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MAJOR ORIENTATION-ERROR ACCIDENTS IN REGULAR ARMY UH-1 AIRCRAFT DURING FISCAL YEAR 1968: ACCIDENT FACTORS

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13. ABSTRACT
This report is the second in a longitudinal series of reports dealing with the pilot disorientation/vertigo problem in Regular Army UH-1 helicopter operations. Individual case history data extracted from the USABAAR master aircraft accident files are presented on 52 major orientation-error accidents that occurred in UH-1 aircraft during fiscal year 1968. Summary data listings involving a variety of operational and pilot-related accident factors are presented for each of the cases. The listings are arranged to distinguish between those factors and events present before takeoff; i.e., the initial conditions associated with a given accident, and those which occurred or were manifested during the actual airborne phase of the accident.

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SUMMARY PAGE

THE PROBLEM

From the military mission viewpoint, the amount of research effort to be expended on the solution of a given aviation medicine problem must be keyed to its operational cost. In the case of orientation-error accidents involving pilot disorientation and vertigo, little quantified data are available to describe either the incidence or cost of such accidents in aviation. In addition, though such accidents have been long recognized as a major aviation medicine problem, there are few data on hand to describe the direct operational setting for these accidents in terms of the pilot, aircraft, mission, and environmental factors that will be present, singly or in some combination, for each mishap. Until such data are assimilated for a considerable number of orientation-error accidents, optimal method of correction, whether it be, for example, redesign of aircraft, cockpit layout, or instruments, or whether it is a matter of pilot selection, training, and utilization, will not be determined.

FINDINGS

To initiate the action necessary to establish the magnitude of the orientation-error problem in Army aviation, an interservice research program was organized under the joint sponsorship of the U. S. Army Aeromedical Research Laboratory, the U. S. Army Board for Aviation Accident Research, and the Naval Aerospace Medical Research Laboratory. The first step was the construction of an operational definition of an orientation-error accident. The assimilation of data pertaining to the incidence and cause of such accidents and their actual and relative costs in terms of fatalities, injuries, and aircraft damage was then set as the working objective of the program using the master USABAAR accident files as reference. Accordingly, the decision was made to implement a five-year longitudinal study of all major and minor orientation-error accidents involving Regular Army flight operations beginning with fiscal year 1967. It was decided to summarize the findings on a fiscal-year basis in three separate lines of reports: The first line would be devoted to defining the over-all magnitude of the orientation-error problem in all aircraft types; the second line to the presentation of similar incidence and cost data for accidents involving only the UH-1 aircraft, the predominant rotary-wing aircraft in the Army inventory; and the third line to the description of the various pilot/operational factors found to be present in the major orientation-error accidents that occurred in the UH-1 aircraft.

This specific report is the second in the series dealing with the third line; i.e., UH-1 accident factors. A brief case history description is given of each major orientation-error accident that occurred in fiscal year 1968 along with various compilations of related background data including pilot experience, psychological and physiological stress variables, mission pressures, visibility conditions, materiel difficulties, facility limitations, and supervisory factors.

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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The authors wish to thank Colonel R. W. Bailey, MSC, USA, Commanding Officer, U. S. Army Aeromedical Research Laboratory, for his direction and assistance in the initial setup and structure of the project and for his continued support of its research objectives. The authors wish to thank also the director of the U. S. Army Board for Aviation Accident Research and his data processing staff for their cooperation in obtaining the desired data from the master accident files. In addition, we acknowledge the assistance of Mrs. Linda Pearce of the Naval Aerospace Medical Research Laboratory (NAMRL) in the conduct of the orientation-error accident analysis program and to thank her for the sustained, always cheerful, working support she has devoted to the accomplishment of the project objectives. Other NAMRL personnel whom the authors wish to thank include Mr. C. A. Lowery and Mr. A. N. Dennis, both of the Bionics Branch, who assisted in the compilation and graphical layout of the data; and Mr. R. C. Barrett of the Visual Aids Branch who photographed the report figures.

INTRODUCTION

To investigate the operational role of pilot disorientation and vertigo in the production of orientation-error type aircraft accidents, the authors have organized an interservice research program under the joint sponsorship of the U. S. Army Aeromedical Research Laboratory (USAARL), the U. S. Army Board for Aviation Accident Research (USABAAR), and the Naval Aerospace Medical Research Laboratory (NAMRL). Since little quantified data were available to describe the actual magnitude of the orientation-error problem in Regular Army flight operations, the decision was made to conduct a five-year longitudinal study, beginning with fiscal year 1967, of all Army aircraft accidents that involved an erroneous judgment of aircraft motion or attitude on the part of the pilot. Two separate, but related, project objectives were set for the longitudinal study. The first was to extract and assimilate the data from the USABAAR master aircraft-accident files which would define the actual and relative cost of orientation-error accidents to Regular Army flight operations. These data, by defining the operational magnitude of the problem, would then serve to define the extent of the research support that should be devoted to its solution. The second working objective was to extract data on a case-history basis which would describe the various pilot/aircraft/mission/environment factors found to be present in each of the orientation-error accidents. Assimilation and analysis of these data over the study period would result in better knowledge of the most common operational causes of orientation-error accidents and thus point out those research directions which offer the greatest potential toward the reduction of accident incidence.

The results of the longitudinal study are being summarized in three separate lines of reports, with one report in each line prepared for each fiscal year of the five-year study. The first line of reports (for example, refs. 1 and 4) is devoted to defining the incidence and cost of all major and minor orientation-error accidents involving all aircraft types, fixed wing as well as rotary wing, that occurred in Regular Army flight operations for each fiscal year. Since the UH-1 "Huey" helicopter has been, and is, the predominant aircraft in the Army rotary-wing inventory, the second line of reports (for example, refs. 2 and 5) is devoted to defining the magnitude of the orientation-error accident problem in only this aircraft. The layout and format of this line of reports are almost identical to those of the first line. The third line of reports (for example, ref. 3) deals exclusively with the various causal factors found to be present in all of the UH-1 major orientation-error accidents. Typical data to be presented include phase of flight, time of day, type of mission, pilot experience, physiological factors, psychological factors, facility factors, environmental factors, and the like.

This specific report is the second in the series dealing with accident factors and concerns only those major orientation-error accidents that occurred in UH-1 aircraft during fiscal year 1968. To facilitate the comparison of these factor data with similar data derived for other fiscal years of the longitudinal study, the layout and numbering of the figures presented in this report are identical to those presented previously (ref. 3). The various rationale involved in both the definition of the orientation-error class of accidents and the analysis of the related accident factors are discussed in detail in the first report of the series (ref. 3). It is of particular importance that the reader recognize that the accident details contained in this report derive solely from the written records

contained in the master file associated with each accident. Accordingly, the extent of the factors that can be listed for a given accident is dependent entirely on the extent of the documentation entered into the record by the field investigation team and its reviewing authorities. The authors wish also to caution against any interpretation of the report data for a given fiscal year that assigns one single factor as the sole causal agent for either a given accident or the entire class of accidents. Though degraded visibility is probably the single most predominant factor in orientation-error accidents, there are usually present additional factors or events, any of which, if eliminated singly, might possibly have prevented the accident. In this context, the listing of a given factor in this report implies only that it was present -- it may or may not have played a causal role. The weight of a given factor as a contributing element will be best judged upon completion of the five-year data assimilation period.

PROCEDURE

A basic requirement for the commencement of this study was a workable definition of the class of accidents to be defined as involving orientation error. The reader is referred to previous reports (refs. 1-3) for a comprehensive definition and discussion of its rationale. Briefly, orientation is considered to involve the correct determination of the dynamic position and attitude of an aircraft in three-dimensional space. The key word here is dynamic, which implies that full knowledge of the motion as well as static attitude and position is required to define its instantaneous spatial orientation. Accordingly, a pilot is considered to have made an orientation error whenever his perception of the motion and attitude of his aircraft differs from the true motion or attitude; i.e., the true orientation of the aircraft. An orientation-error accident is then defined as one that occurs as a result of an incorrect control or power action taken by a pilot (or a correct action not taken) due to his incorrect perception (or lack of perception) of the true orientation of his aircraft.

With this definition of orientation-error accidents serving as a classification reference, an experienced classifier read all briefs in the USABAAR master accident files and selected all major and minor accidents of this type occurring during fiscal year 1968. For redundancy, the entire accident files were also searched by sifting the coded summaries that USABAAR prepares for each accident for a wide range of indicator terms.

The authors then reviewed the accident briefs independently for the purpose of establishing whether or not an orientation-error accident classification would result. In addition, the comprehensive master file on each suspect accident was obtained and reviewed. Whenever there was serious question as to the contribution of orientation error to the accident, or where equally weighted alternative causal factors were present, then the accident was not included in the classification. The net effect of this policy is to give a conservative estimate of the magnitude of the orientation-error accident problem.

From the resulting listing of all major and minor orientation-error accidents that occurred in both fixed wing and rotary wing aircraft, separate identification was made of only those major accidents that occurred in UH-1 aircraft. The master file on each

of these UH-1 accidents was then obtained from USABAAR for review as described previously (ref. 3). In brief, the basic factor data were extracted from the files by the classifier using a combination check-list/narrative type questionnaire developed by the authors of this report. In addition, the classifier and the authors prepared independent check-list summaries of selected accident details represented by the factors data compiled in figures shown later in this report.

RESULTS AND DISCUSSION

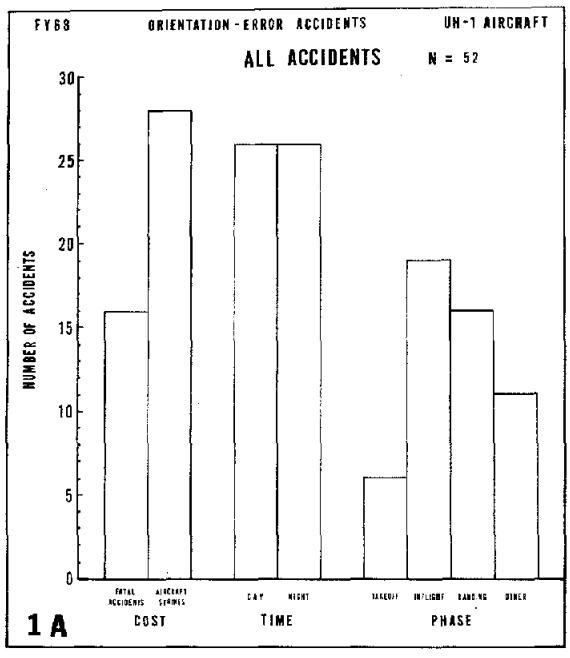
For fiscal year 1968, master accident files pertaining to 52 major orientation-error accidents that occurred in UH-1 aircraft were available for analysis. Of this total, 16 accidents resulted in one or more fatalities and 28 accidents resulted in total strike damage to the aircraft. In terms of personnel, these 52 accidents accounted for 71 fatalities and 56 nonfatal injuries.

As indicated by the cost data presented in Figure 1A, the hazard of the orientation-error class of accidents was considerable for that fiscal year. Some 30.8 percent of the accidents were fatal, while 53.8 percent resulted in a total loss of the aircraft. The time-of-day data indicate an equal incidence for day and night accidents. In terms of the phase of flight in which the accident occurred, 36.5 percent of the accidents occurred during the inflight phase, 30.8 percent during the landing phase, 21.1 percent during the "other" phase, and 11.5 percent during the takeoff phase. It should be noted that the "other" phase classification used in this report denotes localized operations, such as reparking an aircraft, lifting a sling load, or moving an aircraft to a nearby refueling site.

The mission data shown in Figure 1B indicate that the majority (76.9 percent) of the accidents occurred on flights that had some form of combat-related mission assignment. This would be expected since 49 (94.2 percent) of the accidents occurred in Vietnam. The reader is reminded that, although a combat mission may have been assigned to the crew, the resulting mishap was an accident and not a loss attributable to direct enemy action.

In Figure 2A a distribution is given of the number of accidents during each month of the fiscal year. Since the majority of the accidents occurred in Vietnam, the time-of-year incidence of accidents due to weather and dust peaked in that country's monsoon and dust seasons, respectively. Interpretation of these data beyond this point is restricted by the month-to-month variations in the level of combat operations being conducted at a given time. Similarly, the daily variation in frequency of operations would affect interpretation of the hourly distribution data plotted in Figure 2B, which shows accident incidence in 2-hour increments over a 24-hour period.

Additional data related to the time-of-day incidence of the orientation-error accidents are presented in Figure 3. Statistics pertaining to the 26 accidents that occurred under daylight visibility conditions are plotted in Figure 3A. Similar data for the 26 night accidents are shown in Figure 3B. It is obvious that the cost of night accidents in



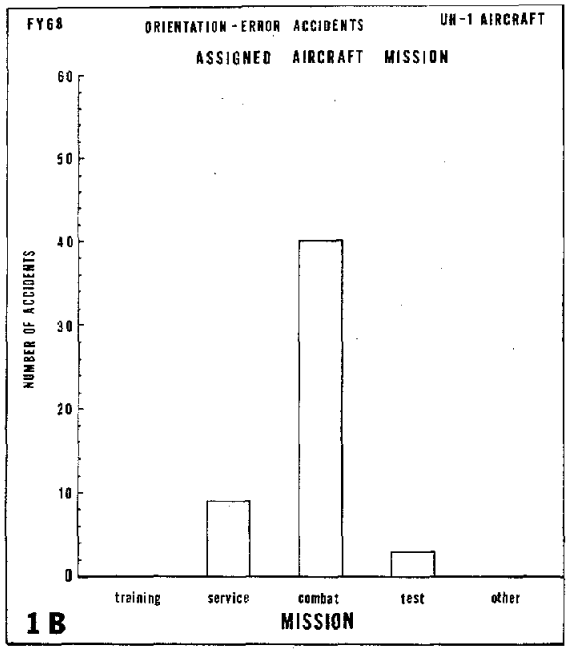
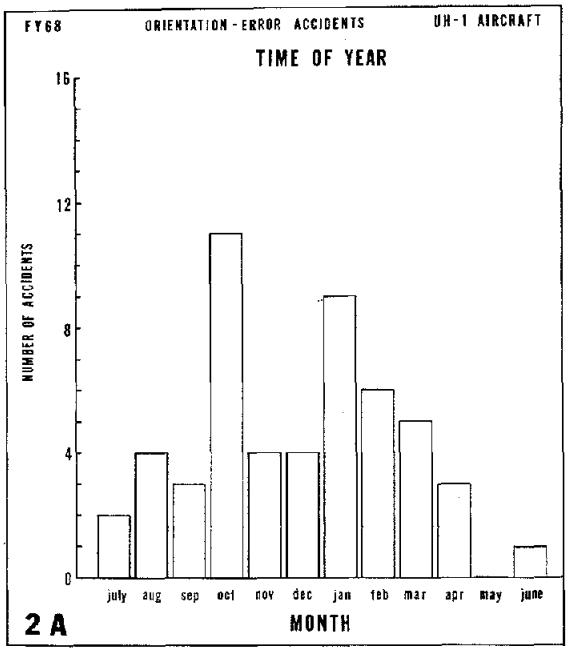


Figure 1

Major orientation-error accidents occurring in Regular Army UH-1 aircraft during fiscal year 1968. Number of fatal accidents, number of aircraft strikes, time of day of the accidents, and the flight phase in which the accident occurred (A); and types of missions assigned to the accident aircraft (B).



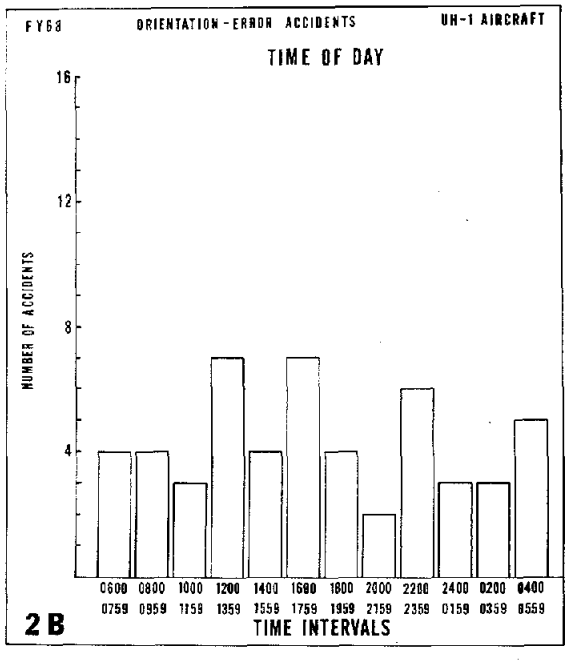
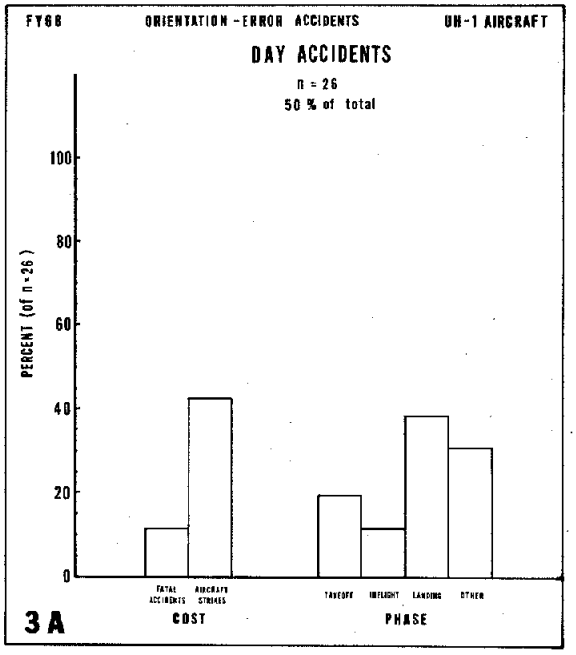


Figure 2

Number of orientation-error accidents as a function of the time of year (A) and the local time of day (B).



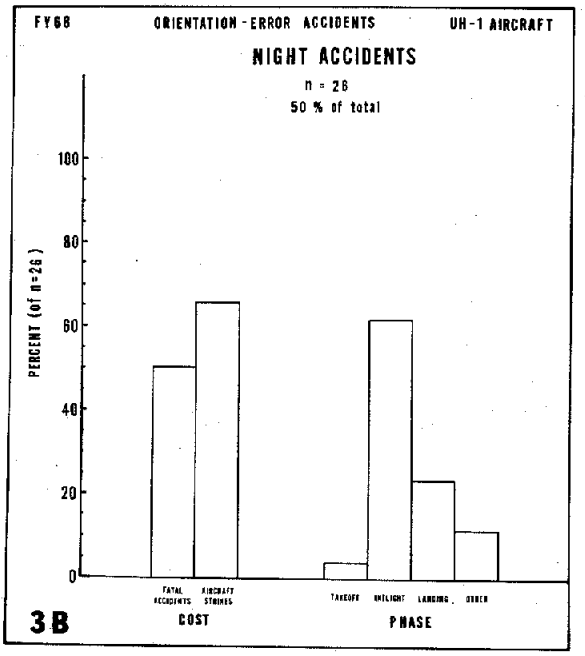
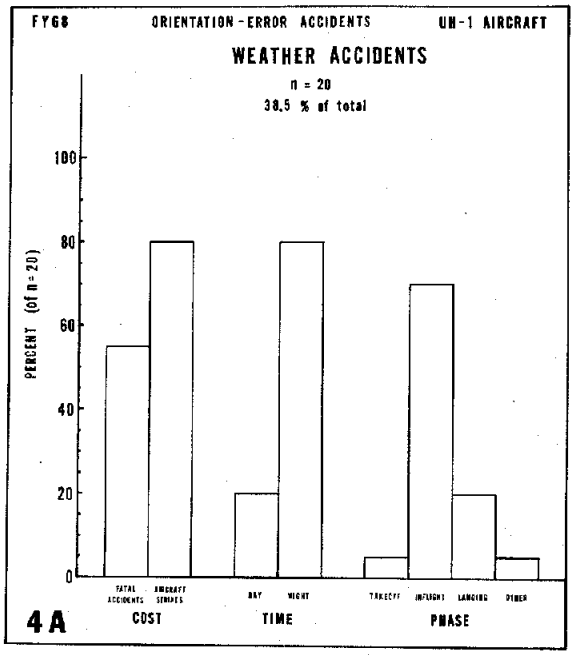


Figure 3

Comparison of percent incidence of fatal accidents, aircraft strikes, and flight phases for the 26 orientation-error accidents that occurred under daylight visibility conditions (A) and the 26 accidents that occurred under night visibility conditions (B). Note the considerably greater hazard of the night flights.



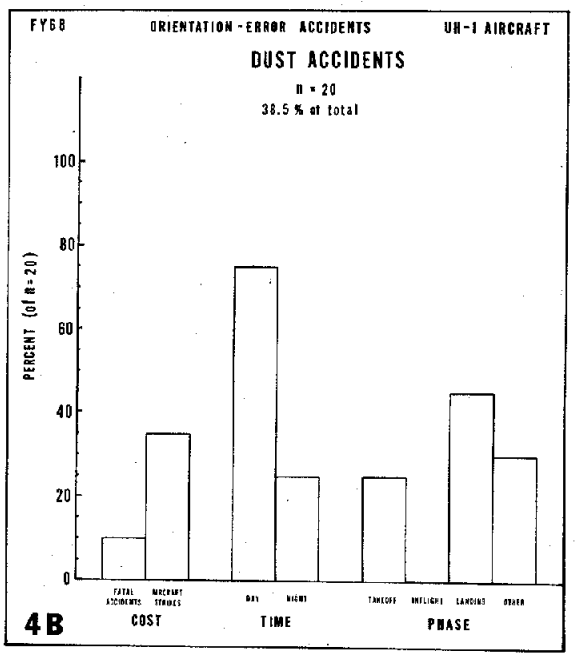


Figure 4

Comparison of percent incidence of fatal accidents, aircraft strikes, day/night accidents, and phases of flight for the 20 orientation-error accidents that involved poor weather (A), and the 20 accidents that involved rotor-raised ground dust or ashes (B). Note the high incidence of fatal accidents and aircraft strikes involved in the weather accidents.

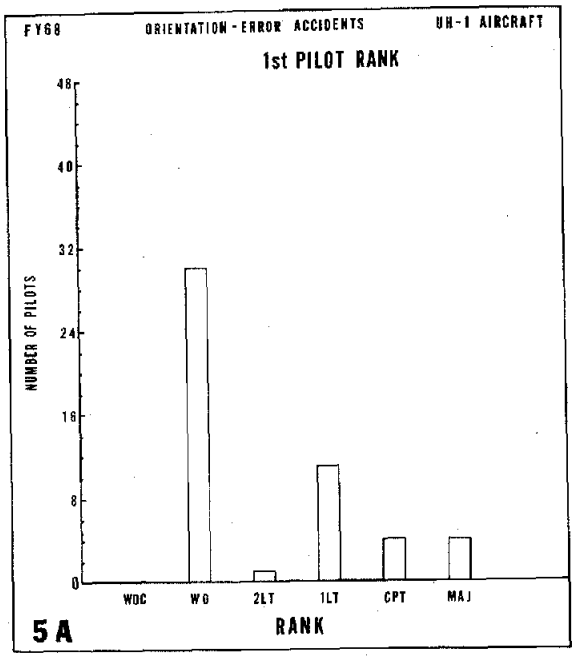
terms of fatal accidents and aircraft strikes was considerably greater than the corresponding costs for daylight accidents. That is, 50.0 percent of the night accidents were fatal as compared to only 11.5 percent of the daylight accidents; 65.4 percent of the night accidents resulted in aircraft strikes as compared to only 42.3 percent of the daylight accidents. In terms of the phase of flight for the night accidents, the greatest incidence occurred during the inflight phase (61.5 percent) followed by the landing, "other," and takeoff phases. For daylight accidents, incidence was greatest during the landing phase (38.5 percent) followed by the "other," takeoff, and inflight phases.

Data pertaining to accidents involving degraded visibility due to weather and rotor-raised ground dust are presented in Figure 4. As denoted in Figure 4A, poor weather of one form or another was present in 20 (38.5 percent) of the 52 orientation-error accidents. The hazard of these weather accidents was most significant since 55.0 percent of the accidents were fatal and 80.0 percent resulted in aircraft strikes. A further significant feature was that the majority (80.0 percent) of the accidents occurred at night. Of the 16 accidents that occurred under these special conditions, i.e., visibility degraded both by weather and by darkness, 10 (62.5 percent) were fatal. Of the four weather accidents that occurred during daylight, only one was fatal. With respect to the total of 11 fatal weather accidents, 10 (90.9 percent) of these occurred at night. In terms of the phase of flight when the accident occurred, the inflight phase had the greatest incidence (70.0 percent).

As indicated in Figure 4B, an additional 20 (38.5 percent) of the 52 orientation-error accidents involved degraded visibility due to rotor-raised ground dust. Though there were only two fatal accidents in this classification, a considerable number (35.0 percent) involved the total loss or strike of the aircraft. In contradistinction to the weather accident data, the majority (75.0 percent) of the dust accidents occurred under daylight visibility conditions. Relative to the phase of flight, landing accidents had the greatest incidence (45.0 percent) followed by the "other" and takeoff phases.

In Figures 5 through 9, summary listings are made of various aviator-related background information. For each figure, a separate compilation is made for each of the two Army pilots normally aboard the UH-1 aircraft. The terms "first pilot" and "second pilot" have been arbitrarily selected to identify the commanding aviator (not necessarily the senior-ranked aviator) and his copilot, respectively. Outside of Vietnam, the first and second pilot notation corresponds to the conventional pilot (P) and copilot (CP) identification. In Vietnam, however, the two aviators are usually identified as the air commander (AC) and pilot (P); the air commander rating applies only after an aviator gains a certain minimum of in-country experience within the air unit to which he is assigned. An air commander is thus identified as the first pilot and the pilot as the second pilot in this report. In the case of student aviators, the individual assigned to fly the aircraft at the time of the accident is identified as the first pilot. Because of incomplete field reports, the total number of pilots will usually vary from figure to figure.

Data pertaining to the military rank of the first and second pilots are shown in Figures 5A and 5B, respectively. Of the 50 first pilots for whom rank data were



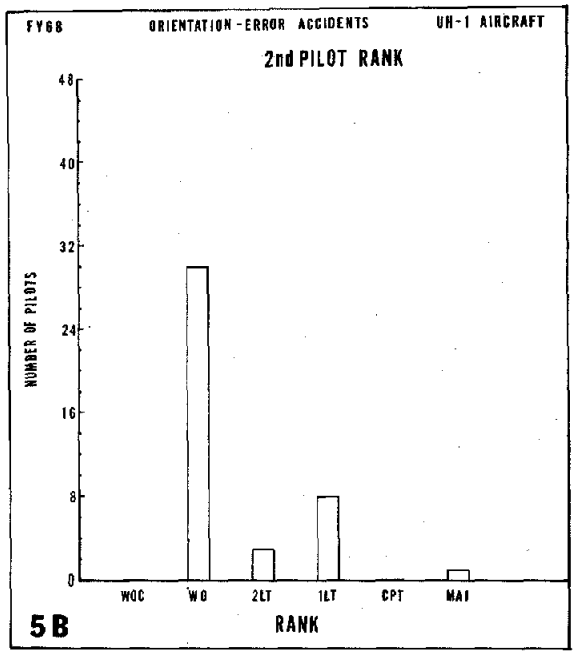
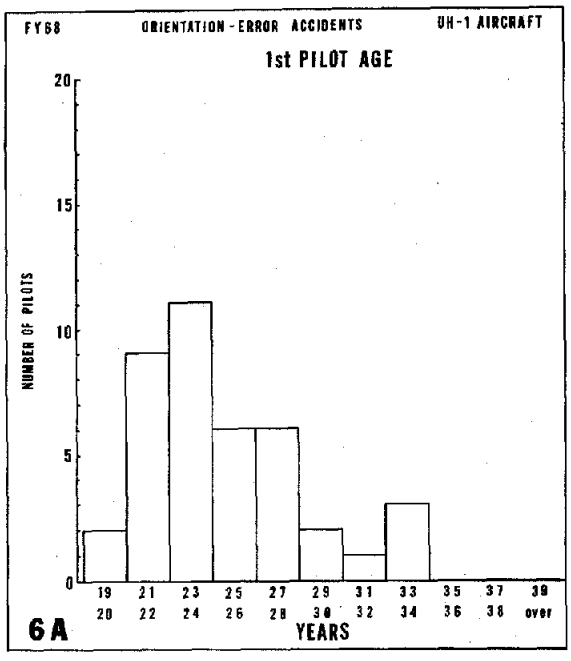


Figure 5

Distribution by rank of 50 first pilots (A) and 42 second pilots (B) involved in the orientation-error accidents. As explained in the text, the first pilot notation is used to describe the commanding aviator aboard the aircraft. In general, for Vietnam accidents, the first pilot is the "air commander" and the second pilot is the "pilot." For accidents occurring elsewhere, the first and second pilot notation usually corresponds to the conventional "pilot" and "copilot" designations, respectively.



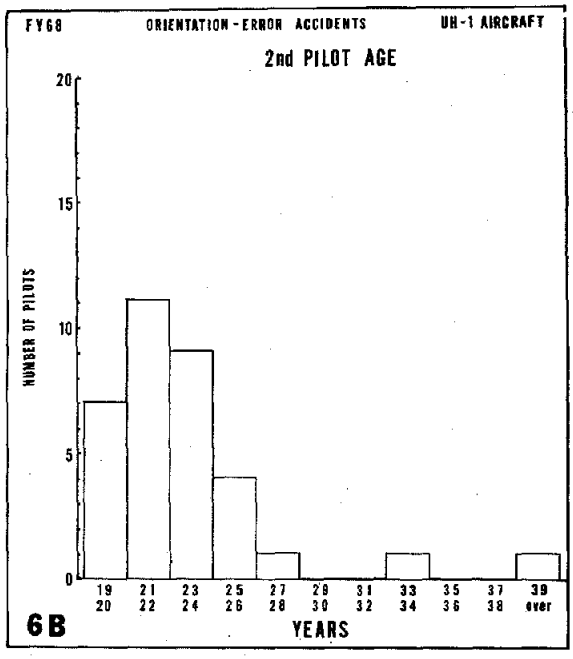
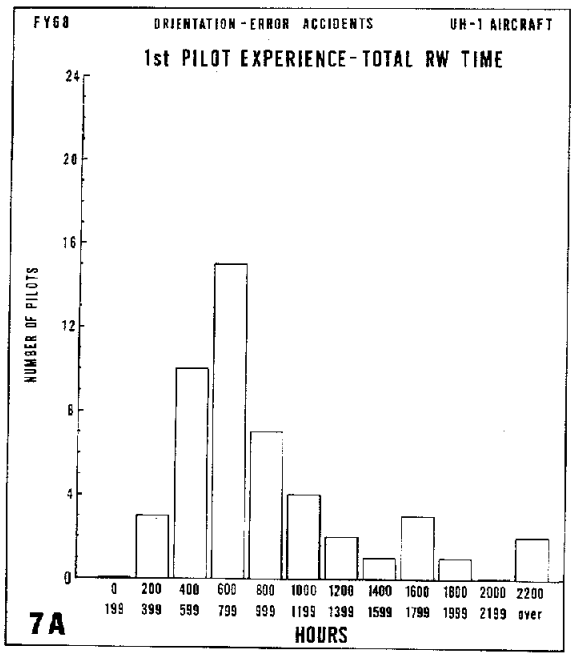


Figure 6

Age distribution of the first pilots (A) and second pilots (B). The median ages were approximately 23.6 years and 21.8 years, respectively.



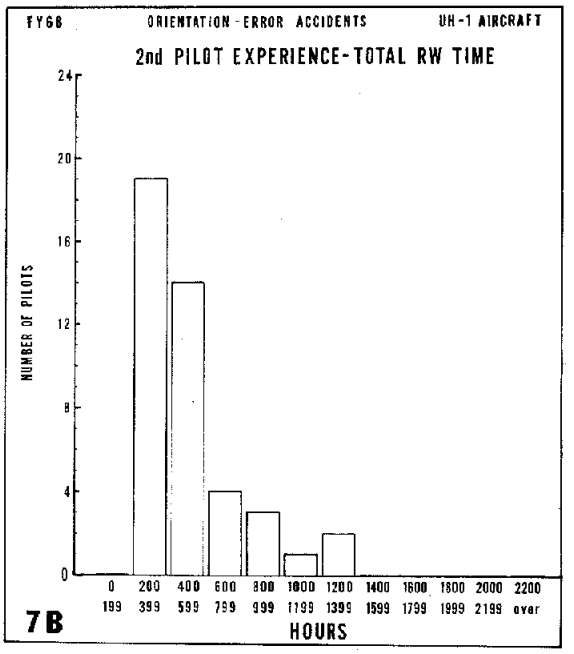
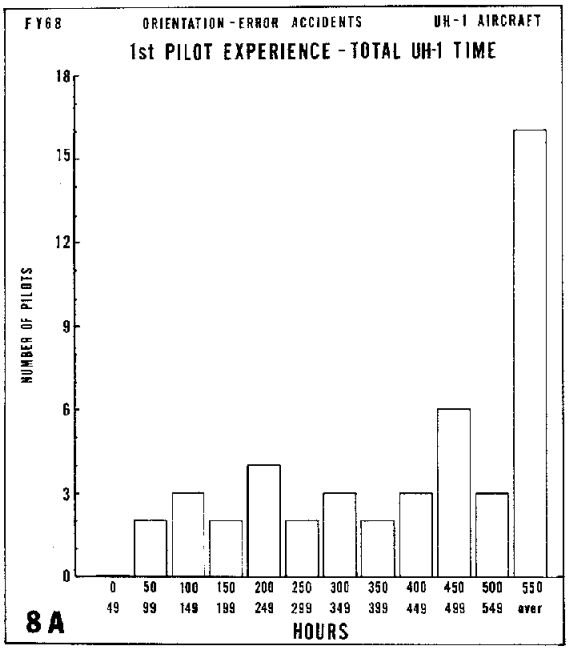


Figure 7

Distribution of total flight hours experience in military rotary-wing aircraft of the first pilots (A) and second pilots (B). The medians were approximately 747 hours and 436 hours, respectively. These data do not include any additional fixed-wing experience. (See Figure 10 for related FW and RW experience data.)



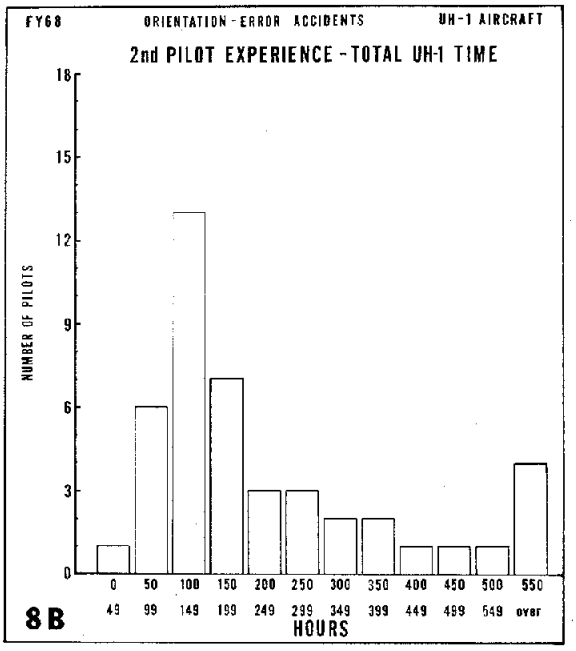


Figure 8

Distribution of total flight hours in the UH-1 aircraft of the first pilots (A) and second pilots (B). The median times were approximately 467 hours and 164 hours, respectively. (See Figure 10 for related UH-1 experience data.)

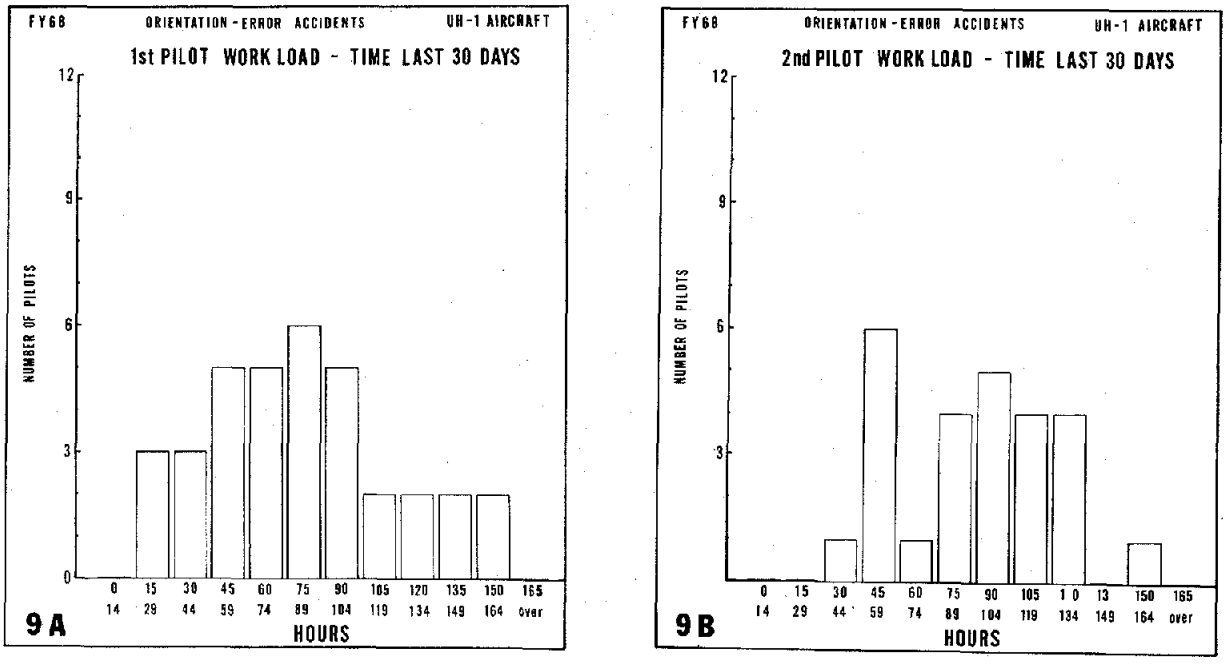


Figure 9

Distribution of pilot workload in terms of the total number of hours flown the 30 days preceding the accident by the first pilot (A) and the second pilot (B). The median workloads were 79 hours and 93 hours, respectively. (See Figure 10 for related fatigue listings.)

available, 20 (40.0 percent) individuals had a rank of second lieutenant or above. Similarly, for 42 second pilots, only 12 (28.6 percent) individuals had a rank of second lieutenant or above. The age distribution data presented in Figure 6A for 40 first pilots indicate a median of 23.6 years; the Figure 6B data indicate a median of 21.8 years for 34 second pilots.

Aviator experience in terms of total flight hours both in all types of military rotary wing (RW) aircraft and in the UH-1 aircraft is described by Figures 7 and 8, respectively. The median for the total recorded RW experience data presented in Figure 7 was 747 hours for 48 first pilots and approximately 436 hours for 43 second pilots. The median times for total UH-1 experience were approximately 467 hours and 164 hours for 46 first and 44 second pilots, respectively.

Work-load data concerned with the total number of hours flown by the aviators during the 30 days preceding the accident are shown in Figure 9; specific hours data were available for only 35 first pilots and 26 second pilots. The median times were approximately 79 hours for the first pilots and 93 hours for the second pilots. Army regulations place 140 hours per 30-day interval as the official upper limit relative to pilot fatigue. After 90 hours, however, observation of the pilot by the air unit commander and flight surgeon is required.

CASE BRIEF 68-1

Vietnam: test mission--maintenance; flight phase--other; night flight; five persons aboard--no injuries.

Test pilot had been on duty for 19 hours when assigned night maintenance checkout of aircraft. Without a copilot aboard and without ground-handler assistance, P lifted aircraft to a hover and attempted to move forward while making a 180-degree left turn so as to avoid nearby parked aircraft. Though pilot thought his turn involved simultaneous forward motion, he actually remained stationary over ground, resulting in the tail rotor striking parked aircraft.

CASE BRIEF 68-2

Vietnam: combat mission--med-evac gun support; flight phase--inflight; night flight; four persons aboard--one minor injury.

Crew had been on duty for 12 hours when assigned gunship mission to support dustoff aircraft performing night emergency med-evac under poor weather conditions. Though AC altimeter was inoperative, AC did not down aircraft since P altimeter functioned properly. At 250 feet, encountered clouds and light rain, resulting in AC decision to begin a left climbing turn. During this climb out, pilots were distracted by nearby enemy gunfire. Unbeknown to pilots, aircraft began to gradually descend instead of climb, resulting in aircraft striking tops of trees during turn. AC regained control of aircraft and made safe emergency landing.

CASE BRIEF 68-3

Vietnam: combat mission--Firefly; flight phase--inflight; night flight; five persons aboard--four fatalities and one minor injury; aircraft strike damage.

Three-ship Firefly team was engaged in second assault operation of the night when group decided to return to base due to poor weather conditions. While enroute, weather further deteriorated, and team inadvertently flew into IFR conditions. At an altitude estimated to be between 400 and 600 feet, team decided to make a 180-degree turn to reestablish VFR conditions. AC of lead aircraft instructed the two other ships to turn right while he turned left. During turn, all aircraft were exposed to heavy rain and turbulence, with control of aircraft difficult. As right-turning aircraft came out into the clear, occupants saw an "orange ball" in the direction of lead aircraft. That aircraft apparently did not maintain altitude during turn and was flown into the ground. The extent of orientation and control difficulties experienced by aircraft is illustrated by statements of a crew member on one of the two aircraft that did not crash -- "The pilots of the flare ship I was on were talking together good, working together, the ship being tossed all over the place. I heard one say to the other, 'Take it! Take it!'; the other said, 'I got it! I got it!'. 'Left pedal' was mentioned by someone. Someone said, 'I got it! Let go, let go, I got it!' The pilot and I saw lights on the left about the same time, but there was some confusion at this point but it was soon over as we descended slowly and the two pilots worked together in an excellent and professional manner . . . ."

CASE BRIEF 68-4

Vietnam: combat mission--support; flight phase--inflight; day flight; nine persons aboard--five fatalities; aircraft strike damage.

Troop ship ordered to checkout a sampan crossing nearby river. AC brought ship to a hover over the fast moving, rapid-like river and started to make a slow right turn around sampan. AC had difficulty maintaining altitude and directional control of aircraft, finally striking water with left skid first in a nose-low attitude. Board mention of illusory effects of swift moving water relative to perception of ground speed and altitude.

CASE BRIEF 68-5

Vietnam: combat mission--assault; flight phase--other; day flight; four persons aboard--no injuries.

After refueling and rearming, P lifted aircraft to a low hover and began a sideways hover toward takeoff site. Aviator in nearby aircraft saw accident aircraft begin a slow drift downward while still hovering sideways. Neither AC nor P detected the descent. Approximately 60 feet from initial hover site, right skid hit ground, aircraft bounced into air and rolled over inverted.

CASE BRIEF 68-6

Vietnam: combat mission--resupply; flight phase--inflight; night flight; four persons aboard--three major injuries and one minor injury; aircraft strike damage.

Experienced AC without an instrument rating assigned a night passenger-transport mission. Making only a visual check of weather, AC made takeoff and soon thereafter encountered light rain. AC continued flight, reached destination, and offloaded passengers. Made takeoff and headed back toward home base. While flying at about 1000 feet, inadvertently entered a very heavy rain shower. AC instructed P to monitor instruments and call out airspeed and altitude as he began a gradual descent to regain visual contact. At about 500 feet, AC experienced vertigo. At about the same time, P called out "zero airspeed," and aircraft began a roll to the right. AC overcorrected to the left, and aircraft began spinning counterclockwise about its vertical axis. Flight attitude at the time of ground contact was approximately level.

CASE BRIEF 68-7

United States: service mission--med-evac; flight phase--inflight; night flight; four persons aboard--four fatalities; aircraft strike damage.

Relatively inexperienced pilots assigned a night med-evac mission. After delivering patient to hospital, crew refueled and departed for home base even though thunderstorms were known to be present. Although there was no mission urgency to return, one of the pilots was to have met his parents later in day in another city. Slightly before daybreak, farmer heard aircraft flying low over farmhouse but could not see it due to low ceiling and heavy rain. Aircraft impacted ground in gradual descent attitude at full throttle. Flight surgeon listed lack of sleep as a factor since crew had departed on mission at about 0230 hours.

CASE BRIEF 68-8

Vietnam: combat mission--command and control; flight phase--other; day flight; eight persons aboard--no injuries.

Aircraft made normal climb out to 800 feet, then engine failed. AC relieved P at controls and placed aircraft into autorotation. While in descent, AC was able to maintain rotor rpm well within the normal autorotation range. As aircraft was flared, the rotor raised a large, thick cloud of red dust. With visibility nearly IFR, AC pulled pitch at an altitude estimated to be 3 to 5 feet. Aircraft impacted ground, with heels of both skids causing main rotor to sever the tail boom. Both pilots had flown over 150 hours during the preceding 30 days.

CASE BRIEF 68-9

Vietnam: combat mission--command and control; flight phase--inflight; night flight; six persons aboard--three fatalities and three major injuries; aircraft strike damage.

Approximately 5 minutes after takeoff, aircraft entered a fog bank at an approximate altitude of 80 feet. Since P attempting to fly VFR, he began a gradual right turn to get out of weather. During the turn, aircraft gradually descended, finally impacting ground in a nose-down, right-skid, low attitude. Crew chief reported, "Well, I felt the aircraft descending. I felt it descending. It wasn't. I mean it feels regular like when you make a turn before . . . ." AC reported to have "felt uneasy" about the flight before takeoff. Both aviators had flown over 100 hours during the preceding 30 days.

CASE BRIEF 68-10

Vietnam: combat mission--med-evac; flight phase--inflight; night flight; five persons aboard--five fatalities; aircraft strike damage.

Relatively inexperienced pilots assigned an urgent med-evac mission under bad weather conditions. AC circled pickup site in heavy rain, with searchlights turned on. Requested ground flares several times but still could not see field. Ground radio operator in communication with aircraft observed that he could hear pilots loud and clear but would have to repeat his call sign three or four times before crew would acknowledge. Pilots stated they were having trouble seeing ground details and asked that ground searchlights be turned on. Aircraft struck ground near pickup site in a near normal flight attitude, with an airspeed of approximately 80 knots. Board mentioned visual illusion problem relative to determining altitude when searchlights turned on in rain and ground lights present. Board review indicated that the condition of the patients to be evacuated warranted a priority rather than urgent rating, which would have allowed flight to be postponed. AC was quoted as saying before flight he thought the weather was too bad and would like to wait until it improved.

CASE BRIEF 68-11

Vietnam: combat mission--support; flight phase--inflight; night flight; four persons aboard--four minor injuries.

Formation of nine aircraft flying in V's of five enroute to combat site. Flight leader had checked weather and received VFR clearance for route of flight. He also sent one aircraft ahead to reconnoiter weather conditions. This aircraft reported light rain conditions throughout vicinity. Formation continued on route and when near destination encountered heavy rain. Received radar vector toward destination which indicated that they were slightly off course. Most pilots in formation could see landing site lights to their right. Flight leader ordered a straight trail formation. Pilots in following aircraft assumed a right turn would be made and moved aircraft to left of lead aircraft. Flight leader then turned left in a steep bank. Accident aircraft then had to make an equally steep bank and decrease airspeed since it was tight inside the turn. AC of this aircraft then determined it was unsafe to continue and broke out of formation in a 360-degree turn to left with P at controls. During turn the P became disoriented and aircraft began a gradual descent. Loss of altitude was recognized at the last instant by AC who came on controls and unsuccessfully tried to avoid the crash. P later stated, "It was then that between watching for other aircraft and my lack of ground reference that I became disoriented. The AC was grabbing the controls as we hit--the only time I became completely disoriented was seconds before we hit the ground--I did have difficulty the entire flight due to reduced visibility caused by the darkness, the rains, and also my lack of ground references." Pilots in other aircraft also reported orientation difficulties and near-miss accident situations. One P stated that when he turned on his landing and searchlights in the heavy rain, he was "dazzled" and immediately turned them off and went back on instruments to remain oriented.

CASE BRIEF 68-24

Vietnam: combat mission--Firefly; flight phase--inflight; night flight; four persons aboard--four fatalities; aircraft strike damage.

Four aircraft, including two gunships, one flareship, and one command ship, on a night Firefly assault mission over flat and open terrain. After target identified and flares dropped, first gunship made a diving run from 1000 feet. Second ship then followed. When second ship had completed attack, crew observed first gunship to level off at 600 feet instead of 1000 feet as had been planned. AC in second ship observed first aircraft initiate second attack run. First aircraft impacted ground without any apparent attempt to pull up. Both aircraft gunners seen to be firing continuously right up to "the instant of the crash." Witnesses stated that flare illuminating the area burned out just before crash. Board mentioned that an "undercurrent from witnesses seemed to indicate that perhaps there was a degree of overconfidence in the AC's attitude."

CASE BRIEF 68-25

Vietnam: combat mission--reconnaissance; flight phase--landing; day flight; eight persons aboard--no injuries.

P made straight-in landing approach to small helipad with wires to either side of flight path. At an altitude of approximately 6 feet, visibility went IFR due to rotor-raised dust. Because of proximity of wires, P decided to land instead of making a go-around. While still IFR, aircraft impacted ground with right skid in a nose-low attitude.

CASE BRIEF 68-26

Vietnam: combat mission--support; flight phase--takeoff; day flight; four persons aboard--one fatality and three major injuries; aircraft strike damage.

Aircraft landed in defensive perimeter of outlying combat position and offloaded two passengers. Landing accomplished without incident, although a substantial amount of dust hampered vision of flight crew. Aircraft raised to hover, and takeoff attempted from same position. Immediately after takeoff, AC visibility went completely IFR due to rotor-raised dust. Aircraft veered to left of desired course, lost altitude, and became entangled in the top band of concertina wire surrounding position. This caused aircraft to strike ground initially in a nose-low, left-skid-first attitude, bounce, and finally come to rest on its right side. AC had flown 146 hours during the preceding 30 days and 42 hours during the preceding 7 days. Maintenance records indicated windshield was badly scratched.

CASE BRIEF 68-27

Vietnam: combat mission--med-evac; flight phase--landing; night flight; four persons aboard--three fatalities and one major injury; aircraft strike damage.

AC of med-evac flight in hurry to complete mission before dark. First landed at mistakenly identified field thought to be pickup site. When location of patient finally determined, made takeoff into fast approaching darkness. When aircraft arrived over pickup site, ground personnel illuminated area with flares and vehicle headlights. AC came in downwind with searchlight on and brought aircraft to a high hover in gusty winds, with fog/cloud cover approximately 20 feet off ground. Aircraft seen to bank left toward dark terrain away from lighted area and descend into trees. Witnesses stated that flares fired into fog might have affected crew visibility. AC had flown 7 hours prior to the accident. Flight surgeon mentioned that "on previous occasions AC exhibited undue temper after having been observed in gross errors in direction of flight." He also concluded from interviews with fellow aviators that the AC "was more prone than the average pilot to be in trouble without realizing it."

CASE BRIEF 68-20

Vietnam: combat mission--assault; flight phase--takeoff; day flight; four persons aboard--no injuries.

Heavily loaded gunship had initiated takeoff when AC decided to abort flight because of height of barriers at end of runway. At an altitude of approximately 15 feet, AC made a right turn and went IFR in red-clay dust. Without any ground visibility, AC set aircraft down hard, impacting terrain with right skid in a nose-low attitude. Six hours before this flight, AC "had been severely criticized over the radio by the air mission commander for getting disoriented and for failing to be in a position to place preparatory fire . . . ."

CASE BRIEF 68-21

Vietnam: combat mission--support; flight phase--inflight; night flight; four persons aboard--four fatalities; aircraft strike damage.

Two gunships standing by to support outlying ground troop base. Radio message received that base under attack and that gunships were to supply fire support. Gunships arrived over combat site, with a low layer of scattered clouds partially obscuring terrain. Night was extremely dark with no distinguishable horizon. As aircraft circled, waiting for specific gunnery orders, passed through areas occasionally illuminated by high-intensity flares. When gunnery orders received, lead aircraft began a diving straight-in machine gun/rocket firing run. Witnesses observing gunship tracers remarked that aircraft seemed to "fly straight into the ground." Instant before crash, AC heard to shout, "Pull it up." Board mentioned target fixation, poor communications between ground unit and aircraft since aviators had to yell to be heard, and lighted gunship reticles that might degrade night vision. Both aviators had flown approximately 100 hours during preceding 30 days. The P, most probably on controls at the time of accident, had 14.2 hours recorded flight time during the preceding 24 hours.

CASE BRIEF 68-22

Vietnam: combat mission--resupply; flight phase--other; day flight; four persons aboard--no injuries.

Crew had been on duty 11 hours and flown 8.5 hours up to time of accident. After returning from a med-evac mission, crew ordered to pick up ammunition for an emergency resupply of troops in enemy contact. AC lifted aircraft to a high hover and moved toward supply point. As aircraft descended to about 10 feet, rotor-raised dust engulfed ship, and no member of crew could see the ground. AC decided to continue to the ground since personnel and stacked supplies in immediate vicinity. Impacted ground in a nose-low attitude. Aviators said they knew dust was in area but they were more concerned about the upcoming mission than the dust problem.

CASE BRIEF 68-23

Vietnam: combat mission--resupply; flight phase--landing; night flight; four persons aboard--no injuries.

Crew had been flying 10 hours and were returning to their base camp that had neither pathfinders nor field lights. On short final, dust from area rose up around the aircraft, and someone on the ground flashed a light into cockpit. With visibility completely IFR, AC decided to land vertically. Overestimating his altitude, AC lowered collective, resulting in a very hard landing. During the 5 days preceding the accident, crew had flown a total of 56 hours.

CASE BRIEF 68-28

Vietnam: service mission; flight phase--inflight; night (dusk) flight; ten persons aboard--ten fatalities; aircraft strike damage.

Crew with minimal sleep following New Year's eve party had been on duty 11 hours when decision made to return to base even though darkness approaching and weather marginal. As flight progressed, weather deteriorated, but P decided to continue on toward base. Passing through heavy clouds, fog, and rain, visibility went IFR, and aircraft impacted ground in a near-normal flight attitude, with an airspeed of approximately 60 to 65 knots. P had flown every day for the 12 days preceding the accident. The CP had only 3 nonflying days in the preceding 20 days. Both aviators had less than 400 hours total RW time.

CASE BRIEF 68-29

Vietnam: combat mission; flight phase--landing; night flight; four persons aboard--one fatality and one minor injury; offboard personnel--two fatalities and two major injuries.

Formation approached dusty landing site and had to make go-around because of inability to see ground obstacles. On the second approach, all aircraft landed except two ships who made a second go-around. On the third go-around, one of these two ships landed. The AC of the remaining aircraft allowed the relatively inexperienced P (244 total RW hours) to remain on controls throughout these difficulties. On the fourth approach, P stated that he used the rotating beacons on the parked aircraft to "maintain his VFR status." Near termination, visibility went IFR due to the dust. P saw flashlight being waved and started to move aircraft in that direction, thinking he was in a gradual descent. In actuality he was at a hover and in a nose-high attitude. Aircraft tail rotor impacted main rotor of parked aircraft while in slight drift. AC came on controls seconds before crash. AC stated that the aircraft searchlight could not be used to locate obstacles during approach since it was jammed and could not be swung from side to side.

CASE BRIEF 68-30

Vietnam: combat mission--assault; flight phase--landing; day flight; four persons aboard--no injuries.

Aircraft fourth ship in a flight of ten assigned a troop pickup mission. On final approach, flight warned of dusty conditions and advised to take separation. With P at controls, aircraft was brought to a 5-foot hover when the aircraft to front was noticed to be hovering forward. P then moved aircraft forward to maintain spacing when visibility went IFR due to dust. AC "felt" the aircraft drifting laterally and took over just as it impacted the ground, collapsing the landing skids. P had flown 126 hours during the preceding 30 days. Each aviator had flown 14 hours during the preceding 24-hour period.

CASE BRIEF 68-31

Vietnam: combat mission--assault; flight phase--inflight; night flight; four persons aboard--three major injuries and one minor injury; aircraft strike damage.

Involved aircraft was lead ship of a team that had been flying for approximately 1-1/2 hours when called to assist a nearby outpost undergoing attack. Upon arrival at outpost, team made four orbits around the site at approximately 300-foot altitude, observing tracer gunfire from various ground positions. On the fourth orbit, a high-intensity Xenon searchlight located on ground at perimeter of outpost, and pointed above horizon, flashed into cockpit. AC stated, "I was dazzled momentarily and before I could recover, the aircraft hit the ground and burst into flames." An interesting illusory effect experienced by AC was reported as follows: The AC stated that the tracer ground fire he observed when straight and level "suddenly appeared as though they were aircraft with beacon lights overhead."

CASE BRIEF 68-32

Vietnam: service mission--ferry; flight phase--landing; night flight; four persons aboard--two major injuries and two minor injuries; aircraft strike damage.

AC was unit maintenance officer and flying recently repaired aircraft to combat site where he planned to evaluate aircraft performance under actual field conditions. This flight also served as a night orientation ride for P who had just been assigned to the air unit. Aircraft was at 1800 feet with ceiling ragged, sometimes dropping to 300 feet, and with scattered rainshowers present. AC contacted GCA and arranged for a precision radar approach to field. Due to blind spot in GCA radar, tower had to vector aircraft off course to establish identity. GCA brought aircraft within sight of field, but runway lights were not turned on. Weather at this time was "300- to 400-feet overcast with fog and drizzle, and visibility a mile or less at times." AC mentioned that reflection of landing lights on visible moisture in air heightened his difficulties in transition from IFR to VFR flight. At an altitude of approximately 300 feet, P accidentally pointed searchlight upward, "flooding the cockpit with glare." At this time, AC initiated his final turn but had difficulty maintaining airspeed. AC banked aircraft right about 30 degrees, pulled in power, and lowered nose to gain airspeed. Before AC could recover he saw trees ahead and attempted to level before aircraft finally impacted terrain. GCA operator observed that AC seemed to respond very slowly to changes in course heading required for GCA landing. AC also stated that he had difficulty staying on desired heading during the flight. AC had little sleep the night before the accident and had been on duty for 16 hours at the time of the accident.

CASE BRIEF 68-33

Vietnam: service mission; flight phase--takeoff; day flight; six persons aboard--no injuries; aircraft strike damage.

Two aircraft had landed at field to check another aircraft down with maintenance difficulties. After inspection of downed aircraft, lead ship made normal takeoff through dust present at landing site. P of second ship lifted to hover and started down runway. After approximately 150 feet, the aircraft went IFR in dust, with ground witnesses stating that no part of the ship was visible. When visibility went IFR, P went on instruments, and AC came on controls with him. Windows were open and dust engulfed cockpit. Aircraft impacted ground with rapid descent rate, bounced, and came down in tilted attitude, with main rotor striking ground.

CASE BRIEF 68-34

Vietnam: combat mission--resupply; flight phase--takeoff; day flight; seven persons aboard--no injuries; aircraft strike damage.

Heavily loaded aircraft began takeoff down runway, which ended with a steep 200-foot dropoff. As aircraft approached end of runway in rotor-raised dust, AC decided to abort takeoff since translational lift had not been achieved. Aircraft then placed into a small flare, which raised additional dust, causing visibility to go completely IFR. Problem complicated by dust entering cockpit through hatch that had to be left open to reduce fume hazard from spilled cargo. AC then decided to back up since he thought he was already over 200-foot ledge. After traveling backward, an estimated 12 to 14 feet, AC attempted to set aircraft down under IFR conditions, but rear of right skid hit ground first, resulting in a main rotor strike.

CASE BRIEF 68-35

Vietnam: service mission; flight phase--other; night (dawn) flight; twelve persons aboard--no injuries.

Aircraft was hovering down taxiway preparing for takeoff when visibility went IFR due to rotor-raised dust. Searchlight reflected off dust, producing glare. AC "became disoriented and aircraft began to turn to the right and drift to the left of the intended hover path." As AC attempted to apply further power, rpm bled off due to heavy load. Aircraft impacted ground, left skid first, with tail rotor becoming enmeshed in concertina wire. AC had failed to perform go-no-go power check during preflight.

CASE BRIEF 68-36

Vietnam: combat mission--troop extraction; flight phase--landing; night flight; four persons aboard--three major injuries and one minor injury; aircraft strike damage.

Two aircraft involved in an urgent night extraction of troops from small clearing with heavy dust and burnt ash covering surface. First aircraft made successful landing and take-off. Second aircraft made approach, encountering dust on short final. AC requested P to turn on landing lights, but because of glare/reflection from dust and ashes, no improvement in visibility resulted. AC had P turn off lights, whereupon all visual contact with ground was lost. Aircraft drifted, with tail rotor striking nearby tree, resulting in a main rotor strike with ship rolling over on side.

CASE BRIEF 68-37

Vietnam: service mission--troop transport; flight phase--landing; day flight; eight persons aboard--no injuries.

Highly experienced AC (2229 total RW hours) made a low reconnaissance of field to determine optimal landing site and then began approach. When approximately 25 feet from touchdown, a truck moved toward the selected site. AC then picked a second touch-down point to right of original site. As he moved toward this site, personnel were seen to be in immediate vicinity. Instead of making a go-around, AC made a turn to the right. At this point, visibility went completely IFR due to rotor-raised dust, and aircraft impacted ground beyond planned touchdown point.

CASE BRIEF 68-38

Vietnam: combat mission--command and control; flight phase--takeoff; night (dawn) flight; four persons aboard--four fatalities; aircraft strike damage.

Crew made takeoff into marginal weather without contacting tower. Ceiling estimated to be 200 to 300 feet due to a layer of fog; visibility 1.2 miles and dark. At approximately 100 feet the aircraft, with landing lights on, turned left in normal takeoff pattern and entered fog bank. At this time landing lights were turned off, and aircraft was then observed to increase its rate of turn, entering into a steep bank and beginning to descend. Bank became excessive, witnesses estimated up to 80 degrees, and aircraft impacted ground. Board mentioned that though AC could have cancelled the mission because of marginal weather, his judgment may have been affected by the fact this was to be his first flight as an AC.

CASE BRIEF 68-39

Vietnam: combat mission--support; flight phase--landing; night flight; three persons aboard--one minor injury.

Aircraft part of three-ship team providing continuous air support to ground unit expecting a large-scale mortar attack. Two of the aircraft, while enroute to a refueling site, encountered deteriorating weather marked by low ceiling, fog, and light rain. Because there were no GCA facilities at refueling site, aircraft made a 180-degree turn and headed for home base, with fuel becoming marginal. Air unit commander at home base began transmitting on FM to give aircraft a homing signal since regular ADF ground equipment not operational. Also sent third aircraft up to circle home base, with the objective of making an immediate pickup of crews of two returning aircraft in the event they ran out of fuel over surrounding hostile territory. The ships arrived over home base, with weather rapidly closing in. First aircraft landed safely, but AC of second aircraft decided to make a 360-degree go-around since he felt he did not have sufficient spacing to execute a safe approach and landing. After entering turn, aircraft descended almost immediately and impacted tops of trees. P came on controls, since feet of AC were entangled in damaged pedals, and recovered altitude making a slow, but hard, landing. Both AC and P had been on continuous duty for 18 hours. Board mentioned that aviators may have set the altimeter on the high side. When the 360-degree was initiated, the aircraft turned away from the lighted field into total darkness so that all reference to a horizon was lost. AC stated that weather was zero-zero at time of turn and, "As I started to turn right there was this wall of nothing, like mist, haze and a cloud, and then the aircraft hit the trees."

CASE BRIEF 68-40

Vietnam: combat mission--med-evac; flight phase--other; day flight; four persons aboard--no injuries.

Crew had returned to home base after completing med-evac mission. Before shutting down, they were instructed by tower to move aircraft to a different parking area. AC lifted ship to hover, with the objective of lifting up and to the right so as to not overfly parked aircraft immediately to his front. Neither aviator sensed that the tail began to drift left. Before the crew chief could warn of drift, tail rotor struck nearby revetment and aircraft settled into ground. Pilots had flown 31 sorties during the preceding 24 hours and had been on continuous duty for 10 hours at the time of the accident.

CASE BRIEF 68-41

Vietnam: service mission--personnel transportation; flight phase--inflight; day flight; eleven persons aboard--eleven fatalities; aircraft strike damage.

P assigned to conduct a routine courier flight without the assistance of a CP. The P, who had not logged any instrument time since he completed flight school over a year prior to the accident, decided to fly through a mountain pass under marginal weather conditions, even though better weather was known to exist at a nearby alternative route. As weather closed in, aircraft entered a gradual turn and impacted mountainside. During flight school, P had extreme difficulty with instrument flying and at one time was considered for permanent grounding. Concurrently, also underwent psychiatric examination relative to severe headaches, with diagnosis indicating a possible fear of flying.

CASE BRIEF 68-42

Vietnam: combat mission--resupply; flight phase--landing; day flight; six persons aboard--two major injuries; aircraft strike damage.

Crew assigned to transport C-rations under bad weather conditions to an outlying unit that classified the delivery as a tactical emergency. Aircraft approached site located in valley at base of three mountains, with visibility hampered by a low ceiling and rain. Yellow smoke from position identifying flares also degraded visibility. Though windshield wipers were operational, AC did not use them at any time during approach. AC made slow shallow approach and flared aircraft at approximately 10 knots. Aircraft drifted right and struck a tree, resulting in a main rotor strike.

CASE BRIEF 68-43

Korea: service mission; flight phase--landing; day flight; twelve persons aboard--no injuries.

Three-ship group making trail-formation approach to field landing site. Flight circled field to evaluate conditions, with lead aircraft initiating the landing approach. During approach, P of lead aircraft decreased speed while checking for wires and obstacles. This caused second aircraft to decrease speed to about 20 knots. Upon landing, lead aircraft raised dust. AC of second aircraft observed dust but was able to maintain VFR contact with ground and continue his approach. At an altitude of approximately 5 feet, however, visibility went completely IFR. AC hesitated momentarily, then continued his approach to the ground, not realizing his nose was high and his descent rate excessive. Hard impact made with ground, resulting in collapse of skids.

CASE BRIEF 68-44

Vietnam: combat mission--support; flight phase--landing; day flight; fourteen persons aboard--no injuries.

Aircraft transporting troops to combat site in urgent need of reinforcements. Area was approximately 50 percent obscured due to smoke from numerous fires. Conditions in the landing zone were further marked by high gusty winds and blowing ashes. Due to location of fires and the urgent need for troops, transports were brought in on a downwind approach and then turned into the wind just prior to landing. Accident aircraft flying trail behind other aircraft when AC found it necessary to come to hover because aircraft in front of him began picking landing spots. Due to heavy load and crosswind situation, AC decided to set aircraft down. Went IFR in blowing ashes, losing all visual contact with ground. Aircraft impacted ground hard with left skid first. AC had flown 158 hours during the preceding 30 days. P had flown 126 hours during the same period.

CASE BRIEF 69-45

Vietnam: combat mission--flare-type Firefly assault; flight phase--inflight; night flight; four persons aboard--four fatalities; aircraft strike damage.

Helicopter fire-team leader who received mission to support ground unit under attack requested a flare aircraft to illuminate target area. Weather conditions marginal relative to implementing mission since flight would have to be flown IFR to reach an altitude sufficient to drop flares. Flare ship made a climbing left turn to altitude and leveled out into weather, including low ceiling, fog, and light rain. Aircraft seen to begin a turn to right and rapidly descend. Radio transmission received in which a panic-stricken voice was heard to say either, "I've got it" or "You've got." Aircraft leveled out but impacted ground with a very high rate of descent. The P and CP had flown 104 and 133 hours, respectively, during the preceding 30 days. Both pilots had been on duty for approximately 21 hours, followed by a 5-1/2 hour sleep period prior to the accident. Flight surgeon report mentions low "espirit de corps" of unit aviators related to their dislike of unit commander.

CASE BRIEF 68-46

Vietnam: combat mission--support; flight phase--other; day flight; eight persons aboard--no injuries; aircraft strike damage.

Aircraft without CP aboard moved to edge of runway awaiting tower clearance for takeoff. P set aircraft down and after several minutes received clearance. Relatively inexperienced P (298 total RW hours) performed pre-takeoff check, raised aircraft to a hover, and moved toward runway. At this point, rotor-raised dust caused visibility to go completely IFR. Ground witnesses stated that "only the rotor blades were visible." P noticed the rpm drop and decided to set the aircraft down. Had difficulty maintaining heading (later determined to be due to a faulty governor). Aircraft was nose high and began a slow drift to the rear and to the right, which was not detected by the P. Aircraft impacted uneven terrain and rolled over on its side.

CASE BRIEF 68-47

Vietnam: combat mission--troop relocation; flight phase--takeoff; day flight; eleven persons aboard--no injuries; aircraft strike damage.

AC volunteered to reposition troops who had been delayed enroute to destination as a result of a breakdown in transport helicopter. Selected paved road as optimal takeoff path even though trees on his left about 75 yards ahead, steel poles on his right about 100 yards ahead, a deep ditch to his right, and an elderly lady riding a bicycle to one side of the flight path. AC lifted heavily loaded aircraft to a hover and began takeoff. Prior to translational lift, rotor rpm started to bleed off, and visibility went completely IFR due to dust. Deciding to abort, AC attempted to set down level. However, aircraft began an undetected drift to the right, with left skid low. As left skid hit ground right skid dropped into ditch, and aircraft rolled over.

CASE BRIEF 68-48

Vietnam: combat mission--assault; flight phase--other; day flight; four persons aboard--four minor injuries; aircraft strike damage.

Five helicopters returning to home base after completing mission encountered heavy air congestion at field due to ongoing USAF-USA tactical operation. As a result of this density, the normal parking area was not available to the flight, and the helicopters were forced to park in unimproved dirt areas. AC of accident aircraft elected not to land with his flight because of the dust created and because there was doubt as to possible parking space. While circling to one side of the field, AC observed three C-130 fixed wing aircraft and at least two CH-47 helicopters land, plus one C-130 circling in the distance at a much higher altitude. Since there was no air-traffic controller assigned to this field, all traffic control was responsibility of flight commanders. When parking space became available, the helicopter section commander radioed AC to approach field for a landing. Keeping the circling C-130 aircraft in sight and avoiding a line of artillery fire to one side of field, AC approached the only clear runway and terminated to a hover. At this point, AC observed another C-130 on a direct collision course just short of touchdown. It would have been impossible to move to the parking area in the time available; if he elected to lift off, a mid-air would be highly probable; if he went down the runway, the aircraft would be run over by the C-130. Accordingly, AC moved aircraft off runway into extremely dusty conditions, with visibility immediately going IFR. Sensing that he had moved a short distance off runway, he then attempted to set down aircraft in a level attitude. In actuality he had moved approximately three times as far as he had intended. Aircraft impacted uneven terrain in a left skid low attitude, resulting in a main rotor strike. P stress due to high degree of congestion highlighted by Board member statement, "I have never before seen such a melee of different type helicopters and fixed wing aircraft operating in the limited space available--USAF tactical aircraft participating in air strikes, USAF resupply aircraft attempting to land, USAF and USA O-1's and O-2's adjusting artillery and air, a helicopter company conducting a combat assault, helicopters conducting combat resupply operations, and med-evac helicopters lifting casualties."

CASE BRIEF 68-49

Vietnam: combat mission--support; flight phase--other; night flight; four persons aboard--no injuries.

Crew had finished rearming aircraft in confined area when instructed to park aircraft across runway. To avoid catching skid in a small ditch between present position and runway, AC (1952 total RW hours) decided to turn the aircraft parallel to runway and liftoff from present position. Aircraft was raised to a hover and turned 90 degrees when visibility went IFR due to dust. AC set aircraft down and waited for dust to clear. When visibility improved sufficiently, second liftoff made, but dust swirling against a nearby 10-foot-high wall caused visibility to again go IFR. As AC attempted to set down, aircraft drifted such that rotor struck wall. Board observed that "dust devils" near wall caused dust to deflect upward and downward in a swirling motion; also that high trees on both sides of runway further limited natural visibility at night.

CASE BRIEF 68-50

Vietnam: combat mission--assault; flight phase--landing; day flight; four persons aboard--one minor injury.

Ten-ship formation inserting troops into field site received warning to expect dusty conditions due to bomb craters. Involved aircraft was in number-six position of the staggered-trail formation used during the approach. As the flight neared termination, rotor-raised dust began to engulf entire flight. Number-six aircraft then moved left in attempt to avoid dust as did several other aircraft. When visibility went completely IFR, AC mementarily hovered aircraft at about 6 feet, then decided to attempt level setdown. Misjudged attitude/rate of descent and landed hard, breaking off tail boom. All other aircraft landed without mishap. AC and P had flown 126 and 114 hours, respectively, during the preceding 30 days.

CASE BRIEF 68-51

Vietnam: combat mission--troop emplacement; flight phase--other; day flight; fourteen persons aboard--two minor injuries.

Aircraft flying in light rain at approximately 1000 feet when engine failure occurred. AC relieved P at controls and entered autorotation. Terrain beneath aircraft was a large, flat, rice-paddy area without any trees or buildings to help provide either relative altitude or true horizon information. As descent started, forward visibility was restricted due to rain on the windshield. Instead of turning on windshield wipers, pilots looked outside windows of aircraft. AC misjudged altitude and flared too low, resulting in hard landing. Touchdown attitude at the time of impact was nose low, with right skid hitting first. AC and P had flown 135 and 134 hours, respectively, during the preceding 30 days.

CASE BRIEF 68-52

Vietnam: combat mission--troop emplacement; night flight; flight phase--inflight; nine persons aboard--one major injury and eight minor injuries; aircraft strike damage.

Aviators had preflighted and accepted aircraft with inoperative RMI and ADF equipment. Departed for destination at sunset, with weather 1300 feet scattered, estimated 2000 feet broken, visibility 6 miles, and winds at 24 knots. Thunderstorms were prevalent in the area over the mountainous terrain. AC proceeded along coastline when weather began to deteriorate. Upon entering rain showers, AC decided to continue toward destination instead of making a 180-degree turn back to VFR flying conditions. Visual contact was lost, and AC inadvertently flew inland away from the coast. At about this time AC reported that he had vertigo and turned control over to P. Course was corrected, and when AC thought aircraft was over ocean, he radioed ahead to have GCA station in operation when they approached destination. At this time, the P also suffered vertigo, and AC relieved him at controls. P stated, "I looked out the window to see if I could see land--when I came back on the instruments we were in a left descending bank--I experienced vertigo as well as the AC." The crew then decided to descend to approximately 300 feet. The AC later stated that during the descent "the pilot mentioned I was in a left-bank--at this time I believe he was about to take control again and we crashed." Two of the aviator passengers felt that lightning possibly contributed to the "vertigo situation" since it caused them (the passengers) to lose their night vision. AC had flown 9 hours preceding the accident flight. Both aviators had logged over 100 hours during the preceding 30 days.

As mentioned in the previous factors report (ref. 3), even a hasty examination of these narrative data will drive home the often-stated point of accident researchers that, in general, no single factor is solely responsible for causing an accident. Though one factor or event may initiate or trigger the orientation error, other factors or events are usually present which act in combination to finally effect an accident rather than a simple incident or near-miss situation.

A selected listing of the various factors derived from the review of the master accident files for these accidents is presented in Figures 10 through 14 on an individual case history basis. Once again the reader is reminded that the listing of any factor or event for a given accident is limited by the amount of data actually contained in the related master accident jacket. The format used in the preparation of Figures 10 through 14 is keyed to the identification of factors and events on an individual accident basis. In each of these figures, a separate vertical column is assigned to each accident where the number at the top of each column corresponds to the accident number used to sequentially identify the individual case history briefs presented earlier. An alphanumeric index code is used to identify selected accident factors where an x-entry denotes the presence of the related factor. In addition to these individual listings, the total number of accidents in which a given factor was present is tabulated in a separate column. Reference should be made to the first report (ref. 3) of this series for details pertinent to the basic classification criteria used for the different factors.

Figure 10 summarizes various accident/aviator background information associated with these 52 accidents. The location of each accident is denoted in rows A1 through A3. For that fiscal year, 94.2 percent of the UH-1 orientation-error accidents occurred in Vietnam. As denoted by the A4-A8 entries, the greatest number (48.1 percent) of the accidents occurred in the D model of the UH-1. Rows A9-A13 indicate the mission assignment, rows A14-A17 the phase of flight in which the accident occurred, and rows A18 and A19 the time of day in terms of daylight or night visibility. Under the miscellaneous heading, A20 denotes those accidents in which one or more fatalities were involved. Row A21 indicates those fatal accidents in which all personnel aboard the aircraft were killed. Entries in row A22 indicate accidents resulting in a total loss or strike of the aircraft. In contradistinction, entries in A23 denote accidents resulting in minimal damage; i.e., the accidents in which the total dollar damage was less than $25,000, which amounts to approximately 10 percent or less of the replacement cost of the aircraft.

The B and C headings in Figure 10 give data relative to the background and experience of the first and second pilots, respectively. The interpretation of the experience data contained in rows B5-B9 and C5-C9 should be related to the data previously presented in Figures 7 and 8, which pertain to only total RW time and total UH-1 time. Rows B5 and C5 denote those aviators with both FW and RW military aircraft time who had a total FW and RW experience of 1000 hours or more. In terms of only RW flight time, entries B6 and C6 denote those aviators with 1000 hours or more of RW experience. In the opposite direction, entries B7 and C7 identify aviators with less than 400 hours RW time, denoting minimal experience. These RW data indicate that 13 (25.0 percent) of

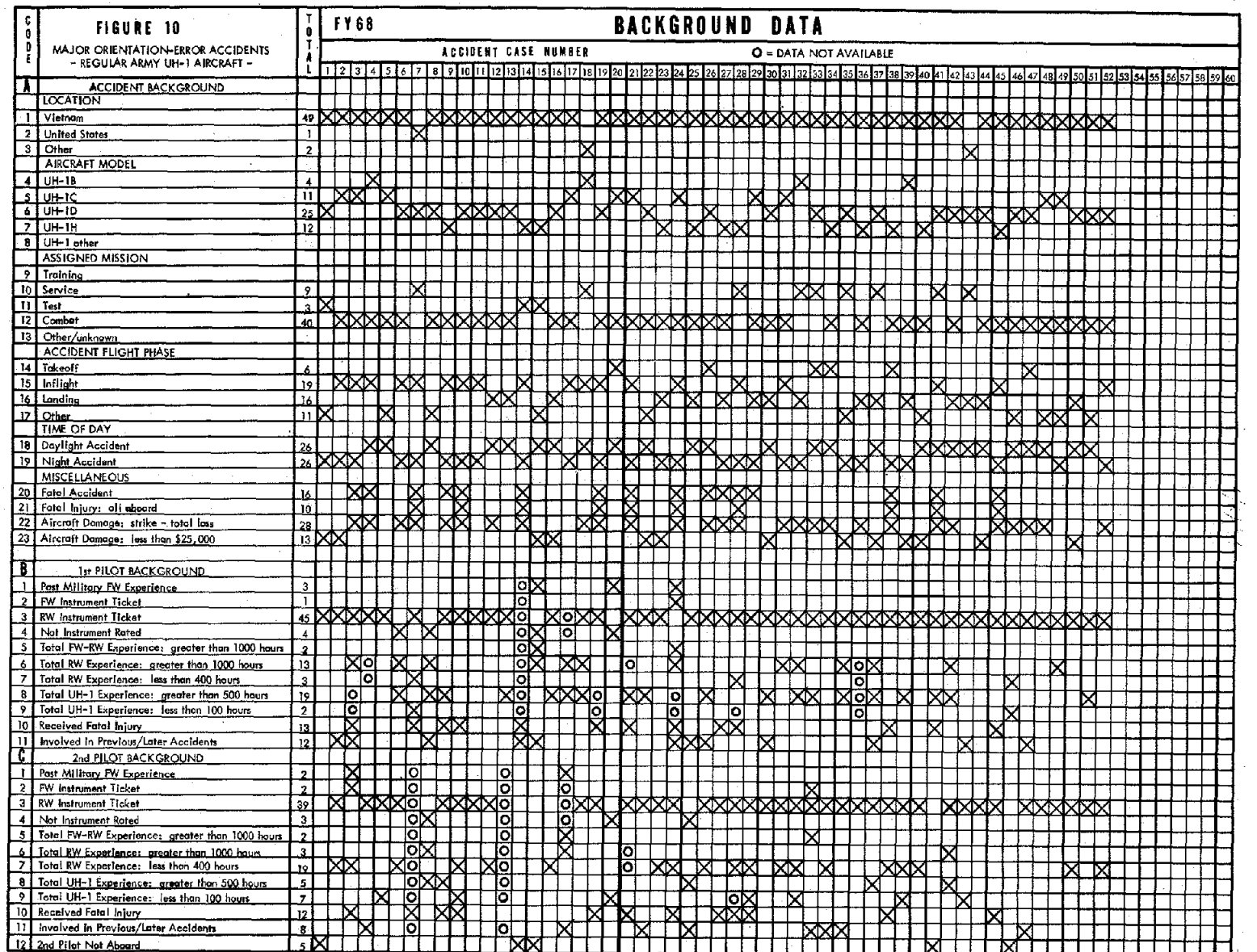


Figure 10

Individual case history listing of basic accident details and selected aviator background information.

the 52 first pilots and 3 (6.4 percent) of the 47 second pilots were known to have had 1000 hours or more experience while 3 (5.8 percent) first pilots and 19 (40.4 percent) second pilots had less than 400 hours experience. However, considering the individual RW experience of each aviator, there was only one accident where both pilots were known to have had a total time of less than 400 hours.

Relative to total time in the UH-1 aircraft, entries B8 and C8 denote aviators with greater than 500 hours, while B9 and C9 denote those with less than 100 hours. These data indicate that 19 (36.5 percent) first pilots and 5 (10.6 percent) second pilots were known to have 500 hours or more. There were 2 (3.8 percent) first pilots and 7 (14.9 percent) second pilots with less than 100 hours experience in the UH-1 aircraft. All flights, however, had at least one aviator aboard who had 100 hours or more UH-1 flight time. Entries B2-B4 and C2-C4 pertain to the instrument ratings of the aviators. These data indicate that there were only 4 first pilots and 3 second pilots who did not possess some form of instrument rating. There were only 2 accidents where neither pilot had an instrument rating.

To gain insight into the availability of post-flight data from the aviators involved in the accident, entries B10 and C10 indicate those pilots fatally injuried. Data pertaining to other accidents the pilots may have been involved in are listed in entries B11 and C11. For that fiscal year, 12 (23.1 percent) first pilots and 8 (17.0 percent) second pilots were involved in one or more additional accidents that occurred either before or after the accident under discussion. Eighteen accidents (34.6 percent) involved the situation where at least one pilot aboard the aircraft had a pre- or post-accident record.

The factor and event data presented in Figures 11 through 14 follow the Figure 10 format with the row entries continuing to be identified in alphanumeric sequence. It should be observed that Figures 11 and 12 are concerned with factors and events which were found to be present, or to have happened, in the time period preceding takeoff; Figures 13 and 14 list factors and events which occurred, so far as the crew were concerned, only after the aircraft became airborne. This approach has been selected with the long-term objective of possibly distinguishing between accidents that may occur as a result of initial conditions existing before flight, and accidents that may occur seemingly as a result of only some inflight event or factor.

In Figures 11 and 12, factors and events which were present before takeoff are listed under physiological, psychological, facility, supervisory, materiel, mission pressure, pilot preflight, and miscellaneous factor headings. The D and F headings pertain to physiological and psychological factors, respectively, associated with the first pilot while the E and G headings list the same factors for the second pilot. This separate listing allows a heavier weighting to be given these factors when both pilots, rather than only one, experience the related difficulties.

Relative to physiological problems that existed prior to takeoff, fatigue was found to be the most obvious factor. Four entries, D1-D4 for the first pilot and E1-E4 for the second pilot have been allotted to the description of this problem. Entries D1 and E1

denote aviators with greater than 140 total flight hours during the 30 days preceding the accident. Army regulations for Vietnam flight operations set this figure as the upper limit which cannot be exceeded except during tactical emergencies. Although it is possible to obtain permission at the battalion level to exceed this limit, the regulations direct the commanders to use the utmost discretion when granting this waiver. For fiscal year 1968 there were 3 accidents in which at least one pilot had flown more than 140 flight hours during the preceding 30 days. The same Army regulations also state that a crew member who accumulates 90 hours in a 30-day period will be closely monitored by the unit commander and the flight surgeon. This monitoring requirement is thus an implied recognition of individual susceptibility to fatigue. For this reason, the authors have chosen to also identify those accidents involving aviators with a work-load greater than 90 hours, and less than 140 hours, the previous 30 days. The related D2 and E2 fatigue entries indicate 11 first pilots and 13 second pilots experienced this workload. There were 19 (36.5 percent) accidents in which either one or both of the aviators had flown more than 90 hours during the 30-day period preceding the accident. Of this total, 9 accidents involved the case where both aviators had flown more than 90 hours during the preceding 30 days.

A third fatigue classification, D3 and E3, involves the identification of aviators who had flown 8 hours or more the 24 hours preceding the accident. Five first pilots and 7 second pilots experienced this workload. In entries D4 and E4, miscellaneous fatigue factors mentioned by the accident board, for example, long duty hours or interrupted sleep, are listed. Treating the four fatigue entries as a group, there were 32 (61.5 percent) accidents in which at least one aviator was exposed to one or more of the stated fatigue listings.

The F and G psychological factor listings are intended to identify any unsual mental condition or attitude that existed before the aircraft actually became airborne. With all F and G headings treated together, there were 13 (25.0 percent) accidents in which one or more of the listed psychological factors were coded as present. It is the opinion of the authors at this point in the analysis that the field accident investigation teams seem in general to be reluctant to enter psychological-related information into the written record.

The H facility factor heading is used to denote any airfield shortcomings which the accident board considered to have some effect on either the accident proper or the course of flight action available to the pilot. The facility factors listed under this heading, distinct from those listed under the P heading in Figure 13, relate to shortcomings present before actual takeoff of the aircraft. There were only 2 accidents coded under this heading.

Factor I deals with supervisory errors which were considered by the accident board to have taken place before the flight became airborne. The listings under this heading denote the individuals assigned primary responsibility for the error. A supervisory factor before takeoff was involved in a total of 15 (28.8 percent) accidents.

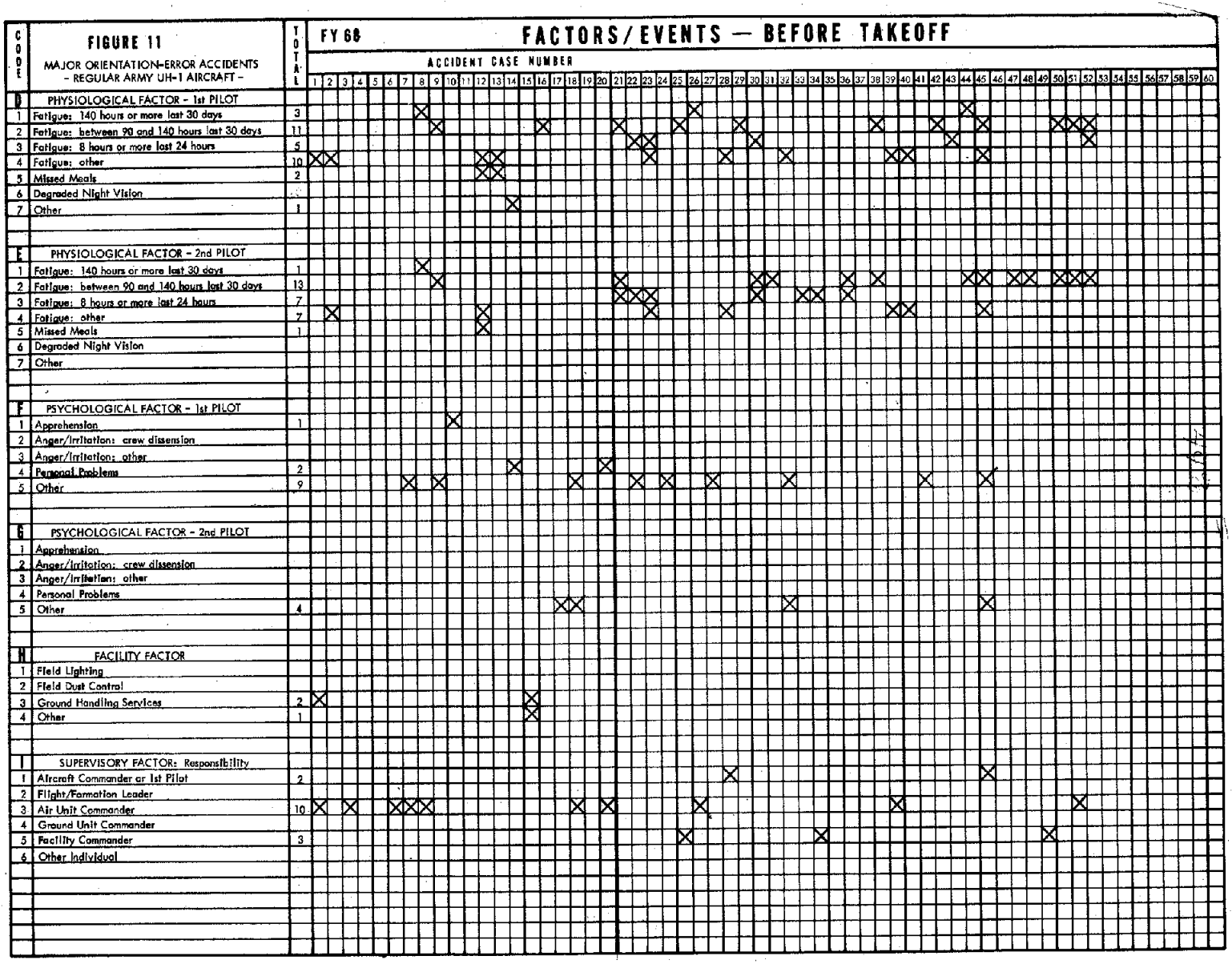


Figure 11

Individual case history listing of selected accident factors and events present before, or at the instant of, takeoff on the accident flight. See text for details.

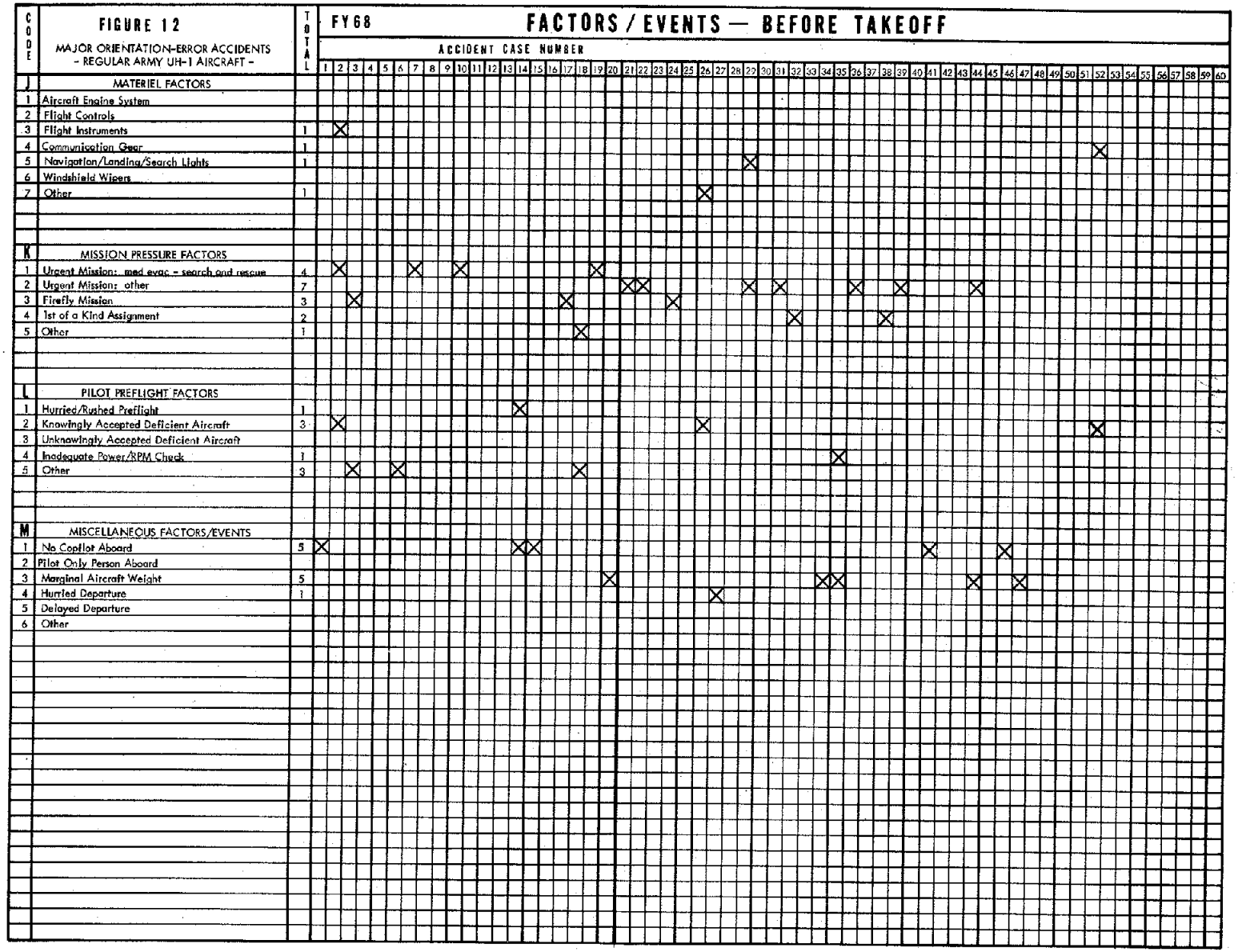


Figure 12

Continuation of the Figure 11 listing of before-takeoff factors and events.

Materiel deficiencies that existed before takeoff are listed under the J heading in Figure 12. The function here is to identify the accident situation where a materiel factor was known to be present, but not necessarily known to the aviators, before the aircraft became airborne. These factors are distinguished from the materiel failures that may have occurred while inflight and are listed under the R heading in Figure 13. It should be observed that an entry in one of the J listings does not imply that the materiel deficiency necessarily affected or effected the accident. The only implication is that there was some difficulty associated with the listed materiel item. A total of 4 (7.7 percent) accidents had one or more of these preflight materiel factor entries.

The K, mission pressure, heading is included as a preflight factor in an attempt to weight the crews' concept of the importance, the uniqueness, or the urgency of the mission. Though such a stress factor could be properly listed under the psychological heading, a separate listing is provided to distinguish among various operational situations. Taking into account all of the K factors, 17 (32.7 percent) accidents involved one or more of these mission-pressure listings.

Section L deals with the crew preflight of the aircraft. The L1 entry denotes a hurried or rushed preflight situation, and as noted previously, entries L2 and L3 indicate the pilot's knowledge of any materiel problems that existed prior to takeoff. The objective here is to establish different factor weights for the situation where the pilot knows in advance that his aircraft is not fully operational, and for the situation where this operational deficiency is not recognized until after the flight becomes airborne. The section M heading is reserved for miscellaneous factors, events, or conditions that may have been present at the time of or before takeoff.

Factors similar to those in Figures 11 and 12 are outlined in Figures 13 and 14 but apply to the inflight phase of the 52 accidents. The N physiological factor and O psychological factor headings pertain to either pilot in this section since the accident review indicated that, in general, the inflight occurrence of such factors affected both pilots. The predominant physiological incident detected to occur inflight, other than the basic orientation-error event, involved night flights where some form of degraded night vision was highly probable. As indicated by the N1 entry, 11 (21.1 percent) of the accidents involved this factor. The main criterion used in classifying this as a factor was that the crew had to be exposed to some form of high-intensity illumination that was turned off shortly before the accident.

Section O is a listing of psychological factors that were coded as occurring inflight. Reports of 4 accidents list apprehension as being present; in 2 of these accidents, Cases 68-19 and 68-45, panic was the end state. This O3 heading is included only to further weight the state of apprehension denoted by O1. A point of consideration relative to the minimal number of listings contained under the inflight psychological factors heading is that all of the nonnormal incidents and events that occur inflight whether they involve some materiel problem, some communication difficulty, or some change in visibility, can certainly affect the mental outlook of the crew. In this respect, the majority of the factors listed under all the other headings will have some psychological input.

The P facility factor heading denotes airfield shortcomings or limitations that affected the accident proper, or the course of action available to the pilot, while the flight was airborne. Though certain of these facility factors involved field sites rather than established heliports, it was the opinion of the accident board that it was reasonable to expect that the specific difficulty could have been prevented. The need for improved lighting was mentioned in 2 cases and improved dust control in 11 cases. In total, 14 (26.9 percent) accidents involved the P facility factor.

Personnel responsible for inflight-related supervisory errors are denoted under the Q heading. In total, the accident boards classified inflight supervisory error as being present in 12 (23.1 percent) of the cases.

Section R deals with materiel malfunctions or difficulties that were encountered while the flight was airborne. Materiel malfunctions outlined previously in the before-takeoff phase under the J heading are not entered here unless an attempt was made to use the defective materiel item while inflight. Inflight materiel difficulties were listed as present in only 5 (9.6 percent) of the accidents.

Section S describes inflight communication factors that were nonmateriel related. Only one accident involved this factor. Section T deals with special distracting events that the pilots encountered while airborne. This factor was listed in 12 (23.1 percent) accidents.

Section U deals with the key initiating factor in orientation-error accidents -- pilot visibility. In 44 (84.6 percent) of the 52 accidents, degraded visibility in one form or another was involved inflight. In 19 of the 26 night accidents, visibility was sufficiently low due to darkness proper, weather, or some other factor that a visual horizon for orientation reference was not available. In addition, 11 of the night accidents involved exposure to some form of light source that degraded the night vision capability of the aviators. Decreased visibility due to weather in the form of clouds, fog, haze, rain, or snow was present in 20 of the accidents. Rain proper was present in 12 of these accidents.

A variety of miscellaneous factors and events related to the accidents are listed in section V. A breakdown of weather relative to visibility and nonvisibility factors is given in V1 through V3. It should be noted that only 4 of the cases involved turbulence or gusty winds. Entries V4 through V14 are self-explanatory. The V15 through V18 entries are the start of a compilation of data pertaining to the motion of the aircraft immediately preceding the accident. In 11 of the cases, an inflight turn was in progress at the time of the accident. Seven additional cases involved the very recent completion of an inflight turn. In the case of hovering aircraft, 5 accidents occurred during a hovering turn. Eleven accidents involved the sideward or backward drift of the aircraft while hovering.

Entry V19, the observation of erratic flight motion, is included to provide additional background data on control or orientation difficulties while inflight. Entries V20 through V23 pertain to any misleading sensations or illusions reported in the accident files. In

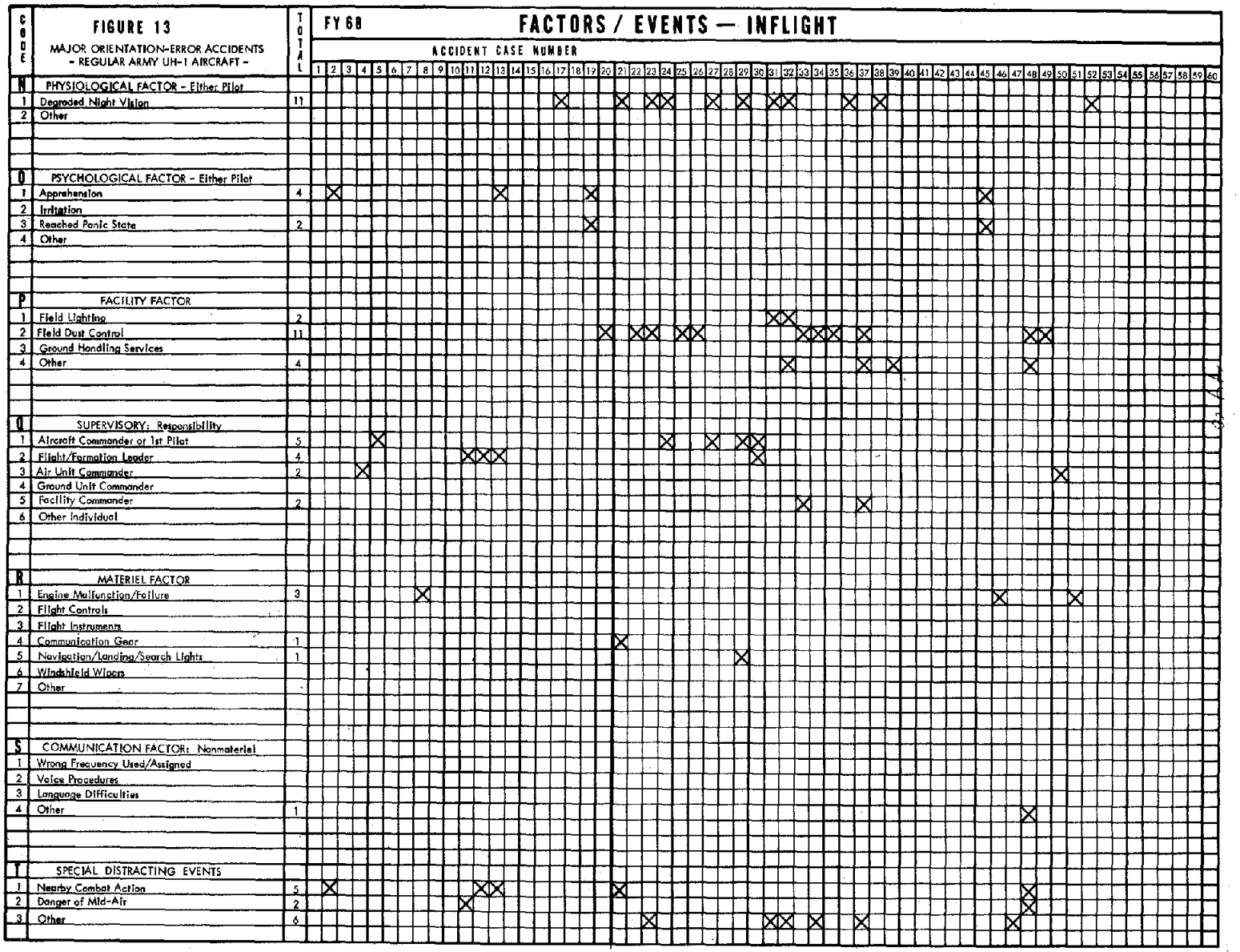


Figure 13

Individual case history listing of selected accident factors and events considered to have occurred, or to be first manifested to the crew, while the aircraft was inflight.

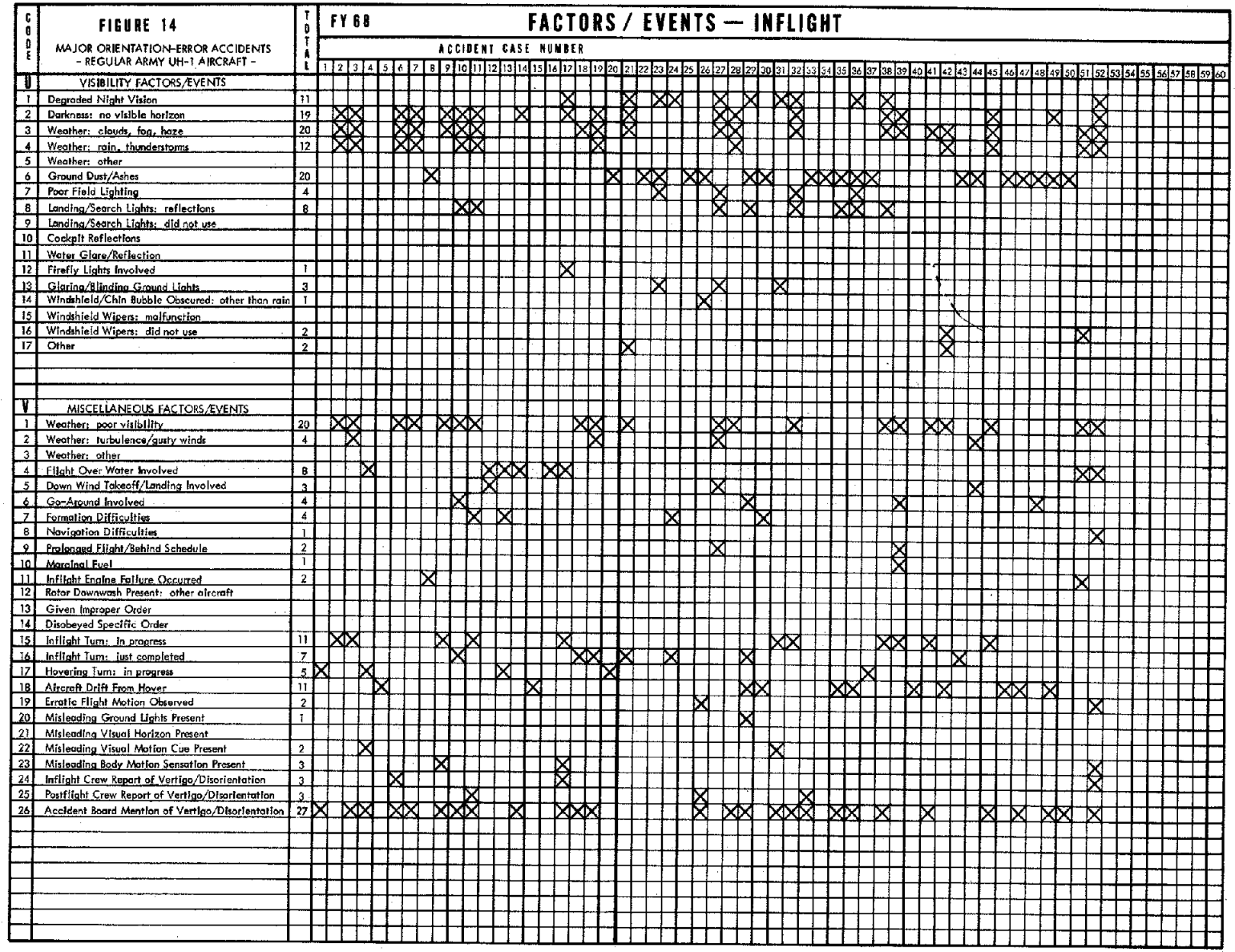


Figure 14

Continuation of the Figure 13 listing of inflight factors and events.

3 of the accidents, one or more of the pilots reported experiencing body sensations of motion that were in conflict with the actual motion of the aircraft. The V24 entries indicate that in 3 accidents, the crews recognized, while inflight, that they were experiencing orientation error manifested classically as vertigo or disorientation. The V25 entries indicate that 3 additional crews made post-flight comments to the effect that they experienced vertigo. As shown by V26, the accident investigation teams or reviewing authorities made specific mention of either vertigo or pilot disorientation in 27 (51.9 percent) of the 52 orientation-error accidents.

As has been stated before, this longitudinal study is aimed at the compilation of accident factor data over a five-year period. Discussion or interpretation of these data beyond the above will await the assimilation of additional data for subsequent fiscal years.

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