Syria	Sulfur mustard; Artillery or rocket barrage	Assad regime airbase; Unknown number of casualties
April 15-16, 2017	Abar, Mosul, Iraq	Chlorine; 2 rockets	Iraqi soldiers; 0 deaths and 13 casualties

**Table 5. Chemical Weapons Use in Iraq and Syria by the Islamic State (IS) – Selected<sup>87</sup>**

*Kobane, Syria (October 21, 2014)*

An IS “bomb” (likely a rocket or artillery shell) detonated near a hospital in west Kobane during the later evening hours and released a chemical agent.

Approximately 25 Kurdish fighters and civilians were affected by the chemical blast. The symptomatic effects on those injured included “choking, breathing difficulties, bleeding eyes, and burning skin” as well as the development of large body blisters.<sup>88</sup> This signature suggests that a sulfur mustard agent was likely utilized, although this would represent an outlier of such IS use patterns that were thought to not begin until later in 2015. Chlorine would not produce such physiological effects, although some potent types of military riot control agents (such as chloroacetophenone [CN] or chlorobenzylidenemalononitrile [CS]) could potentially produce such outcomes, as do some pesticides such as phosphine.

*Highway Between Mosul and Syrian Border, Iraq (January 23, 2015)*

An interdicted IS VBIED (or more likely an armored VBIED [AVBIED]) attack on Peshmerga fighters resulted in their being subjected to the effects of chlorine in this incident:

The Kurdish statement said the car bombing attempt happened on a highway between Mosul and the Syrian border. A Kurdish security source said that the peshmerga fired a rocket at the car carrying the bomb so there were no casualties, except for the suicide bomber. . . . About a dozen peshmerga fighters experienced symptoms of nausea, vomiting, dizziness or weakness, the source said.<sup>89</sup>

*Tikrit Region, Iraq (March 12, 2015)*

A video embedded in the incident source article shows the detonation of a chlorine IED along the side of a roadway in the Tikrit area. While the chlorine gas



produced is not generally lethal, it can be incapacitating to Iraqi soldiers subjected to the effects of this choking agent. It also produces a psychological effect on troops subjected to these attacks. Dozens of these roadside chlorine IEDs have been defused by Iraqi bomb squad personnel in the offensive against the IS in the Tikrit region since the end of February 2015.<sup>90</sup>

*Marea, Syria (August 21 and September 1, 2015)*

In two IS attacks on Marea, sulfur mustard was utilized in an undisclosed percentage of the 52 artillery and Gvozdika missiles (122 mm) fired into the town in the initial incident, and in the 18 artillery and Gvozdika missiles (122 mm) in the second incident. In the first incident, 76 casualties resulted, and in the second incident, 37 casualties took place, with individuals suffering from symptoms of toxic gas poisoning, including breathing issues, eye problems, and skin sores and blisters. The chemical artillery fires against the town were a prelude to the ongoing IS offensive in that area of Aleppo province against Kurdish forces.<sup>91</sup>

*Dumise and Sinjar, Iraq (February 11 and 25, 2016)*

The IS launched 19 chlorine-carrying rockets from about 5 km away into the community of Sinjar. Nearly 110 people—mostly Peshmerga fighters—suffered headaches, nausea, and vomiting from the attack. The region has been plagued with snipers, sporadic mortar salvos, and chemical weapons attacks, with an IS chemical incident taking place earlier in February. In the attack focused on Dumise, near Sinjar, mortar fires were utilized. Roughly 30 120 mm shells, some likely loaded with chlorine and others with sulfur mustard, were utilized, causing 175 casualties.<sup>92</sup>

*Taza, Iraq (March 9 and 12, 2016)*

At least 40 surface-to-surface rockets, with an undisclosed number carrying sulfur mustard agent, were fired by the IS at the Shiite Turkmen town of Taza over the course of 4 days of fighting. About 600 casualties were said to have resulted from the attacks, with 8 people said to be in severe condition and 1 person killed.<sup>93</sup>

*Deir-e-Zor, Syria (April 5, 2016)*

A ground offensive against defensive positions in villages outside the Assad regime airbase at Deir-e-Zor took place in coordination with either an artillery or rocket barrage of sulfur mustard gas. The intent of the chemical barrage was to pin down regime soldiers in the airbase so that they could not be used to reinforce the defensive positions being attacked by IS forces. The chemical attack had no apparent effect on the outcome of the ground offensive. No information was provided on Assad regime soldier casualties from the sulfur mustard attack other than the fact that a number of them suffered breathing problems.<sup>94</sup>

*Abar, Mosul, Iraq (April 15 and 16, 2017)*

An IS rocket with a chlorine payload landed on an Iraqi troop position in the Abar area of Mosul, injuring seven soldiers. The next day, a similar attack took place, also presumably utilizing chlorine, that injured six more soldiers in the Mosul area. The attacks were intended to slow down the advance of Iraqi troops against the last IS stronghold still remaining in western Mosul. Gas masks were issued to Iraqi troops to protect them from these types of attacks.<sup>95</sup>

## CONTEMPORARY CHEMICAL WEAPONS IN SYRIA AND IRAQ: ANALYSIS AND LESSONS LEARNED

The two case studies of chemical weapons programs and use related to the Assad regime and the IS provide quite a few valuable insights for U.S. Army operational planning as well as higher-level ancillary strategic considerations. The following lessons learned concern the Assad regime's chemical weapons program and their use of chemical warfare agents in Syria.

- The Assad regime has and will continue to view chemical weapons as a strategic resource. They represent a weapon of mass destruction, albeit a "poor man's atomic bomb" equivalent, that provides the regime with a deterrent to foreign state incursions and a means to either hold or acquire strategically valuable territory within Syria for regime survival purposes. This has, however, turned out to be a weak deterrent to nuclear-armed states like the United States and Israel that have conducted targeted strikes inside Syria in the past. Chemical weapons use has also been very judicious vis-à-vis the initial and even later regime stockpiles of these agents. The regime's perspective on chemical weapons is an evolved one, as opposed to the less sophisticated IS orientation to these munitions that is more operationally and tactically focused. This may be due to the decades-long association the Assad (father and son) regimes have had with chemical weapons and the fact that the Syrian Arab Republic is an established autocratic state, unlike the IS that was a relatively new proto-state even at its height.

- Assad regime survival is more important than its chemical weapons program or engaging in chemical warfare. Even though chemical weapons are of strategic value, they are still considered a bargaining chip if regime survival is ultimately at stake. This is why much of the chemical weapons program was traded away post-Ghouta to ensure the Syrian civil war was not further widened via increased foreign military aid to rebel groups and Western coalition attacks on regime facilities and military assets. The regime view was that only parts of the chemical weapons program needed to be declared to “politically” satisfy the CWC conditions placed upon it, and that the program could be reconstituted at a later date. The regime survival imperative would also suggest that under no circumstances would the regime authorize attacks with chemical weapons anywhere near where U.S. personnel were operating in Syria – the immediate blowback potentials would simply be too high.
- To protect the Assad regime’s chemical weapons program and its ability to use chemical weapons, deception and outright lies have been actively utilized by the regime on an ongoing basis. Further, the regime’s Russian and Iranian allies are also involved in the sustained effort to promote fake news and propaganda narratives that protect the regime and its chemical weapons program. In news broadcasts and social media posts, incidents of regime use of chemical weapons are said either not to have taken place or blame is instead placed on rebel groups and Western liberal democratic coalition members

for carrying out the chemical weapons attacks. This also means that the relationship of the regime with the UN and their chemical weapons inspectors is one in which only the chemical production facilities, storage facilities, and delivery systems the regime is willing to bargain away have been shown to the UN inspectors. Moreover, when chemical weapons use incidents do take place, the UN inspectors are only shown sites or provided with information the regime wants them to have.

- The Assad regime continues to engage in brinkmanship when utilizing chemical warfare attacks on its enemies within Syria. The Syrian Arab Republic's intent has been to gain as much military advantage by their use of chemical weapons up to the point that international opinion begins fully to turn against the regime or the regime is immediately threatened by attacks by the United States, France, Israel, and other Western coalition states. This pattern of brinkmanship can first be seen with the initial pattern of sarin attacks in 2013, leading up to the Ghouta incident that resulted in being a miscalculation on the part of the Assad regime. The next phase of chemical agent use, beginning in April 2014, was more discreet and subtle, utilizing chlorine while the regime cooperated with the CWC in the destruction of its declared chemical weapons program. This was followed by the regime testing the new U.S. administration (as it had done with the former one) in what was likely to become a new round of sarin gas attacks in April 2017 that was met with an immediate U.S. cruise missile response.

- Some chemical weapons are more favored than others for battlefield use by the Assad regime. Reports of chemical weapons use by the regime are clustered around sarin (a nerve agent) and chlorine (a choking agent). For whatever reason, sulfur mustard has not been utilized by the Assad regime in any identifiable quantities that have been picked up by the world's news or social media. Up to 180 metric tons of this chemical agent may potentially exist in regime stockpiles. The identified use of VX has also not taken place. The regime may still have some stockpiles of this agent left; however, this is a speculative assumption. VX is far more toxic than sarin, so it is unknown if this agent is being held as a reserve for its deterrence value – possibly against Israel – or if it is considered a chemical weapon of last resort in case the regime has to make a last stand in defense of its controlled areas in Damascus. One reason sulfur mustard may not have been utilized is that the regime can get away with using the less-toxic chemical chlorine with some impunity but not sulfur mustard and sarin. However, sarin is far more effective than sulfur mustard and is the lethal chemical weapon of choice when the regime needs to clear or hold key sections of cities.

Lessons learned concerning the IS's chemical weapons program and their use of chemical warfare agents in Iraq and Syria include:

- The IS approached chemical weapons use with an operationally and tactically focused thought process. Due to the low lethality of the chemical agents produced and the limited range of their

delivery systems, the IS perspective on chemical weapons has never advanced beyond the operational level. These weapons are viewed on par with other tools of war and, as such, hold no strategic value for deterrence purposes. Further, international laws and norms outlawing the use of these agents, such as the CWC and earlier arms control treaties, are meaningless to an entity that is anathema to the Westphalian order in the Middle East. Given the IS's ongoing propensity to advocate active shooter, bombing, and vehicular overrun attacks in Europe and North America, these weapons are also highly valued for the "strategic terrorism" potentials that they may offer when utilized against civilian targets in the West. Such threatened chemical weapons attacks in the West, however, have not as yet materialized or even been interdicted.<sup>96</sup>

- The IS weaponized chemical agents as it could and utilized them as soon as feasible. The chemical weapons program developed by the IS (like its other specialized weapons producing unmanned aerial systems [UAS], rockets and mortars, and AVBIEDs) engaged in just-in-time production of its munitions. Unlike a state, which is based on an industrial model of production with large stockpiles of armaments accumulated (as was evident in the Assad regime chemical weapons program), the IS engaged in do-it-yourself and cottage industry type manufacturing, with small-scale production taking place. During its entire existence, the IS has been on a perpetual war footing with its armaments either immediately sent to the front lines or stockpiled for near-term offensive and

defensive operations. An additional reason for their not engaging in the stockpiling of large caches of chemical weapons is that such storage facilities would become ideal targets for U.S. and coalition air and missile strikes.

- The chemical weapons sophistication achieved by the IS never matured past a moderate level of chemistry, with a weaker form of sulfur mustard being the deadliest agent produced. The terrorist organization appears to have begun with pesticide and chlorine agent use in mid-2014, and then in 2015 included sulfur mustard, albeit a weak powdered form, in its chemical weapons arsenal. No evidence of nerve agent lab synthesis or production exists for this group. This is likely due to the fact that the IS either: a) has been unable to repurpose and weaponize nerve agents said to have been acquired from Assad regime stockpiles in Syria and older Saddam regime stockpiles in Iraq; b) had these interdicted prior to such use with this information not released to the public, which represents a very low probability event; or c) did not acquire usable weaponized munitions, chemical agents, or precursors from these stockpiles in the first place.
- The development of the IS chemical weapons program was hindered by ongoing U.S. and coalition subject matter experts and facilities targeting operations. The counter-IS chemical weapons program effort began with the recapture of the former Saddam-era Al Muthanna chemical weapons facility in late November 2014. This event was then followed by the elimination of Abu Malik, a chemical warfare expert,



in January 2015. IS chemical weapons expert Sleiman Daoud al-Afari was then hunted down and captured in February 2016, with his subsequent debriefing providing targeting information that allowed for strikes on an IS chemical production facility and a tactical unit to be conducted. In May 2016, a senior IS chemical expert was then targeted and killed, with follow-on air strikes taking place on multiple IS chemical weapons and production facilities in September 2016. Key IS chemical weapons research and production sites were then overrun in the Mosul area in early 2017, with some of the remaining IS chemical weapons experts being placed on targeting lists in June 2017. From July through September 2017, ongoing air and artillery strikes on some of the remaining IS chemical production and storage facilities persisted.

- The chemical weapons program never developed to the point that it supported combined arms operations or was integrated with the IS UAS or AVBIED programs. A review of IS chemical warfare incidents supported by earlier IS operational use analysis,<sup>97</sup> as well as a familiarity with IS UAS and AVBIED utilization, suggest that the program did not mature beyond its experimental stage of development to the tactical, technical, and procedural stage or from a larger operational perspective.<sup>98</sup> No examples of IS fighters (not even *inghimasi* or martyrdom-oriented ones) engaging in immediate follow-on attacks into chemical weapons use zones were identified. Rather, chemical weapons use appeared to be more of a stand-alone activity, although an attempt to synchronize

this use with the attack on the Assad regime Deir-e-Zor air base was noted, as was using roadside chlorine IEDs to cover withdrawing IS forces. Also of interest is the fact that, later in the Syrian and Iraqi conflicts, UAS intelligence, surveillance, and reconnaissance; command and control; and propaganda videotaping functions were integrated in support of IS AVBIED attacks. While some UAS intelligence, surveillance, and reconnaissance and artillery spotting of chemical weapons barrages has taken place, the integration of more developed UAS and AVBIED activities with chemical warfare operations is absent.<sup>99</sup>

## **U.S. Army Policy and Planning Considerations**

The Assad regime and IS chemical weapons programs and selected use incidents highlighted in this monograph offered a number of lessons learned. In turn, these lessons learned and the underlying chemical weapons program and incident information they are derived from provide insights that can aid in the development of U.S. Army policy guidance related to operating in environments contaminated by chemical weapons and ancillary mitigation, deterrence, and elimination (i.e., arms control) issues.

It should be noted, however, that the policy and planning considerations provided here have been decoupled from present Department of Defense countering weapons of mass destruction (CWMD) programs and policies.<sup>100</sup> The reason for this variance is that the present CWMD approach is primarily focused on homeland security, public health, and disaster

relief and only broadly addresses chemical, biological, radiological, and nuclear event incidents.<sup>101</sup> Further, concern exists that the present CWMD orientation ignores the reality that the U.S. Army may someday be forced to operate in threatened or actual environments contaminated by chemical weapons:

There is no question that since the Cold War began, every presidential administration has viewed WMD as a top national security threat. However, the operational community does not view WMD as an immediate concern, leaving details such as military strategies and doctrine to a largely technically and tactically focused DoD counter-WMD community. This has traditionally resulted in segregated policies and specialized issues rather than integrating WMD concerns into mainstream concepts and preparing the general force to address WMD within conventional and irregular operations. The updated strategy follows that pattern, offering a national-level discussion on countering WMD that fails to provide the services a meaningful directive to improve their ability to meet stated policy objectives.<sup>102</sup>

An additional concern related to this approach is that it results in the defunding of U.S. Army CWMD programs and the ensuing force reductions this entails.<sup>103</sup> Further, U.S. Special Operations Command, since early 2017, has been placed in the lead for CWMD efforts.<sup>104</sup> While this may offer some new advantages, it will not necessarily enhance the needs of strategic Landpower projection in environments contaminated by chemical weapons. Given these concerns, the U.S. Army counter-chemical warfare policy and planning guidance proposed herein, decoupled from the present CWMD approach, is as follows.<sup>105</sup>

- Support joint and interagency intelligence collection and analysis of the state or nonstate chemical warfare program of concern. Open

source, restricted, and classified intelligence on a chemical warfare program, and the chemical weapons use patterns of a threat entity, can be aggregated, fused, and analyzed at the appropriate clearance level. This should be an ongoing activity that draws upon U.S. Government information databases and reports, academic literature, traditional news, and social media, as well as more specialized private intelligence subscription services. State and nonstate chemical warfare programs will be organizationally different in nature and, as a result, will require different forms of analytics to be applied against them, including order of battle (line and block), systems, and network analysis.<sup>106</sup>

- Recognize the context within which the state or nonstate chemical warfare program exists. As was seen with the Assad regime and the IS, they each approached their chemical weapons program and use in very different ways. In addition to engaging in intelligence collection and analysis of a chemical warfare program, the military and political context of the program must be determined vis-à-vis the state or nonstate entity to which it belongs. Understanding a program's context and its relationship to other military programs allows for more appropriate and focused strategies to be developed to counter it.
- Support the Joint Force in implementing National Command Authority (NCA) guidance concerning preconflict removal and elimination of the state or nonstate chemical warfare program. The Assad regime acceded to the CWC and subsequent elimination of its declared chemical weapons program components signifies that imposing international arms control

agreements on rogue states, even if it is done so under the threat of direct attack, does in fact have some utility. While the international agreement with the Assad regime was far from optimal, it portrays the fact that proactive chemical weapons removal, even if only partial in nature, is far more preferable than allowing chemical weapons programs to remain intact, given the battlefield threat that more lethal nerve agents represent to U.S. Landpower forces. Further, as in the case of Libya, denying the IS access to the last remaining Gaddafi-era chemical weapons stockpile in Ruwagha has to be lauded as a proactive policy.

- Be prepared to support the Joint Force to implement NCA guidance related to deterrence and chemical warfare use response protocols. Depending on the size and sophistication of the chemical warfare program of concern, pre-conflict provisions may be actively required to deter the use of chemical weapons against in-theater U.S. Army and Joint Forces. As an example, given both the nature of the IS and its marginal level of development, chemical weapons use deterrence simply does not work. Additionally, no proportional or escalatory response to such a marginal chemical weapons attack would even be considered. When faced with the threat of a full-scale North Korean sarin artillery barrage on Seoul, however, the threat of a tactical nuclear response would likely be warranted for both deterrence and actual response requirements. Any such nuclear deterrence and response protocols would, by necessity, require U.S. Army forces to engage in higher-level

planning subordinated to Joint Force and NCA structures.

- Support the Joint Force to implement NCA guidance concerning preemptive strike options against the state or nonstate chemical warfare program. As part of the predeployment planning process, preemptive conventional strike considerations are required to be addressed. This is also not an Army-specific consideration; rather, the Army must once again work within the Joint Force and NCA structure with such an action possibly resulting in a retaliatory chemical weapons use strike against out-of-theater Army, joint, or allied forces. Even with actionable indications and warnings of a threat entity (specifically, a state) preparing to engage in a preemptive chemical weapons strike of its own against U.S. or allied forces, no proportional or escalatory (e.g., tactical nuclear) preemption of such a strike should be undertaken. To do so would undermine the U.S. strategic narrative, our underlying liberal democratic values, and be in variance with international laws and norms of behavior.
- Train, equip, and organize the force for operations in the projected environment contaminated by chemical weapons that may emerge. This recommendation falls under the purview of preexisting Army schools and forces, including the chemical training component of the Chemical, Biological, Radiological, and Nuclear Defense School at Fort Leonard Wood, MO, and the 48th Chemical Brigade headquartered at Fort Hood, TX. It is essentially an existing standard operating procedure. However, the type

of predeployment training and equipping of the force required for the projected environment contaminated by chemical weapons will benefit from the initial analysis of the chemical warfare program of concern; the chemical weapons use patterns; and the contextual relationship of the program to the state or nonstate entity within which it exists. Hence, the present chemical warfare threat potentials of North Korea are vastly different and far more severe than Iranian, or for that matter, even Assad regime legacy and reconstituted capabilities. Predeployment training and equipping for force projection purposes simply has to reflect the reality that chemical weapons defense is not a “one size fits all” proposition.

- Extend chemical warfare defense planning to rear area basing, coalition force, and civilian populations in the areas of responsibility of the Army Landpower force. Rear area strikes on Army forces and coalition forces attacked with chemical weapons scenarios are required to be considered in Landpower deployments, with force and allied force protection planning required for such contingencies. As an example of such coalition force chemical warfare defense needs, the U.S. military distributed 40,000 gas masks to Iraqi Security Forces brigades, 1,500 gas masks to the Iraqi Counter Terror Service, and 9,000 gas masks to Kurdish Peshmerga fighters operating against IS forces.<sup>107</sup> Under principles of international humanitarian law, the Army also has a duty to protect civilian populations. Such protection thus needs to be extended to include chemical weapons defense

planning for such vulnerable populations existing in Army areas of responsibility.

- Prepare for the trans-conflict targeting of the state or nonstate chemical warfare program. This recommendation is conceptually linked to the earlier “support the Joint Force to implement NCA guidance concerning preemptive strike options” recommendation taking place during the pre- to early-entry of ground forces phases; however, in this instance, it is taking place after ground forces have been deployed to the theater of operations. The highly successful U.S. Central Command strategy of targeting the IS chemical warfare program, its leadership, infrastructure, and weaponized agents represents an example of this form of targeting. This counter-chemical weapons strategy not only kept the IS program from developing past its nascent stages, but degraded it by early to mid-2017 to the point that this threat group now has little to no capacity to create or field chemical weapons.
- Develop a strategic counter-narrative plan against the expected propaganda campaign that will be utilized by the state or nonstate entity possessing the chemical warfare program. This proposed area of guidance very much represents an unforeseen, yet important, requirement for Army counter-chemical weapons planning. The Assad regime chemical weapons program and use case study signifies that active propaganda campaigns may emerge to both protect the chemical weapons program of concern and to create confusion concerning incidents of chemical weapons use, by either stating such use did not take place, that the target of the attack was



the actual perpetrator, or that a third party such as a U.S. ally or even the United States itself was responsible for the chemical attack. The Assad regime, in coordination with their Russian and Iranian allies, has elevated such active propaganda, with the inclusion of fake news reports and social media posts, to such an effective level, at least at times, that the U.S. Army must now initiate strategic counter-narrative planning as a supportive component to chemical warfare defense considerations.

Additional considerations in support of the above policy and planning guidance focus on a number of elements. First, red teaming and wargaming should be utilized in support of the guidance discussed earlier. Such analytic techniques offer a cost-effective and proven method of validating the counter-chemical warfare policies and plans to be formulated. Second, leadership development in the area of counter-chemical weapons expertise beyond the operational level should be fostered. Chemical weapons have strategic impact potentials, especially when ballistic missiles with nerve agent payloads are pointed at U.S. allies. Finally, research and writing pertaining to Army chemical weapons defense policy should be encouraged at the War College level. This area of concern is very much an understudied field at the strategic Landpower studies level with little to no work being carried out on this subject matter.<sup>108</sup> Given the very real 21st-century threat that the potential use of chemical weapons represents, more professional consideration by Army strategic leaders will be required to address it properly.

## ENDNOTES

1. For example, see Malcolm W. Browne, "IDEAS & TRENDS: Chemical Weapons; 'Poor Man's Atomic Bomb' Is Once Again Used in Battle," *The New York Times*, April 17, 1988, available from <http://www.nytimes.com/1988/04/17/weekinreview/ideas-trends-chemical-weapons-poor-man-s-atomic-bomb-once-again-used-battle.html>; and W. Seth Carus, "'The Poor Man's Atomic Bomb?' Biological Weapons in the Middle East," Policy Paper 23, Washington, DC: The Washington Institute for Near East Policy, 1991, pp. 1-52, available from [http://www.washingtoninstitute.org/uploads/Documents/pubs/PP\\_23\\_PoorMansAtomicBomb.pdf](http://www.washingtoninstitute.org/uploads/Documents/pubs/PP_23_PoorMansAtomicBomb.pdf).

2. Tom Shales, "The Grim News from Behind a Mask," *The Washington Post*, January 18, 1991, available from [https://www.washingtonpost.com/archive/lifestyle/1991/01/18/the-grim-news-from-behind-a-mask/e5f8eb20-8ffe-4a00-81c6-aa338a07aaca/?utm\\_term=.86f76ab4ecf9](https://www.washingtonpost.com/archive/lifestyle/1991/01/18/the-grim-news-from-behind-a-mask/e5f8eb20-8ffe-4a00-81c6-aa338a07aaca/?utm_term=.86f76ab4ecf9). Note: The author remembers watching a real time CNN broadcast of these strikes while a reporter under extreme duress hurriedly attempted to don his personal protective equipment. The palpable fear expressed in that news report signifies the psychological effects the threat of chemical weapons use can have on individuals.

3. These figures are pretty well agreed upon. For a source guide on chemical weapons and other weapons type casualties during World War I, see H. L. Gilchrist, *Comparative Study of World War Casualties from Gas and Other Weapons*, Chemical Warfare School, Edward Arsenal, MD, Washington, DC: U.S. Government Printing Office, 1928.

4. Javed Ali, "Chemical Weapons and the Iran-Iraq War: A Case Study in Noncompliance," *The Nonproliferation Review*, Spring 2001, pp. 43-58, available from <https://www.nonproliferation.org/wp-content/uploads/npr/81ali.pdf>; Interagency Intelligence Memorandum, *Impact and Implications of Chemical Weapons Use in the Iran-Iraq War*, Top Secret, approved for public release April 2004, Langley, VA: Central Intelligence Agency, April 1988, p. 7, available from [https://www.cia.gov/library/readingroom/docs/DOC\\_0001079783.pdf](https://www.cia.gov/library/readingroom/docs/DOC_0001079783.pdf).

5. Robin Wright, "Iran Still Haunted and Influenced by Chemical Weapons Attacks," *Time*, January 20, 2014, available from <http://world.time.com/2014/01/20/iran-still-haunted-and-influenced-by-chemical-weapons-attacks/>.

6. In the case of Japan, the Aum Shinrikyo cult engaged in two sarin attacks in June 1994 against a courthouse and in March 1995 against a subway; and in the case of Afghanistan, the Taliban targeted numerous girls' schools with pesticides sporadically from April 2010 onward. A number of the Syrian and Iraqi chemical weapons use on the battlefield and the incidents are discussed later in this monograph. For information on the girls' schools attacks, see Rod Nordland, "Gas Sickened Girls in Afghan Schools," *The New York Times*, August 31, 2010, available from <http://www.nytimes.com/2010/09/01/world/asia/01gasattack.html>; and Vasudevan Sridharan, "Afghanistan: 300 Schoolgirls Hit by Suspected Taliban Poison Gas Attacks in Herat," *International Business Times*, September 4, 2015, available from <http://www.ibtimes.co.uk/afghanistan-300-schoolgirls-hit-by-suspected-taliban-poison-gas-attacks-herat-1518418>.

7. Such concerns have existed in the past. For example, a major fear was that Saddam Hussein would strike coalition forces with chemical weapons as he did those ground forces that entered Kuwait during Operation DESERT STORM. The threat was viewed as so high that British Prime Minister Margaret Thatcher in the fall of 1990, prior to the liberation of Kuwait, even suggested to President George Bush, via classified correspondence to his defense secretary Dick Cheney, that the United States be prepared to respond to such an Iraqi chemical attack with chemical weapons of its own. Bush refused to consider such an option. See, "Margaret Thatcher Suggested Threatening Saddam with Chemical Weapons," BBC News, July 20, 2017, available from <http://www.bbc.com/news/uk-politics-40667031>.

8. Reid Kirby, "Sea of Sarin: North Korea's Chemical Deterrent," *Bulletin of the Atomic Scientists*, June 21, 2017, available from <http://thebulletin.org/sea-sarin-north-korea-s-chemical-deterrent10856>. See also Stuart Leavenworth, "North Korea's Trump Card—Chemical Weapons Targeting American Troops," *Miami Herald*, August 14, 2017, available from <http://www.miamiherald.com/latest-news/article167158052.html>.

9. "Chemical Weapons—Iran," GlobalSecurity.org, March 31, 2017, available from <https://www.globalsecurity.org/wmd/world/iran/cw.htm>. Iran is thought to have a more technically sophisticated chemical weapons program than its Syrian ally and, in fact, has provided it with blister and nerve agent production equipment since 2004; Benjamin Weinthal, "How Iran Enables Syria's Chemical Warfare against Civilians," *The Jerusalem Post*, April 17, 2017, available from <http://www.jpost.com/Middle-East/How-Iran-enables-Syrias-chemical-warfare-against-civilians-488180>; and Anthony H. Cordesman, *Iran's Military Forces in Transition: Conventional Threats and Weapons of Mass Destruction*, Westport, CT: Praeger Publishers, 1999, p. 133.

10. Lazar Berman and Elhanan Miller, "Hezbollah's Long-Range Missiles Can Carry Chemical Weapons," *The Times of Israel*, October 6, 2013, available from <https://www.timesofisrael.com/hezbollah-missiles-can-deliver-chemical-weapons/>.

11. In recent years, the Assad regime has gone out of its way not to come into direct military conflict with the United States and coalition states over its chemical weapons program and chemical weapons use. As a result, the use of Syrian chemical weapons against U.S. forces is viewed as highly unlikely and would only take place within certain wild card type scenarios.

12. Robert Burns, "U.S.: Shell that Hit Iraqi Base Contained Sulfur-Mustard Agent," *Military Times*, September 22, 2016, available from <https://www.militarytimes.com/news/pentagon-congress/2016/09/22/u-s-shell-that-hit-iraqi-base-contained-sulfur-mustard-agent/>. U.S. troops went through decontamination showers as a precaution against possible chemical exposure. See Barbara Starr, "ISIS Suspected of Mustard Attack against US and Iraqi Troops," CNN, September 27, 2016, available from <http://www.cnn.com/2016/09/21/politics/mustard-gas-us-troops/>.

13. David Martin, "Iraqi Unit with U.S., Australian Advisers Hit by ISIS Mustard Agent," CBS News, April 18, 2017, available from <https://www.cbsnews.com/news/iraqi-unit-with-us-australian-advisers-hit-by-isis-mustard-agent/>.

14. Different schema exists for explaining chemical warfare capability development. See, for instance, the "Figure II-3. Weapons of Mass Destruction Activity Continuum," in U.S.

Strategic Command, *Joint Publication 3-40, Countering Weapons of Mass Destruction*, Washington, DC: U.S. Government Printing Office, October 31, 2014, p. II-2, available from [http://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3\\_40.pdf](http://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_40.pdf).

15. An example of a sophisticated chemical weapons defense can be seen in Field Manual (FM) 3-7, *NBC Field Handbook*, “Chapter 2: Chemical” and “Chapter 3: Protection and Decontamination,” Washington, DC: Headquarters, Department of the Army, September 29, 1994, available from <https://fas.org/irp/doddir/army/fm3-7.pdf>.

16. W. Seth Carus, *Policy Focus: Chemical Weapons in the Middle East*, Research Memorandum No. 9, Washington, DC: The Washington Institute for Near East Policy, December 1988, pp. 4-5, available from <https://www.washingtoninstitute.org/uploads/Documents/pubs/PolicyFocus9.pdf>.

17. *Syria Chemical Chronology*, Monterey, CA: Nuclear Threat Initiative (NTI), James Martin Center for Nonproliferation Studies at the Monterey Institute of International Studies, 2011, available from [http://www.nti.org/media/pdfs/syria\\_chemical.pdf?\\_=1316466790](http://www.nti.org/media/pdfs/syria_chemical.pdf?_=1316466790).

18. *Syria's Offensive Chemical Warfare Capability: An Intelligence Assessment*, Langley, VA: Central Intelligence Agency, November 1, 1985, Top Secret, Declassified, released November 15, 2011, available from <https://www.cia.gov/library/readingroom/document/cia-rdp86t00587r000400550004-2>.

19. See Executive Council, *Decision: Destruction of Syrian Chemical Weapons*, Den Haag, Holland: Organization for the Prohibition of Chemical Weapons (OPCW), September 27, 2013, available from [https://www.opcw.org/fileadmin/OPCW/EC/M-33/ecm33dec01\\_e\\_.pdf](https://www.opcw.org/fileadmin/OPCW/EC/M-33/ecm33dec01_e_.pdf).

20. *Syria's Accession to the Chemical Weapons Convention Enters into Force*, Den Haag, Holland: OPCW, October 14, 2013, available from <https://www.opcw.org/news/article/syrias-accession-to-the-chemical-weapons-convention-enters-into-force/>.

21. *Syria Submits its Initial Declaration and a General Plan of Destruction of its Chemical Weapons Programme*, Den Haag,

Holland: OPCW, October 27, 2013, available from <https://www.opcw.org/news/article/syria-submits-its-initial-declaration-and-a-general-plan-of-destruction-of-its-chemical-weapons-pro/>.

22. "Syria Declares New Chemical Weapons Facilities," BBC News, October 8, 2014, available from <http://www.bbc.com/news/world-middle-east-29534926>.

23. This table is a reproduction of "Table 2. Syria's Declared Chemical Weapons Program," found in Albert J. Mauroni, *Eliminating Syria's Chemical Weapons*, The Counterproliferation Papers, Future Warfare Series No. 58, Maxwell Air Force Base, AL: U.S. Air Force Center for Unconventional Weapons Studies, June 2017, p. 17, available from <http://www.au.af.mil/au/csds/pub/pdfs/monographs/58EliminatingSyriaCW.pdf>. The citation for Mauroni's table is: "Based upon various sources, Category 1 and 2 refer to the Chemical Weapons Convention's (CWC) schedule of chemicals that can be inspected within a party's national boundaries." Also see Chemical Demilitarisation Branch, *Removal and Destruction of Syrian Chemical Weapons*, Den Haag, Holland: OPCW, n.d., available from [https://www.armscontrol.org/files/Panel2.1\\_Anelli\\_TuckerConference.pdf](https://www.armscontrol.org/files/Panel2.1_Anelli_TuckerConference.pdf).

24. For CWC chemical schedules, see United States Chemical Weapons Convention Website, Washington, DC: Bureau of Industry and Security (BIS), available from <http://www.cwc.gov>.

25. Adam Entous and Naftali Bendavid, "Mission to Purge Syria of Chemical Weapons Comes Up Short," *The Wall Street Journal*, July 23, 2015, available from <https://www.wsj.com/articles/mission-to-purge-syria-of-chemical-weapons-comes-up-short-1437687744>.

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99. No examples of UAS chemical weaponization derived from 40 mm grenade and tailfin assembly integration with agent bursting payloads have been identified. This may be due to the fact that chlorine and sulfur mustard agents utilized in such small payload quantities would be ineffective unlike the use of nerve agents which do not exist in the IS arsenal. AVBIED chemical agent dispersal seems to have fallen out of favor with the IS, with a dichotomy now existing between conventional explosive AVBIED attacks and standoff rocket and artillery (including mortar) attacks which may either be conventional explosive or chemical weapons based.

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