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**Helicopter Downwash Applied
to Fog Clearing
a status summary**

Army Electronics Command

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HELICOPTER DOWNWASH APPLIED TO FOG CLEARING: A STATUS SUMMARY

By

Walter S. Nordquist, Jr.

David H. Dickson

October 1972

Approved for public release; distribution unlimited.

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UNITED STATES ARMY ELECTRONICS COMMAND - FORT MONMOUTH, NEW JERSEY

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This report summarizes the results of a literature search and a survey of helicopter pilots concerning the use of helicopter-induced downwash to effect temporary clearings in fog. While the technique has been unsuccessfully applied in a variety of situations, the available information indicates that the criteria for determining the probability of successful application of this method are yet to be completely established. In general larger helicopters, such as the CH-54, can be successfully used for clearing fogs of 500-600 foot depth; however, smaller helicopters, such as the UN-1, do not work well for fogs of depths over 100-300 feet.			

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Fort Monmouth, New Jersey

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INTRODUCTION

Many years of research have been devoted to searching for methods of improving visibility within fogs. A relatively new method which appears to have merit, particularly for achieving temporary clearing over a small area, is that associated with the downwash created by a helicopter (Figure 1).

This report contains a brief historical background on the use of the downwash technique for fog clearing, the results of application of the technique, tabularized accounts of the successes and failures by various categories of helicopter type and fog characteristics*, and a few concluding remarks on what can be inferred from the information available. A recent survey of helicopter pilots concerning their experiences in applying the downwash technique to fog clearing is included in the appendix.

BACKGROUND

The direct investigation of helicopter downwash as a fog clearing technique has a relatively short history. The first reported effort was that performed by the Cold Regions Research and Engineering Laboratories (CRREL) of the US Army above a thin-warm advection fog along the wharf at Thule, Greenland in 1964 [1]. In 1968 the US Air Force's Cambridge Research Laboratories (AFCRL) applied the technique to create "holes" in stratus clouds near Eglin Air Force Base, Florida [2,3] and ground and steam fogs at Smith Mountain Lake, Virginia [3]. In 1969 the Atmospheric Sciences Laboratory (ASL) of the US Army joined with CRREL and AFCRL to conduct an extended series of tests applying the technique to radiation fogs near Lewisburg, West Virginia [4, 5, 6], while the US Army's Concept Team in Viet Nam (ACTIV) conducted a limited number of experiments on stratus cloud decks [7].

Since 1969 there have been helicopter downwash experiments on deep coastal advection fogs at Arcata, California in a joint ASL-Naval Weapons Center (NWC) effort in 1970 [8], on thin radiation fogs at Fort Rucker, Alabama by ASL [9], and on ice fog at Fairbanks, Alaska by CRREL [10] in 1971.

*Because of the variety of descriptors used for designating fog types, the descriptors used in this report are those used in the information sources. The designations of shallow and deep refer to the vertical extent of the fog while thin and dense are used to designate the visual density of the fog (the less the horizontal visibility, the denser the fog).



FIGURE 1. CH-54 HELICOPTER PERFORMING DOWNWASH OPERATION NEAR ARCATA, CALIFORNIA, FALL 1970.

Additionally a survey of helicopter pilots on their experiences with the technique was conducted in 1971 [11], the responses from which are included in the appendix. A report was subsequently made on the use of the technique for rescue purposes in Viet Nam [12].

RESULTS OF DOWNWASH MODIFICATION ATTEMPTS

A. General

Temporary clearings in a fog can be accomplished for a variety of fog conditions[†] and of helicopter types. One important consideration in evaluating the status of the technique concerns what those who have observed the application of the technique have to say about it. This consideration provides a context for the interpretation of the tabularized data.

Thus, the first portion of this section contains a chronological ordering of quotes and comments about the technique as observed in the field. The statements indicate various anticipated results. The second portion summarizes the results in tabular form for (1) individual experiments giving helicopter type, cloud type, cloud top, cloud thickness, and hover altitude, and for (2) degree of success for cloud type and cloud depth categories by helicopter type.

The tabular presentations have been prepared in "number of occurrences" form rather than in statistical form. This manner of presentation was chosen because of the limited number of experiments in each category and a lack of information on how many times the technique may have been tried, for fog modification or for other purposes, without success.

B. Quotes and Comments on the Technique

1964 - Following experiments using an H-34 helicopter Hicks [1] concluded: "... certain types of shallow fogs can be dispersed ... by helicopters flying at near-hovering air speeds at altitudes a few feet above the top of the fog."

[†]The types of clouds have been designated as reported. The designations in the tabular presentations are: Fog (category unspecified), Fog, Adv (advection fog), Fog, Grd (ground fog), Fog, Ice (ice fog), Fog, Rad (radiation fog), and Fog, stm (Steam fog).

- 1968 - Following experiments using an HH-53 helicopter Plank and Spatola [2] stated: "... a large helicopter ... should be able to create a swath of clearing, some 200-500 ft wide, along an airport runway 10,000 ft long, through ground fog 200 ft thick, in less than 10 minutes."
- 1968 - Following experiments using a CH-3E helicopter Plank [3] declared: "... helicopters can create operationally-useful clearing in particular types of ground fog of shallow depth and relatively-small liquid water content. A helicopter of the CH-3E type ... should be able to accomplish effective clearing of such fogs to depths of 300 feet or so. Partial clearing, or visibility enhancement, might be achieved with fog layers as deep as 500 feet."
- 1969 - Following experiments using CH-46, CH-47, and CH-54 helicopters Plank, Spatola, and Hicks [4] concluded: "... created cleared zones ranging from 500 to 3000 foot size and produced appreciable visibility enhancement over zones even larger. Six helicopter landings were accomplished at the airport ... through fog layers 200-400 feet thick."
- [5] "... cleared zones large enough to permit helicopter landings can be created by single helicopters (of the types used in the Lewisburg program) in most naturally-occurring fog situations in which fog depths are less than about 300 feet. If multiple helicopters are employed ... this will (a) increase the size of the cleared landing area in fog of 300 ft depth or (b) permit the creation of useable-size landing zones in fog of 400 ft depth, or possibly even fog of 500 to 600 ft depth..."
- [6] "... the capability (to accomplish areal clearing) is nearly an order of magnitude greater for fog of 200 ft depth than for a fog of 500 ft depth."
- 1969 - Following experiments using CH-47 and CH-54 helicopters Christensen [7] stated: "... CH-47 and CH-54 helicopters were successfully used to dissipate fog and stratus clouds on four occasions."
- 1970 - Following experiments using a CH-54 helicopter [8] it appeared that short period clearing over limited areal extent could be accomplished for fogs as deep as 800 feet thick if the helicopter was flown in a tight circle immediately above the top of the fog. No noticeable clearings were noted for fog depths greater than 800 feet.

- 1971 - Following experiments using CH-47 and CH-54 helicopters [9] it appeared that fog clearing could be accomplished with hover altitudes of 500 feet above ground or less.
- 1971 - Following experiments using a CH-47 helicopter Hicks and Kumai [10] concluded: "... clearings in ice fog large enough to allow VFR operations can be made under certain limited meteorological conditions ..."
- 1971 - The comments received from helicopter pilots responding to a survey [11] ranged from: "Decisively cleared area of operations" (p. 15) to "I don't believe that it is possible..." (p. 19).

C. Tabulated Data

Table I has been extracted from the published form of a lesson plan prepared by ASL for the Army Aviation School [13]. This provides an overview of probabilities of success of the technique. Data in Table II is extracted from the documented experiments and reported experiences totaling 116 individual cases, over half of which used the larger helicopters (CH-47, CH-54, and HH-53). Table II presents the cloud type, cloud top, and cloud depth as well as the helicopter hover altitude and the success (YES = a clearing was observed, NO = a clearing was not observed) for each of the cases. Table III tabulates the number of successes for various categories of cloud type and cloud depth.

It is difficult to draw specific conclusions from the tables; yet, interpolation of Tables II and III in the light of the comments at the beginning of this section suggests that Table I may be fairly realistic. There does not seem to be any particular pattern to the exceptions within the presented categories in this report.

TABLE I

FOG DEPTH PENETRATION BY HELICOPTER TYPES

FOG THICKNESS	CARGO	UTILITY	ATTACK
100'	YES	YES	YES
300'	YES	SOMETIMES	SOMETIMES
500'	MOST OF THE TIME	NO	NO
700'	SOMETIMES	NO	NO
1000'	MAYBE	NO	NO

TABLE II
RESULTS OF FOG MODIFICATION ATTEMPTS BY HELICOPTER TYPE

HELICOPTER TYPE	CLOUD			HOVER ALTITUDE (FT ABV CLOUD TOP)	NUMBER OF SUCCESSSES		SOURCE
	TYPE	TOP (FT)	DEPTH (FT)		YES	NO	
OH-6A	FOG	UNKNOWN	UNKNOWN	UNKNOWN	2	1	APPENDIX
UH-1	FOG	UNKNOWN	UNKNOWN	UNKNOWN	3	1	APPENDIX
		100	100	"	1		"
		200	150	"	1		"
		700	700	"	1		"
	FOG, GRD	UNKNOWN	UNKNOWN	UNKNOWN		1	"
		8	8	"	1		"
		50	40	"	1		"
		100	100	"	1		"
AH-1G	FOG						
		30	30	UNKNOWN	1		APPENDIX
		75	75	0	1		"
H-34	FOG, ADV	250	250	20	1		[1]
		280	280	10	2		"
		300	300	25	1		"
CH-34	FOG	UNKNOWN	UNKNOWN	UNKNOWN	1	1	APPENDIX
		300	300	"	1		"
CH-3E	FOG, GRD	200	200	100	1		[3]
	FOG, STM	50	50	100	1		"
		300	300	UNKNOWN	10		"
CH-46	FOG	60	60	50	1		APPENDIX
	FOG, RAD	300	300	200	1		[5]
		350	350	150	3		"
		400	400	50	4		"
		500	500	0	1		"
HH-53	FOG STRATUS	UNKNOWN	UNKNOWN	UNKNOWN	1		[12]
		2000	2000	50	1		[2]
		2000	1000	150	2	1	"

TABLE II (CONTINUED)

RESULTS OF FOG MODIFICATION ATTEMPTS BY HELICOPTER TYPE

CH-47	FOG	UNKNOWN	UNKNOWN	UNKNOWN	2		APPENDIX
		"	"	20			"
		200	200	UNKNOWN			"
		300	300	0			"
		300	300	15			"
		500	500	0			"
		700	700	100			[7]
	FOG, ICE	150	150	0			[10]
	FOG, RAD	UNKNOWN	UNKNOWN	UNKNOWN	2	4	[9]
		225	225	150			[5]
		250	250	50			"
		"	"	75			"
		"	"	200			"
		300	300	50			"
		"	"	100	2		"
		"	"	150			"
		"	"	350			"
		350	350	50			"
		"	"	100	3		"
		"	"	300			"
		400	400	50	3		"
		500	500	100	2		"
		"	"	175			"
		"	"	200			"
CH-54	FOG	UNKNOWN	UNKNOWN	UNKNOWN			APPENDIX
		150	150	0			"
	FOG, ADV	300	300	100			[8]
		550	550	50			"
		900	900	40		1	"
		1300	1300	40		1	"
		1800	1800	100		1	"
		2000	2000	100		1	"
	FOG, RAD	UNKNOWN	UNKNOWN	UNKNOWN	2	6	[9]
		250	250	50			[5]
		"	"	325			"
		300	300	50			"
		"	"	200			"
		"	"	350			"
		350	350	350			"
		400	400	50			"
		500	500	0			"
		"	"	200			"
		550	550	150			"
	STRATUS	600	100	100			[7]
		800	200	100			"
		3550	1300	100			"

TABLE III
SUCCESS OF TECHNIQUE FOR CLOUD TYPE AND
CLOUD DEPTH BY HELICOPTER TYPE

TYPE OF HELICOPTER	OH-6A YES NO		UH-1 YES NO		AH-1G YES NO		H-34 YES NO		CH-34 YES NO	
CLOUD TYPE										
FOG, ADV	**	**	**	**	**	**	4	**	**	**
FOG, GRD	**	**	4	1	**	**	**	**	**	**
FOG, ICE	**	**	**	**	**	**	**	**	**	**
FOG, RAD	**	**	**	**	**	**	**	**	**	**
FOG, STM	**	**	**	**	**	**	**	**	**	**
FOG	2	1	6	1	2	**	**	**	2	1
STRATUS	**	**	**	**	**	**	**	**	**	**
DEPTH OF CLOUD (FT)										
UNKNOWN	2	1	3	2	**	**	**	**	1	1
LESS THAN 100	**	**	2	**	2	**	**	**	**	**
100-249	**	**	4	**	**	**	4	**	**	**
250-499	**	**	**	**	**	**	**	*	1	**
500-999	**	**	1	**	**	**	**	**	**	**
GREATER THAN 999	**	**	**	**	**	**	**	**	**	**
TOTALS	2	1	10	2	2	0	4	0	2	1

TABLE III (CONTINUED)

SUCCESS OF TECHNIQUE FOR CLOUD TYPE AND
CLOUD DEPTH BY HELICOPTER TYPE

TYPE OF HELICOPTER	CH-3E		CH-46		CH-47		CH-54		HH-53		TOTAL	
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
CLOUD TYPE												
FOG, ADV	**	**	**	**	**	**	2	4	**	**	6	4
FOG, GRD	1	**	**	**	**	**	**	**	**	**	5	1
FOG, ICE	**	**	**	**	1	1	**	**	**	**	1	1
FOG, RAD	**	**	9	**	23	4	11	6	**	**	43	10
FOG, STM	11	**	**	**	**	**	**	**	**	**	11	0
FOG	**	**	1	**	7	1	2	**	1	**	22	5
STRATUS	**	**	**	**	**	**	3	**	3	1	6	1
DEPTH OF CLOUD (FT)												
UNKNOWN	**	**	**	**	5	4	3	6	1	**	15	14
LESS THAN 100	1	**	6	**	**	**	**	**	**	**	11	0
100-249	1	**	4	**	3	1	3	**	**	**	19	1
250-499	10	**	**	**	17	1	7	**	**	**	35	1
500-999	**	**	**	**	6	**	4	1	1	**	12	1
GREATER THAN 959	**	**	**	**	**	**	1	3	2	1	3	4
TOTALS	12	0	10	0	31	6	18	10	4	1	35	21

CONCLUDING REMARKS

Helicopter downwash can be beneficial in attaining temporary clearings in fog with depths up to as much as 1000 feet. The degree of success appears, however, to be small for such extreme thicknesses. Some assurance of success is available for the larger helicopters (CH-47, CH-54 and HH-53) only for fogs of depths less than about 500 to 600 feet and for the smaller helicopters (UH-1, OH-6A) only for fogs less than 100 to 300 feet deep. Information to delineate the criteria for the degree of success is not, as yet, available.

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APPENDIX

FOG DISSIPATION QUESTIONNAIRES†

†Comments containing military information not germane to the contents of this report and pilot identification have been deleted from the enclosed questionnaires.

FOG DISSIPATION QUESTIONNAIRE

Numerous experiments have been carried out with helicopters in attempts to dissipate warm fog. Many of these experiments have been successful, while others have failed. There are at present several documented cases of rotary wing aircraft being used to dissipate fog; however, it is believed that other experiences that might provide valuable information on the subject may have gone unreported or undocumented.

In order to expand the data base on the subject, it is requested that anyone with personal experiences or knowledge of the downwash of rotary wing aircraft being used to dissipate fog, please supply the information on the questionnaire. Information pertaining to the fog dissipation project at Ft. Rucker, Ala., during 1 to 28 February 1971 may be omitted.

Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

II. a. Location/Date/Time of Fog Dissipation Experience: 7 April 1968
Early Morning Camau

b. Type Terrain: Wet Humid Rice Paddies with Bamboo Surroundings

c. Visibility on ground and on top of fog: 50 feet and 1/2 mile

d. Aircraft type/gross weight: OH6A 2154

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Observed slick (UH-1's) platoon who landed in a very inaccessible area by fluctuating power at forward hover altitude. Decisively cleared area of operations. Smoke helps as well.

III. Summarize what was done and what resulted from that action: In this action, troops benefited from better ground visibility. Recommend future oscillating movements (forward-backward) by choppers in low lying foggy areas in Delta operations. This does not work in mountains as air pressure is too thin for rotor wash to have any affect as I readily learned further to the North.

FOG DISSIPATION QUESTIONNAIRE

Numerous experiments have been carried out with helicopters in attempts to dissipate warm fog. Many of these experiments have been successful, while others have failed. There are at present several documented cases of rotary wing aircraft being used to dissipate fog; however, it is believed that other experiences that might provide valuable information on the subject may have gone unreported or undocumented.

In order to expand the data base on the subject, it is requested that anyone with personal experiences or knowledge of the downwash of rotary wing aircraft being used to dissipate fog, please supply the information on the questionnaire. Information pertaining to the fog dissipation project at Ft. Rucker, Ala., during 1 to 28 February 1971 may be omitted.

Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: I Corps, Republic of Vietnam
0630 Fire Support Base Birmingham, May 1970

b. Type Terrain: Rolling Hills, Elephant grass.

c. Visibility on ground and on top of fog: Ground-0; on top 4-5 miles

d. Aircraft type/gross weight: OH-6A 2600 lbs.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Slow forward hover 8 feet off a 70° incline

III. Summarize what was done and what resulted from that action: Support Base requested
that a team try to clear perimeter wire of fog. Top of firebase protruded
out of the fog. We hovered one ship after the other around the perimeter
with no great success. We blew dust up, which only complicated the
visibility problem.

FOG DISSIPATION QUESTIONNAIRE

Numerous experiments have been carried out with helicopters in attempts to dissipate warm fog. Many of these experiments have been successful, while others have failed. There are at present several documented cases of rotary wing aircraft being used to dissipate fog; however, it is believed that other experiences that might provide valuable information on the subject may have gone unreported or undocumented.

In order to expand the data base on the subject, it is requested that anyone with personal experiences or knowledge of the downwash of rotary wing aircraft being used to dissipate fog, please supply the information on the questionnaire. Information pertaining to the fog dissipation project at Ft. Rucker, Ala., during 1 to 28 February 1971 may be omitted.

Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

II. a. Location/Date/Time of Fog Dissipation Experience: 8 February 1970, 0700 hours.
Minh Thanh Strip, Vietnam

b. Type Terrain: Flat-airfield surrounded all sides with rubber trees.

c. Visibility on ground and on top of fog: On ground 10-15 feet; on top 5-8 miles

d. Aircraft type/gross weight: AH-1G 9500 lbs.
Two aircraft were used.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: 30 knots forward flight.

III. Summarize what was done and what resulted from that action: Three passes were made
with skids of aircraft in fog. Fog was initially 50-75 feet in depth.
After third pass, a C-123 aircraft was able to land and maintain visibility
with runway. Prior to passes with AH-1G, runway was not visible from
altitude of 100 feet.

FOG DISSIPATION QUESTIONNAIRE

Numerous experiments have been carried out with helicopters in attempts to dissipate warm fog. Many of these experiments have been successful, while others have failed. There are at present several documented cases of rotary wing aircraft being used to dissipate fog; however, it is believed that other experiences that might provide valuable information on the subject may have gone unreported or undocumented.

In order to expand the data base on the subject, it is requested that anyone with personal experiences or knowledge of the downwash of rotary wing aircraft being used to dissipate fog, please supply the information on the questionnaire. Information pertaining to the fog dissipation project at Ft. Rucker, Ala., during 1 to 28 February 1971 may be omitted.

Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: 11 Corps, 1-2 miles southwest of
DAC to Airstrip; 8 to 9 am; May or early June of 1969

b. Type Terrain: Mountains

c. Visibility on ground and on top of fog: 1 to 10 feet hazy on ground; 20-30 feet of
fog type clouds then clear sky.

d. Aircraft type/gross weight: AH-1G 9,000 lbs. and CH-47 fully loaded. the AH-1G
was used mostly because it was too dangerous to use the CH-47.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you
consider pertinent to the experience: Slow to fast flight; on fast flights pitch
collective was lowered and a deceleration entered over the firebase.

III. Summarize what was done and what resulted from that action: Upon deceleration, the
rotor wash of the AH-1G was used to dissipate the fog (clouds). The team
made about 8 to 10 passes over the area, this made enough visibility for
the 47 and one 54 to drop their cargo and leave. This was on a high
firebase during Ben Het and Dac To battle - May/June of 1969.

FOG DISSIPATION QUESTIONNAIRE

Numerous experiments have been carried out with helicopters in attempts to dissipate warm fog. Many of these experiments have been successful, while others have failed. There are at present several documented cases of rotary wing aircraft being used to dissipate fog; however, it is believed that other experiences that might provide valuable information on the subject may have gone unreported or undocumented.

In order to expand the data base on the subject, it is requested that anyone with personal experiences or knowledge of the downwash of rotary wing aircraft being used to dissipate fog, please supply the information on the questionnaire. Information pertaining to the fog dissipation project at Ft. Rucker, Ala., during 1 to 28 February 1971 may be omitted.

Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: I and II Corps, Republic of Vietnam, Monsoons season.

b. Type Terrain: Central Highlands of II Corps and I Corp

c. Visibility on ground and on top of fog: VFR on top; and ground fog during monsoons.

d. Aircraft type/gross weight: UH-1H 8700 lbs.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Hover either constant or slowly forward.

III. Summarize what was done and what resulted from that action: Flew dustoff in the II Corps area and with the experience I encountered, I never saw fog dissipated. I don't believe that it is possible, there is always fog coming through the rotor wash. The ship I've seen that was successful was the Air Force Kamman Husky.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: Korea - Stanton Airfield
mornings throughout the year.

b. Type Terrain: Airfield set in bottom of valley with 800 foot hills on both
sides.

c. Visibility on ground and on top of fog: 0-0 below 700 feet with unrestricted
visibility above 900 feet.

d. Aircraft type/gross weight: UH-1D crewchief and 1400 lbs of fuel 7200 lbs.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you
consider pertinent to the experience: Slow hover forward.

- III. Summarize what was done and what resulted from that action: Fog was removed only from
area inside of rotor diameter (48'). Fog settled right back in once
aircraft moved forward.

FOG DISSIPATION QUESTIONNAIRE

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Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: West Germany, Spring 1961/Dawn

b. Type Terrain: Grass covered meadow surrounded by heavy woods on three sides.

c. Visibility on ground and on top of fog: Ground 0-0, on top clear above visibility unlimited.

d. Aircraft type/gross weight: UH-1B 5800 lbs.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Hover and slow forward flight just above the layer of ground fog.

- III. Summarize what was done and what resulted from that action: Ground fog started to form as fixed wing radio relay aircraft were being recovered at a field location. Fog was approximately 6-8 feet deep on the surface. UH-1 was used to clear field strip runway length and width long enough to recover 3 fixed wing aircraft. Duration of clearance was approximately 15 minutes. Subsequent attempts after fog depth increased proved futile.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

- II. a. Location/Date/Time of Fog Dissipation Experience: Germany, 1962 - date unknown;
time - late afternoon to early hours of darkness.

- b. Type Terrain: Rolling hills, valleys

- c. Visibility on ground and on top of fog: Ground visibility 1/2 mile or less.
On top visibility - in excess of 3 miles.

- d. Aircraft type/gross weight: UH-1B with two pilots (non-instrument rated) and
crewchief.

- e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Fast hover, altitudes of up to 15-20 feet,
back and forth over the 1000-1500 foot tactical landing strip.

- III. Summarize what was done and what resulted from that action: As I remember the incident,
the UH-1B aircraft was utilized to clear the top from the tactical landing
strip and allow 6 to 10 L-19 aircraft to land on two occasions, about one
hour apart. The ground fog was forming at the surface and was 50 to 100
feet thick. The helicopter rotor wash apparently mixed the air in the
calm wind condition and increased visibility to one mile or more. Fixed
wing aviators then landed to tactical landing lights.

Numerous experiments have been carried out with helicopters in attempts to dissipate warm fog. Many of these experiments have been successful, while others have failed. There are at present several documented cases of rotary wing aircraft being used to dissipate fog; however, it is believed that other experiences that might provide valuable information on the subject may have gone unreported or undocumented.

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Please cut out this page, fold and mail.

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FOG DISSIPATION QUESTIONNAIRE

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Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

- II. a. Location/Date/Time of Fog Dissipation Experience: Vietnam (Quan Loi) Spring 1969

- b. Type Terrain: Knob surrounded by valleys.

- c. Visibility on ground and on top of fog: 10-20 feet ground visibility - clear on top.

- d. Aircraft type/gross weight: UH-1H/OH-6A.

- e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Hovering around an area.

- III. Summarize what was done and what resulted from that action: Hovered 2 aircraft in an area at different times to clear enough area so an O-1 FAC could land.
We managed to stir it up but not to dissipate it.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

II. a. Location/Date/Time of Fog Dissipation Experience: Republic of Vietnam, February
1970/ 1900 hours.

b. Type Terrain: Mountainous ridgeline landing zone

c. Visibility on ground and on top of fog: 0-0 below and clear above.

d. Aircraft type/gross weight: UH-1H (350 lbs fuel) crew of 4 and 6 troops and
UH-1H, light fuel load (350 lbs) and crew of 5.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Aircraft #1 - slow flight around hovering
aircraft; Aircraft #2 - Hover.

III. Summarize what was done and what resulted from that action: Until reaching minimum
fuel required for safe flight back to base camp; both aircraft were
capable of keeping 50 yard to 100 yard diameter.

FOG DISSIPATION QUESTIONNAIRE

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Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: Republic of Vietnam, approximately
15 miles west-northwest Vi Thau, Mekong Delta.
1966 at 0700 hours. (after 29 January and before 1 April)
b. Type Terrain: Dry Rice paddies that had not been planted in several seasons.
c. Visibility on ground and on top of fog: Fog layer bottom about 50 feet above ground
ceiling of fog approximately 200 feet.
d. Aircraft type/gross weight: UH-1B's gunships loaded with ammunition and crews -
30 minutes fuel.
e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you
consider pertinent to the experience: Slow forward flight - five helicopters
in platoon daisy-chained landing zone to blow fog away for flight of 25
slicks (UH-1's)
- III. Summarize what was done and what resulted from that action: Landing zone selected
was covered with fog. Gunships blew fog from landing zone for flight
of 25 slicks (UH-1's).
- _____

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: Vietnam, February 1968, first
light.

b. Type Terrain: Jungle double canopy - in valley.

c. Visibility on ground and on top of fog: Visibility on ground approximately 200
meters top of fog - 4 to 5 miles.

d. Aircraft type/gross weight: 2 UH-1E 7500 lbs. 2 CH-46 13000 lbs.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you
consider pertinent to the experience: Slow forward flight initially until troops
located. Hover by CH-46 for hoist pick up.

- III. Summarize what was done and what resulted from that action: Mission was Med Evac (27
casualties) launched at 1st light. Once troops were located, hovering
helicopters kept the area clear for approximately 200 meters around zone.
Zone closed after second CH-46 departed.

FOG DISSIPATION QUESTIONNAIRE

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Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

- II. a. Location/Date/Time of Fog Dissipation Experience: Republic of Vietnam 1970 -
approximately February (am)

- b. Type Terrain: Flat, grassy

- c. Visibility on ground and on top of fog: Ground 25 meters; on top - 10+ nautical
miles.

- d. Aircraft type/gross weight: UH-1 Approximately 8000 lbs.

- e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Hover and slow flight.

- III. Summarize what was done and what resulted from that action: Approach to landing
through heavy ground fog from ground to 50-100 feet above ground. One
aircraft was talked down by ground control. An approach lane was cut
through the fog enabling four other helicopters to approach and land in
the same area.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: Republic of Vietnam, Phu Vinh,
December 1965 - January 1966 - early morning

b. Type Terrain: Landing zone had river on one side and dense forest on other
sides.
c. Visibility on ground and on top of fog: Visibility on top was unlimited; on ground
0-0.
d. Aircraft type/gross weight: UH-1D 9500 lbs.
e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you
consider pertinent to the experience: Company helicopter was in 2 flights of
10 aircraft in staggered trail formation in slow forward flight.
- III. Summarize what was done and what resulted from that action: Landing zone was covered
by layer of ground fog about 100 feet thick. Company made about 3
passes (normal approach to landing zone but slow flight) after 3 passes
landing zone was clear enough to land. Very little surface wind.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: January 1900-2100 hours.

b. Type Terrain: 2 feet grass/sod in field 100 meters by 150 meters with 100 foot trees 360° perimeter.
c. Visibility on ground and on top of fog: Small patches forming in landing zone 10' to 20' above ground and 25' to 50' thick. Visibility in patches good.
d. Aircraft type/gross weight: UH-1D

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Hover above the patch to dissipate every 20-30 minutes.

- III. Summarize what was done and what resulted from that action: Kept landing zone open for landings in landing zone until mission complete.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: Northwest Rotenbach (W. Germany)
Fall - morning.

b. Type Terrain: Farmland rolling.

c. Visibility on ground and on top of fog: Inversion to 100 feet 0-0, clear on top.

d. Aircraft type/gross weight: CH-34

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Hover.

- III. Summarize what was done and what resulted from that action: During a field problem our
helipad was 0-0 at 0800 hours. Two CH-34's were inbound. Once over
helipad they were able to observe parked aircraft. Aircraft on ground
were started while overhead aircraft hovered, allowing takeoff. After
aircraft had departed, the fog closed the field location once more. I
would say it took 30 minutes to clear the area enough for takeoff.

FOG DISSIPATION QUESTIONNAIRE

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Please cut out this page, fold and mail.

- I. a. NAME: 18
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

- II. a. Location/Date/Time of Fog Dissipation Experience: 1965 Coleman Barracks, Germany

- b. Type Terrain: Level

- c. Visibility on ground and on top of fog: _____

- d. Aircraft type/gross weight: CH-34

- e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Hover

- III. Summarize what was done and what resulted from that action: This was attempted in conjunction with the removing of snow from the runways at Coleman Barracks. It proved fairly successful at removing the snow but had little success with the fog.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: (Westphalia) north portion of
West Germany, September 1967, 2100 hours local.

b. Type Terrain: Flat farmland wooded perimeters.

c. Visibility on ground and on top of fog: Visibility ground nil; fog depth 60 feet;
above fog-clear; wind nil - ground fog condition.

d. Aircraft type/gross weight: CH-46A 18,200 lbs.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you
consider pertinent to the experience: Hover and slow forward flight about 50 to
100 feet above fog.

III. Summarize what was done and what resulted from that action: Area cleared of sufficient
size for 4 United Kingdom Westland Wessex (Turbine H-34). They chained
into the area and hovertaxed clear under assistance from ground crew with
flashlight wands. Aircraft doing clearing was able to land in its own
cleared area.

FOG DISSIPATION QUESTIONNAIRE

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Please cut out this page, fold and mail.

- I. a. NAME: 22
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

- II. a. Location/Date/Time of Fog Dissipation Experience: Republic of Vietnam
II military region

- b. Type Terrain: Mountainous (Pinnacle)

- c. Visibility on ground and on top of fog: 0 on ground; 1/2 mile on top

- d. Aircraft type/gross weight: CH-47 13,000 lbs.

- e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Slow forward descent into pinnacle.

- III. Summarize what was done and what resulted from that action: Rotorwash leading aircraft
cleared fog enough to maintain visual contact with ground. Hovering
on the firebase, the rotorwash cleared fog away from the mountain top
by approximately 200 feet.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

II. a. Location/Date/Time of Fog Dissipation Experience: Cau Mau, Republic of Vietnam,
June, July 1970. Early morning.

b. Type Terrain: Delta.

c. Visibility on ground and on top of fog: Ground 0-0. On top - unlimited clear.

d. Aircraft type/gross weight: CH-47B - Fuel full, crew of 5, no cargo.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Slow forward flight along the top of the cloud layer.

III. Summarize what was done and what resulted from that action: Slow forward hovering flight touching top of cloud layer. Pedal turn and descended down through very large hole in cloud layer. Once on ground about 1 1/2 to 2 minutes hole was closed.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: Republic of Vietnam
November 1970 - Early afternoon.

b. Type Terrain: Mountain pinnacle.

c. Visibility on ground and on top of fog: 1/16 mile to 0 in fog; 10 miles on top.

d. Aircraft type/gross weight: CH-47A, 22,000 lbs.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Slow, climbing forward flight (less than 5 knots).

- III. Summarize what was done and what resulted from that action: Aircraft was sitting on resupply pad with clouds forming around the mountain top which enveloped the aircraft. As pitch was pulled, cloud was dissipated in a 150-200 foot circle around the aircraft. Slow hovering flight was accomplished at about 20 feet altitude up a 30° slope. The next resupply pad, 50-75 foot higher than the first, cleared as we hovered upward towards it.

FOG DISSIPATION QUESTIONNAIRE

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- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: _____ Republic of Vietnam
_____ 1968-1969.

- b. Type Terrain: _____ Central Highlands vicinity Bao Loc

- c. Visibility on ground and on top of fog: _____ Ground visibility zero-zero/Depth of fog
_____ 100-200 feet. Visibility on top unlimited.

- d. Aircraft type/gross weight: _____ CH-47A/ 28,000-33,000 lbs.

- e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: _____ Slow forward flight as low as visibility permitted. Each sweep would cut a path approximately two (2) rotor diameters wide and clear area would persist for approximately 10-15 minutes. Used to clear airfield for fixed wing landing and CH-47 approaches.
- III. Summarize what was done and what resulted from that action: _____ Fog would regularly cover much of the lower areas and prevent operations into and out of airfield and sling load area. CH-47 would make slow, low pass and dispersal of fog would last long enough to make a 360° and land or pick up slingload and depart.

FOG DISSIPATION QUESTIONNAIRE

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c. SSAN: _____
d. UNIT, DUTY PHONE: _____

- II. a. Location/Date/Time of Fog Dissipation Experience: Song Be Strip Republic of Vietnam
March 1970 0630-0700 hours.

- b. Type Terrain: Rolling Hills, elevation of strip approximately 780-feet.

- c. Visibility on ground and on top of fog: On ground approximately 1/4 miles, 200-300 feet deep, ceiling and visibility unlimited on top on the fog.

- d. Aircraft type/gross weight: CH-47A at 33,000 lbs gross weight.

- e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Slow forward flight length of field with a double conex external load.

- III. Summarize what was done and what resulted from that action: Radiation type fog 200-300 feet deep. We could make out the field from above and made a low pass. A circling OV-10 told us we were clearing a hole. We continued making successive runs and finally hovered down the strip. The OV-10 landed behind us followed by 3 other CH-47's. Airspeed was 70 knots initially and slower with successive runs until we were able to make the strip out plainly, then we were able to come to a hover and drop off our load.

FOG DISSIPATION QUESTIONNAIRE

Numerous experiments have been carried out with helicopters in attempts to dissipate warm fog. Many of these experiments have been successful, while others have failed. There are at present several documented cases of rotary wing aircraft being used to dissipate fog; however, it is believed that other experiences that might provide valuable information on the subject may have gone unreported or undocumented.

In order to expand the data base on the subject, it is requested that anyone with personal experiences or knowledge of the downwash of rotary wing aircraft being used to dissipate fog, please supply the information on the questionnaire. Information pertaining to the fog dissipation project at Ft. Rucker, Ala., during 1 to 28 February 1971 may be omitted.

Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____
- II. a. Location/Date/Time of Fog Dissipation Experience: Thein Phouc, Vietnam
March 1970

b. Type Terrain: Rolling Hills.

c. Visibility on ground and on top of fog: Approximately 50 meters on top unlimited.

d. Aircraft type/gross weight: CH-54A, gross weight of 38,000 lbs.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: I used a slow forward flight at a height just above the fog.

- III. Summarize what was done and what resulted from that action: The fog was approximately 100-150 feet thick and with about 4 low-slow passes cleared an area large enough for a safe landing. The area once cleared, stayed open. It was at least one hour before the fog burned off in the surrounding area that I hadn't cleared.

FOG DISSIPATION QUESTIONNAIRE

Numerous experiments have been carried out with helicopters in attempts to dissipate warm fog. Many of these experiments have been successful, while others have failed. There are at present several documented cases of rotary wing aircraft being used to dissipate fog; however, it is believed that other experiences that might provide valuable information on the subject may have gone unreported or undocumented.

In order to expand the data base on the subject, it is requested that anyone with personal experiences or knowledge of the downwash of rotary wing aircraft being used to dissipate fog, please supply the information on the questionnaire. Information pertaining to the fog dissipation project at Ft. Rucker, Ala., during 1 to 28 February 1971 may be omitted.

Please cut out this page, fold and mail.

- I. a. NAME: 28
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

II. a. Location/Date/Time of Fog Dissipation Experience: NuiBara mountain Republic of Vietnam; September and October, 1969; 1500-1600 hours.

b. Type Terrain: Single mountain with elevation approximately 2200 foot MSL rising from rolling terrain which averages 700 to 800 foot MSL in elevation.

c. Visibility on ground and on top of fog: Top of mountain was completely obscured in a small cloud.

d. Aircraft type/gross weight: CH-47A at 33,000 gross weight.

e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Hover and slow flight

III. Summarize what was done and what resulted from that action: We were attempting to re-supply an outpost on the top of the mountain, from Songe Be Strip. Every-time the top would clear, it would be socked in again by the time we could hook up to a load and reach the top. By chance 2 CH-47's were at the top at the same time. One attempted an approach, but had to break it off. As he made his go around, the top cleared enough for the sister ship to make his approach and drop off his load. The empty ship then duplicated the maneuver for the loaded ship which also delivered its load. We used this on 2 or 3 occasions after this. Sometimes it worked, sometimes it didn't.

FOG DISSIPATION QUESTIONNAIRE

Numerous experiments have been carried out with helicopters in attempts to dissipate warm fog. Many of these experiments have been successful, while others have failed. There are at present several documented cases of rotary wing aircraft being used to dissipate fog; however, it is believed that other experiences that might provide valuable information on the subject may have gone unreported or undocumented.

In order to expand the data base on the subject, it is requested that anyone with personal experiences or knowledge of the downwash of rotary wing aircraft being used to dissipate fog, please supply the information on the questionnaire. Information pertaining to the fog dissipation project at Ft. Rucker, Ala., during 1 to 28 February 1971 may be omitted.

Please cut out this page, fold and mail.

- I. a. NAME: _____
b. RANK: _____
c. SSAN: _____
d. UNIT, DUTY PHONE: _____

- II. a. Location/Date/Time of Fog Dissipation Experience: Republic of Vietnam
January and February 1970.

- b. Type Terrain: Vung Tau and Long Binh.

- c. Visibility on ground and on top of fog: 0-0 below and clear on top.

- d. Aircraft type/gross weight: CH-54 full fuel.

- e. Flight Posture (hover, slow forward flight, etc.) and any additional flight information you consider pertinent to the experience: Aircraft at hover.

- III. Summarize what was done and what resulted from that action: Aircraft hovering above fog was able to clear an area the diameter of rotor system.

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