

NATIONAL TRANSPORTATION SAFETY BOARD

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AIRCRAFT ACCIDENT REPORT

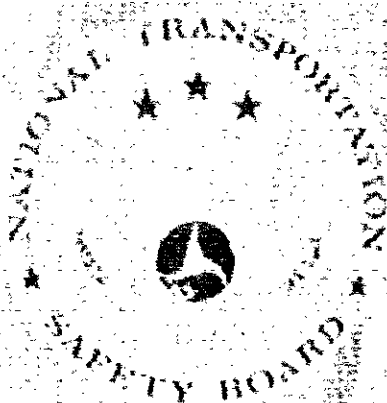
PUERTO RICO INTERNATIONAL AIRLINES, INC.

DE HAVILLAND HERON 114-2, N563PR

SIERRA DE LUGUILLO

SAN JUAN, PUERTO RICO

MARCH 5, 1969



NATIONAL TRANSPORTATION SAFETY BOARD

Bureau of Aviation Safety

Washington, D. C. 20591

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File No. 3-2365

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Adopted: April 24, 1970

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NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
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Adopted: April 24, 1970

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SYNOPSIS

Puerto Rico International Airlines (PRINAIR), N563PR, a De Havilland Heron 114-2, a regularly scheduled air taxi passenger flight from St. Thomas, Virgin Islands, to San Juan, Puerto Rico, crashed in the Sierra de Luquillo mountains while being vectored for an ILS approach to Runway 7 at the San Juan International Airport, at approximately 1738, March 5, 1969. The aircraft was destroyed. The accident was fatal to all 19 occupants aboard the aircraft: two crewmembers and 17 passengers.

The flight was operating on an IFR clearance and flying in actual IFR weather conditions. Following the transfer of control from San Juan Air Route Traffic Control Center to San Juan Approach Control, the flight was given an erroneous position report. Indications are that the flight complied with the subsequent radar vectors and altitude assignments until the accident became unavoidable.

The aircraft was not equipped with a radar transponder or distance measuring equipment (DME).

The Board determines that the probable cause of this accident was the vectoring of the aircraft into mountainous terrain, under IFR conditions, without adequate obstruction clearance altitude by a controller who, for reasons beyond his control, was performing beyond the safe limits of his performance capability and without adequate supervision.

Shortly after the accident, the Board made certain recommendations to the Federal Aviation Administration dealing with the operation of aircraft without distance measuring or transponder equipment in instrument flight conditions in the San Juan area. A review of approach control procedures in locations with a similar topography was also recommended. In response to these recommendations the FAA took several actions which satisfied the intent of the Board.

1. INVESTIGATION

1.1 History of the Flight

Puerto Rico International Airlines (PRINAIR), Flight 277, a De Havilland Heron 114-2, N563PR, was a regularly scheduled air taxi passenger flight from St. Thomas, Virgin Islands, to the San Juan, Puerto Rico, International Airport.

At 1715 ^{1/} on March 5, 1969, PRINAIR 277 departed St. Thomas on an Instrument Flight Rules (IFR) clearance to San Juan via Route 2 to Isla Verde intersection, to maintain 4,000 feet. (See Map, Attachment 1.) The flight proceeded initially under the control of the San Juan Air Traffic Control Center (ARTCC).

At 1718:40, the Center advised San Juan Approach Control that PRINAIR 277 was estimating Isla Verde intersection at 1738, maintaining 4,000, and that it would be a radar handoff from the east on Route 2.

At 1730:50, the Center identified to Approach Control the radar target of PRINAIR 277, which was then 27 miles east of San Juan on Route 2. When this was accomplished, and the radar target verified by the approach controller, a center-to-approach control handoff was effected.

At 1732:05, PRINAIR 277 contacted San Juan Approach Control and advised that the flight was maintaining 4,000. Approach Control replied: "PRINAIR two seven seven San Juan Approach Control radar contact three miles east of Isla Verde fly a heading of two five zero for a vector to ILS final maintain four thousand." When this transmission was made by the trainee ^{2/} controller working the AR-1 (Arrival Radar) position, the aircraft was actually observed by him on the radarscope 3 miles east of the Fajardo intersection. It should be noted that the Isla Verde intersection is located about 10 miles west of the Fajardo intersection; both intersections are part of the Route 2 structure.

The controller, who was working the coordinator position in the Terminal Radar Approach Control (TRACON) room, noticed this error but made no comment. When interviewed, he referred to this error as "a

^{1/} All times used herein, unless otherwise indicated, are Atlantic standard based on the 24-hour clock.

^{2/} The term "trainee," in this context, refers to a certificated controller who is in the process of being area-qualified in a facility to which he has recently been transferred.

slip of the tongue" and indicated that he did not consider this a case of misidentification since there was no target on the radarscope 3 miles east of the Isla Verde intersection. Furthermore, he pointed out the target on the radarscope to the AR-1 controller, who acknowledged. The coordinator also stated that he assumed that the instructor controller, who was supervising the AR-1 controller as part of the latter's facility checkout, had caught this mistake.

The instructor controller indicated that he was not aware of the error in phraseology and that he was given collateral duties immediately following PRINAIR 277's handoff.

At 1732:25, PRINAIR 277 acknowledged by stating: "Okay we'll maintain four thousand and we're turning to a heading of two five zero."

At 1733:15, Approach Control issued a clearance for PRINAIR 277 to descend to and maintain 3,000 feet. PRINAIR 277 acknowledged.

At 1737:25, PRINAIR 277 asked for a lower altitude.

At 1737:35, Approach Control issued the following: "PRINAIR two seven seven San Juan Approach Control turn left heading two two zero continue to maintain three thousand vectors to ILS final." PRINAIR 277 acknowledged as follows: "Ah left heading two two zero for two seventy seven and we're at three thousand at the present time." Approach Control responded with "maintain three thousand." During an interview, the AR-1 controller indicated that he had lost radar contact with PRINAIR 277 in a area of precipitation and that the 220° vector was intended as an identification turn.

At 1738:50, Approach Control issued the following: "PRINAIR ah two seven seven turn back right now heading of two eight zero." According to the AR-1 instructor controller, who was also acting as coordinator at this time, this vector was given after he directed the AR-1 controller to bring the aircraft back to the northeast. Neither this transmission -- nor any of the subsequent transmissions -- was acknowledged by the flight.

The wreckage was located the following day by an aircraft flown over a track reconstructed from recorded clearance instructions and vectors given to PRINAIR 277. It was found on the 143° radial and 13.4 nautical miles from the San Juan VORTAC near the top of a knoll in the Luquillo National Forest, at an elevation of 2,400 feet. There are two mountain peaks in that area that rise to 3,496 and 3,525 feet m.s.l. The geographical coordinates of the wreckage site were latitude 18° 17' 15" N. and longitude 65° 49' 30" W.

The time of the accident was between 1737 and 1738, as determined from the time of the last acknowledged transmission by the flight to Approach Control. In addition, a watch recovered from the wreckage indicated stoppage at 1736. There were no known witnesses to the accident.

1.2 Injuries to Persons

| <u>Injuries</u> | <u>Crew</u> | <u>Passengers</u> | <u>Others</u> |
|-----------------|-------------|-------------------|---------------|
| Fatal | 2 | 17 | 0 |
| Nonfatal | 0 | 0 | 0 |
| None | 0 | 0 | |

1.3 Damage to Aircraft

The aircraft was destroyed by impact. There was no fire.

1.4 Other Damage

None.

1.5 Crew Information

The two crewmembers were properly certificated and qualified to conduct this flight. (For details see Appendix B.)

1.6 Aircraft Information

The aircraft was properly certificated and maintained in accordance with existing requirements.

The weight and center of gravity (c.g.) of the aircraft were determined to have been within prescribed limits at the time of the accident. (For detailed information see Appendix C.)

1.7 Meteorological Information

At the time of the accident, the weather over the area of the accident site was characterized by low cloudiness and moderate to heavy rain showers, which were associated with a cold front oriented east-northeast, west-southwest over southeastern Puerto Rico.

The Roosevelt Roads 1730 weather observation reported 800 feet scattered, estimated 1,000 feet broken, 3,000 feet broken, visibility 1 mile in heavy rain showers, wind 330° 6 knots, gusts 11 knots, and altimeter setting 29.88 inches. Heavy rain showers continued until 1752.

The San Juan 1655 weather observation reported 1,000 feet scattered, estimated 2,200 feet broken, 9,000 feet broken, high broken, visibility 12 miles, temperature 80° F., dew point 76° F., wind 010° 10 knots, altimeter setting 29.88 inches, and haze aloft all quadrants. At 1755, scattered clouds were reported at 1,000, 2,200, and 9,000 feet, along with an indeterminate cirriform broken layer.

The San Juan 2009 winds-aloft observation was as follows for 3,000 and 4,000 feet m.s.l., respectively: 360° true 16 knots and 005° true 15 knots. The radiosonde ascent made at the same time showed abundant moisture in the lower levels, and the freezing level was at 15,600 feet m.s.l.

The aviation terminal forecast for San Juan, valid for 21 hours beginning at 1700, called for a ceiling of 2,000 feet broken, 8,000 feet broken, 30,000 feet broken, wind 360° 10 knots and gusty, occasional ceiling 1,200 feet broken, visibility 2 miles, moderate rain showers, chance of ceiling 700 feet overcast, visibility 3/4 mile, thunderstorm, moderate rain showers, wind 260° 18 knots, gusts 30 knots.

AIRMET Bravo 1, valid from 1600 to 2000, predicted scattered, locally numerous showers and a few thundershowers in an area 25 nautical miles either side of a line from northwest Puerto Rico to 120 nautical miles northeast of San Juan. The area was forecast to move southeast at 20 knots.

Weather briefings at St. Thomas are handled by the San Juan International Flight Service Station. Neither the Flight Service Station nor the Weather Bureau Forecast Office at San Juan provided a weather briefing to the crew of Flight 277.

1.8 Aids to Navigation

There were no reported difficulties with any navigational aids utilized for the flight from St. Thomas. The flight was operated under radar control. According to the AR-1 controller, radar contact was lost when the aircraft's target disappeared in the precipitation on his radarscope, which was operated in the linear polarization mode.

The aircraft was not equipped with a transponder or distance measuring equipment (DME).

1.9 Communications

There were no reported discrepancies in the radio communications with the aircraft involved and radio contact was maintained until just before the accident occurred.

1.10 Aerodrome and Ground Facilities

Not involved in this accident.

1.11 Flight Recorders

A flight recorder and cockpit voice recorder were not installed in the aircraft, nor were they required by Federal Aviation Administration Regulations.

1.12 Wreckage

The aircraft came to rest near the top of a knoll in the Sierra de Luquillo mountains at an elevation of approximately 2,400 feet. This knoll is located in a dense rain forest and bordered on the north-east and south by ridges at or above 3,000 feet. The nearest of these is a 3,000-foot ridge located on a magnetic bearing of 040° and about 2,000 feet from the accident site.

The aircraft cut a rectangular swath, approximately 15 by 70 feet, through 30-foot high trees and impacted the ground at an estimated angle of 70°. The nose section and the four engines were buried in the ground. The overall direction of impact was approximately 300° magnetic.

With the exception of the outboard 10-foot portion of the right wing, all parts of the aircraft were recovered in the main wreckage area and in proper relation to each other. A search for the missing wing section was conducted in the immediate area and along the probable flightpath, but dense foliage and inaccessible terrain frustrated the search efforts.

Two large pieces of the right wing were identified and examined at the accident site. The largest of these was a 12-foot section which extended from the wing root outboard to the area of the No. 4 engine attachment fittings. The second piece, which consisted of the adjacent 8-foot section of wing with the outboard 4 feet of flap attached, extended outboard to a fracture in the area of the inboard end of the right aileron. Both ends of this section exhibited jagged chordwise fractures. Although no impact marks were observed on the leading edge of this section, its outboard end was crushed aft. The box section of this piece of wing exhibited considerable spanwise damage and its entire trailing edge was folded forward over the top of the leading edge. This section also exhibited spanwise buckles which were deeper and more pronounced at the outboard end.

No detailed examination of the aircraft engines and propellers was conducted. All four engines and propellers separated from the wing and penetrated the ground until only the rear portions of the engine accessory sections were visible. Since all equipment and personnel had to be lowered from helicopters into the wreckage site by slings, no heavy equipment was available to dig the engines out of the ground.

1.13 Fire

Fire did not occur.

1.14 Survival Aspects

This was a nonsurvivable accident.

1.15 Tests and Research

All pertinent ground facilities were checked subsequent to the accident and found to be operating within established tolerances.

1.16 Other Information

At about 1730, when PRINAIR 277 was handed off from San Juan Center to San Juan Approach Control, the AR (Arrival Radar) and the DR (Departure Radar) positions in the TRACON room were manned by two trainee controllers who were not yet facility-qualified at the radar positions. Both trainees were supervised by qualified instructor controllers. A fully qualified controller acted as coordinator for the Arrival and Departure positions. The FD (Flight Data) position was also manned by a trainee controller. All three trainees were qualified for duty in the Control Tower Cab.

At about 1733, the coordinator was instructed by the watch supervisor to go to the Control Tower Cab to provide lunch relief for one of the tower operators. The watch supervisor assigned the coordinator's duties to the instructor controller who was supervising the AR-1 controller. While executing his collateral duties, the instructor controller kept his headset and microphone plugged into the transmitter/receiver panel at the AR-1 monitor position. As a result, some of the transmissions that he made using the coordinator's handset caused interference on the AR-1 frequency.

The official FAA transcription of recorded conversations between San Juan Approach Control and PRINAIR 277 from 1732 to 1750 on March 5, 1969, lists only the conversation between the AR-1 controller and the

crew of the aircraft involved. This transcription indicates that no transmissions affecting PRINAIR 277 took place between approximately 1733:20 and 1737:25. At 1737:25, PRINAIR 277 asked for a lower altitude and the controller responded with instructions to turn left to a heading of 220° and to maintain 3,000 feet. This was the last vector acknowledged by the crew.

A transcription of the transmissions between the AR-1 controller and other aircraft during this 4-minute 5-second interval indicates that this controller made 18 and received 19 communications involving four different aircraft (not including PRINAIR 277). During the last 25 seconds of this 4-minute 5-second interval, he was told twice by a Pan American Clipper crew that somebody was interfering on the frequency of his transmissions.

The AR-1 controller started his FAA employment about 10 years ago and had been a qualified radar operator for several years before transferring to San Juan, Puerto Rico. He arrived in San Juan with his family --wife and four children, ages 8, 6, 5, and 3-- on December 1, 1968. He moved with his family into an efficiency apartment for the duration of his 60 days of temporary quarters allowance. At the end of the 60-day period, his household goods had not yet arrived, due to a strike of the shipping company involved. Efforts to extend the temporary quarters allowance period were not successful. On or about the 1st of February, he moved with his family into an unfurnished house and borrowed a refrigerator, some card tables and chairs, and some cots from his associates. He bought some lawn chairs, pads, and linens. Two investigation team members visited the controller's residence on March 17, 1969, and found that the only furniture in the house consisted of what was described above. The sleeping accommodations in the main bedroom consisted of two bunk-type mattresses, about 4 inches thick, placed on the floor.

The AR-1 controller had been off duty during the two days preceding the accident. He reported for duty at about 1500 on the day of the accident.

In an interview conducted on March 17, 1969, the AR-1 controller indicated that, about 3 years earlier, he had been referred by a regional flight surgeon to a psychiatrist and a psychologist as a result of the outcome of a psychological test and that he, subsequently, had been cleared. He also indicated that he considered himself very tense and anxious at the time which, in his opinion, was the reason for his referral to the specialists.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The investigation revealed no reasons to suspect mechanical or other aircraft problems as causal factors. Although the aircraft impacted some 600 feet below its last assigned altitude, the absence of the outboard 10-foot section of the right wing in the main wreckage area suggests that a prior impact occurred some distance back along the flightpath. The loss of controllability after separation of the right wingtip could easily explain the final impact heading and the altitude at which the aircraft came to rest.

Despite extensive efforts, the initial impact point and the missing section of the right wing were never located. For this reason, it was impossible to verify this speculative explanation. However, the nature of the outboard fracture of the right wing is consistent with this theory. The aft crushing and extensive spanwise damage observed on the 10-foot section of the right wing is typical of that which might be expected to occur if the wing struck a tree or other sharp object just outboard of the fracture. While similar damage might result from a ground impact similar to that sustained by N563PR, the lack of impact damage on the leading edge of this section precludes that possibility in this case.

Most likely, the point of initial impact was one of the ridges or peaks located east and northeast of the accident site. Several of these peaks and ridges have an elevation of 3,000 feet or higher. The prevailing weather conditions at the time of the accident undoubtedly precluded timely visual observation of the terrain ahead of the aircraft. It appears, therefore, that the basic reasons for this accident must be sought in the factors that allowed the vectoring of the aircraft into this terrain below obstruction clearance altitude.

The indication that PRINAIR Flight 277 followed given instructions to the letter for about 5 minutes suggests that the accident was the end result of a chain of conditioning events, rather than one single error or deficiency. The term "conditioning events" is used here to indicate that these events shaped the circumstances that made the accident possible; they will be discussed in chronological order.

At 1732:05, the crew received an erroneous position report from the AR-1 controller which put the aircraft 10 miles farther west than it actually was. This "slip of the tongue" in itself was not a critical error, although it may have affected the controller's later actions.

To go uncorrected, this error required the passive cooperation of three parties: (a) the AR-1 controller's direct supervisor (the instructor controller) who was not aware of the error, (b) the coordinator who noticed the error but expected that it would be caught by the instructor, and (c) the aircraft crew who acknowledged the erroneous position report without further comment.

The assumption seems justified that the crew did not use the aircraft's navigational equipment to verify the accuracy of the radar position report, or that atmospheric conditions interfered with the reception of navigational signals. Over-reliance on radar service, as well as the absence of DME, may have played a role.

At approximately 1733, the Watch Supervisor assigned the coordinator to Tower Cab duty and gave the AR-1 controller's instructor collateral duties. This appears to be a case of a self-induced supervision problem, since each of the three trainee controllers could have assumed the Tower duty, thereby leaving the supervisory structure in the IFR room intact. This would have increased the chances that momentary overloads would not jeopardize the performance of individual controllers.

No recorded transmissions between PRINAIR 277 and the AR-1 controller took place between 1733:20 and 1737:25. The aircraft was proceeding on a vector of 250° during this period and, presumably, towards an area of precipitation on the radarscope. The AR-1 controller was vectoring four other aircraft in addition to PRINAIR 277. During this time interval, he made or received a transmission about every 6 seconds, which would constitute a considerable workload under the existing weather conditions. In addition, there was a stress-producing and irritating element in the fact that his instructor's transmissions interfered with his own transmissions, which caused pilots to complain.

At 1737:25, PRINAIR 277 asked for a lower altitude. Apparently it was this transmission that drew the AR-1 controller's attention to the flight after concentrating for 4 minutes and 5 seconds on the handling of other IFR traffic. At this time, he gave the aircraft a vector of 220°. This 30° heading change was acknowledged by the crew but not observed by the controller, probably because it took place in an area of precipitation. Although the radar was operating with linear polarization, it is doubtful whether circular polarization and its suppression circuitry would have made any difference in the conspicuity of the aircraft's primary return during heavy precipitation. On the other hand, it is relatively certain that a transponder target would not have disappeared in precipitation with the radar equipment operating in the circular polarization mode.

Since there appears to be an intangible factor that has a bearing on the AR-1 controller's stress tolerance, the Board wishes to state its approach to the investigation of the human factors aspects of aircraft accidents in general.

The Board believes that the probing of all the reasons behind human error accidents will contribute materially to the prevention of future accidents. Therefore, the Board, in discharging its statutory responsibilities with respect to cause determination and accident prevention must, in those cases where the human factor is present, attempt to analyze the available evidence from a psychiatric and psychological standpoint. If such analysis tends to support a reasonable conclusion that these factors caused or contributed to an accident, the Board is competent to make such a judgment.

In this case, the AR-1 controller was referred for psychiatric and psychological assessment in early 1966, following a psychological screening test. In response to the Board's request for further details of the test procedures and the related FAA Air Traffic Controller Health Program, the Acting Federal Air Surgeon forwarded a letter to the Board, dated June 10, 1969. (Appendix D.) This letter indicates that of the 12,200 controllers tested in late 1965 and early 1966, 91 or 0.7% were referred for complete psychiatric and clinical psychological assessment, 15 of which, eventually, were removed from controller duty.

The AR-1 controller was one of the group of 91 selected for further testing. However, the regional flight surgeon, not a qualified psychiatrist, reviewed the additional testing and cleared the controller to continue to serve in his previous capacity. Since the reasons for the referral were a high degree of anxiety and a low stress tolerance level, it is the Board's opinion that the FAA should have directed that a qualified psychiatrist review the psychiatric and clinical psychological assessment. In the Board's opinion, a flight surgeon is not necessarily the best judge of these factors that may affect a controller's performance under stress. The Board does recognize that since this was the first psychological screening test of controller personnel, it may have suffered from a lack of reliable indicators in screening criteria.

The unusual stresses in a traffic control environment and the difficulty of accurately assessing an individual's stress tolerance dictate the use of the highest practicable standards. By the same token, it should be emphasized that an individual with a marginal tolerance for the stresses of a controller's task may be more than adequate in different job situations. The Board therefore concludes that the psychiatric and psychological assessment of controllers under the Air Traffic Controller Health Program should be expanded. Not only should personnel entering on duty be assessed, but all controller personnel should be periodically tested. The program should be under the strict supervision of qualified psychiatrists and psychologists.

To summarize the role played by the AR-1 controller's stress tolerance: the Board is of the opinion that the controller's low stress tolerance and high anxiety factor may have been the reasons he did not adequately perform his required duties. However, his actual performance depended on a variety of environmental factors that may not have been readily appreciated or predictable at the time he was cleared for duty in 1966.

Each of these conditioning events and circumstances, although relatively harmless when considered separately and at random, had to be present or occur, in a specific sequence or pattern in order to set the stage for the critical event -- the 220° vector at 1737:35 that turned the aircraft directly towards obstructing terrain. Although it is difficult to assess the weight of each of the conditioning events, it can be speculated that the elimination of almost any of them would have precluded the occurrence of the critical event.

Several hypotheses can be offered to explain the apparent irrationality of the 220° vector.

As mentioned earlier, the AR-1 controller gave the aircraft crew an erroneous position report, although he saw the aircraft in its actual position on the radarscope approaching the Fajardo intersection. Had the aircraft actually been near Isla Verde instead of Fajardo, the subsequent vectors (250° and 220°) would have been routine. The controller's unexplainable fixation on the term Isla Verde may have made him overlook the inherent danger of the 220° vector.

This fixation theory loses most of its explanatory value when the video mapping of the radarscope is considered. The Isla Verde and Fajardo intersections, about 10 and 20 miles east of the center of the radarscope, respectively, are clearly displayed, as are the two peaks, El Yunque and El Toro, in the Sierra De Luquillo mountains, where the aircraft crashed. The accident site is located about 10 nautical miles south of the Isla Verde intersection. Even a casual

observer of the radarscope would realize that a prolonged 250° vector from the vicinity of Fajardo could endanger the aircraft, depending on wind conditions, and that a subsequent 220° vector could be catastrophic.

It can also be postulated that the controller's preoccupation with IFR traffic closer to the San Juan Airport preempted his attention to the extent that he forgot about PRINAIR 277. The sudden realization that he had lost track of this aircraft, when the crew initiated communications after about 4 minutes of silence, may have prompted him to almost automatically revert to a 30° identification turn without giving any thought to the terrain implications. The controller's limited, but adequate, familiarity with the terrain involved may have been canceled out by his loss of time orientation concerning PRINAIR's progress on the 250° vector.

Another hypothesis can be based on the AR-1 controller's heavy workload at the time he was handling PRINAIR 277. To properly evaluate the effect of a controller's workload on his performance, his saturation point, or stress tolerance, has to be considered. This varies with individuals and, with an individual, it may vary from day to day depending on mental and physical energy reserves, as well as environmental and personal factors. Without describing the traits associated with high or low stress tolerance, it is postulated that this controller was more sensitive to the attention-narrowing effects of acute and chronic stresses than the average controller. To what extent 5 weeks of inadequate living conditions would induce chronic fatigue, which, in turn, might make him less tolerant to acute stresses, is difficult to assess. This situation would not necessarily have been mitigated by the fact that he had been off duty during the 2 days preceding the accident. Actually, this might have added to his distress due to the more protracted confrontation with a frustrating living situation which he could not change.

Considering the cumulative effects of chronic and acute stresses which affected this controller, it may be expected that even the seemingly minor irritation of the interference with his transmissions, just before he gave PRINAIR 277 the 220° vector, took its toll. In summary, he probably had reached, or already passed, his saturation point as an effective controller at this time.

The foregoing should not be interpreted as an assertion that every individual would be affected in the same manner under similar conditions. The intent is only to indicate that a unique, but controllable, combination of circumstances placed this controller in a position where the decrement in his performance could go unnoticed and uncorrected. The

scope of this report does not allow speculation on the expert use of prognosticative data in the prevention of the development of such a situation.

2.2 Conclusions

(a) Findings

1. The flight crewmembers were properly certificated and qualified for the operation involved.
2. The aircraft was airworthy and its gross weight and center of gravity were within limits.
3. There was no indication of a mechanical failure or malfunction of the aircraft structure or powerplants.
4. The aircraft was not equipped with a transponder or distance measuring equipment (DME).
5. The aircraft was operated in Instrument Meteorological Conditions (IMC), while on an Instrument Flight Rules (IFR) clearance.
6. There were no reported difficulties with navigational aids or radar equipment.
7. In the initial contact with the aircraft, the AR-1 controller erroneously reported radar contact 3 miles east of the Isla Verde intersection instead of the Fajardo intersection, 10 miles farther east. The aircraft crew made no comments.
8. The AR-1 controller, who vectored the aircraft, was in a trainee status as part of his facility checkout.
9. The instructor controller, who was supervising the AR-1 controller, did not notice the erroneous position report given to the aircraft.
10. The coordinator who noticed the erroneous position report did not take corrective action.
11. Assignment of the coordinator to Tower duty by the Watch Supervisor resulted in collateral duties for the instructor controller supervising the AR-1 controller. Each of the three trainees in the TRACON room was qualified for Tower duty.

12. The AR-1 controller had a heavy workload which was aggravated by radio transmission interference
13. The AR-1 controller lost track of the aircraft in an area of precipitation. In an effort to reidentify the aircraft, he vectored it toward mountainous terrain at an altitude too low to provide obstruction clearance.
14. The AR-1 controller and his family had been subjected to inadequate living conditions for about 5 weeks prior to the day of the accident.
15. Environmental and personal factors beyond his control lowered the AR-1 controller's performance capability to the extent that he could no longer safely handle a heavy workload.
16. In 1966, the AR-1 controller was referred for a psychiatric and psychological assessment, as a result of the outcome of a psychological screening test, and subsequently cleared for controller duty.

(b) Probable Cause

The Board determines that the probable cause of this accident was the vectoring of the aircraft into mountainous terrain, under IFR conditions, without adequate obstruction clearance altitude by a controller who, for reasons beyond his control, was performing beyond the safe limits of his performance capability and without adequate supervision.

3. RECOMMENDATIONS

The complex man-equipment-environment interfaces in this accident sequence make it difficult to convert each of the conditioning events into an effective and practicable recommendation. The Board believes that most of these events represent departures from accepted procedures, standards, and practices which became critical only in the total context of the circumstances. In that respect, this accident is a dramatic reminder of the fact that in aviation, every form of complacency with regard to the quality of equipment or the performance of personnel, be it in the cockpit or in the control room, should be treated as an error-provoking and accident-inducing factor. There is no need to belabor this point with recommendations which would only be repetitious of what has been said in the past after similar occurrences. The answer lies in sound management and operational policies.

With regard to the critical event in this accident, the Board is of the opinion that prevention of its recurrence has to be sought in steps that preclude the assignment of distressed personnel to vital tasks. This not only implies management awareness of the immediate and cumulative effects of stress-producing environmental factors on workload and performance capability, but the judicious application of proven norms to the methods of selecting, training, screening, assigning, and medically supervising controller personnel.

Although this accident revealed several areas where supervisory alertness could have eliminated, or reduced the seriousness of, several of the conditioning events and thereby minimized the probability of the accident, it emphasizes particularly the medical area and the need for compatibility between a controller's stress tolerance and his anticipated workload. The Board is of the opinion that this accident proves, although in a negative manner, that properly administered and interpreted psychological tests can be invaluable in achieving such compatibility which, eventually, would serve the welfare of the controllers as well as the public. The Board therefore recommends that the psychiatric and psychological assessment of controllers under the Air Traffic Controller Health Program be expanded. Not only should personnel entering on duty be assessed, but all controller personnel should be periodically tested. The program should be under the strict supervision of qualified psychiatrists and psychologists.

Shortly after this accident, the Board made recommendations to the Federal Aviation Administration dealing with the operation of aircraft without distance measuring or transponder equipment in instrument flight conditions in the San Juan area. A review of approach control procedures in locations with a similar topography was also recommended. (See Appendix E.)

In response to these recommendations, the FAA took several actions which satisfied the intent of the Board. (See Appendix F.)

By the National Transportation Safety Board:

| | | |
|-----|---------------------------|----------|
| /s/ | <u>JOHN H. REED</u> | Chairman |
| /s/ | <u>OSCAR M. LAUREL</u> | Member |
| /s/ | <u>FRANCIS H. McADAMS</u> | Member |
| /s/ | <u>LOUIS M. THAYER</u> | Member |
| /s/ | <u>ISABEL A. BURGESS</u> | Member |

April 24, 1970.

Investigation and Hearing1. Investigation

The National Transportation Safety Board received notification that the aircraft was missing at approximately 1900 e.s.t. on March 5, 1969. The wreckage was located at about 1330 A.s.t. the next day. An investigation team consisting of personnel from the Board's Field Office in Miami, Florida, and main office in Washington, D. C., was immediately dispatched to the scene of the accident. No formal working groups were established during the investigation of this accident. However, the participants were given the opportunity to partake in the factfinding processes in the areas of: Operations, Air Traffic Control, Weather, Structures, Powerplants, Systems, and Human Factors.

Participants in the investigation were representatives of: Federal Aviation Administration, Puerto Rico International Airlines, Inc., Professional Air Traffic Controllers Organization, Air Traffic Controllers Association.

The on-scene phase of the investigation lasted approximately 5 days. On March 14, 1969, the Chairman of the Board dispatched a special team to San Juan to pursue the human factors aspects of the accident. The accident inquiry was conducted in accordance with the provisions of Annex 13 of ICAO (International Civil Aviation Organization).

2. Hearing

A public hearing was not held in connection with the investigation of this accident.

3. Preliminary Reports

There were no preliminary reports issued in connection with the accident.

Crew Information

Captain Miguel A. Gonzalez, aged 58, was upgraded to captain on the DeHavilland 114 on March 3, 1968. He possessed airline transport pilot certificate No. 1698913, with type ratings for the Douglas DC-3/DC-4, Lockheed 049/1049, Britannia and De Havilland 114. His first-class medical certificate was dated March 19, 1968, and required that he wear glasses for near vision.

Captain Gonzalez had a total of approximately 26,800 first-pilot hours with a total flight time in De Havilland 114 aircraft of 1,000 hours. He had 300 flight-hours within the 90-day period preceding the accident. He had a total of 1,400 actual instrument flight-hours and 4,550 night flight-hours, 50 of which were in the De Havilland 114.

Captain Gonzalez had successfully completed his last proficiency check in the De Havilland 114 on January 25, 1969. He had flown 5:30 hours and had 14 hours of crew rest in the 24-hour period preceding this flight.

First Officer Carlos E. Montilla, aged 21, was assigned to duty as a copilot on the De Havilland 114 on February 8, 1967. He possessed commercial pilot certificate No. 1721484 with airplane single/multi-engine and instrument. His second-class medical certificate was dated December 30, 1968, and required that he wear glasses. First Officer Montilla had a total of 1,524 flying hours, of which 1,200 hours were in De Havilland 114 type aircraft. He had flown 150 hours within the 90-day period preceding the accident. He had flown 3:50 hours and had 16:30 hours of crew rest in the 24-hour period preceding this flight.

Aircraft Information

The aircraft, a De Havilland Heron 114, N563PR, S/N 14125, had a date of manufacture of August 25, 1967. At the time of the accident, it had accumulated a total of 4,167:10 hours.

N563PR was powered by four Rolls-Royce Gipsy Queen 30 MK 2 engines, which were equipped with Hawker Siddeley Model PD 190/212/1 propellers.

The company records indicate that N563PR had been maintained in accordance with all company procedures and an FAA-approved progressive maintenance program. The last major inspection (Progressive Number 18) was accomplished on March 1, 1969, at which time the aircraft had a total of 4153:45 hours. A preflight inspection was accomplished on March 5, 1969.

**DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION**

WASHINGTON, D.C. 20590



10 JUN 1969

Mr. Charles O. Miller
Director, Bureau of Aviation Safety
National Transportation Safety Board
Department of Transportation
Washington, D. C. 20591

Dear Mr. Miller

The enclosed paper entitled "Psychiatric Assessment of Air Traffic Controllers" is forwarded in response to the questions which you raised in your letter of 1 May 1969.

Your attention is called to the fact that psychological screening tests are only a part of the FAA's Air Traffic Controller Health Program, designed to assure the medical fitness of controllers to perform their duties and also to preserve the useful working life of controllers by early detection of departures from normal health. An additional benefit is the identification, over the years, of the possible effects which this kind of work may have on their health and well-being.

The complete program, in operation only since late 1965, has demonstrated its value in identifying controllers who clearly do not meet the standards of medical fitness which this work demands, as specified by the Civil Service Commission. It has also resulted in the early detection of a variety of correctable medical conditions and conditions which, although not correctable, are considered acceptable for safe controller performance. The program has not been in effect for a sufficient period of time, however, to permit many meaningful conclusions regarding the possible effect of the work on controller health. Studies leading to statistically valid conclusions in this area will continue.

We trust the enclosed information is helpful to you and the Board in your continuing efforts in the field of aircraft accident investigations.

Sincerely,

A handwritten signature in cursive script that reads "H. L. Reighard".

H. L. REIGHARD, M.D.
Acting Federal Air Surgeon, AM-1

Enclosure

5 June 1969

PSYCHIATRIC ASSESSMENT OF AIR TRAFFIC CONTROLLERS

Introduction

In late 1965 the Federal Aviation Administration implemented the Air Traffic Controller Health Program which had been under development in the preceding two years. The program provides for complete medical assessment of controller applicants prior to entry on duty and annual medical assessments of controllers on duty. The purpose of the program is to establish the medical fitness of controllers to perform their duties in accordance with the demands of the air traffic control system, to detect the presence of disease in its early form, and to study the effect of job demands on controller health and welfare, with the passage of time.

The program is administered by Regional Flight Surgeons in seven locations in the United States, with the assistance of designated aviation medical examiners and the medical laboratories of certain other government agencies.

The standards of medical fitness which apply to controllers were issued by the Civil Service Commission in April 1965. Examinations conducted under this program are prescribed, along with appropriate review procedures, in FAA directives. At present all controllers in terminal control facilities and air route traffic control centers are required to be examined annually. The cost of the routine examinations and any required specialist examinations is borne by the FAA.

Background

From the standpoint of reliability on a second-to-second basis, few occupations are as demanding as that of air traffic control. Of course this has been most apparent to controllers themselves. Controllers, as well as others in the agency, have also been concerned about the effect that such intense demands might have on a controller's health and efficiency.

In 1956 and 1957 a non-governmental organization, The Flight Safety Foundation, Inc., studied the medical aspects of air traffic control activities. This study recommended that standards of medical fitness be required for all air traffic control specialists, tailored to the demands of the job. The study also recommended that the control specialists in air route traffic control centers be included in the examination program. There was an existing requirement that control specialists in terminal facilities (towers) pass a Class II airman examination annually, which was paid for by the tower operator.

The Flight Safety Foundation recommendations essentially coincided with the opinion of our medical staff. However, the staff felt that the examination required should be of sufficient scope to be of value to a preventive medical program in addition to a fitness for duty determination, and that, if this were required, it should be paid for by the agency. Appropriated funds required for such a program were made available in late 1963. From the knowledge accumulated over a period of years from selected research studies on air traffic controller populations and from specific observations of work demands in control facilities, a set of medical standards was devised. The standards were officially adopted by the U. S. Civil Service Commission in April of 1965, which made them the criteria by which the medical fitness of air traffic control specialists is now judged.

The examination now consists of a general medical examination performed by a designated aviation medical examiner, supplemented by such laboratory examinations as electrocardiography, audiometry, and chest x-ray examination. Examinations are performed on an annual basis in the birth month of the controller.

In addition to the above tests, performed in medical facilities, the psychological screening part of the medical assessment is performed by group administration in the control facilities. All portions of the medical assessment program, except the psychological screening portion, have been performed on all on-duty controllers each twelve months since the program began in 1965. Psychological screening tests were administered to all on-duty controllers during late 1965 and early 1966.

Plans for continuation of psychological screening testing on an annual basis have been postponed for the following reasons:

1. Certain administrative and procedural difficulties encountered during the first round of testing required study.
2. The agency's clinical psychologist, who was the program manager for this phase of the medical assessment, left agency employment in late 1966 and was not replaced until early 1968.
3. Extended analyses of the data and experience of the first round of testing, planned at the time of original implementation, were performed, but had to await the arrival of the replacement psychologist.
4. Certain revisions of the test instrument used were undertaken with the assistance of the psychology staff of the Civil Service Commission and the test authors.

Implementation plans for the next round of testing are now nearing completion and tests will hereafter be performed on an annual basis.

Psychological Screening Program

After considerable study of the psychological test instruments available, particularly with regard to their validity and ease of administration to some 14,000 personnel, the 16 Personality Factors Test was selected. This is a self-administered personality questionnaire containing 187 questions. For each question the examinee has a choice of three possible answers. In general those questions dealing with attitude or personal preference provide two choices of answers at opposite poles of attitude or preference. The third answer is a rather noncommittal - no comment - kind of answer. For these questions there are really no right or wrong answers, and, as is usual with this kind of test, the answers to individual questions are of no interest to us. The way in which the individual handles the overall test, when compared with his peers or a standard reference group, gives the information we seek.

The test was designed to provide information on 16 factors of personality structure. The test is scored by computer, which provides a printed profile for each test subject.

The test is used only as a screening device, and it is similar to other laboratory tests such as an electrocardiogram or chest x-ray, and is used only to identify those individuals who are thought to be in need of further, more comprehensive, psychiatric assessment. From clinical experience in the use of this test on other groups of persons, in the absence of specific knowledge of the way air traffic controllers would handle the test, a cutting score was established at a level such that not more than one percent of controllers were expected to exceed it. Prior clinical experience suggested that this level should give the maximum yield of controllers in need of psychiatric review while, at the same time, avoiding the selection of significant numbers of persons without identifiable psychiatric difficulties.

Psychological Test Results

The overall results of the first round of psychological testing provided information concerning controllers as compared with a standardized sample of the general population. As a group, controllers possess a higher intelligence, greater self-discipline and self-control, a tough realism, greater conscientiousness and less anxious insecurity than the general population.

By the application of the selected cutting score, 151 of the 12,200 controllers tested were selected for further assessment. Of these, 60 were cleared by Regional Flight Surgeons without referral for more formal psychiatric assessment. Of the 91 who were referred for complete

psychiatric and clinical psychological assessment approximately half (45) were found to have some identifiable emotional problem. Of these, 31 were found to have moderate to severe psychiatric disturbance, 15 of which were affected to such a degree as to be determined not fit to continue as controllers.

Of those found to possess recognizable psychiatric disturbance, not severe enough to require permanent removal from duty, arrangements were made for appropriate treatment and followup either while temporarily removed from duty or while continuing to serve as controllers.

Program Assessment and Planned Modifications

As previously indicated numerous analyses have been made of the results of the initial psychological screening test. Among other things these results were correlated with certain other factors and events which occurred subsequent to the completion of the first round of testing in early 1966. As an example, the psychological test profiles of those controllers who became psychiatric "casualties" since that time have been carefully studied to identify those combinations of personality indicators that may now be considered as indicators of the development of psychiatric difficulty. From these and other studies a more sophisticated set of screening criteria have been established for use with future test results. It is expected that these refinements, combined with the use of a screening system, employing a panel of medical and psychological specialists, will result in much greater precision in identifying controllers who should be referred for comprehensive psychiatric and clinical psychological evaluations.

In addition, psychiatric and psychological consultants have been engaged at strategic geographical locations to assist in the performance of the evaluations which will be required. They were selected for their competence in performing such evaluations and have been specifically indoctrinated concerning the working environment of controllers and the demands of this kind of employment.

Studies continue in an effort to determine the extent to which the demands of the job produce identifiable psychological and psychiatric effects.



H. L. REIGHARD, M.D.
Acting Federal Air Surgeon, AM-1

**NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C. 20591**

March 17, 1969

Mr. David D. Thomas
Acting Administrator
Federal Aviation Administration
800 Independence Avenue, S. W.
Washington, D. C. 20590

Dear Mr. Thomas:

Our continuing investigation of the aircraft accident involving Puerto Rico International Airlines, near San Juan, Puerto Rico, on March 5, 1969, has disclosed the following salient facts.

On March 5, at approximately 1740 A. s. t., Prinair Flight 277, a DeHaviland Heron, on a scheduled air taxi flight, IFR from St. Thomas, Virgin Islands, to San Juan International Airport, crashed in mountainous terrain 14 nautical miles southeast of the San Juan VORTAC. Nineteen persons aboard the aircraft were killed, including two crew members and seventeen passengers. San Juan International Airport elevation is nine feet above sea level - terrain in the area of the accident rises to 3,524 feet m. s. l.

Prinair Flight 277 departed St. Thomas at approximately 1717 local time, on an IFR flight to maintain 4,000 feet via Route 2 to San Juan. The flight was identified by the ARTCC at 1724. At 1731, the Center made a routine handoff to San Juan Approach Control at a point 27-1/2 miles east on Route 2, 3 miles east of the Fajardo intersection.

At 1732 Flight 277 was advised by Approach Control that he was in radar contact. The flight was then vectored and cleared to descend to 3,000 feet for initial approach to the San Juan ILS final approach course.

The radar target for this flight was lost in an area of precipitation south of the San Juan VORTAC. The aircraft was not equipped with DME or transponder.

The wreckage was located the following day by an aircraft flown over a track reconstructed from the recorded vectors given to Prinair Flight 277.

Although our investigation of this accident is continuing there is one area which we believe requires immediate corrective action. The Safety Board recommends that:

- (a) All aircraft not transponder- or DME-equipped and operating under instrument flight conditions in the San Juan approach control area be required to maintain the highest minimum obstruction clearance altitude for that area until over the VORTAC. That such flight should be descended to approach minimums within five miles radius of the VORTAC when under radar control or make a descent following the Standard Instrument Approach Procedure.
- (b) The Administrator review approach control procedures at other locations where similar topography exists and apply the foregoing procedure where applicable.

As part of the Board's continuing investigation, we have established a select group to investigate the man-equipment-environment elements related to the air traffic control system at San Juan.

Sincerely yours,

/s/

Joseph J. O'Connell, Jr.
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Appendix F

WASHINGTON, D.C. 20590



OFFICE OF
THE ADMINISTRATOR

MAR 21 1969

Honorable Joseph J. O'Connell, Jr.
Chairman, National Transportation
Safety Board
Washington, D. C. 20591

Dear Mr. Chairman:

This is in response to the investigation concerning the accident involving PRINAIR's Flight 277 near San Juan, Puerto Rico, on March 5, 1969.

We agree with the facts documented in your letter of March 17, 1969, as to the events leading up to the accident. Prior to the receipt of your recommendations, we had placed a limitation on the use of the San Juan ASR system in that aircraft shall not be vectored below a line five nautical miles south of the centerline on Route 2. We believe this procedure accomplishes the intent of your recommendation relating to San Juan, and will provide more operational flexibility.

We have also issued instructions nationally which stress that controllers should use extreme caution when reidentifying an aircraft after radar contact is lost. The procedure further requires that when a heading is issued for reidentification purposes that the controller shall assure that the heading will not immediately place the aircraft in an area which will require an increased minimum IFR altitude.

Further, we have issued a notice to all facilities which stresses the importance of accuracy obstruction altitude information displayed on radar video maps, overlays, and other material used by control personnel. This notice requires that radar video map and overlay alignment are checked at least once each watch period.

With specific reference to San Juan, we have thoroughly flight checked the radar since the accident, and have imposed additional restrictions on the use of the radar. These restrictions are not related to the accident, but we wish to take every precautionary measure at that location.

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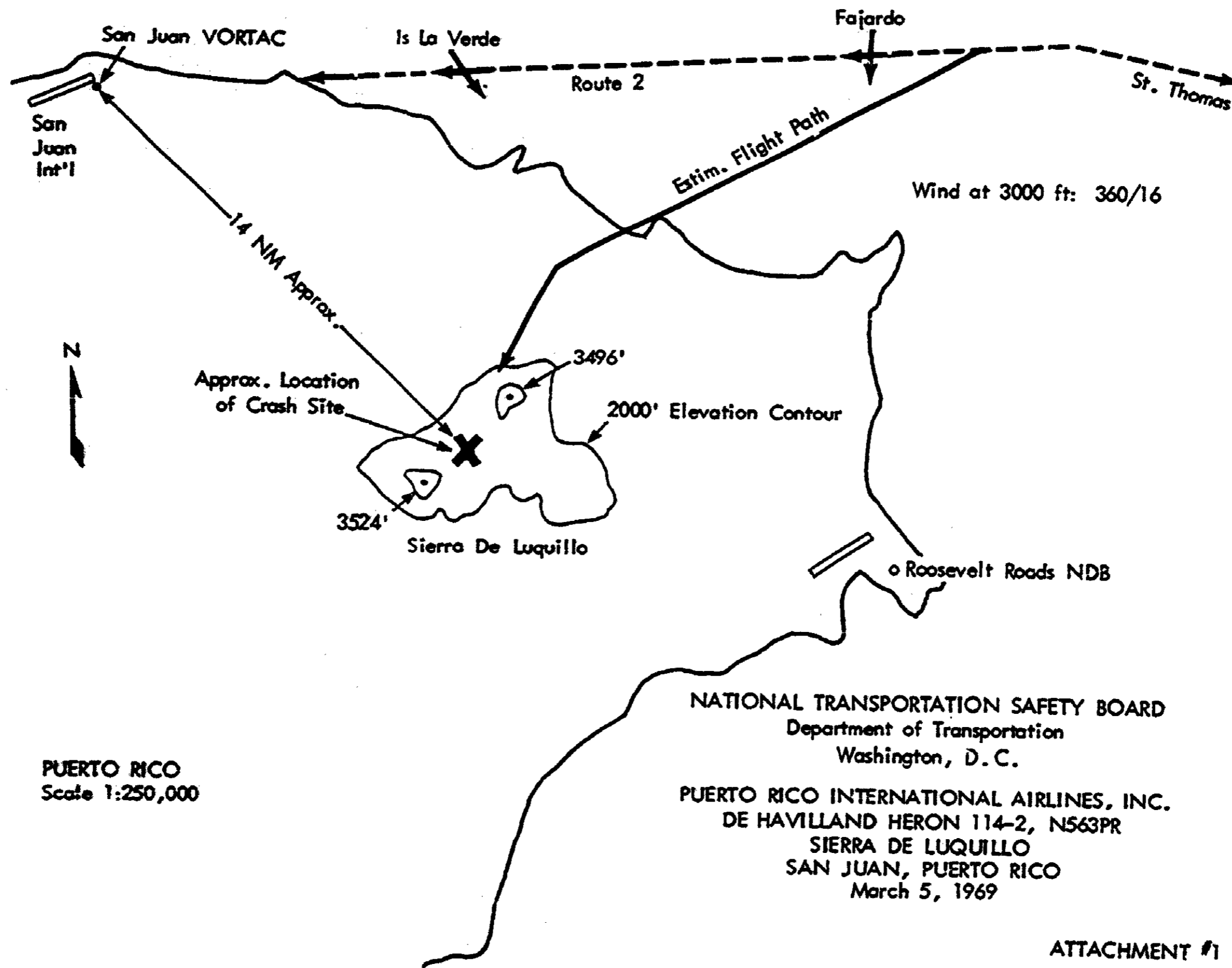
We appreciate receiving your recommendations and we will also appreciate any additional thoughts or suggestions as your investigation progresses.

Sincerely,

D. D. Thomas

D. D. Thomas
Acting Administrator

Enclosures



PUERTO RICO
Scale 1:250,000

NATIONAL TRANSPORTATION SAFETY BOARD
Department of Transportation
Washington, D. C.

PUERTO RICO INTERNATIONAL AIRLINES, INC.
DE HAVILLAND HERON 114-2, N563PR
SIERRA DE LUQUILLO
SAN JUAN, PUERTO RICO
March 5, 1969

ATTACHMENT #1

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