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Soviet Chemical Warfare Agent Production Program

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Interagency Intelligence Memorandum

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DIRECTOR, INTELLIGENCE COMMUNITY STAFF
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July 1987

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NI IIM 87-10009JX

SOVIET CHEMICAL WARFARE AGENT PRODUCTION PROGRAM

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Information available as of 11 April 1987 was used in the preparation of this Memorandum, approved for publication on 16 June by the Chairman of the National Intelligence Council.

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PREFACE

This Interagency Intelligence Memorandum provides a current assessment of the Soviet capability for producing chemical warfare agents and addresses questions of production methods and location of production sites. It describes the background and development of the production effort and identifies areas of key technologies, as well as issues of technology transfer. It attempts to explain the inherent difficulties involved in monitoring either the types or amounts of chemical agents produced and in identifying chemical production facilities.

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In August 1986 the Intelligence Community noted the Soviets are maintaining chemical warfare agent production capability as part of their industrial base.

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the Soviets maintain the world's most comprehensive chemical and biological warfare program and that this capability constitutes a serious threat to NATO.

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This publication was prepared under the auspices of the National Intelligence Officer at Large and coordinated within the Intelligence Community.

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KEY JUDGMENTS

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the variety and combinations of raw materials and intermediate chemicals, as well as the complex processes and possible variations in design of production facilities that could be employed, make the identification of a specific CW agent and its respective production facility very difficult

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Augmented Soviet CW agent production, or breakout production capability in the event of a CW arms control treaty, is possible using converted industrial chemical plants (especially those designed to produce organophosphorous pesticides). Estimates are that as few as four converted plants could provide 10,000 to 20,000 tons of agent per year (14 tons/plant/day)—more than enough to replenish operational stockpiles and conduct training. It would be extremely difficult to locate industrial plants that had been converted to CW agent production.

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There are at least nine Soviet chemical facilities that we believe have produced or can produce traditional CW agents. Of these nine, we assess that at present three, and possibly four, are currently active on an intermittent basis. Two others are facilities suspected to be engaged in

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production of new chemical agents of microbiological origin.

With their history of emphasis on CW preparedness, the Soviets have the production capacity to manufacture a significant stockpile of various CW agents and could have produced large amounts of agent relatively undetected. While we believe that they currently manufacture only a few hundred tons of agent per year, their interest in expanding and modernizing their CW program continues.

The Intelligence Community believes that Western technology is aiding Soviet military development of chemical weapons. Direct purchase of Western plants has eliminated the time and expense required for research on and development of process technologies and also provides a direct conduit for acquiring other Western chemical expertise.

We assess that the Soviets recently have achieved the capability to microencapsulate traditional chemical and biological warfare (CBW) agents and that they may be developing and testing microencapsulation of new agents as well.

the Soviets may be planning to employ new agents derived from biotechnology. Biotechnology could be used to produce toxic chemical materials that previously could not be obtained in large amounts and to create entirely new agents.

Their biotechnologically derived agent program would not necessarily require unique production facilities or storage sites. Even on-site inspections would not be sufficient to ensure timely detection of prohibited biotechnology-based activities. Establishing intent would be a critical factor.

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DISCUSSION

1. The Soviet Union for nearly 60 years has maintained an active program in military chemical warfare (CW) involving both research and development (R&D) and agent production. The USSR has no equal in the world in its current capability to produce chemical agents and munitions. they could have produced, since the mid-1950s, at least 150,000 metric tons of various types of such agents.

2. It was not until March 1987 that the Soviet Union would even admit to having a chemical weapons program. In April 1987, in a speech in Prague, Mikhail Gorbachev announced that the Soviet Union has halted the production of chemical weapons. The Intelligence Community has not been able to ascertain the veracity of his announcement. The Soviets probably are aware that they are ahead of Western nations in many aspects of the CW production effort and are likely to continue to go to great lengths to protect and retain that lead.

History

3. Russian interest in CW began in the late 1800s with the study of the toxic chemical mustard. Though before World War I the CW emphasis was on R&D of potential agents rather than on production, Russia's chemical industry during World War I rapidly developed a CW production capability and was able to provide its armed forces with weaponized versions of the toxic industrial chemicals chlorine and phosgene.

4. Interest in CW continued after the war and led to extensive research on toxic agents and weapon stabilization. The Soviet chemical industry was expanded significantly during the 1930s, as was the level of technical education available in the Soviet Union. During this period the Soviets produced and stockpiled blood, blister, and vomiting agents. By 1937 the Soviet Army was fully equipped to conduct offensive and defensive chemical warfare operations if the decision were made to do so. During World War II the Soviets manufactured a variety of standard agents at both converted industrial chemical plants and specially constructed sites. The Hirsch report indicated hundreds of plants involved in the Soviet CW program.[1]

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5. At the end of World War II the Soviets captured stocks of chemical warfare agent and munitions, as well as the large-scale (1,000 tons per month) German tabun (GA) nerve agent plant and a sarin (GB) pilot plant (100 tons/month) at Dyhernfurth and possibly an incomplete full-scale (500 tons/month) sarin plant at Falkenhagen. At least part of the Dyhernfurth equipment was relocated to the Volgograd Chemical Combine, and was used in the construction of a nerve agent pilot plant It is possible that plans and some equipment from Falkenhagen were also captured. Mustard plants at Ammendorf and Gendorf may also have been captured by the Soviets and the equipment and technology transferred to the USSR. The capture of these facilities and information from the Spandau CW research center gave the Soviets a production capability for these highly toxic agents more quickly than if they had had to develop them indigenously, as well as information on the production and weaponization technologies and unknown quantities of finished chemical agents in bulk storage.[2] the Soviets began production of nerve agents (sarin and tabun) by the mid-1950s. Later information suggests the Soviets considered tabun an obsolete agent in the late 1950s and removed it from their inventory. (Annex A summarizes known Soviet chemical agents.)

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[1] Col. Walter Hirsch was an Austrian chemical officer who took part in the Russian and Italian campaigns, 1917-18, and after the German annexation of Austria in 1938 became the head of the German Army Ordnance Office, CW Proving Section. As such, he controlled and directed German CW research, development, and testing. After capture by the British in 1945, he wrote a lengthy and definitive report on the Soviet CW program.

[2] Preliminary analysis of 1940s Allied intelligence information indicates that there may have been a number of German depots on the Eastern Front after the war with large stocks of bulk and weaponized chemical warfare agents, including nerve agents.

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6. Since the early 1960s there have been various reports of Soviet production of soman (GD), the most deadly of the G-type nerve agents. In 1960 Soviet scientist M. M. Dubinin at the International Conference on Biological and Chemical Warfare implied that the USSR probably had solved the problems of the industrial manufacture of soman. In 1961 a Soviet patent was granted for the preparation of pinacoline, a compound used to manufacture pinacolyl alcohol, a key precursor of the nerve agent soman. The process as patented was apparently readily adaptable to large-scale production. Consequently, in the years since the patent was issued, the USSR could have manufactured large quantities of pinacolyl alcohol and have used it for the production of soman. The Soviets have acknowledged production of the key soman precursor, pinacolyl alcohol, in their civilian industry. In negotiations for a chemical weapons limitation agreement, the Soviets have intimated that they make use of significant quantities of pinacolyl alcohol.

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7. The Intelligence Community believes that Soviet research on V-agents, organothiophosphorus compounds also used in some pesticides, was well advanced by the 1960s. Commercial production methods for a number of these pesticides were readily available in both Soviet and Western open literature and are similar to production methods for V-agents. This would have made it relatively easy for the Soviets to

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produce V-agents using extensions of existing commercial chemical processes and technologies. We are unsure about the extent to which they produced or weaponized V-agents and about the amount in the Soviet inventory.

8. Intelligence Community organizations over the past years have narrowed to about nine the number of plants that may be involved with *traditional* CW production Some of these plants were reported by Hirsch to be making agent in the 1940s.

9. The Soviets allocated almost $2 billion in the early 1970s to a modernization program to overcome a perceived US lead in chemical and biological warfare (CBW). A portion of this Soviet program was directed to provide a new generation of chemical and biological weapons to be fielded in the late 1980s.[3]

10. Another part of the Soviet modernization program involves the development and production of new agents that are biologically produced but are capable of being employed as chemical agents. These agents are bioregulators and toxins and are produced through genetic engineering. In the mid-1970s, the Soviets recognized the military potential of genetic engineering and established two major military genetic engineering institutes, at Serpukhov and Kol'tsovo. Various sources indicate that by the early 1980s these institutes were doing research and were constructing buildings capable of producing microbiological products, including new agents. Nonliving, biologically produced new agents would probably be tested at Shikhany.

Production Capability

11. There are at least nine [4] Soviet chemical facilities that we believe have produced or can produce traditional CW agent

12. Fragmentary reporting over a number of years has indicated that the non-Soviet Warsaw Pact (NSWP) countries have been involved in some aspects of chemical warfare R&D, at least limited production, and extensive troop training in a CW environment. While we do not know the extent of the NSWP program, it could serve as a residual production effort and/or as a reservoir of technological expertise for traditional chemical agent manufacture. We have no intelligence information that details Soviet policy or practice on the export of technology or manufacturing of components to Pact countries, but we believe the

[3] There are four general types of new agents. These include: newly developed types of chemical agents, toxins, and bioregulators produced by genetically engineered microbes, and microbes genetically engineered to cause diseases. This last type of agent is not discussed in this paper.

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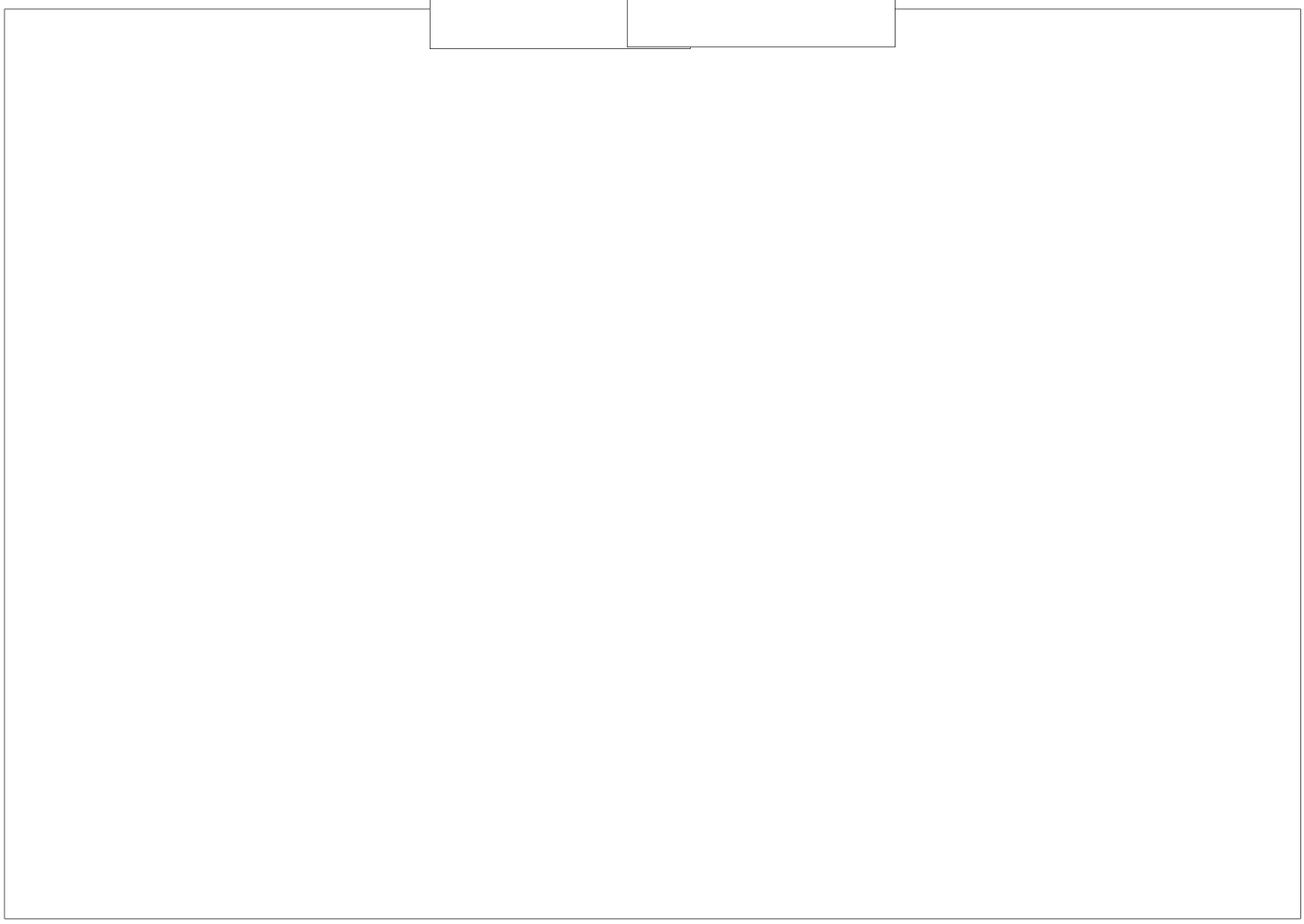

Soviets would have helped in establishing and monitoring the NSWP CW program. We would assume also that they have considered the possibilities of converting some NSWP chemical facilities to making CW agents

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13. Romania currently is assessed to have a CW program for development of indigenous production of CW agents and antidotes.

The Intelligence Community believes that Czechoslovakia too has had a CW facility for many years, possibly for limited production as well as for R&D on CW agents. East Germany during the 1950s reportedly had CW production capability. We have no recent information, however, to establish the existence of a current CW agent production program in East Germany or Poland.

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14. The production processes for traditional agents have been known for a long time, and protective equipment (masks, suits, etc.) has been developed against them. The Soviets have the necessary technical expertise to develop binary systems. We have no evidence that they intend to produce binary chemical munitions or that research on binary systems is under way. Soviet literature indicates a significant research effort in the areas of organofluorine compounds, organosilicon compounds, caged organophosphates, toxins, and cyclic peptides. The toxicity, stability, and penetrating ability of some compounds in these classes suggest them as possible sources of new agents.

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[5] Romania is a special case among the NSWP countries because it does not believe it would get nuclear weapons from the Soviets in wartime. Hence, it has developed its own CW agents and munitions.

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16. Information suggests that the Soviets may be developing perfluoroisobutylene (PFIB), an organofluorine compound, or a related compound as a CW agent:

- They have reportedly been developing an agent containing fluorine that penetrates Western canisters.
- The leading Soviet organofluorine researcher, I. L. Knunyants (a general officer in the Soviet Army), has reportedly worked with the USSR's chemical defense academy.
- Soviet open literature states that PFIB is three to 10 times as toxic as phosgene—indicating that, if it penetrated masks, it could incapacitate personnel. Since the onset of symptoms caused by PFIB-type compounds are delayed, the Soviets may be trying to synthesize an agent with similar toxicity but with more rapid onset of symptoms.
- The Soviets have discussed various methods of manufacturing PFIB, but claim that it is not manufactured on a large scale—that they use it for laboratory synthesis only and that it is produced as a byproduct at the Kirovo-Chepetsk and Perm' chemical plants.

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17. The Soviets already have produced toxins that they or their allies have used in Southeast Asia. Although some toxins can be chemically synthesized, the trichothecene mycotoxins used in Southeast Asia presumably were produced by Fusarium fungi. There are eight known or suspected BW plants in the Soviet Union. Two of the suspected plants, Berdsk and Kurgan, are known to have produced agricultural biochemicals using Fusarium fungi; we therefore consider them to be possible sources of the trichothecene mycotoxins. Although there is no evidence of toxin production at the six remaining plants, we suspect that several could produce toxins if required.

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Production Activity

18. The Soviet Union, with its history of emphasis on CW preparedness since World War II, has had a production capacity to manufacture a significant stockpile of various CW agents. What makes the estimates of the production effort difficult is that if the Soviets had perceived a need they could, given their industrial capability, have produced large amounts of agent relatively undetected. Because of the existing stockpile, we believe that they currently need the capability to manufacture only a few hundred tons of agent per year. This is more than enough for testing, troop training, and stockpile replenishment. Any one of the identified production facilities could probably fulfill the training and replenishment demand. We believe that suspected Soviet CW agent plants are large enough to produce thousands of tons per year of agent if a wartime mobilization required it.

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The production of intermediate chemicals, or of the traditional CW agents themselves, is not a high-technology process. 25X1

31. While the production of basic and intermediate chemicals is the primary concern of a nation's chemical industry, it is difficult to differentiate between industrial chemical production and the production of chemicals that could be used to produce CW agents. Most intermediate chemicals necessary for the production of nerve agents are easily produced. 25X1 25X1

Supplementary Production Capability

Production by the Soviet Chemical Industry

30. The Soviet Union has a well-developed civilian chemical industry and is self-sufficient in raw materials needed to produce starting or intermediate chemicals for CW agent production. The required technology base imbedded in any established chemical industry represents a latent CW production capability.

32. Dual-use plants produce chemicals that can be used as both CW agents and as civilian industrial chemicals. Chemicals in this category include hydrogen cyanide and phosgene. Both have applications as CW agents and as industrial feedstocks, and both are produced, handled, transported, and used in very large quantities throughout the worldwide chemical industry on a daily basis. 25X1 25X1

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Conversion

33. Engineering analysis indicates that an augmented Soviet agent production or breakout production capability, using converted chemical plants, is possible and, in some cases, relatively straightforward. The time required for conversion is primarily dependent on the similarity of the process at a given plant to nerve agent process. Converted plants could include those originally designed for conversion, dual-use facilities, or other industrial chemical facilities that could be converted. The easiest type of plant to convert to nerve agent production would be organophosphorus (OP) pesticide plants. Some plants, such as petrochemical complexes, might require complete refitting—a much longer process.

34. the Soviets have devoted significant attention during the past several decades to planning for versatility in production at their chemical plants. They might have drafted contingency plans for such conversions in advance, with production equipment already in place, and might have trained key operations personnel in the manufacture of agents. Otherwise, depending on the chemical processes already in place, the time could vary from a few weeks to as much as two years.

35. If the Soviets ceased production at their dedicated military CW agent facilities, because of technical difficulties, improvements to process technologies, or new agent programs, or under a CW treaty requirement, they would need to convert no more than three or four commercial plants to meet their current production needs. As few as four converted plants could probably provide 10,000 to 20,000 tons of agent per year (14 tons/plant/day)—more than enough to replenish operational stockpiles and conduct training.

36. The Intelligence Community believes that the Soviets could probably convert any of 40 or so pesticide plants into CW agent production in a matter of weeks to months, depending on the priority assigned to the project. Such conversions would require changes to equipment and to operating procedures. OP pesticide plants lack some characteristics found in nerve agent plants, but among the shared characteristics are the ability to handle corrosive and toxic substances, safety features to protect the workers and the surrounding environment, and the correct processing equipment made of specialized materials. Both nerve agent and OP pesticide plants would have detectors and alarms to detect fugitive emissions and also would have positive-pressure air systems

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Technology Transfer

38. The Soviets have on many occasions contracted with Western countries for construction of chemical plants in the USSR. This provides them with the ability to adapt or copy Western process methods for use in other Soviet facilities. Direct purchase of Western plants eliminates the time and expense required for research and development on process technologies and also provides a direct conduit for acquiring other Western chemical expertise.

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39. We believe that Western technology is aiding Soviet military developments in chemical weapons. Today, the Soviet military controls CW production lines and freely levies requirements on the chemical industry. The chemical industry also provides indirect support by satisfying much of the raw material requirement for military end items. By the mid-1980s the availability and use of acquired foreign technology had become an integral part of the planning cycle for new chemical plant construction in the Soviet Union. This period also marked the beginning of a dramatic increase in chemical production capacity that has depended heavily on imported Western technology.

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40. Incorporating Western technology into Soviet military programs, rather than relying wholly on Soviet indigenous capabilities, could yield significant

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savings in program costs, free indigenous R&D resources for efforts in other areas, and enable the Soviets to develop and produce effective military systems at earlier dates than would otherwise be possible. The USSR benefits significantly from acquisition of various Western technologies, such as process control technology, corrosion-resistant processing equipment, and microencapsulation.

44. ***Microencapsulation.*** Since the 1970s, the Soviets have shown an interest in the application of microencapsulation to military delivery of chemical and biological agents:[8]

— In the late 1970s the Soviets negotiated a contract with a US pharmaceutical firm to obtain a complete "turnkey" microencapsulation facility. Though the contract was canceled by the US Government and most of the equipment never reached the Soviet Union, the Soviets *did obtain* complete design information, including process specifications and batch reactant recipes.[9]

45. We assess that the Soviets have recently achieved the capability to microencapsulate conventional CBW agents and that they may be developing and testing microencapsulation of new agents as well.

If pursued to its technological limits and integrated into their CBW production scheme, microencapsulation could give the Soviets a new capability in chemical and biological warfare.

[8] Microencapsulation is a chemical or physical process resulting in the formation of a protective coating around a small solid particle or liquid droplet.

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Trends in Soviet Chemical Industry Methodologies

46. The chemical industry of the USSR is engaged in a massive effort to develop and acquire state-of-the-art technologies. Upgrading its technologies and diversification into production of fine chemicals and biotechnologically oriented products will not only boost the Soviet economy but also make the Soviet CBW program more viable.

47. The industry is emphasizing production of specialty chemicals—integral to the production of hyperpure compounds essential to biotechnology industries as well as to thermonuclear energy, electronics, and lasers. By the year 2000, the Soviets hope to double (over 1985 figures) their production of high-purity compounds, and triple production of biological reagents. In the area of biological reagents, techniques have been developed to produce such products as amino acid derivatives that have applications in medicine and in genetic engineering.

48. Evidence suggests that the Soviets may be planning to employ new agents derived from biotechnology. The Intelligence Community believes that the USSR initiated a program in the early 1970s to apply advances in biotechnology, such as genetic engineering, to the development of a new class of agents. These techniques could be used to produce toxic materials that previously could not be obtained in large amounts and to create entirely new agents. These new agents could pose significant problems to medical and protective systems. In addition, the equipment in the laboratory buildings and the expertise required to conduct such work is an integral part of biomedical research and, therefore, difficult to detect.

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ANNEX A

SOVIET CHEMICAL WARFARE AGENTS

In terms of tactical purpose, the Soviets divide toxic agents (table 2) into groups according to the nature of their action: lethal agents, incapacitants, irritants, and training agents. In terms of physiological action on the organism, the Soviets make the following distinctions:

(a) Neuroparalytic action: GA (tabun), GB (sarin), GD (soman), and VX.

(b) Skin-blistering: H (commercial sulfur mustard), HD (distilled mustard), HT and HQ (mustard formulas), HN (nitrogen mustard), and L (lewisite).

(c) General toxic action: AC (prussic acid), CK (cyanogen chloride).

(d) Suffocating: CG (phosgene).

(e) Psychochemical: BZ.

(f) Irritants: CN (chloroacetophenone), DM (adamsite), CS, and CR.

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Table 2
Soviet Chemical and Toxin Agents

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US Code	Agent	Class of Agent Designation	
		Physiological Action	Military Action
AC	Hydrogen cyanide	Blood	Lethal
BZ	Unknown	Psychological	Incapacitant
CG	Phosgene	Choking	Casualty
CN	Chloroacetophenone	Tear gas	Riot control
DA	Diphenyl chloroarsine	Vomiting; lung irritant	Casualty
DM	Adamsite	Vomiting; lung irritant	Casualty
DP	Diphosgene	Choking	Casualty
GB	Sarin	Nerve	Lethal
GD	Soman	Nerve	Lethal
GD	Thickened soman	Nerve	Lethal
H	Sulfur mustard	Blister	Casualty
H	Thickened sulfur mustard	Blister	Casualty
HL	Mustard-lewisite mixture	Blister	Casualty
NH-3	Nitrogen mustard	Blister	Casualty
L	Lewisite	Blister	Casualty
L	Thickened lewisite	Blister	Casualty
PS	Chloropicrin	Choking	Irritant
EA-5830	O-ethyl-S-2-dimethylaminoethyl (Vx) methyl phosphonothioate	Nerve	Lethal
Toxins	T-2	Toxin	Casualty

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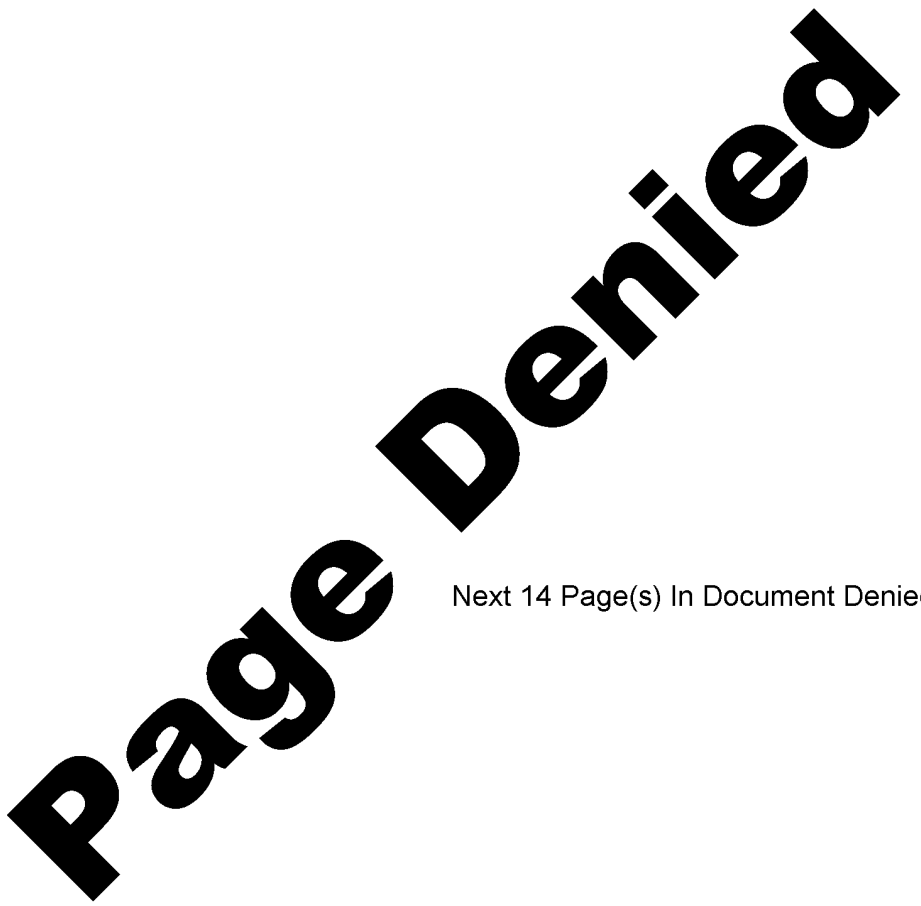

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