The Reauthorization of the National Transportation Safety Board

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Submitted to the Aviation Subcommittee, House Committee on Transportation and Infrastructure

Cynthia C. Lebow
PREFACE

This document presents the written testimony of Cynthia C. Lebow, as submitted to the Aviation Subcommittee, House Committee on Transportation and Infrastructure on Thursday, May 6, 1999.
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Testimony presented to the Aviation Subcommittee, House Committee on Transportation and Infrastructure

by

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Mr. Chairman and Members of the Committee, thank you for inviting me to participate in your hearings on the reauthorization of the National Transportation Safety Board. My name is Cynthia C. Lebow; I am the Associate Director of the Institute for Civil Justice at RAND. My testimony today is based on a study of the capability of the NTSB to conduct major commercial aviation accident investigations. Although the study is still in progress, it is nearing completion, and I am pleased to discuss some of our initial findings and research results with you today. RAND is a nonprofit institution that helps improve policy and decisionmaking through research and analysis. This statement is based on a variety of sources, including research conducted at RAND. However, the opinions and conclusions expressed are those of the author and should not be interpreted as representing those of RAND or any of the agencies or others sponsoring its research.

INTRODUCTION

Commissioned by the NTSB itself, our nine-month study has included a review of future aerospace technologies that will impact the work of the Board, the workload, staffing, training, and operations of the agency, and the functioning of the party system as an integral element of the investigative process. The independence of the NTSB is of critical importance to the safety of the traveling public. The agency's straightforward mission—to determine the cause of transportation accidents and to issue safety recommendations to prevent similar accidents from happening in the future—is fundamental to ensuring that unsafe conditions are identified and that appropriate corrective action is taken as quickly as possible. The NTSB's unique role in transportation safety is contingent on the ability of the Board and the professional staff to conduct independent, timely, and accurate investigations of accidents and major incidents and in so doing, to assure public confidence in the safety of our national transportation systems. Aviation consumes about 40 percent of the NTSB's resources, and the gravity of its mission is most obvious when a major commercial aviation accident occurs. By design, most of our research and analysis has focused on the ability of the NTSB to conduct these kinds of investigations although many of our findings will be applicable to the investigation of other kinds of transportation accidents as well.
STUDY OBJECTIVES AND METHODS

At the behest of NTSB Chairman Jim Hall, RAND designed a research agenda to examine two interdependent aspects of NTSB operations: (1) a study of NTSB practices and policies with regard to the training and qualifications of aviation accident investigators, including a determination of the adequacy of such policies and practices in light of future technological developments in aviation and avionics; and (2) a review of the functioning of the party process as a means of supplementing NTSB skills and technical knowledge, including an examination of the liability environment in which the party system operates.

In tackling this research, we were able to involve personnel from several different RAND programs, including the Institute for Civil Justice, the Science and Technology Policy Institute, and Project Air Force. This multi-disciplinary approach enabled us to employ a variety of quantitative and qualitative research techniques, including case studies of recent NTSB aviation investigations, a structured survey of the NTSB technical staff, extensive personal interviews with numerous NTSB employees and outside stakeholders, site visits to the facilities of aircraft manufacturers and airline operators, workshops with interested groups, government officials, and family representatives, and quantitative analysis of data provided by the NTSB and other sources. It is our belief that this research has provided the most comprehensive examination of NTSB operations that has ever been undertaken in the 36-year history of the agency.

EMERGING TRENDS IN AVIATION

As the NTSB prepares for the future during the course of this reauthorization process, significant challenges can be anticipated. RAND's research suggests that while there may be fewer major aviation accidents, those that do occur will be far more complex, presenting NTSB investigators with unprecedented analytical challenges. The TWA 800 and USAir 427 accidents are not anomalies outside the normal pattern of the agency's investigative work—they are representative of the "worst case," but potential, accidents of the future. In order to meet its diverse investigative responsibilities, including the Board's international obligations, the NTSB is likely to face an unrelenting workload. At the same time, investigators will confront a growing diversity of aircraft of all kinds, from new types of general aviation planes to unmanned commercial space vehicles to larger, more complex commercial transport airplanes.

The NTSB Budget

By Federal standards, the NTSB is a very small agency. The NTSB's budget request for Fiscal Year 2000 is $53 million, the first time that budgetary authority has been sought at this level. The NTSB has sought supplemental funding in situations where unique investigative efforts have been required or when several pending accident investigations caused an unplanned surge in workload. This was the case, for example, in FY 1997, when the agency needed more resources to support the large-scale investigations of TWA 800 (including the reconstruction of the fuselage at
a facility at Calverton, New York) and Valujet 592. The NTSB's field and regional offices consume approximately 50 percent of the fiscal resources dedicated to aviation. The majority of this allocation goes to the investigation of general aviation accidents, even though the Safety Board is primarily identified in the public mind with the investigation of major commercial aircraft accidents.

The Accident Rate

Typically, a discussion of the aviation accident rate deals with the relative safety of flying. The usual metric is the number of accidents per flight hour or the number of fatalities per passenger mile. RAND's research provided a different perspective on this measurement, based on information derived from the NTSB's own aviation investigation database.

We are all familiar with the fact that aviation safety efforts have dramatically reduced the number of major domestic air carrier accidents; in 1998 there were none. It is also important, however, to recognize that this statistic is not the prime driver of the NTSB workload. The NTSB must review both fatal and non-fatal accidents, as well as major incidents where no one was injured and no aircraft destroyed. When these data are examined, we find that the Part 121 (domestic commercial aircraft) fatal accident rate has not changed significantly in the past 30 years.

There has been recent growth in the rate of non-fatal accidents in this category, a near doubling since 1986. While safety has improved dramatically given the increase in the volume of flights and the number of passenger miles flown, as measured in the number of accidents that must be investigated, the NTSB still has nearly the same workload. The NTSB must maintain sufficient resources to investigate the number of accidents, fatal or non-fatal, which occur. Given the increasing complexity of aircraft accident investigations, the agency's workload has actually been increasing quantitatively.

Given the variability in annual air carrier accidents over the past two decades, the NTSB must strike a balance between the expense of staffing for peak demands and staffing for somewhat lower work periods. Projected accident rates illustrate three possible accident futures: (1) there is no change in the accident rate as accidents grow in step with traffic growth; (2) a 50 percent reduction in the accident rate by 2007 (industry goal); or (3) an eighty percent reduction in the accident rate by 2007 (White House goal). In the unfortunate event that the first future becomes reality, the NTSB may need to increase its staff. In the second case, the reduction in the accident rate is almost offset by increasing traffic. In the third scenario, the accident rate falls at a rate greater than traffic growth resulting in a net decline in annual U.S. carrier accidents. At this point, two years into a ten-year program, with success by no means assured, it is too soon to consider making NTSB staff adjustments based on an expectation of fewer accidents in the future.

Support for foreign accident investigations also increases the investigative workload of the NTSB. During the past decade, the Major Investigations Branch of the NTSB averaged support for 46 foreign accident investigations per year without dispatching investigators, and on average,
dispatched personnel to another 10 foreign investigations per year. This support can be relatively minor or it can represent a major effort, such as the investigative support provided by the NTSB to Canadian investigators in the MD-II Swissair III accident in 1998.

**Systems Complexity**

The NTSB must be prepared to meet the challenge of developing new investigative methodologies in response to the rapid growth in systems complexity. The growth in complexity is exponential in many areas, but the most significant trend is the interconnectedness of systems. In the past, aircraft systems were single-point, sensor-to-instrument systems. Current generation aircraft are highly integrated systems with extensive cross-linking. Complex systems are often highly interactive and tightly coupled failures in one area can propagate rapidly without the ability to isolate them. Redundancy, fault tolerance, and fail-safe systems enhance reliability, but all engender additional complexity that, in turn, can be the source of failures.

Although the NTSB has long dealt with increasing complexity, two factors will drive a fundamental reordering of investigative management and processes. The first is the large number of failure scenarios that need to be evaluated in a complex systems accident. The second is the lack of permanent evidence that is often associated with a complex systems event. The NTSB should expect growth in the number of failure potentialities that investigators will need to vigorously explore. In the investigation of a complex systems accident, the NTSB will most likely experience lack of failure mode data, exhaustion of resources, and demands of specific expertise that may be beyond the scope of Board personnel. A lack of clear failure evidence is a particular challenge to traditional Safety Board investigative practices. RAND found that NTSB investigators are well prepared for accidents in which the failure mode reveals itself through careful examination of the wreckage. The "broken belt" or "severed cable" represents a type of mechanical failure that can be located in an analysis of debris. However, in complex systems, "reactive state" failures can occur, leaving no trace of what occurred.

Increases in aircraft complexity emphasize the importance of investigator training. Accident investigators must be trained, not simply in investigative techniques, but in a broad, multidisciplinary routine that matches the complexity of the systems they will be called upon to analyze. New approaches will be needed and cooperative relationships must be sought between the NTSB and manufacturers, operators, academia, and other government agencies.

**Size of Aircraft**

The potential for tragedy continues to grow as passenger loads increase. The single worst event in aviation history was a runway incursion involving two Boeing 747 aircraft in Tenerife, Canary Islands, in 1977. The crash killed everyone on both aircraft, a total of 574 people. Today, aircraft have grown in size and utilize a packing density such that the potential exists for a loss event of similar magnitude with a single airplane. Alarming, there have been recent incidents that clearly demonstrate that such potential is real. For example, last year a United Boeing 747 with 400 people aboard narrowly missed a hill after experiencing an engine loss on takeoff from
San Francisco International Airport. This and similar close calls could be the harbingers of a domestic accident of unprecedented proportions.

On the horizon, industry planners are considering very large transport planes that would be capable of carrying up to 800 passengers. From a different perspective, regional turbo-prop commuter aircraft are rapidly being replaced with small regional jets that transport up to 60 people. A single event in which many hundreds of people are killed would receive unprecedented public and media attention. An accident of such magnitude would stretch current NTSB capabilities severely and leave few remaining resources available for other investigations. In addition, aircraft like the Boeing 747-400 combine unprecedented passenger capacity with the latest generation technology. Should such a major fatal accident occur, and should it involve complex design-related issues, the event would all but consume the Safety Board's aviation staff.

Growth in Foreign Aircraft

Overall, air travel worldwide is expected to grow by about 5 percent per year for the next 10 years in the air carrier segment of the industry. The introduction of new design aircraft is expected to be evolutionary and many of the current fleet as well as newly produced designs already in existence will remain a part of the worldwide air carrier fleet for many years to come. To meet this demand, the size of the worldwide commercial aircraft fleet will nearly double over the next 15 years. Most of this growth will be the evolutionary development of existing designs, and we expect that the average age of aircraft in the fleet will continue to rise. An important development that the NTSB must consider is that the worldwide fleet will consist of growing portions of aircraft of foreign manufacture. This proportion is expected to almost double in the next 20 years, from 21 percent to 39 percent. During 1998 alone, Airbus Industries orders rose to within 100 airplanes of Boeing aircraft orders. Airbus Industries' goal is a sustainable 50 percent share of the aviation market. As U.S. and foreign carriers increase their use of these airplanes, the NTSB will have to become much more familiar with the design and operation of these airplanes to be in an informed position to investigate accidents that might occur. That familiarity must also extend to working with the foreign aviation community, including manufacturers, operators, regulators, and accident investigators.

General Aviation

Another trend impacting the work of the NTSB is a renaissance in general aviation. Modest reform of liability laws, the overall health of the economy, and the growing popularity of aviation as a sport have combined to cause a projected growth in general aviation flight hours of as much as 30 percent over the next 20 years. However, the future nature of GA accident investigations will be influenced by more than an increase in flying hours alone. The variety in the type of GA vehicles that will be operating and the amount of technology being inserted into new designs are growing dramatically. Personal use aircraft encompasses aircraft such as the well-known Cessna, Piper and Beechcraft metal single and light-twin engine aircraft, to retired military fighters and trainers (some capable of supersonic flight), to many kinds of kit and homebuilt airplanes. Many
homebuilt aircraft utilize advanced composite materials and new types of engines that represent the leading edge of GA technology. The diversity of GA aircraft will place heavy demands on the skill and experience of NTSB accident investigators in the immediate future.

THE NTSB AVIATION WORKFORCE

A critical aspect of RAND's research was an examination of the NTSB workforce with a view toward determining whether the professional staff was adequately prepared and trained to deal with the accident picture that we forecast. In carrying out this evaluation, we designed and administered a structured survey of the NTSB technical staff, asking them to appraise their own capabilities and skills. We considered the hiring and staffing patterns within the agency, as well as staff workload and work patterns and assignments. We also examined in detail the training offered to new and experienced personnel to assure that the knowledge required to do complex aviation accident investigations was available or could be acquired. Ultimately, the quality and independence of the Board's investigations and safety recommendations hinges upon the investigative skills and technical knowledge of a cadre of dedicated public servants assigned the task of unraveling highly complex events in the glare of public attention and concern.

Our analysis of the workload, staffing, and training issues pertinent to the NTSB is ongoing. However, it is possible to present some initial findings relevant to the issues at hand in the reauthorization process.

Workload: The NTSB staff operates under a continuing excessive workload. This is especially true for the Aviation Safety Division, but is applicable to the surface mode divisions as well. Based on data from the Aerospace Industries Association, the average industry workweek for engineering and professional staff is approximately 42 hours; the average continuous workload for the Aviation Safety investigative staff is approximately 52 hours per week, stretching to 62 hours per week during peak periods such as during the Valujet and TWA 800 investigations. Further evidence came from examining NTSB overtime payments reflecting an increasing workload.

NTSB Staffing: Staffing in the Office of Aviation Safety, which encompasses employees in headquarters as well as the regional and field offices, has grown about 28 percent during the past decade, reaching 149 employees. During the same period, the Office of Research and Engineering which provides key support for accident investigations across transportation modes, grew by about 57 percent. In the past two years, the growth in NTSB staff was primarily a result of the new family affairs responsibilities assigned to the agency. One notable result from the survey is the "aging" of the Aviation Safety staff. In an agency that is dependent on the knowledge and skills of its most experienced investigators, about 14 percent of the total Aviation Safety workforce responding to our survey was at or above age 55. In an organization as small as the Office of Aviation Safety, block retirement of a substantial fraction of the most experienced staff
could create significant staffing problems. Some initiatives have already been taken, including the use of retention bonuses, to encourage several people intending to retire to postpone that action.

**Competitive Salaries:** The Office of Aviation Safety tends to hire experienced employees. Many of the respondents to the RAND questionnaire came to the NTSB having more than 10 years of professional experience. A key staffing question is whether the NTSB salary structure is competitive enough to attract and retain the kind of experienced personnel that is needed in the future. RAND compared typical NTSB salaries with engineering salaries in the aerospace industry and found that the NTSB salary structure does not appear competitive for mid-career personnel. Over the long run, salary disparities could prevent the NTSB from attracting the kind of quality employees it needs to fulfill its mission. Further analysis is needed to fully define the dimensions of the compensation problem at the NTSB, looking more closely at such factors as the benefits of federal employment in comparison to compensation packages in the private sector.

**Training:** The NTSB must be concerned not only with having a competitive salary structure to attract skilled staff, but also with having a training program to keep the skills of its staff current so they can effectively investigate accidents. At the very minimum, the NTSB staff must know what questions to ask those involved with the accident, such as the airlines, aircraft manufacturers, or regulators, and be able to discern whether they have been provided with correct or adequate answers. RAND examined a variety of issues associated with training activities at the NTSB, including the training budget, the degree to which workload influences the level of training activity, the sources of training, and the content of available training courses.

The employees reported that training suffers due to the heavy workload and the data, though limited, supports this view. As overtime expenditures rose per full time equivalent (FTE) in the Office of Aviation Safety, training hours and training expenditures fell. About 40 percent of the NTSB’s most experienced employees responding to the survey reported that they are not training at all. This is particularly troublesome because tenure at the NTSB does not automatically afford a skilled engineer or pilot the opportunity to renew his or her skills as part of a daily work routine. Travel and tuition budgets for training have fluctuated significantly during the past decade; spending for training in FY 1999 is only about 81 percent of the FY 1992 level in inflation-adjusted terms.

Approaches to training are by no means universal at the NTSB, but Aviation Safety employees who do derive much of their training primarily from the NTSB itself and from aircraft manufacturers. Membership in professional societies was also among one of the more frequently mentioned sources. According to questionnaire responses, employees derived remarkably little training from other U.S. government agencies (such as NASA or DoD), from temporary personnel exchanges with other investigatory agencies, or from aviation operators. The costs of private-sector training courses have frequently exceeded budgets for training at NTSB, although the principal "cost" to the NTSB of training is the cost of not having staff available for accident
investigations while they are away training. This "cost" can become particularly high when workloads are heavy.

Beyond the core investigatory skills, the NTSB will need to assure that its staff acquires the knowledge needed to prepare for the emerging aviation developments discussed above. This implies that NTSB employees must become familiar with, among other things, foreign aircraft systems and operations, aging aircraft, complex integrated systems and failure diagnosis, human factors, cockpit automation, emerging National Air Space architecture and operations, and new aerospace vehicles. Such training may represent a departure from the status quo and could require a much greater investment in training, so long as the workload of NTSB investigative employees is adjusted to make such additional training feasible.

The inter-related issues of workloads, staffing, and training at the NTSB deserve immediate attention if the agency is to meet its growing and changing responsibilities. We believe that the RAND study, when reported in its entirety, will provide a roadmap for this small, but critically important agency as it strives to meet the many challenges that lie ahead.

I will be pleased to answer any questions that you may have at this time.