MANAGEMENT OF THE DEPARTMENT OF DEFENSE VIETNAM HERBICIDE PROGRAM

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CHAPTER I

INTRODUCTION

The use of cover and concealment on the battlefield is an old and effective tactic. One of the earliest and foremost writers on the subject of war, Carl von Clausewitz, stated as his first general principle for defense, "To keep our troops covered as long as possible. Since we are always open to attack, except when we ourselves are attacking, we must at every instant be on the defensive and thus should place our forces as much under cover as possible."[1] This principle is equally applicable and actively practiced today by the Viet Cong and North Vietnamese Army in their guerrilla operations in South Vietnam. The key to defeating guerrillas is finding them; they move by stealth, attack, and disappear in the jungle.[2] The most common methods for establishing the presence of guerrilla forces is with the use of patrols, ground and aerial observation, and information from a friendly populace. Detecting the guerrilla would be much easier if there were efficient means of removing leaves from the jungle that provides cover.

Modern technology in the form of chemical herbicides has provided a

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[1]Carl von Clausewitz, Principles of War, trans. and ed. by Hans W. Gatzke(Harrisburg, Pa.: Military Service Publishing Co.,1942), p. 15.

[2]Stanley D. Fair, "No Place to Hide," Army Magazine (September, 1963) pp. 54-55.

means of denying to the guerrilla some of the concealment afforded by this dense jungle vegetation. Defoliation[1] as a military tactic, developed and brought into operational use by the United States forces in Vietnam, is now a standard procedure for overcoming the concealment provided by a jungle canopy. The military applications for defoliants are based on the expectation that removal of the leaves from vegetation will improve vertical and horizontal visibility so that the guerrilla can be detected. The opportunities for ambush and surprise should be reduced and counter guerrilla operations facilitated.

In 1961,chemicals were first evaluated and used as defoliants for military purposes in South Vietnam.[2] By April 1967,usage had increased to such an extent that the requirements for the military preferred herbicide exceeded the United States production capacity fourfold.[3] It was necessary for some domestic users of these herbicides to substitute other chemicals for purposes of brush control[4]

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[1]The words defoliant and herbicide will be used interchangeably throughout this study. As defined by Department of the Army Technical Manual 3-216,a defoliant is a chemical compound used to prematurely remove the leaves from plants;while a herbicide is defined as a chemical preparation used to kill or to inhibit the growth of plants.

[2]W. B. House, et al., (Midwest Research Institute). Assessment of Ecological Effects of Extensive or Repeated Use of Herbicides, by Advanced Research Projects Agency, Department of Defense, MRI Project No. 3103-B, Final Report, (1967), p. 116.

[3]"Drafting a weed killer," Business Week (April 22, 1967) p. 37.

[4]U. S. Department of Agriculture, Agricultural Stabilization and Conservation Service, The Pesticide Review 1967, by H. H. Shepard, J. N. Mahan and D. L. Fowler, (Washington, D. C., October 1967), pp. 27-30.

as the Department of Defense preempted the production of chemicals for defoliation in South Vietnam.[1] According to an industry spokesman, the chemicals were "all gone" and expansion of production was necessary to satisfy military demands, to say nothing of domestic needs.[2]

The factors leading to the shortage of herbicide preferred by the military, the decision, and the decision-making process used by the Department of Defense to alleviate the shortage, form the basis for this study. Particularly of interest and impacting on the decision-making process is the total preemption by the military of a commercially developed and marketed commodity to the detriment of the civilian sector.

The alternatives developed by the Department of Defense for meeting the long-run military requirements for herbicide were drafted considering the continuing civilian requirements and civilian production capability. The possibility of government surplus herbicide and excess production facilities following hostilities could not have been removed from the considerations of the defense decision-makers. The fifty billion dollar war surplus following World War II and the twelve billion dollar surplus after the Korean War are still remembered by many taxpayers.[3] The

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[1]"Market Newsletter," Chemical Week, (April 15, 1967), p. 45.

[2]"Drafting a week killer," op. cit., p. 37.

[3]Robert F. Sanchez, "War on Waste," Army Digest, (December, 1968), pp. 4-7.

logistic guidance announced by Secretary of Defense McNamara in 1966 before the House Armed Services Committee influenced the decision-making process:

> With regard to the preparation of the FY 1967-71 program and the FY 1966 Supplemental and FY 1967 Budget, we have had to make a somewhat arbitrary assumption regarding the duration of conflict in Southeast Asia. Since we have no way of knowing how long it will actually last, or how it will evolve, we have budgeted for combat operations through the end of June 1967. This means that if it later appears that the conflict will continue beyond that date, or if it should expand beyond the level assumed in our present plans, we will come back to Congress with an additional FY 1967 request.[1]

Whether these several factors adversely affected the rapid provisioning of herbicide for military operations in South Vietnam merits investigation.

The Research Question

The research question is todefine the decision-making process used in the management of herbicides by the Department of Defense and evaluate the effectiveness of the process to satisfy military requirements.

The subsidiary questions that emerge are limited to those which have significant bearing on the alternatives for meeting the herbicide shortage and the reasons for shortages developing nearly six years after the first use of herbicides in South Vietnam. They are:

1. What alternatives wereavailable to meet the military demand for herbicides?

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[1] U. S., Congress, House, Committee on Armed Services, Fiscal Year 1967 Supplemental Authorization For Southeast Asia, H. Rept. 4515, 90th Cong., 1st sess., 1967, p. 50.

CHAPTER II

HISTORY OF THE MILITARY HERBICIDE PROGRAM

The problems introduced by the large scale use of herbicides in the Vietnam conflict, though technologically new to warfare, were problems of shortages and resource allocation. Solutions for these problems created a need for decision-making processes at the highest defense management level.

The necessity for management to identify and analyze the nature of the problems confronting it, and evaluate the various solutions, is emphasized by Richards and Greenlaw.[1] The factors highlighted in this chapter will serve to identify and outline the problems involved in the herbicide program.

Factors Leading to the Use of Herbicides in South Vietnam

The operational use of herbicides in Vietnam is the culmination of nearly twenty years of research and testing. In 1941, E. J. Kraus, Head of the Botany Department of the University of Chicago, was the first to suggest that chemical growth regulators might work as herbicides when purposefully applied to weeds in toxic

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[1]Max D. Richards and Paul L. Greenlaw, Management Decision-Making (Homewood, III: Richard D. Irwin, Inc., 1966), p. 31.

doses.[1] Interest was heightened with the findings of P. W. Zimmerman of the Boyce-Thompson Institute that the phenoxyacetic acids, such as 2,4-dichlorophenoxyacetic acid (2,4-D), were exceedingly powerful growth regulators. Successful testing of 2,4-D led Kraus in late 1942 to suggest to the National Academy of Sciences that the toxic properties of growth regulating substances for the destruction of crops or the limitation of crop production might be of military interest. It was proposed that the herbicidal properties of these growth regulating chemicals be field tested.[2]

Largely on the basis of the findings and recommendations made by Kraus, the U. S. Army undertook an intensive research program to identify and field test suitable herbicide agents for military use. This work was assigned to Camp Detrick, Maryland, now Fort Detrick,[3] and still the center for research and development of herbicide agents for the Department of Defense. During World War II the more promising agents investigated were 2,4-D and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T).

This initial work conducted at Fort Detrick was in developing agents for the destruction of crops. The war in the South Pacific

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[1]House, op. cit., p. 109.

[2]Ibid., p. 109.

[3]Camp Detrick, Maryland was designated Fort Detrick on 1 February 1956. The latter designation is used hereinafter in this study.

at that time was making new demands on military technology. In 1963, Charles E. Minarik, Chief, Crops Division, Fort Detrick, recalled:

> There was a great deal of interest at that time in destroying vegetation in the South Pacific theatre. . . .We were asked to investigate chemicals that were available in large quantities in the United States that could be employed in 'defoliating' this vegetation.[1]

Near the close of World War II successful aerial spray tests of several defoliants were conducted on sub-tropical vegetation in the Florida Everglades. These tests demonstrated that spray droplets applied to a forest canopy penetrated, not only the top leaves, but the middle stratum, and some even reached the forest floor.[2] By the end of World War II, the feasibility of using herbicides for large scale defoliation had been established, and only the ending of the war precluded the operational testing of herbicides in an active theater of war.

In a post-war program, Fort Detrick continued to examine chemicals for defoliation. The more promising agents were tested on vegetation in the United States and Puerto Rico. In 1959, at Camp Drum, New York, one of the more significant tests was conducted. Aerial application of a mixture of undiluted esters of 2,4-D and 2,4,5-T at 0.75 gallons per acre denuded the trees over an area of four square miles.[3] This mixture of 2,4-D and 2,4,5-T, code named

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[1] Ibid., p. 111 [2] Ibid., p. 111

[3] Robert A. Darrow, George B. Truchelut, and Charles M. Bartlett, (U.S. Army Biological Center, Ft. Detrick, Md.), OCONUS Defoliation Test Program, sponsored by the Advanced Research Projects Agency, Department of Defense, Technical Report 79, (July, 1966), p. 13.

Orange [1] for the identifying orange band on the fifty-five gallon container, is the military agent of choice for defoliation operations in South Vietnam and is the agent for which a critical shortage developed during 1966 and 1967.

Shortly after the successful defoliation test at Camp Drum, the government of South Vietnam requested that the U. S. Army undertake trials of defoliants for use against guerrilla forces.[2] It was recognized by the government of South Vietnam and the U. S. advisors in South Vietnam that a capability for destroying the concealment afforded by thick jungle growth would facilitate counter guerrilla operations. The clearing of vegetation from roadsides, railways, and canals would substantially reduce the opportunity for ambush and thus permit friendly operations to proceed in a more timely manner.

In response to this request, the United States in 1961 shipped to South Vietnam a variety of potential herbicide agents, including Orange. Personnel from Fort Detrick, under the sponsorship of the Department of Defense Advanced Research Projects Agency, conducted the aerial and ground spray tests. These tests established

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[1]The code name "Orange" will be used in this study to denote any 50-50 mixture of the esters of 2,4-D and 2,4,5-T. It is recognized that this code name was not adopted until 1965 and prior to that time the code name "Purple" was used to denote a slightly different mixture of 2,4-D and 2,4,5-T.By using"Orange" throughout, the technical slight is minor.

[2]House, op. cit., p. 113.

that Orange was successful in killing the majority of the vegetation species encountered in South Vietnam. Because of this successful experiment, it was selected as the military agent of choice for defoliation operations. The test results were sufficiently encouraging for the government of South Vietnam to announce on January 1, 1962 plans for the operational use of herbicides to counter guerrilla activities.[1] The use of herbicides as a military weapon had been demonstrated in a war-time situation, after nearly twenty years of research, testing and development.

Build Up of Military Requirements

The period 1941 through 1961 can best be described as one of establishing the utility of defoliation as a military weapon with perhaps no more than a few thousand gallons of Orange applied in South Vietnam by the end of 1961. During 1962, operational techniques were developed and the requirement for an aircraft capable of carrying and dispensing large volumes of herbicide was established. To meet this requirement, the U. S. Air Force dispatched in late 1962 to South Vietnam several C-123 aircraft, equipped with special 1,000 gallon tanks and high pressure spray nozzles along the wings.[2] The C-123 aircraft proved to be well suited for the spray mission,

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[1] Ibid., pp. 113-114.

[2] Seymour M. Hersh, Chemical and Biological Warfare--America's Hidden Arsenal (New York, N. Y. : Bobbs-Merrill Company, 1968), p. 146.

being highly resistant to small arms fire while delivering a large herbicide payload. This ability to deliver nearly 1,000 gallons of herbicide per sortie subsequently permitted the planning and conduct of large scale defoliation operations in South Vietnam. During 1962, when the C-123 aircraft was becoming operational in the defoliation role, nearly 50,000 gallons of herbicide were dispensed in South Vietnam. In 1963, slightly more than 100,000 gallons of herbicide were used and more than 200,000 gallons were used in 1964.[1,2] The majority of this herbicide was Orange.

The period 1962 through 1964 was one of refining operational techniques for aerial delivery of herbicide. Additionally, the utility of defoliation as an aid to combat operations was demonstrated to the ground commanders. The increase in usage between 1962 and 1964 reflects its acceptance as an integral part of counter guerrilla operations. During this period, the methods for optimizing defoliation were established. One of the more important findings, and one affecting herbicide requirements, was the establishment that three gallons of undiluted Orange per acre was the optimum coverage for the South Vietnam vegetation. This rate of application is considerably greater than used for defoliation applications in the United States.

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[1]House, op. cit., p. 150.

[2]In developing the quantities of herbicide used, coverage data in acres sprayed per year, as stated by House, are converted to gallons per year by multiplying by three. This is in keeping with the recommended application rate of three gallons per acre for Orange.

With higher application rates, it was demonstrated that leaf fall occurs more rapidly, usually within four to six weeks, and defoliation remains effective for greater periods of time, often as long as twelve months.[1]

Through 1964, there is no evidence of concern by the military users or the civilian suppliers of an Orange shortage developing. Management that was responsible for the program probably estimated that the about 200,000 gallons used in 1964 represented a peak and that the same level would continue. The full commitment of the United States to the Vietnam conflict had not yet occurred. Any significant increases in defoliation operations would also require additional aircraft.

During 1965, the United States policy for conducting the conflict in Vietnam changed from one of primarily advising and supporting the South Vietnamese armed forces, to actively participating in combat operations. The introduction and build-up of United States combat units, both ground and air, into South Vietnam increased the requirements for defoliation. As new base camps and lines of communication were established, requirements for defoliation of these areas developed. In addition to these new requirements, the necessity for re-spraying areas treated in earlier years, but recovered by the rapid growing jungle vegetation, also developed.

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[1] "Herbicide Hassle: the Army fires back," Chemical Week (January 13, 1968), pp. 67-68.

These increases in requirements resulted in more than 400,000 gallons of herbicide used in 1965.[1]

During 1966 and 1967, defoliation operations continued to increase. Not only were friendly base camps and lines of communication being defoliated, but also targets of vast size were included. The New York Times reported that defoliation missions were being conducted in Laos along the Ho Chi Minh infiltration route.[2] This route, several hundred miles long, was and is the principal infiltration route for combat supplies and manpower moving south from North Vietnam. In order to impede infiltration through the demilitarized zone between North and South Vietnam, it, too, was defoliated.[3] Other potential large area targets for defoliation included the Viet Cong sanctuaries such as War Zones C and D encompassing hundreds of square miles of jungle. These locations are shown in Figure 1. The spraying of these large areas significantly increased the requirements for herbicides. More than three times the quantity of herbicide used in all previous years in South Vietnam was applied during 1966--slightly in excess of 2,600,000 gallons.[4] In 1967, herbicide usage more than doubled over the 1966

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[1]House, op. cit., p. 150

[2]William Beecher, "U.S. Will Step Up Defoliation Missions in Vietnam", New York Times, September 10, 1966, p. 12.

[3]"An End to Hanoi's Jungle Sanctuary?" U. S. News and World Report (October 3, 1966), p. 21.

[4]House, op. cit., p. 150.

figure,with approximately 6,000,000 gallons used.[1] With the continuation of the high level of hostilities in Vietnam during 1968,all indications were that the use of herbicides would increase. One magazine reported that the Department of Defense requirements for fiscal year 1968 would be 80,000,000 pounds each of 2,4-D and 2,4,5-T, or about 16,000,000 gallons of Orange.[2,3] Another source stated the annual requirement for Orange to be in the "area of 10 million gallons."[4] Either figure is well above the industry production capacity. For the purpose of this study, a Department of Defense requirement for Orange for 1968 and beyond, of 10 million gallons annually will be assumed.

To spray this ever increasing quantity of herbicide, the U. S. Air Force equipped and assigned additional C-123 aircraft to the defoliation operation. In 1966,there were seven spray equipped aircraft operating in South Vietnam,[5] with plans to increase this

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[1]Headquarters, U. S. Air Force, Office of the Deputy Chief of Staff, Systems and Logistics, reports 5,600,000 gallons of herbicide bought for use in Vietnam during July 1966 through June 1967. Data for fiscal year 1968 indicates 8,200,000 gallons were procured. These data support a calendar year 1967 figure of 6,000,000 gallons cited above.

[2]"Market Newsletter," Chemical Week (April 15, 1967), p. 45.

[3]One gallon of Orange contains 4.74 pounds of 2,4,5-T and 4.24 pounds of 2,4-D.

[4]Letter from Sellers, Conner and Cuneo, Attorneys and Counselors to the Assistant Secretary of Defense (Installations and Logistics), October 29, 1968.

[5]"Operation Ranch Hand," Flying Magazine (November, 1966), p. 56.

number to eighteen aircraft in late 1966 and early 1967.[1] Further expansion of the program resulted with additional C-123 aircraft being assigned. One writer stated that, "During 1967. . . defoliation is now a $71 million operation involving almost two dozen huge tankers."[2]

Although it is not the intent of this chapter to examine the management controls exercised by the Defense Department during this period of increasing herbicide requirements, there was concern by the responsible personnel at the United States Military Assistance Command, Vietnam, with possible program limitations imposed by herbicide availability. The author recalls two instances, one in 1965 and the second in 1966, when during the planning for increasing the number of C-123 spray aircraft, queries were made on herbicide availability. On both occasions,the reply indicated that herbicide availability would support the increase in spray aircraft,although, on the second occasion insufficient Orange would be available but,as a complement,Tordon 101, code named White, could satisfy the increased requirement.[3]

Limited quantities of White were initially introduced into

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[1]Beecher, op. cit., p. 12.

[2]Arturo F. Gonzalez,Jr., "Defoliation--A Controversial U. S. Mission in Vietnam," Data on Defense and Civil Systems (October,1968), pp. 12-15.

[3]Tordon 101 is the registered tradename of the Dow Chemical Company for its discovered and developed herbicide containing ½ pound of 4 amino 3,5,6-trichloropicolinic acid(picloram) and 2 pounds of 2,4-D per gallon.

South Vietnam during 1966 for evaluation. Although Fort Detrick had reported favorably on Tordon as a herbicide,[1] the White formulation had not been tested sufficiently as a military herbicide for Fort Detrick to recommend its use in South Vietnam. The Dow Company sent representatives to South Vietnam to discuss the use of this chemical with the military operating and management personnel. As a result, in December 1965, limited quantities of White were requested for evaluation by the Military Assistance Command, Vietnam. It was planned to conduct an evaluation of White during 1966, prior to any decision for large scale usage. However, during 1966 and 1967, events rapidly overtook this plan and it became necessary to introduce large quantities of White as a complement for Orange until the supply of it improved. Table 1 summarizes the Orange herbicide requirements from 1962-1968.

TABLE 1

REQUIREMENTS BY THE DEPARTMENT OF DEFENSE
FOR HERBICIDE ORANGE 1962-1968
(Requirements in Thousands of Gallons)

YEAR	REQUIREMENT
1962	50
1963	100
1964	200
1965	400
1966	2,600
1967	6,000
1968	10,000

[1]The Dow Chemical Company, "Tordon Herbicide for Defoliation" (Paper presented to Department of Defense Research and Engineering, Research and Technology Division, Washington, D. C., August 18, 1965).

The next section will develop the industrial production capacity for Orange; however, there is little question that in the latter part of 1966 demand exceeded supply. The record of the Joint Congressional Committee on Defense Production states:

> Herbicides for Southeast Asia--The fiscal year 1966 herbicide requirements, used for defoliation in Southeast Asia, were relatively small and were met readily from commercial capacity.
>
> The CINCPAC /Commander in Chief, Pacific/ stated 'Orange' herbicide requirements for fiscal years1967, 1968, and 1969 were so great as to require the creation of additional production capacity.[1] /sic./

Industrial Capacity

To ascertain the ability of industry to meet the military demand for Orange, production figures for the N-butyl esters of 2,4-D and 2,4,5-T were extracted from the United States Tariff Commission reports of Synthetic Organic Chemicals for 1961 through 1967.[2] On the basis of these figures, the maximum possible Orange production, in gallons per year, was calculated.[3] These calculations show that the production of Orange is constrained by the production of 2,4,5-T. This information is presented in Table 2.

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[1]U. S. Congress, Joint Committee on Defense Production, Seventeenth Annual Report, H. Rept. 1052, 90th Cong., 2d sess., 1968 (Washington: U. S. Government Printing Office, 1968), p. 240.

[2]U. S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales, 1961 through 1967. (Washington, D. C.: Government Printing Office).

[3]Calculations based on all available 2,4,5-T used for the production of Orange, with one gallon of Orange containing 4.74 pounds of 2,4,5-T.

TABLE 2

U. S. PRODUCTION OF 2,4-D, 2,4,5-T, AND ORANGE 1961-1967

Year	Production		
	2,4-D 1,000 pounds	2,4,5-T 1,000 pounds	Orange 1,000 gallons
1961	4,117	1,277	269
1962	5,609	1,147	242
1963	5,795	1,336	281
1964	7,242	1,754	370
1965	12,084	6,485	1,370
1966	17,966	10,146	2,140
1967	25,402	19,422	4,100

Table 2 shows an ever-increasing production of 2,4-D and 2,4,5-T. This growth rate closely parallels the increasing use of herbicides by the Department of Defense. The period 1961 through 1964 most probably represents the normal increase in domestic use of these herbicides for agricultural and brush control applications. The rapid and steady growth of production during 1965 through 1967 is directly related to the increasing military demand and the response to this demand by the chemical manufacturers.

In early 1967, it was estimated that the total military requirement for Orange was four times the United States production capacity.[1] At that time, the Department of Defense was projecting a 1968 herbicide requirement of approximately 10,000,000 gallons

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[1] "Vegetation destruction in Vietnam will hamper vegetation control in the U. S.," Chemical Engineering (April 24, 1967), p. 88.

and an estimated Orange production of only 2,100,000 gallons. Research has failed to reveal any evidence of new plant construction by industry. However, the reports of the United States Tariff Commission certainly reflected a major expansion in production. Several explanations were given for this expansion: existing production facilities were operated in excess of rated capacity, minor additions were made to existing plants to increase production, and some shifting of production facilities from other products.[1] To the defense managers, it appeared that by 1967 all Orange facilities were in full production and any further expansion would require new construction.

In 1966, White was introduced as a complement to Orange. The sole producer of White is the Dow Chemical Company and it has not consented to releasing production statistics to the general public. A reasonable estimate of White production is 4,000,000 gallons annually.[2]

A recapitulation of the Department of Defense herbicide requirements and the industrial production capacity for the years

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[1]"Production of Orange Herbicide," Memorandum For The Record, Directorate For Production Services, Office of the Secretary of Defense, November 14, 1968. (Typewritten.)

[2]This estimate is based on an article by George R. Harvey and Jay D. Mann, "Picloram in Vietnam," Scientist and Citizen (September, 1968), pp. 165-171. The domestic production of natural alpha-picoline, the starting material for the synthesis of picloram, was at least two million pounds per year in 1967. By industrial processes, one pound of alpha-picoline can be converted to one pound of picloram. Since White contains one half pound of picloram per gallon, at least 4,000,000 gallons of White could be produced annually.

1965 through 1968 is given in Table 3.

TABLE 3

REQUIREMENTS BY THE DEPARTMENT OF DEFENSE AND PRODUCTION OF CHEMICALS USED FOR DEFOLIATION 1965-1968
(In Thousands of Gallons)

Year	Requirements	Production		
		Orange	White	Total
1965	400	1,370	a/	1,370
1966	2,600	2,140	a/	2,140
1967	6,000	4,100	4,000	8,100
1968	10,000	4,100	4,000	8,100

a/ Production not significant

Without any civilian use of 2,4-D and 2,4,5-T, and with the continued use of White as a complement to Orange, production capacity was insufficient to meet the 1968 military herbicide requirements. With the normal civilian use of 2,4-D and 2,4,5-T in excess of fifty percent of the domestic production, the shortage becomes even more critical.[1] This potential herbicide shortage in the civilian sector played an important role in the decision-making process.

Research and Development

There are two aspects of research and development that relate to the decision making process to alleviate the herbicide shortage. The results of an extensive field test conducted in Thailand, and the lack of any significant military field tests of White, both entered

[1] U. S. Congress, Joint Committee on Defense Production, Seventeenth Annual Report, op. cit., p. 13.

the decision-making process.

To support the defoliation operations in South Vietnam, Fort Detrick conducted tests in Thailand in 1964 and 1965 to determine the effectiveness of aerial applications of several herbicides. Thailand was selected because of the similarity in vegetation and climate. Not being in a war zone, scientific and long term observations could be made of the results of defoliation. One aspect of these tests relates directly to this study project--the recommended application rates for Orange.

During 1963 through 1965, there was considerable controversy as to the most effective and efficient application rate for Orange. The military personnel responsible for the program in South Vietnam claimed that three gallons of undiluted Orange per acre was correct. Others at Fort Detrick claimed that this rate was high by at least a factor of two, and that better results could be obtained by a 50-50 mixture of diesel oil and Orange applied at a rate of three gallons per acre.[1] While this argument could be considered academic in 1964, it was not so in 1966-1967. The results of these tests supported the findings from South Vietnam showing that, for maximum defoliation and duration, Orange should be applied at three gallons per acre of

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[1]Based on agricultrual spray techniques in the United States, adequate vegetation control is obtained with lower application rates of Orange than is used in South Vietnam. The argument for a diesel oil - Orange mixture is that 1.5 gallons of Orange per acre is adequate, providing the volume of spray is sufficient to obtain complete and uniform coverage of the vegetation.

undiluted chemical.[1] This test result reinforced the operating experience from South Vietnam enabling the Defense Department to strongly defend against any reduction in Orange application rates as a means of easing the herbicide shortage.

The lack of any significant military field tests with White is due primarily to the late development of this compound. By 1964, only limited quantities were available from the commercial producer. Approximately 100 gallons were included in the Thailand tests. The limited testing by Fort Detrick showed that White was highly effective but generally slower than Orange in defoliation response. Additional tests were needed to confirm these findings.[2] Prior to 1965, no field tests had been made on the Southeast Asian vegetation. The significance of this lack of testing became important when Orange shortages developed and full interchangeability between White and Orange was suggested by the producer, the Dow Chemical Company. The military, because of these limited tests, could not support this recommendation.

The problems affecting the management and decision making process in the use of herbicides are quite complex. The preferred herbicide for use in South Vietnam is Orange. White, although a complement in the short run to Orange, is not considered interchangeable for Orange in the long run. The required application

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[1]Darrow, op. cit., p. 7.

[2]Ibid., p. 116.

rate for defoliation in South Vietnam is three gallons of undiluted Orange per acre. The maximum industrial production capacity of Orange without facility expansion was estimated by the end of 1967 to be about 4,100,000 gallons annually. The 1968 military requirement for Orange was about 10,000,000 gallons. The normal civilian consumption of 2,4-D and 2,4,5-T was approximately fifty percent of the domestic production.

CHAPTER III

ORGANIZATION FOR MANAGING THE HERBICIDE PROGRAM

The organization within the defense establishment for managing the herbicide program will be examined to determine the means used for the decision-making process. The roles of other federal agencies interacting with the Department of Defense during this decision-making phase will also be examined. Interaction between the public and private sectors of the economy will be included. The private sector, primarily the chemical producers and herbicide consumers, has no formal organization to act in their interest. Their viewpoint was represented by the federal agency concerned. For example, agriculture was represented by the Department of Agriculture and the chemical producers by the Department of Commerce.

Source of Herbicide Demand

The herbicide demand, which by 1966 exceeded supply, was generated at the operating management level in South Vietnam. This was the demand that management in the Department of Defense used in planning ways to alleviate shortages. Koontz's principle of adequate communication regarding planning, that the best planning occurs when

everyone responsible for it has access to complete information,[1] is difficult to accomplish when one level of management is in Washington and the other in South Vietnam. There is evidence that planning could have progressed more rapidly had a better flow of information and understanding existed between Washington and South Vietnam.

In South Vietnam, the U. S. Military Assistance Command is responsible for forecasting herbicide requirements. In general, prior to mid-1965, these requirements were based on a detailed annual plan of herbicide operations, with requirements based on the planned area for defoliation. With the build-up of United States forces in South Vietnam, the areas requested for defoliation exceeded the spray capability of the available C-123 aircraft. Forecasting herbicide requirements was reduced to estimating the total number of sorties for the C-123 aircraft available annually and multiplying by 1,000 gallons of herbicide per sortie.[2] This method of forecasting the requirement is easy to perform, but its accuracy depends upon the ability to forecast sortie rates. Any over optimism on future sortie rates, based on favorable operating conditions that do not

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[1]Robert N. Anthony, Planning and Control Systems; A Framework for Analysis (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1965), p. 151.

[2]An additional quantity of herbicide, less than five percent of the total, was disseminated from ground spray apparatus and helicopter spray systems. This small amount was included in determining the overall herbicide requirement.

continue, could significantly overstate annual herbicide requirements. Unless the planners in Washington were thoroughly familiar with the operating conditions, computational methods and limitations used for developing herbicide requirements, the demand generated by such a method could be highly inaccurate.

The Air Force is responsible for the supply management of herbicides for use in South Vietnam. Prior to 1967, the herbicide demand, or requirement, generated by the U. S. Military Assistance Command was forwarded to an Air Force Air Materiel Area, an operating agency of the Air Force Logistics Command.[1] Funds for this requirement, following approval of the Air Force budget, were furnished the Defense General Supply Center, Richmond, Virginia by the Air Materiel Area. The Defense General Supply Center procured the required herbicide, and the Air Materiel Area then assumed responsibility for delivery to the operating forces in South Vietnam.

Without a herbicide shortage, this system was responsive and in keeping with Secretary McNamara's concept that an organization as vast as the Department of Defense can be effectively managed only by the centralization of policy formulation and the decentralization of operations. He believed in a pyramid of decision-making and, that it should be pushed to the lowest level that has the

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[1]Information of the Air Force logistics and management of herbicides was obtained from Mr. Fred Knapp, Office of the Deputy Chief of Staff, Systems and Logistics, Headquarters, U. S. Air Force.

ability and information to apply approved policy.[1] Given a developing shortage of herbicide, then the system must be equally responsive to the pushing of this information to the apex of the pyramid for the required policy decisions.

All evidence points to the effectiveness of the system to rapidly push information of the impending herbicide shortage to the top management of the Department of Defense. With the increased herbicide requirements generated from South Vietnam in 1966, the Defense General Supply Agency was unable to completely fill this demand and assistance of the Business and Defense Services Administration, Department of Commerce was requested.[2] A quick survey of industry by this administration revealed that there was not only insufficient production facilities to meet both the military and civilian demands, but also an unwillingness by the producers to divert more than about two thirds of their output to military uses.[3] Decisions curtailing the civilian supply would be necessary if the needs of the Department of Defense were to be satisfied. By October 1966, personnel from the Department of Defense were meeting with representatives from the Departments of Commerce, Interior, and Agriculture, the General Services Administration, and/Office of the

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[1]William W. Kaufman, The McNamara Strategy (Evanston, Ill.: Harper and Row, Publishers, Inc., 1964), p. 172.

[2]Office of Emergency Preparedness, Summary of Correspondence Relating to Herbicides, prepared June 21, 1967 (typewritten), p. 1.

[3]Interview with Miss Jane Lewis, Chemicals Division, Business and Defense Services Administration, Department of Commerce, December 19, 1968.

Emergency Preparedness to discuss this subject.[1] The Defense Production Act of 1950, as amended, provides the legal basis for diverting material in the civilian market to military usage. An examination of this act and the responsibilities of the various federal agencies in addressing the herbicide shortage are discussed in the following section.

Defense Production Act of 1950[2]

The Defense Production Act provides controls for the production and distribution of national resources to promote the national defense. Title 1, sec. 101 of this Act provided the statutory authority for preemption of herbicide production for use by the military:

> Sec. 101. (a) The President is hereby authorized (1) to require that performance under contracts or orders, (other than contracts of employment) which he deems necessary and appropriate to promote the national defense shall take priority over performance under any other contract or order, and for the purpose of assuring such priority, to require acceptance and performance of such contracts or orders in preference to other contracts or orders by any person he finds to be capable of this performance, and (2) to allocate materials and facilities in such manner, upon such conditions, and to such extent as he shall deem necessary or appropriate to promote the national defense.
>
> (b) The powers granted in this section shall not be used to control the general distribution of any material in the civilian market unless the President finds (1) that such material is scarce and critical material essential to the national defense, and (2) that the requirements of the national defense for such material cannot otherwise be met without creating a significant dislocation of the normal distribution of such material in the civilian market to such a degree as to create appreciable hardship.[3]

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[1]Office of Emergency Preparedness, op. cit., p. 1.

[2]The Defense Production Act of 1950, with its several amendments, will be cited hereinafter as the Defense Production Act.

[3]Public Law 774, 81st Cong., enacted September 8, 1950 (64 Stat. 798).

An important aspect of this act is that imposing priorities in the performance of contracts or orders under section 101.(a) does not impose controls directly over the consumer. A Presidential finding under the provisions of section 101.(b) would be necessary for such control. No such finding has been deemed necessary during the Vietnam conflict. In this regard, the Secretary of Commerce, John T. Conner, advised the Joint Committee on Defense Production in October 1965:

> It is the Government's policy to impose civilian industrial controls only if no other method of meeting defense needs is available to us. We will not, except as a last resort, move to a system of expanded controls similar to those necessary in past years, such as during the Korean emergency. We have a flexible and dynamic economy which permits a great degree of substitution and resourcefulness in meeting defense needs and civilian sector needs of 195 million people. As a matter of policy, we seek to avoid restricting the normal operation of our economy.[1]

In implementing the Defense Production Act to herbicides, section 101.(b) was avoided by imposing military priority orders up to 100 percent of the industry production capacity for Orange and White, thus negating controls as none of these herbicides remained for civilian use.[2]

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[1]U. S. Congress, Joint Committee on Defense Production, Defense Production Act Progress Report No. 45, 89th Cong., 1st sess., October 4, 1965 (Washington: U. S. Government Printing Office, 1965), p. 4.

[2]Office of Emergency Preparedness, op. cit., p. 2.

Department of Defense Organization

Prior to 1966, the only management function exercised by the Office of the Secretary of Defense for herbicides was in the review process of the Air Force budget. It was the shortage of herbicide that triggered and alerted the defense management system. The Directorate for Production Services, Office of the Assistant Secretary of Defense for Installations and Logistics assumed the prime role within the Department of Defense for ways to alleviate this shortage.[1] This directorate is responsible for policies, plans, and procedures related to production schedules, priorities, and allocations, mobilization planning, industrial facilities and tools, and materials.[2]

Throughout the decision-making process to alleviate the herbicide shortage, the Directorate for Production Services planned, prepared, coordinated and recommended the Department of Defense plans and procedures for providing herbicide for use in South Vietnam. This directorate worked closely with the staff of the Joint Chiefs of Staff in obtaining firm requirements and supporting justification for herbicides in South Vietnam. By turning to the Joint Chiefs of Staff for requirements information, command attention was focused on

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[1]Interview with Mr. Carl Rolle, Directorate for Production Services, Office of the Assistant Secretary of Defense for Installations and Logistics, December 19, 1968.

[2]Department of Defense, Organization and Functions, Office of the Assistant Secretary of Defense for Installations & Logistics, September 30, 1968.

the herbicide problem. The Joint Chiefs of Staff, in turn, went through the Commander-in-Chief, Pacific to the Commander, Military Assistance Command, Vietnam for the necessary information. The basic source of information, Military Assistance Command, Vietnam, was the same as before the herbicide shortage, but the command channel, as opposed to the logistical channel, was now utilized in furnishing the information to the top decision-making level within the Department of Defense.[1] This method facilitated the passage of information and provided to the Office of the Secretary of Defense recommended requirements for herbicides by the Joint Chiefs of Staff. The Department of Air Force function of exercising supply management for herbicides did not change once the requirements and policies were established by the Secretary of Defense. The Production Services Directorate also utilized the expertise of the Department of Army with regard to herbicide agent characteristics and construction techniques for production facilities.

By centralizing the decision-making process in the Office of the Secretary of Defense, the responsibilities of the Departments

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[1]Apparently, the operating personnel in Vietnam were not fully aware of the magnitude of the herbicide shortage until late 1966. The author has discussed this with the former Chief, Chemical Operations Division, U.S. Military Assistance Command, Vietnam, who stated that he became aware of significant herbicide shortages only after the Joint Chiefs of Staff and CINCPAC requested requirements data in November and December 1966. The seriousness with which the Military Assistnace Command considered this shortage is reflected by the addition, on December 20, 1966, of herbicides to the list of critical materials included in the FLAGPOLE list. This listing of materials in short supply, code named FLAGPOLE, was considered essential for operations in Vietnam and all possible assistance to eliminate these shortages was requested of the Joint Chiefs of Staff.

of Army and Air Force could be coordinated and directed to meet the herbicide requirements as determined by the Joint Chiefs of Staff. Centralization of the decision-making process in this instance was in keeping with Secretary McNamara's philosophy of managing the Department of Defense.

> Too often responsibility and authority have been so fragmented by overlapping and diffused organizational arrangements within the Department as to make it virtually impossible to pinpoint responsibility. In such situations decentralization of decision-making authority is unwise, if not impossible. As a matter of fact, in these circumstances decisions must be made at higher levels in the Department--often at the very top--because no one else has the clear authority to make them.[1]

Also, negotiations with other federal agencies was facilitated by having the decision-making process centralized at the level of the Office of the Secretary of Defense.

Other Federal Agencies Involved

The Office of Emergency Preparedness and the Business and Defense Services Administration, Department of Commerce were concerned primarily with the establishment of priorities and production capabilities. The Departments of Interior and Agriculture, Federal Communications Commission, Interstate Commerce Commission and the General Services Administration acted as claimant agencies for herbicides. It was the mission of these latter agencies to determine the herbicide requirements of the civilian sector and to evaluate the impact of shortages.

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[1]Robert S. McNamara, "Managing the Department of Defense," Civil Service Journal, April-June 1964, p. 5.

The Office of Emergency Preparedness provides assistance and advice to the President in coordinating and determining policy for all emergency preparedness activities of the Government. This responsibility includes developing policy guidance in the use of available resources, the requirements that might be levied against these resources under various emergency situations, and the development of a system for reaching central program decisions for the use of resources under emergency conditions.[1] This Office also controls programs authorized by the Defense Production Act. The statutory authority for the Office of Emergency Preparedness to be involved in decisions affecting the distribution of herbicides is well established. Added emphasis was given when the Secretary of Agriculture urged the Director, Office of Emergency Preparedness to "assume Federal Government leadership in initiating steps relative to the shortage of the Herbicides 2,4-D and 2,4,5-T."[2]

In exercising this leadership, the Office of Emergency Preparedness worked closely and in coordination with the Business and Defense Services Administration, an operating unit of the Department

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[1]General Services Administration, Office of the Federal Register, National Archives and Records Service, United States Government Organization Manual 1968-69 (Washington, D. C.: Government Printing Office, June 1, 1968), pp. 66-67.

[2]Letter from Secretary of Agriculture to Director, Office of Emergency Preparedness, January 26, 1967.

of Commerce.[1] Functions of this organization that relate to the problems of this study are:

> 1. Assure the achievement of military and atomic energy programs by channeling, where necessary, the materials and products required therefore in accordance with the provisions of the Defense Production Act of 1950, as amended.
>
> 2. Insure the development of practical mobilization programs by ascertaining the production potential of the industrial economy as related to materials, products and facilities, for defense supporting and essential civilian needs, for which the Department of Commerce is the cognizant agency.
>
> 3. Except as otherwise provided by law or Executive Order, establish the Business and Defense Services Administration as the logical point in Government for representation of the domestic interests of business and industry in their relations with other governmental agencies.
>
> 4. Provide other departments and agencies of the Executive Branch and the Congress with required information and judgment concerning the viewpoints and interests of business and industry.
>
> 5. Obtain the views and advice of business through the establishment of, and consultation with, industry councils and industry advisory committees, and through cooperation with trade associations.[2]

It was through the Business and Defense Services Administration that the government directed the output of herbicide production into military channels. Further, this administration dealt with the chemical producers, providing them with demand data and obtaining

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[1]Interview with Mr. Albert S. Sanders, Jr., Deputy Chief, Materials Policy Division, National Resources Analysis Center, Office of Emergency Preparedness, December 16, 1968.

[2]U. S. Department of Commerce, Organization and Functions of the Business and Defense Services Administration (Washington, D. C.: October 1, 1953), pp 2-3.

from them supply capabilities. The close working relationship established between industry and the Business and Defense Services Administration facilitated the acquisition by the government of the individual industrial production data for Orange and White. This information was essential in assessing the magnitude of the herbicide shortage.[1] The Business and Defense Services Administration also determined that the herbicide producers were reluctant to expand their capacity with their own funds to meet the increased military demands, unless they were given assurances that the defense procurement would continue for several years.[2]

The findings of the Department of Agriculture were the most important of the other federal agencies, representing claimants within the civilian sector for herbicides. In analyzing the shortages of 2,4-D and 2,4,5-T, the Department of Agriculture estimated that there would be an "unrest among all farmers and ranchers" who needed these herbicides but would be unable to obtain them, and stated that living with this situation would be "difficult for the Administration."[3] While agriculture uses about one-half of the total domestic production of 2,4,5-T, principally on rangeland in Texas and adjoining states,

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[1]Interview with Miss Lewis, op. cit.

[2]Letter from Director, Office of Emergency Preparedness to Assistant Secretary of Defense (Installations and Logistics), October 9, 1966.

[3]Letter from Secretary of Agriculture to Director, Office of Emergency Preparedness, August 4, 1967.

it was believed that shortages of this chemical for up to a year could be tolerated. This shortage might reduce beef production and result in beef prices slightly higher to the consumer. A shortage of 2,4-D would have an even greater impact on agriculture. Agriculture uses about 60 percent of the total domestic production, principally for controlling weeds in corn, wheat, and other small grains. With a twenty percent shortage, the Department of Agriculture estimated "that the cost to farmers would be $70-75 million in additional production expenses."[1]

Investigation by other federal agencies revealed varying requirements for 2,4-D and 2,4,5-T in their claimant sectors. Shortages in other sectors would not be as serious as in agriculture. While large quantities of 2,4,5-T are used for right-of-way clearance along railroads and powerlines, suspension of clearing for twelve to eighteen months would not seriously affect operations. There was considerable concern expressed for the small chemical formulator and applicator, who, because of a shortage of these chemicals, could suffer an extensive business loss or be forced out of business.[2]

The impact of herbicide shortages on the civilian sector would have to be taken into consideration in the decision-making process for meeting the military demand and alleviating the herbicide shortage.

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[1] Ibid.

[2] Interview with Miss Lewis, op. cit.

The question of the relative utility of a commodity in the civilian sector versus the military sector would have to be addressed.

The organization for managing the herbicide program at the defense level was examined to determine the means used for the decision-making process. The Office of the Secretary of Defense achieved centralized control by establishing program management within the Directorate for Production Services. The statutory authority for controlling the distribution of herbicide resources was the Defense Production Act. In implementing this act, two other federal agencies performed major roles, the Office of Emergency Preparedness and the Business and Defense Services Administration. The Department of Agriculture, representing the major civilian sector claimant for herbicides, expressed concern with any extended curtailment of herbicides for agriculture.

CHAPTER IV

ANAYLSIS OF THE HERBICIDE MANAGEMENT PROCESS

A military herbicide requirement of approximately 2,600,000 gallons for 1966, increasing to about 10,000,000 gallons for 1968, has been identified. Production was not sufficient to meet this increased demand. The organization within the Department of Defense for the herbicide decision-making process, as well as the interaction with other federal agencies,has been examined. The purpose of this chapter is to investigate and analyze the alternatives developed for alleviating the herbicide shortage and to evaluate the decision-making process, considering the decisions adopted and their impact on herbicide operations in South Vietnam.

The problem consisted of acquiring, in the short run, the maximum amount of herbicide to maintain military operations until production expanded to meet the long run civilian and military demands. Decisions would be required to curtail the amount of herbicide available for civilian use and to establish the means to expand production.

Alternatives for Meeting Herbicide Requirements

The only alternative for meeting the demand, both civilian and military, on a continuing basis was the expansion of herbicide production facilities. It was estimated that the engineering and construction of new facilities would require from eighteen to

twenty-four months.[1] Before exploring this aspect of the problem, an examination will be made of the alternatives considered and the course of action adopted to meet the military demand for herbicide until additional production became available. The alternatives considered were:[2]

1. The reduction of Orange application rates from three gallons per acre to two gallons per acre.

2. The dilution of Orange with diesel oil in a 50-50 mixture and applied at three gallons per acre.

3. The use of 2,4-D at three gallons per acre.[3]

4. The use of White as a complement to Orange.

5. Allocation of part or all of the domestic production of Orange to the military.

Either of the first two alternatives would essentially double the coverage obtained from the available Orange, and, in effect, meet the military requirements for 1967 and 1968. Either of these two alternatives in combination with alternatives three or four would

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[1]Letter from the Dow Chemical Company to the Director of CBR and Nuclear Operations, OACSFOR, Headquarters, Department of the Army, February 24, 1967.

[2]The author was assigned to Headquarters, Department of the Army, during the time when decisions to alleviate the herbicide shortage were formulated and made. The background material, except where otherwise noted, is from his own notes and recollection.

[3]The Department of Agriculture urged adoption of either alternative one or two. Based on agricultural spray applications in the United States, it was felt that three gallons of undiluted Orange per acre greatly exceeded the amount of herbicide required to cause defoliation. The use of 2,4-D was not encouraged by the Department of Agriculture because of its important agricultural applications.

meet both the 1967 and 1968 military requirement and provide some Orange for civilian consumption. Regardless of which alternative was adopted, it appeared that allocation of Orange production would be required to assure that the military received adequate supplies.

The defense decision-makers asked the Military Assistance Command, Vietnam for comments on those alternatives that would alter their operating procedures. The personnel in Vietnam replied that any alternative changing the application rate from three gallons of undiluted Orange per acre was unacceptable. Their reasons were that experience in Vietnam, as well as the test program conducted in Thailand by personnel from Fort Detrick, showed that maximum leaf fall and duration of defoliation was obtained at this application rate. Shorter duration of defoliation would necessitate respraying more often. Because of the need to respray more often, these alternatives would not, in the long run, result in any significant overall decrease in herbicide requirements. In fact, sortie requirements would increase, subjecting the air crews to a greater hazard from enemy ground fire and increasing the cost.

In proposing the use of 2,4-D, it was suggested that by spraying this chemical on targets containing primarily broad leaf vegetation, defoliation response would not greatly suffer. This alternative also was not acceptable to the operating personnel in Vietnam. Their objections were that the majority of the areas for defoliation contained a variety of vegetation species and the efficiency of defoliation would suffer by using only

2,4-D.[1]

White was accepted as a complement until such time as Orange availability met their demand. The Military Assistance Command had applied limited quantities of White and observed that leaf fall was several weeks slower than with Orange. However, once leaf fall occurred, defoliation was comparable to areas sprayed with Orange, although insufficient time had elapsed to observe the duration of defoliation.[2] White, being slower acting and the duration of defoliation unknown, was not considered to be fully interchangeable with Orange in the long run.[3]

To satisfy the objections of the Military Assistance Command and to more closely meet the herbicide requirement, preemption of all Orange production, supplemented with White, would be required. A recommendation to this effect, as well as the necessity for the Department of Defense to undertake a program for creating new capacity for the production of Orange, was presented to the Secretary of Defense.

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[1]While 2,4-D is effective on broad leaf species, and 2,4,5-T is effective on woody species, neither, as well as White, is effective grass control agents. For this purpose, Agent Blue, cacodylic acid, is used in South Vietnam.

[2]Interview with Lieutenant Colonel Philip L. Boster, January 10, 1968. Colonel Boster was assigned to the Chemical Operations Division, Military Assistance Command, Vietnam, 1966-1967.

[3]There did remain a continuing requirement for small quantities of White for use in areas where Orange, due to its volatility could evaporate and the vapors be deposited on nearby crops. The active ingredients of White are non-volatile, and therefore there is no vapor hazard associated with its use.

Approved by Secretary McNamara, this recommendation and a statement of the military requirements for herbicide was furnished on February 16, 1967 to the Director, Office of Emergency Preparedness.[1]

In preparing this recommendation for the Secretary of Defense, the Directorate for Production Services carefully reviewed the herbicide requirements, justification, and rationale provided by the Military Assistance Command.[2] Requirements were based on the estimated sortie rate. The justification for defoliation was its saving of the lives of military personnel by exposing enemy positions.[3] Whether the defense decision-makers disputed the requirements, or were in a position to, with Secretary McNamara's stated policy that "General Westmoreland's military requirements would be met," is unknown.[4] However, there is evidence that the herbicide requirements were overstated.

In 1966, the estimated sortie rate was 1.0 per aircraft per day, while the 1968 herbicide requirement was evidentaly calculated

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[1]Letter from Secretary of Defense to Director, Office of Emergency Preparedness, February 16, 1967.

[2]Interview with Mr. Carl Rolle, op. cit.

[3]John Maffre, "Pentagon Drafts Plant to Make Viet Defoliant," The Washington Post, July 18, 1968, p. G6.

[4]U. S. Congress, House, Committee on Armed Services, op. cit., p. 83.

on a sortie rate of 1.3 per aircraft per day.[1] To support an increased average sortie rate of 1.2 instead of 1.0 for twenty-four aircraft, about 1.75 million gallons more of herbicide are required annually. A recent letter to the Assistant Secretary of Defense for Installations and Logistics contends that the military herbicide requirement has decreased--or was overstated, as no evidence has been uncovered of any decrease in the number of spray aircraft in South Vietnam.

> In the fall of 1966, the annual requirement of Orange is believed to have been in the area of 10 million gallons, ...At that time, and up through the current contracts which were started in June 1968, the Government apparently has contracted for as much of this requirement as possible. The current contracts expire in February 1969, with three months option on the part of the Government to extend at the same rate of production for an additional three months period or through May 1969.
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> The producers have now received telegrams stating that the contract period will be extended through August 1969, instead of expiring at the end of February 1969, although the contract amounts will remain the same. This will have the effect of reducing shipments during this period to approximately 60% of the contract delivery rate.[2]

The purpose of mentioning a possible overstatement of requirements is not to criticize those that developed the requirements or the defense decision-makers for accepting them. Rather, it is

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[1]In 1966, with seven aircraft, 2,600,000 gallons of herbicide were dispensed. In 1968, with twenty-four aircraft, the herbicide requirement was 10,000,000 gallons. Computing the sortie rate on a 365 day year results in 1.0 for 1966 and 1.2 for 1968.

[2]Letter from Sellers. . . ., op. cit. By extending the contract period without any increase in total quantity delivered, the Department of Defense reduced the monthly herbicide demand placed on the producers.

emphasize the difficulty of the decision-maker to critically review information based on operating conditions 10,000 miles distant, despite the present sophisticated means of telecommunications. Effective planning requires the decision-maker to have available to him not only an understanding of objectives but also an understanding of the planning premises to achieve these objectives.[1] Whether this information, in sufficient detail, was available to the defense decision-maker is questionable.

Several meetings of representatives of the Office of Emergency Preparedness, the Business and Defense Services Administration and the Departments of Defense and Agriculture were held in late February 1967 to determine feasible actions for meeting the military herbicide requirements stated by the Secretary of Defense.[2] These meetings resulted in a recommendation to, and approval by, the Director, Office of Emergency Preparedness, that the producers of Orange and White be issued military priority orders for these chemicals to the full extent of their capability to produce.[3] These orders, under the provisions of Section 101.(a), Defense Production Act, were furnished the chemical producers on March 24, 1967 by the Business of Defense Services Administration.[4] This 100 percent preemption of

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[1]Anthony, op. cit., p. 152.

[2]Letter from Director, Office of Emergency Preparedness to Acting Secretary of Commerce, March 20, 1967.

[3]Letter from Director, Office of Emergency Preparedness to Secretary of Defense, March 20, 1967.

[4]Telephone interview with Mr. R. A. Hickman, Director of Government Marketing, the Dow Chemical Company, October 25, 1968.

production was to remain in effect until December 31, 1967.[1] The President was informed of this action and also that adverse reactions from farmers and ranchers might ensue as shortages in the civilian sector developed.[2] These reactions did not develop and will be discussed later.

In implementing the Defense Production Act, allocations of herbicides in the civilian sector were avoided, although allocations had been recommended by the Secretary of Agriculture.[3] This action was not compatible with the "guns and butter" policy followed by the Government in conducting the Vietnam conflict. The military demand for Orange was so large that it could absorb the entire production capacity during 1967. Rather than attempt the difficult determination of which of the civilian sectors had the greatest need for this chemical, and then meet this civilian demand at the expense of the military demand, producers were given military priority orders to their maximum capability to produce. By completely removing the product from the civilian sector, allocation was avoided.

Perhaps the only other instance that a consumable civilian commodity had been completely removed from the market to meet

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[1]Letter from Director, Office of Emergency Preparedness to Administrator, Business and Defense Services Administration, March 6, 1967.

[2]Office of Emergency Preparedness, Summary of Correspondence, op. cit., p. 3.

[3]Letter from Secretary of Agriculture to Director, Office of Emergency Preparedness, January 26, 1967.

military requirements occurred during World War II. During that war, the Government directed the entire output of nylon yarn to essential military needs.[1]

A chronological listing of the significant events, from the first indication of a possible herbicide shortage to the preemption of production, is informative in detecting the progress in reaching a decision.

July 1966--First indication by the Business and Defense Services Administration of a possible shortage of herbicides.

October 1966--Preliminary estimate of herbicide production capacity completed. Office of Emergency Preparedness requested Department of Defense to provide the military requirement and other federal agencies to provide their claimant requirements.

November 1966--Initial Department of Defense herbicide requirement furnished to the Office of Emergency Preparedness.

December 1966--Updated estimate of production capacity developed. Department of Defense herbicide requirement revised.

January 1967--Claimant agencies requirements furnished to the Office of Emergency Preparedness. Office of Emergency Preparedness requested Department of Defense to expedite updated requirements information.

February 1967--Revised Department of Defense requirements furnished to the Office of Emergency Preparedness. Department of Defense requested that all production of Orange be for military use.

March 1967--Decision to preempt entire production of Orange and White made by the Office of Emergency Preparedness. Chemical producers notified to provide 100 percent of production to the Department of Defense.[2]

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[1]U. S. Tariff Commission, Textile Division, Nylon and Other Noncellulosic Synthetic Fibers (Washington, D. C.: Government Printing Office, 1947), p. 457.

[2]Office of Emergency Preparedness, Summary of Correspondence . . ., op. cit., pp. 1-3.

Eight months elapsed from the initial indication of a herbicide shortage to preemption of production. The length of time required to reach a decision provides strong support for those that argue that the government way of doing things is often slow and inefficient.[1]

The lack of complete information best characterizes the reason for slowness in reaching this decision. Incomplete and changing production figures, incomplete knowledge of the civilian demand and the impact of shortages in this sector, an apparent change in the military requirements between November 1966 and February 1967, all contributed to the delay. Perhaps the key element in prolonging the decision-making process was the apparent change in military requirements. Within a month following the Department of Defense revised requirements information, the decision to preempt production was made and implemented. The decision-making process was necessarily slow, due to the need for thoroughness, but once firm information was available, a decision was rapidly reached.

The decision to preempt production involved several federal agencies, with the Office of Emergency Preparedness playing the major role. The decision and means to expand herbicide production facilities were performed by the Department of Defense. The Office of Production Services exercised centralized control and prepared recommendations for the Secretary of Defense to accomplish this action.

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[1]U. S. Industrial College of the Armed Forces, National Security Management, Management: Concepts and Practice. Edited by Fred R. Brown (Washington: ICAF, 1967), p. 235.

When the problem of expanding production facilities is addressed, several significant problems develop. One of the most important is the determination of who will construct the facilities, which is dependent, among other factors, on expected demand, life of the facilities, costs, and financing. One of the most troublesome and interrelated is financing. The means available when the government desires such expansion are total private financing, total government financing, or a combination. From the government's viewpoint, the policy of private financing, with complete acceptance of risks, usually is preferred. If the private sector is unwilling or unable to assume the total risk, then a means of sharing the risk, such as indemnification by the government in the event of program cancellation, is warranted. If the private sector will not accept these methods, or it is more advantageous to the government, then total government financing and ownership is necessary. The published Department of Defense policy for industrial facility expansion states in part:

> It is the policy of the Department of Defense to minimize Government ownership of industrial facilities insofar as possible in consonance with the need to assure economical support of essential defense production, maintenance, and research and development programs.[1]

The Department of Defense managers have attested to this policy, among them the Assistant Secretary of the Air Force for

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[1]Department of Defense Directive 4275.5, "Industrial Facility Expansion and Replacement," November 14, 1966, p. 5.

Installations and Logistics:

> Our basic policy is that industry will provide all facilities needed to support defense production programs. Like all policies, however, provisions are made for exceptions--in this case, for situations involving high risk defense programs impracticable for industry to support, and where substantial cost savings can be obtained.[1]

Adhering to this policy, the Department of Defense attempted to obtain herbicide facility expansion through total private financing. The producers were unwilling to undertake this expansion because of the uncertainties associated with the Vietnam conflict. Their market forecasts did not indicate that the civilian demand would be available to utilize the expanded facilities following cessation of hostilities.[2] The uncertainties of facility expansion confronting all industry to support the Vietnam conflict were known to defense managers and the necessity for government support was recognized. The Assistant Secretary of Defense for Installations and Logistics stated:

> To the extent that current /facilities/problems stem from the need to support our operations in Vietnam, I can recognize the uncertainties which cause your companies to hesitate to make substantial capital investments for increased production capacity. In such instances, the Department of Defense is prepared to work out an equitable arrangement whereby we would assume a share of the financial burden.[3]

Unable to induce the producers to undertake facility expansion

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[1]Robert H. Charles, Assistant Secretary of the Air Force for Installations and Logistics, address at Annual Meeting of the Forging Industry Association, White Sulphur Springs, West Virginia, May 26, 1967.

[2]Interview with Mr. Carl Rolle, op. cit.

[3]Paul R. Ignatius, Assistant Secretary of Defense for Installations and Logistics, address before the American Forging Association, Chicago, Illinois, November 16, 1966.

on their own, the Secretary of Defense on February 16, 1967 directed the Secretary of the Army to prepare a facilities plan to produce eight million gallons of Orange annually. This production would include 2,4-D, 2,4,5-T and the critical intermediate, tetrachlorobenzene (TCB).[1] It was believed that the conversion of an existing government facility would be the quickest and most economical method, but the Army was permitted to investigate other means.[2] The Army response, furnished on May 25, 1967, provided three alternatives for expansion of Orange production.

1. A complete government-owned, contractor operated (GOCO) facility to produce TCB, 2,4-D, 2,4,5-T and the finished Orange.

2. Multi-year procurement contracts for Orange, as an inducement for industry expansion. Industry could amortize their capital investment over a three year period. In the event contracts were cancelled in less than three years, the contractor would be indemnified.

3. A GOCO facility to produce 2,4-D, 2,4,5-T and Orange with multi-year procurement contracts for TCB. The procurement contracts would be an inducement for industry expansion of TCB production and would provide for indemnification in the event of contract cancellation.[3]

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[1]The limitation on 2,4,5-T production was not only facility capacity but availability of TCB. The only producers of TCB in the United States are the Dow Chemical Company, which consumes its entire output, and Hooker Chemical Company, which sells its output to other firms for the production of, among other things, 2,4,5-T.

[2]Memorandum for the Record, "Production of 'Orange' Herbicide," Directorate for Production Services, Assistant Secretary of Defense for Installations and Logistics, November 14, 1968. (Typewritten.), p.4.

[3]Staff Study, "Production of Herbicide, Orange," prepared by Edgewood Arsenal, Maryland, undated. (Typewritten.) This study formed the basis of the Army reply to the Secretary of Defense for facility expansion to produce Orange.

An analysis of these alternatives led the defense decision-makers to adopt the third proposal, primarily because it was estimated to be the least costly.[1] Also, the problem of the government producing TCB would be avoided. This chemical is extremely difficult to produce; furthermore, the government would have no use for the many by-products which are obtained.[2] There were other advantages in adopting this alternative. The government would own a production facility for 2,4-D, 2,4,5-T and Orange, a facility with a mission similar to government owned ammunition plants. When the requirement for herbicide operations in South Vietnam terminated, the plant could be placed in a standby condition. In the event of future military requirements for herbicide, the facility could be placed in production. Because of the disparity between wartime military requirements and peacetime consumption of ammunition, government ownership of this industrial capacity is necessary.[3] The same reasoning applies to herbicides. By having a GOCO facility, the problem of surpluses could be circumvented. Not being committed to production contracts with industry, production in the GOCO facility could rapidly adapt to changing military requirements, as will occur with the cessation of hostilities

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[1]Interview with Mr. Carl Rolle, op. cit.

[2]Memorandum for Record, "Production of 'Orange' Herbicide," op cit., p. 4.

[3]U. S. Industrial College of the Armed Forces, National Security Management, Production for Defense, by Harry B. Yoshpe and Charles F. Franke (Washington: ICAF, 1968), p. 49.

in Vietnam. Further, the GOCO facility would avoid unnecessary industrial expansion beyond the civilian market requirements. If one or two chemical firms had undertaken expansion with government assistance, these new, more efficient facilities may have placed the owners in a position to capture the majority of the civilian market.

The Army recognized these advantages, but recommended the alternative of multi-year procurement contracts for Orange. The major reason for this recommendation was that production would be obtained nearly one year sooner. The Army also stated that this method fulfilled the Department of Defense policy of procuring from industrial sources.[1]

Apparently, the decision made by the Secretary of Defense was based on the least cost, rather than the least time to acquire production. Admittedly, both cost and time were estimates and subject to interpretation by the decision-makers. If the lower cost of the GOCO Orange facility is accepted, then the decision is in agreement with the Department of Defense policy for industrial facility expansion. Facilities may be provided by the Department of Defense when it will "result in substantially lower cost to the Government."[2] The decision by the Secretary of Defense to create

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[1]Staff Study, "Production of Herbicide, Orange," op. cit., Annex 2.

[2]Department of Defense Directive 4275.5, op. cit., p. 8.

a new capacity for Orange by construction of a GOCO facility was made on July 31, 1967. The Army was directed to undertake this project at an estimated cost of nearly twenty million dollars. Production from this facility is scheduled to commence in August 1969.[1]

Other Considerations

The factors, other than operational considerations, influencing the decision-making process were the potential impact of herbicide shortages in the civilian sector, the logistic guidance for supporting the Vietnam conflict, and government expenditures to support facility expansion. Of these, shortages in the civilian-agriculture-sector posed the greatest concern. During World War II and the Korean War, programming the optimum ratio between military and civilian products was difficult.[2]

One of the justifications for the defoliation program by the Department of Defense was the saving of lives. Hitch and McKean have noted that, "there is no generally acceptable method for valuing human lives."[3] On the other hand, the Department of Agriculture estimated the annual economic losses to agriculture would be in excess of seventy million dollars from a shortage of herbicide. Given these conditions,

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[1]Memorandum for Record, "Production of 'Orange' Herbicide," op. cit., pp. 4-5.

[2]ICAF, Production for Defense, op. cit., pp. 152-155.

[3]Charles J. Hitch and Roland N. McKean, The Economics of Defense in the Nuclear Age (Cambridge, Mass.: Harvard University Press, 1960), p. 185.

the decision-makers were forced to a subjective determination of the utility of military versus civilian requirements. For herbicides, the military requirement was considered more important.

Despite the concern expressed by the Secretary of Agriculture, a serious shortage of 2,4-D for agricultural use did not develop. An embargo on the export of this chemical was considered as a means of retaining maximum quantities in the United States. At the urging of the Business and Defense Services Administration, this was not adopted. Rather, provisions were made for the duty free import, mainly from Canadian sources, of 2,4-D.[1] The Armed Services Procurement Regulation provides for duty free imports. Emergency purchases of war materials from foreign sources is authorized when there is a shortage of domestic supply and the materials are considered necessary for the adequate maintenance of the armed services.[2] The Defense Department authorized the duty free import of 2,4-D to satisfy, in part, the military requirement, freeing domestic production for civilian use. With the exception of a limited number of the smaller herbicide formulators and applicators, dependent upon 2,4,5-T, the herbicide shortage does not appear to have had a serious impact on the civilian sector.[3]

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[1]Interview with Miss Jane Lewis, op. cit.

[2]Department of Defense, Armed Services Procurement Regulation --the 1965 Edition (Washington: U. S. Government Printing Office, 1965), p. 631. The authority for these duty free imports is Schedule 8, Part 3, Item No. 832, Tariff Schedules of the United States.

[3]Interview with Miss Jane Lewis, op. cit.

The Department of Defense logistic guidance for the Vietnam conflict was based on the cessation of hostilities at the end of the fiscal year under consideration. This guidance reduced unobligated balances, prevented large inventories and decreased the requirements for storage facilities.However,if a Department of Defense policy that projected an end to the Vietnam conflict further ahead than the next fiscal year,might well have induced greater private financing of facility expansion. If this policy attracted the chemical producers, the defense decision-makers would then have had a feasible alternative for herbicide facility expansion at a considerable savings to the government.

Cost and time to establish production facilities were major considerations of the defense decision-makers. A decision criterion of least cost for the expansion of Orange production was selected by the defense decision-makers. The construction of the GOCO Orange facility, with multi-year procurement contracts for TCB, while estimated to be lower in cost to the government, was not the fastest means of achieving expansion. The multi-year contracts for Orange were estimated to be faster by one year than the method selected.

Evaluation of Decisions to Satisfy Military Requirements

The decision-making process resulted in two decisions to alleviate the herbicide shortage. The first decision, preempting Orange and White production for military use, was a decision involving the Department of Defense and other federal agencies. The second decision, the means for expanding Orange production, was within the

Department of Defense. Greenwood, in discussing the control theory of management, notes that "organizational control is achieved by establishing performance standards and comparing actual performance with these standards."[1] For herbicides, providing the required quantities of these chemicals to the operating personnel in South Vietnam was the performance standard. How well this standard was met reflects, in part, the correctness of the decisions made.

The decision in March 1967 to preempt production was the only feasible alternative to meet the military demand. The fact that serious shortages did not develop in the agricultural sector resulted from the related decision not to place an embargo on the export of 2,4-D, but rather to import this material duty free. These decisions resulted in maximum quantities of Orange and White available for the military and reduced the impact of shortages in the civilian sector. Although the decision resolved the problem of providing, in the short run, herbicide for use in South Vietnam, the decision-making process required excessive time. An earlier decision would have provided greater quantities of herbicide for military use. The slowness of the decision-making process apparently was due to the Department of Defense being unable to quickly resolve the military requirement.

The decision by the Department of Defense to establish a GOCO facility was not the most rapid means of expanding Orange production.

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[1]William T. Greenwood, Management and Organizational Behavior Theories (Cincinnati, Ohio: South-Western Publishing Company, 1965), p. 808.

The Army study considered multi-year procurement contracts to be faster. The GOCO facility is scheduled to initiate production in August 1969, two years following the decision. By October 1968, the chemical industry had substantially expanded, voluntarily, the production of 2,4-D and 2,4,5-T. A firm representing a group of herbicide producers noted:

> By virtue of increases in capacity which individual members of the domestic industry have made since the time of the Weldon Spring decision,[1] the domestic industry is now able to produce approximately 38.5 million pounds /8.1 million gallons/ of T acid and 100.0 million pounds /23.5 million gallons/ of D acid annually. These figures reflect the current capacity of plants located within the United States of the domestic industry. In addition, some members of the domestic industry have plants in Canada which are used to meet requirements of T and D within the United States.
>
> This reflects a substantial increase in the capacity of the domestic industry to produce both T and D over its capability which existed during the latter part of 1966, when the decision was made that domestic capacity was insufficient to meet demand.[2]

It does not appear that the defense decision-makers selected the optimum alternative for facility expansion. The chemical producers have demonstrated that herbicide production expansion through industry is quicker than the means selected by the Department of Defense. Considering that the industry expansion was undertaken

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[1]Weldon Spring, approximately thirty miles west of St. Louis, Missouri is the location of the government Orange facility. This site was used for an Army Ordnance facility during World War II. During 1956-1966, it was used by the Atomic Energy Commission in processing uranium and thorium. The Army selected this site as being the most economical for the construction of the Orange facility.

[2]Letter from Sellers. . . ., op. cit.

voluntarily, one speculates what results could have been obtained had the Department of Defense negotiated multi-year procurement contracts for Orange. Expansion would certainly have occurred sooner, and most probably at a lower cost to the government.

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