Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

AVIATION OCCURRENCE REPORT

NEAR COLLISION WITH BUILDING

PROVINCIAL AIRLINES LTD.
SWEARINGEN SA226-AT MERLIN C-GTMW
SYDNEY, NOVA SCOTIA
14 APRIL 1994

REPORT NUMBER A94A0078

Canada

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- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
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Synopsis

C-GTMW, a Swearingen SA-226 operating as Speedair 703, was on a courier flight from Moncton, New Brunswick, to Sydney, Nova Scotia. While being radar vectored for an instrument landing system (ILS) approach, the aircraft was flown through the localizer. The pilots were then issued another heading by the Moncton Area Control Centre (ACC) controller to re-intercept the localizer. Shortly afterwards, the pilot advised the Moncton ACC controller that they were doing an overshoot. The pilot received clearance for another approach to runway 19 and landed at Sydney Airport without further incident.

The recorded Moncton ACC radar data showed that, before overshooting, the aircraft had descended to an altitude of 200 feet above sea level (asl). Several eye witnesses on the ground reported that the aircraft nearly hit the Lingan power generating plant, located one and one-third nautical miles east of the November approach beacon.

The Board determined that the crew of Speedair 703 did not properly plan and fly their approach to the Sydney Airport, which resulted in a near collision with the Lingan power generating plant. Contributing factors to this occurrence were as follows: the flight crew's complacent attitude, their loss of situational awareness, their decision to continue an unstabilized approach, and the controller's lack of compliance with the radar vectoring procedures outlined in the *Air Traffic Control* (ATC) *Manual of Operations* (MANOPS).

Ce rapport est également disponible en français.

Table of Contents

1.0 Factual Information

1.1 History of the Flight

C-GTMW, a Swearingen SA-226 operating as Speedair 703 (SPR703), was on a courier flight from Moncton, New Brunswick, to Sydney, Nova Scotia. The crew was advised by the Moncton ACC controller that they would be given radar vectors for a straight-in ILS[1] approach for runway 19 at the Sydney Airport.

While on radar vectors, SPR703 approached the localizer for runway 19 with a speed of approximately 290 knots and a heading of 090 degrees magnetic, an angle of 98 degrees from the final approach course. The aircraft flew through the localizer at about 2,000 feet above the glide slope and two miles outside the November beacon (the final approach fix, or FAF). The flight crew were then issued other headings by the Moncton ACC controller to re-intercept the localizer. Shortly afterwards, the pilot of SPR703 advised the Moncton ACC controller that they were doing an overshoot. The flight crew received clearance for another approach to runway 19, flew the approach, and landed at Sydney Airport without further incident.

1 See Glossary for all abbreviations and acronyms.

2 Units are consistent with official manuals, documents, and instructions used by or issued to the crew.

3 All times are ADT (Coordinated Universal Time minus three hours) unless otherwise noted.

Moncton ACC radar data showed that the aircraft descended to an altitude of 200 feet asl east of the November beacon before the crew commenced the overshoot; the reference elevation of the Sydney Airport is 203 feet asl. Several eye witnesses on the ground reported that the aircraft nearly hit the Lingan power generating plant, located one and one-third nautical miles (nm)[2] east of the November approach beacon.

This incident occurred at 0820 Atlantic daylight time (ADT)[3] during the hours of daylight, at latitude 46°06'N and longitude 060°02'W.

1.2 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	2	-	-	2
Total	2	-	-	2

1.3 Damage to Aircraft

None.

1.4 Other Damage

None.

1.5 Personnel Information

	Pilot-in-command	Co-Pilot
Age	37	33
Pilot Licence	ATPL	ATPL
Medical Expiry Date	01 Jan 95	01 Oct 94
Total Flying Hours	6,600	4,900
Hours on Type	750	500
Hours Last 90 Days	300	200
Hours on Type Last 90 Days	290	20
Hours on Duty Prior to Occurrence	4	5.5
Hours off Duty Prior to Work Period	9	10

1.5.1 Captain's History

The captain started his flying training in 1974, and in 1976 he obtained a commercial pilot licence. He was a flying instructor until 1979, when he got his first job flying multi-engine aircraft. His multi-engine aircraft experience, prior to joining this company, included the Swearingen SA226, Hawker Siddeley 748, de Havilland Twin Otter, and de Havilland Dash 8.

He was hired by Provincial Airlines Limited (PAL) in September 1993 as a Piper Navajo captain, and in January of 1994, he successfully upgraded to captain on the SA226. During the 90-day period prior to the occurrence, he had flown mainly as captain on the SA226. During the 18 days up to and including the day of the occurrence, he had flown 16 days but had not exceeded the maximum flight duty limitations as defined by the current Transport Canada regulations.

The captain has considerable experience with regional airlines that utilize Standard Operating Procedures (SOP) manuals, including Eastern Provincial Airlines and Air Atlantic. He had also received crew resource management (CRM) training during his employment with these regional airlines.

During the 90 days prior to the occurrence, the captain and co-pilot had flown together as SA226 crew members on one other day.

1.5.2 Co-Pilot's History

The co-pilot started his flying training in 1981, and in 1982 he obtained a commercial pilot licence. After two years as a flying instructor, he obtained a multi-engine instrument rating. His twin-engine aircraft experience, prior to joining PAL, included the Beechcraft C99, Cessna Citation, and considerable experience on the Piper Navajo.

The co-pilot was hired by PAL in May 1993 as a Navajo captain, and in September of 1993 he was also trained as a SA226 co-pilot. During the 90-day period leading up to this incident, he flew as a Navajo captain on 47 flights and as SA226 co-pilot on 23 flights.

The co-pilot had received CRM training every six months from Flight Safety International during the three-year period he was employed flying the Cessna Citation.

1.5.3 Air Traffic Controller

Controller Position	Low Level Radar
Age	44
Licence	IFR
Medical Expiry Date	01 Oct. 94
Experience	
- as a Controller	24 years
- as an IFR Controller	22 years
- in Present Unit	22 years
Hours on Duty Prior to Occurence	2 hours
Hours Off Duty Prior to Work Period	8 hours

The controller completed his Air Traffic Control (ATC) training in 1970 and successfully checked out in Fredericton tower prior to going to the Moncton ACC as an instrument flight rules (IFR) controller. He has been controlling low-level traffic for 20 years, and has two years experience controlling high level traffic.

1.6 Aircraft Information

Particulars	
Manufacturer	Swearingen Aviation
Type	SA226-AT Merlin IV
Year of Manufacture	1970
Serial Number	AT002
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	6,327.4 hr
Engine Type (number of)	Garrett TPE 331 (2)
Propeller/Rotor Type (number of)	Hartzell HC-B3TN-5E (2)
Maximum Allowable Take-off Weight	12,500 lb
Recommended Fuel Type(s)	Jet A, Jet A-1, Jet B,
Fuel Type Used	Jet A

The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

The aircraft was not equipped with a serviceable auto-pilot, nor was one required by regulation.

The aircraft has two navigation/communication units (nav/coms), two horizontal situation indicators (HSI), one distance measuring equipment (DME) unit, one automatic direction finder (ADF), a marker beacon panel, and a global positioning system (GPS). All this equipment was serviceable and functioning at the time of the occurrence.

1.7 *Meteorological Information*

The recorded Sydney Airport weather at 0825 ADT, five minutes after the occurrence, was a partially obscured overcast ceiling measured at 100 feet above ground level (agl), visibility 1 mile in light rain and fog, and winds from 180 degrees magnetic at 15 knots. The altimeter setting was 29.96 inches of mercury (in. Hg).

1.8 *Aids to Navigation*

The Sydney Airport has an ILS approach to runway 19 with an inbound track of 188 degrees magnetic. The November beacon is located 3.7 nm from the runway threshold with a glide-path beacon-crossing altitude of 1,330 feet asl. The ILS decision height is 395 feet asl (200 agl) and the non-directional beacon minimum descent altitude is 600 feet asl (405 agl).

A very high frequency omni-directional range (VOR) co-located with a DME transmitter is situated at the Sydney Airport.

There were no reported problems with the Sydney navigation aids prior to or after the occurrence.

1.9 *Communications*

Communications between Air Traffic Services (ATS) and SPR703 were normal throughout the occurrence flight.

1.10 *Aircraft Flight Path*

The recorded Moncton ACC radar data shows that SPR703 began its descent from an en route altitude of 13,000 feet asl about 45 miles back from the Sydney Airport; the flight had been cleared to 6,000 feet asl, and at 18 nm, was cleared to 2,000 feet asl. Initially the aircraft descended at approximately 1,800 feet per minute (fpm) with a ground speed of about 290 knots on a heading of 105 degrees magnetic. As the aircraft approached the localizer for runway 19, on a radar-vectored heading of 090 degrees magnetic, its ground speed was about 300 knots and its rate of descent increased to about 4,200 fpm.

SPR703 flew through the localizer, about 2 nm outside the November beacon and about 2,000 feet above the ILS glide slope. The radar indicated that, at a point approximately 1.3 nm east of the November beacon, the aircraft was 200 feet asl and then it began to climb.

Several eye witnesses on the ground reported that the aircraft nearly hit the Lingan power generating plant, located about 1.3 nm east of the November beacon.

The coal-fired power plant supplies most of the electrical power for Cape Breton Island. At the time of the incident, there were approximately 50 people working in and around the plant. The operation of the plant requires the use of a large amount of flammable substances and high pressure steam.

The power plant building has three levels, the tops of which are at 100, 141, and 203 feet agl. Two smoke stacks, each 500 feet high, are located adjacent to the eastern side of the main building. The eye witnesses reported that the aircraft's wing tip passed about 50 feet from the main building at about 140 feet agl.

Appendix A depicts the aircraft's flight path and position in relation to the building at the closest point.

1.10.1 *Crew Intentions*

The crew had been cleared for an ILS approach to runway 19 and had been given vectors to re-intercept the localizer for that approach. When the crew saw that they had flown through the localizer, they decided to modify their approach and descend to the non-directional beacon (NDB) approach minimum descent altitude (MDA) of 600 feet asl for runway 19. The pilot not flying (PNF), the captain, was instructed by the pilot flying (PF), the co-pilot, to call out when reaching 600 feet asl. When the aircraft reached 600 feet asl, it was not on the localizer or the glide slope, so the PNF called for an overshoot. Since the aircraft was at such a high rate of descent, the momentum of the aircraft would have continued the descent profile below 600 feet asl. It could not be established exactly to what indicated altitude the aircraft had descended when the crew commenced the overshoot.

1.11 Crew Coordination

1.11.1 Responsibilities of Pilot Flying and Pilot Not Flying

A NASA contractor report, number 166433, titled *Flight Crew Performance When PF and PNF Duties Are Exchanged*, discusses the roles of the pilots in general as follows:

> When the co-pilot is flying, the captain often fails to execute normal co-pilot functions and duties.

The report also describes the roles of the pilots during the approach and landing as follows:

> It had been discovered that coordination between the pilots, which was satisfactory when the captain landed the aircraft, was often less so when the co-pilot was controlling the aircraft and the captain undertook the duties normally those of the co-pilot.

The report summarizes the responsibilities of PF and PNF as follows:

> The PF's primary duty is to know the intended flight path of the airplane and then to keep it safely on that flight path. The PF is expected to fly the airplane (or monitor operation of the automatic pilot) in such a way that it proceeds safely and efficiently. The PF is expected to follow established rules and procedures and is responsible for complying with air traffic control clearances. In the parlance of the flight deck, the PF's job is to "mind the store." The PNF is expected to handle radio communications, perform operational monitoring, assist in traffic watch, and perform other supplemental or supportive tasks as required by standard operating procedures or as directed by the PF.

The *PAL Operations Manual*, section 4.24.3, states that, when making an instrument approach under radar guidance, the PNF shall monitor the aircraft's position closely by use of other instrument approach or navigation aids, i.e., ILS, NDB, VOR.

Good CRM requires that all crew members be aware of the plan and, as well as performing the tasks for which they are responsible, actively keep each other informed of all significant events or developments. In this way they contribute to each other's and their own situational awareness.

1.11.2 Standard Operating Procedures Manual

Provincial Airlines does not have an SOP manual nor are they required by regulation to have one. Transport Canada, which must approve SOP manuals, recommends the development and use of these manuals. An SOP manual, which is written mainly to enhance crew coordination, defines the responsibilities of PF and PNF. The company has some SOPs incorporated into its operations manual; however, they are generic for all aircraft and it is left up to the individual pilots, based on their experience and training, as to how they coordinate the functions of PF and PNF. However, individual interpretations when applying the SOPs can be quite varied.

1.11.3 Descent Preparation

The PAL descent checklist for the SA226, completed prior to the descent, includes a check of altimeters and an approach briefing. A typical approach briefing involves a discussion of the arrival procedures, speeds, aircraft configuration, navigational aid set-up, etc.

The PNF received descent clearance, current Sydney weather, and an incorrect altimeter setting of 29.74, which was set on both altimeters. Another aircraft approaching Sydney queried the controller about the 29.74 altimeter setting and the controller responded with a Sydney altimeter of 29.96. The PF, hearing this exchange, called Sydney Flight Service Station (FSS), confirmed that the correct altimeter setting was 29.96, and reset his altimeter but did not pass this information to the PNF. This error would result in the PNF's altimeter reading 220 feet higher than the actual aircraft altitude. The PAL operations manual section 4.12, Adjustment and Tolerance of Altimeters, states: "When changing an altimeter setting each pilot will call out the new setting as he adjusts his instrument."

1.11.4 Complacency

As pilots routinely fly the same routes to the same destinations, their performance can become automatic and they may pay less attention to detail. They may become overconfident and may also become complacent.

Complacency results from a state of over-confidence, repetition of action, contentment with the status quo, familiarity, and boredom. It is associated with experience and confidence, both found in high time pilots.[4]

The pilots of SPR703 reported to the investigator that their approach briefing prior to this incident was performed mainly as a matter of routine and was not adequately discussed.

1.11.5 Situational Awareness

Situational awareness can be defined as all the knowledge that is accessible and that can be integrated into a coherent picture, when required, to assess and cope with a situation. People performing a complex job, such as flying an instrument approach, depend on situational awareness when making and implementing plans to intercept the localizer, establish a stable approach, and land the aircraft.

Situational awareness does not happen instantaneously, but develops on three different levels. First, the person has to perceive the situational elements from information displays, communication, or from viewing the scene. The person then integrates the information by using his or her experience and knowledge. Finally the person projects the information into the future to make and modify plans as the task progresses.

The development and maintenance of situational awareness is helped by experience and knowledge of how aspects of the situation--in this case, the controller, the other pilot, and the aircraft--interact and affect each other. Situational awareness is impaired by inadequate information and poorly coordinated actions. Inability to focus attention on the situation at hand, because of distractions or the need to attend to different, unrelated tasks (such as correcting an altimeter setting) will also impair the development and maintenance of situational awareness.

Both flight crew members indicated that their complacency contributed to their loss of situational awareness.

1.12 Aircraft Descent Planning

4 "Complacency Revisited" an article by R.A. Alkov for the U.S. Naval Safety Centre.

The Transport Canada *Instrument Procedures Manual* (IPM) states:

1. The pilot should keep a clear mental picture of where the aircraft is in the approach sequence, so as to begin descent as soon as cleared to a lower altitude. It is far better to reduce vertical speed towards the end of the descent than to increase it as the aircraft intercepts the final approach track.

2. Pilots must plan their own descent profiles, even when under radar control.

3. If the aircraft is inbound on the localizer and inadvertently above the glide path, the pilot must use extreme caution because he must follow a non-standard procedure and might require excessive descent rates to regain the glide path.

The PAL company practice for the SA226 is to descend from cruising altitude at or near the maximum operating speed (V_{mo}) of 248 knots indicated airspeed (KIAS). As the aircraft gets within 10 nm of the airport, below 3,000 feet asl, the pilot should comply with the *Aircraft Speed Limit Order* and reduce speed to 200 KIAS. Prior to crossing the FAF, approach flaps should be lowered and the speed decreased to 176 KIAS, the landing gear extension speed. The landing gear would normally be extended when the aircraft is in level flight, approaching the FAF, and the glide slope indicator shows one dot above interception. The normal approach speed for this aircraft is 140 knots.

To properly position and configure the aircraft for the approach within the distance and time available, a pilot must consider the aircraft's ground speed, time-to-go, distance from the airport, and rate of descent. Changes to speed and rate of descent must be made as required to achieve the goal of maintaining the proper descent profile. Operational monitoring of the descent profile, to ensure that this goal is accomplished, is a function of the PNF.

The Moncton ACC controller advised SPR703 of its position in relation to the approach when it was about 10, 6, and 3 nm back from the approach beacon for runway 19 at Sydney. When the aircraft was 3 nm from the localizer and approximately 4,500 feet asl, the Moncton ACC controller asked the pilot if they would be able to get down. The PNF responded that it would not be a problem. At this time the aircraft's descent rate increased to 4,200 fpm.

1.13 Organizational and Management Information

The PAL group of companies has grown rapidly since 1986, increasing the number of employees from about 30 to about 200. Major expansion took place in 1989 with the purchase of Eastern Flying Services in Halifax, Nova Scotia. The PAL group has also diversified in several areas during this period. In addition to courier operations, the PAL group is involved in offshore surveillance, flight training, scheduled domestic passenger flights, charter, air ambulance, aerial photography, and fixed-base operations/refuelling services in both Halifax and St. John's, Newfoundland. The PAL group currently operates about 35 aircraft.

During this period of rapid growth, the PAL group has also experienced a large turnover in pilots due to the simultaneous expansion of the company and additional hiring by the two regional commuter airlines. PAL has had several chief pilots during this period. With the addition of an aircraft over 12,500 pounds during the summer of 1993, PAL hired a chief pilot whose extensive aviation background included a term as director of training for the Toronto Flight Safety International facility.

1.14 Company Training Programs

1.14.1 General

PAL has a pilot training program incorporated into its operations manual which is approved by Transport Canada. The chief pilot or a designated senior captain is responsible for flight crew training. The training program outlines both initial and recurrent training requirements for pilots flying each aircraft type. The training program includes ground school and flight training.

1.14.2 Ground School

The ground school concentrates mainly on aircraft systems and performance. Very little time is spent on human factors issues. Physiological and physical phenomena relating to flight in a low pressure environment are covered in ground school for those pilots crewing pressurized aircraft.

The SA226 initial ground school outline specifies the time to be spent on each individual aircraft system, for a total of 23 hours. The yearly recurrent ground training requirement is 12 hours. The training program indicates that a pilot shall receive instruction relating to the operations manual, including duties and responsibilities of flight crew members. There is no specified time, indicated in the training program, to be spent on operations manual training.

CRM is not an organized part of the ground school and there is no opportunity to discuss past CRM-related incidents.

1.14.3 Flight Training

The flight training on an aircraft type consists of the practice of manoeuvres and procedures outlined in the operations manual to gain sufficient proficiency to pass the Transport Canada pilot proficiency check (PPC) ride. As the company does not have an SOP manual and few SOPs are included in the operations manual, this training does not emphasize crew coordination or CRM.

Some Transport Canada inspectors will not conduct PPC rides with two company pilots performing the functions of PF and PNF unless the aircraft is equipped with a jump seat and the company has an approved SOP manual for that aircraft. Company PPC rides are, therefore, usually conducted with a Transport Canada inspector occupying the right seat and performing the functions of PNF.

1.15 Aviation Courier Attitude

During the course of the investigation, it was identified through several interviews with air traffic controllers and pilots that a "courier attitude" exists in the aviation industry. This attitude leads to a modified standard being applied to courier flights, affecting how pilots fly these aircraft and how controllers control them.

Courier contracts are typically awarded to the lowest contract bidder who can provide the on-time reliability specified in the contract. For this purpose, exact records are kept by the couriers as to aircraft arrival times. Because route segment times in the contract are based on maximum aircraft speed, pilots feel that they must push the operation to keep these times to a minimum. The contract times do not take into consideration delays due to weather, traffic, and mechanical breakdowns. In a poor economic climate, all the individuals involved in these operations feel pressure to meet the contract specifications and preserve their jobs.

Pilots involved in flying passengers must always take into account the safety of the flight and the comfort of their passengers. To achieve passenger comfort, rates of turn, bank angles, descent rates, aircraft configuration changes, and speed changes are kept as smooth as possible, which is usually specified in an SOP manual. When only cargo is being carried, pilots continue to fly their aircraft safely; however, without passenger comfort to worry about, pilots feel that they are able to go to the maximum safe aircraft limits on a routine basis.

The accepted practice for any pilots who recognize that their aircraft is not safely established on an approach would be to overshoot, inform ATC, and fly another approach. The pilots of SPR703 found themselves passing through the localizer, well above the glide slope, in a rapid descent at a high ground speed. Rather than overshoot and try another approach, they attempted to re-intercept the final approach course and descend to the minimum descent altitude for a non-precision approach. The pilots reported that, had it been a passenger flight, they would not have continued with the approach after they went through the localizer.

The controller knew that SPR703 was a courier flight and he stated that he was surprised when they were unable to intercept the final approach course on the initial attempt. He also stated that he felt the vectors given to SPR703 were well within the capabilities of the flight crew and aircraft.

1.16 Controller Procedures

1.16.1 Radar Vectors

The *ATC Manual of Operations* (MANOPS), section 544.1, states that controllers shall "vector an aircraft to intercept the final approach course: 2 miles or more from the point at which final descent will begin; and at an angle of 30 degrees or less." Also, 544.1 note 1 states: "It is essential that aircraft are correctly vectored to prevent them from overshooting the turn on to a final approach course. Heading adjustments required to return to a final approach course increase pilot workload at a critical time of the approach."

The minimum radar vectoring altitude to the runway 19 ILS approach at Sydney is 2,000 feet asl. The controller cleared SPR703 down to this altitude when the aircraft was about 18 nm from the airport. At 2,000 feet asl, the final descent point (glide path interception) for this approach is 2.3 nm back from the November beacon (the FAF). To intercept the final approach course 2 nm back from the final descent point, as required by MANOPS, an aircraft level at 2,000 feet asl would have to intercept the final approach course 4.3 nm back from the FAF. The controller reported that he vectored SPR703 to intercept the final approach course 2 nm back from the FAF to provide separation from another aircraft intercepting at about 7 nm, and because he anticipated that these vectors would present no problem for the crew. When SPR703 was 3 nm from the localizer the controller asked the crew of SPR703 if they would be able to continue their approach from their present position.

The Moncton controller vectored the aircraft to the ILS localizer on a heading of 090 degrees magnetic, 98 degrees from the final approach course of 188 degrees magnetic. Just prior to the aircraft intercepting the localizer, the controller issued SPR703 a heading of 160 degrees, followed 12 seconds later by 220 degrees and then 240 degrees. The aircraft's groundspeed during this time was about 290 knots.

1.16.2 ATC Safety Alert

ATC MANOPS section 528.1 states the following:

> Issue a safety alert to an aircraft if you are aware the aircraft is at an altitude which, in your judgement, places it in unsafe proximity to terrain, an obstruction or another aircraft.
>
> Note 1. While a controller may not immediately see the development of every situation where a safety alert should be issued, he must remain vigilant of such situations and issue a safety alert when the situation is recognized. Conditions such as workload, traffic volume, the quality or limitations of the radar system, and the available lead time to react, are factors in determining whether it is reasonable for the controller to observe and recognize such situations.

When the controller advised the pilot of SPR703 that they were 3 nm from the localizer, he asked if they were able to continue. The pilot of SPR703 replied in the affirmative and said that it would not be a problem. The radar display shows that SPR703 passed through the localizer at about 2,000 feet above the glide path with a ground speed of about

300 knots. The controller issued the aircraft a heading of 220 degrees then another of 240 degrees to re-intercept the localizer.

During this time, the aircraft had progressed about 1.3 nm east of the beacon. The controller cleared SPR703 for the straight-in approach and told the pilot to contact Sydney FSS. He changed range on the radar to check on some other aircraft, momentarily lost the picture, and did not see SPR 703 descend to 200 feet asl. The controller's workload was assessed as moderate with normal complexity.

2.0 Analysis

2.1 Introduction

Given the considerable experience, training, and background of the pilots and controller, this analysis concentrates on the human and environmental issues in order to determine how this incident occurred. The crew did not follow standard procedures and rules, which contributed to their loss of awareness of the aircraft's position during the approach. How this occurred is examined in the following areas: complacency, breakdown of CRM, company training program, aviation courier attitude, and controller procedures.

2.2 Complacency

Both crew members indicated that they felt complacency was a contributing factor to their loss of situational awareness. Both pilots had flown into the Sydney Airport many times and they reported that the approach briefing, completed prior to the descent, was routine and ineffective. Descent planning regarding the aircraft's ground speed, descent rate, final landing configuration, and positioning on the approach was not adequately discussed.

Both pilots had a complacent attitude regarding the radar vectors received from the controller. They were anticipating that the controller would vector them so that they would intercept the final approach course with a minimum amount of manoeuvring. The aircraft was not stabilized for the final approach because the crew were confident that they could manage the aircraft's speed, altitude, and angle of descent to position the aircraft to intercept the ILS.

2.3 Crew Coordination

The lack of efficient crew coordination is evidenced by the pilots' not following the proper altimeter setting procedures as outlined in the PAL operations manual. The approach was flown with an altimeter setting of 29.96 on the PF's instrument and an incorrect setting of 29.74 on the PNF's instrument. Neither pilot adequately performed his functions as PF or PNF.

The fact that both pilots had considerable experience as captains may have contributed to an attitude where each individual thought that the other had the situation in hand. Had the crew coordination been better, the pilots might have recognized the situation which developed during the descent in time to make corrections to the descent profile.

The PNF did not properly monitor the descent and make recommendations to the PF for corrections to the descent profile. The aircraft was flying high and fast, and was approaching the localizer at a considerable angle to the final approach. Adequate information was available in the cockpit and from the controller for the crew to make the adjustments necessary to maintain the desired descent profile. The crew could have corrected the situation if they had started their descent sooner, anticipated the high ground speed, or increased the rate of descent and slowed the aircraft down sooner. A speed closer to the aircraft's gear extension speed, which is normal for beacon crossing, would have made it possible for them to turn the aircraft quicker and possibly intercept the final approach course.

A Transport Canada requirement for PAL to have an SOP manual and for the crew of SPR703 to be trained in its use would have decreased the likelihood of this type of occurrence. The duties of PF and PNF would have been clearer, and this might have alleviated any problems associated with the fact that both pilots were captains on their respective aircraft types. Since the pilots had only flown together once during the previous 90 days, they may have been unfamiliar with the details of how to handle their individual duties, given that the SOPs in the operations manual are general in nature. An SOP manual for this aircraft might have alleviated this problem as well.

2.4 Training Program

A training program which includes human factors issues, dealing with topics like complacency, fatigue, pilot attitudes, maximizing crew rest, etc., might have helped the crew deal with the situation they encountered during this approach.

A training program which included CRM training might have contributed to a greater degree of crew coordination in the cockpit of SPR703. It should also be noted that, even though both crew members had received CRM training in the past, the effectiveness of this training was not evident. If this training were incorporated into the yearly recurrent training program, its effectiveness would likely be increased.

If Transport Canada permitted PPC check rides with two PAL company pilots functioning as the PF and PNF, CRM could be emphasized and evaluated.
Two-pilot rides would also encourage CRM procedures during initial and recurrent flight training.

2.5 Aviation Courier Attitude

The crew elected to continue the approach after they flew through the localizer well above the glide slope, in a rapid descent, with a high ground speed, while receiving vectors for three turns totalling
150 degrees in a short time span. The aircraft was not stabilized at any time on the final approach course. Normally, pilots recognizing that the aircraft is not stabilized would overshoot and carry out another approach. As shown in the excerpts from the *Instrument Procedures Manual*, the pilots went against the basic recommendations for carrying out a successful approach. By deciding to descend to NDB minima and continue the descent, the crew was modifying their approach at a critical time inside the final approach beacon when their total attention was required.

To continue an unstabilized approach seems to be an acceptable risk for courier pilots; since passengers are not on board, the aircraft can be flown more aggressively. The pressure to stay on schedule, the pilots' natural desire to make a successful landing from the first approach, and the lack of worries about passenger comfort have combined to create a situation where the pilots fly their aircraft to the maximum safe limits. Courier pilots have accepted tight approaches similar to this one and have managed to successfully carry them out. Controllers, knowing the capabilities of courier pilots and their aircraft, have applied this knowledge to provide a more expeditious traffic flow.

The controller provided the crew with three position reports for the aircraft; however, at no time did he specify that he would be vectoring them to intercept the localizer 2 nm back from the November beacon. The controller felt that these vectors would present no problem for the crew.

2.6 Controller Procedures

2.6.1 Radar Vectors

ATC MANOPS instructs controllers to vector aircraft so that they will intercept the final approach course 2 nm or more from the point at which final descent will begin and at an angle of 30 degrees or less. The controller in this incident vectored SPR703 to the final approach course at an angle of 98 degrees and just prior to the runway localizer, then instructed the aircraft to turn 70 degrees for the intercept. Given the aircraft's high ground speed, it was unlikely the aircraft could have turned the 70 degrees and been established on the final approach intercept heading prior to crossing the localizer.

The controller was vectoring SPR703 to intercept the final approach course 2 nm back from the November beacon. MANOPS instructions indicate that this intercept should have been at least 4.3 nm back from the November beacon.

2.6.2 ATC Safety Alert

The Moncton controller cleared SPR703 for the approach to runway 19 and instructed the pilot to contact Sydney FSS. At this point, he switched to another radar display in order to observe other traffic he was controlling. Considering that SPR703 had already flown through the localizer, and given the aircraft's high ground speed, the weather being right at limits, and the fact that the controller found it necessary to give the aircraft a 50-degree angle to re-intercept the localizer, the point can be made that the controller should have recognized this as the development of a situation where a safety alert should have been issued. Even though the controller asked the flight crew of SPR 703 if they were going to be able to make the approach and the flight crew responded in the affirmative, the controller had an obligation to monitor the approach. The controller may have been relying on past experience vectoring courier aircraft to decide that this was a position from which the crew of SPR703 would be able to successfully complete the approach.

3.0 Conclusions

3.1 Findings

1. The flight crew were certified, trained, and qualified for the flight in accordance with existing regulations.

2. The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

3. The Moncton ACC controller was certified, trained, and qualified for his position.

4. All the navigational aids at Sydney were reported to be serviceable at the time of the occurrence.

5. The crew flew the approach in a manner which required an abnormally high descent rate, in excess of 4,000 feet fpm, within three miles of the FAF.

6. SPR703 flew through the localizer for runway 19 at 98 degrees to the final approach course, in a high rate of descent.

7. The aircraft descended about 400 feet below the MDA without the crew acquiring the runway environment.

8. SPR703 descended to about 140 feet agl and passed within 50 feet of the Lingan power generating plant.

9. The crew lost their situational awareness and failed to monitor their descent profile.

10. The crew allowed the aircraft's speed to exceed the requirements of the Air Regulations and the company procedures.

11. The crew had a complacent attitude which resulted in poor crew coordination.

12. The crew never established the aircraft in a stabilized configuration for the approach.

13. The controller's workload was assessed as moderate with normal complexity.

14. The controller did not follow all the procedures for issuing radar vectors as outlined in the ATC MANOPS section 544.1.

15. PAL does not have an SOP manual for the SA226, nor are they required to by existing regulations.

16. PAL does not have any CRM included in their training program nor is any required.

17. The pilots of SPR703 had only flown together as a crew on the SA226 on one day during the 90 days prior to the occurrence.

18. The captain of SPR703 had flown 16 of the last 18 days prior to the occurrence.

19. A "courier attitude" exists within the aviation community where pilots and controllers apply different operational procedures to cargo flights than they do to passenger flights.

3.2 Causes

The crew of Speedair 703 did not properly plan and fly their approach to the Sydney Airport, which resulted in a near collision with the Lingan power generating plant. Contributing factors to this occurrence were as follows: the flight crew's complacent attitude, their loss of situational awareness, their decision to continue an unstabilized approach, and the controller's lack of compliance with the radar vectoring procedures outlined in the *Air Traffic Control* (ATC) *Manual of Operations* (MANOPS).

4.0 Safety Action

4.1 Action Taken

4.1.1 Controlled Flight into Terrain (CFIT)

The circumstances of this occurrence are similar to those of a CFIT incident. CFIT occurrences are those in which an aircraft, under the control of the crew, is flown into terrain (or water) with no prior awareness on the part of the crew of the impending disaster. Over the eleven-year period from 01 January 1984 to 31 December 1994, 68 commercially operated aircraft not conducting low-level special operations were involved in CFIT accidents in Canada. In view of the frequency and severity of such accidents, the Board is conducting a study of CFIT accidents to identify systemic deficiencies. The study will include, *inter alia*, an examination of CFIT data involving unstabilized approaches.

4.1.2 ATC Radar Vectoring Procedures

The radar vectors that were provided to this flight did not conform to ATC requirements and contributed to the unstable approach. Moncton ACC has indicated that greater emphasis will be placed on "vectoring techniques" during refresher training, and that glide path interception distances will be depicted for aircraft altitudes ranging from the minimum vectoring altitude to 5,000 feet asl.

5 TSB occurrences A90P0337, A91A0198, A91C0083, A92P0015, A93H0023, A93P0131, A94H0001, and A94W0026.

Considering that similar inadequacies with radar vectoring may exist in other ATC units, the TSB sent an Aviation Safety Advisory to Transport Canada (TC) highlighting the need to ensure that all ATC units are providing radar vectors in accordance with MANOPS section 544.1. In their response to the Advisory, TC indicated that, on a national scope, the requirement of the ATC MANOPS section 544 will be included as a mandatory topic for refresher training for all controllers who provide radar vectors to the final approach.

4.1.3 Standard Operating Procedures (SOP)

At the time of the occurrence, the operator did not have an SOP manual for the Swearingen SA226, nor was one required by regulation. The operator has now developed SOPs for the SA226. It is also understood that the new Canadian Aviation Regulations will require SOPs for all operations where two pilots are required.

4.1.4 Crew Resource Management (CRM) and Pilot Decision Making (PDM)

CRM and PDM training were not included in the operator's training program, nor were they required to be. Use of proper CRM and PDM techniques might have precluded this occurrence.

The Board has investigated several recent occurrences[5] where inappropriate decisions were made by aircrew, although available cues should have alerted them to potentially dangerous situations. The Board recognizes the endeavours of TC and the aviation community to foster training in CRM and PDM; however, ineffective CRM and PDM continue to contribute to unsafe situations in commercial air transportation. While some air carriers have developed the necessary training on their own, other operators will require direction and assistance in setting up meaningful training programs. Therefore, to ensure that all operators and aircrew involved in commercial aviation have access to training for better coping with day-to-day operating decisions, the Board has recommended that:

> The Department of Transport establish guidelines for crew resource management (CRM) and decision-making training for all operators and aircrew involved in commercial aviation; and

(A95-11, issued May 1995)

The Department of Transport establish procedures for evaluating crew resource management (CRM) and pilot decision-making (PDM) skills on a recurrent basis for all aircrew involved in commercial aviation.

(A95-12, issued May 1995)

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members Zita Brunet and Hugh MacNeil, authorized the release of this report on 12 April 1995.

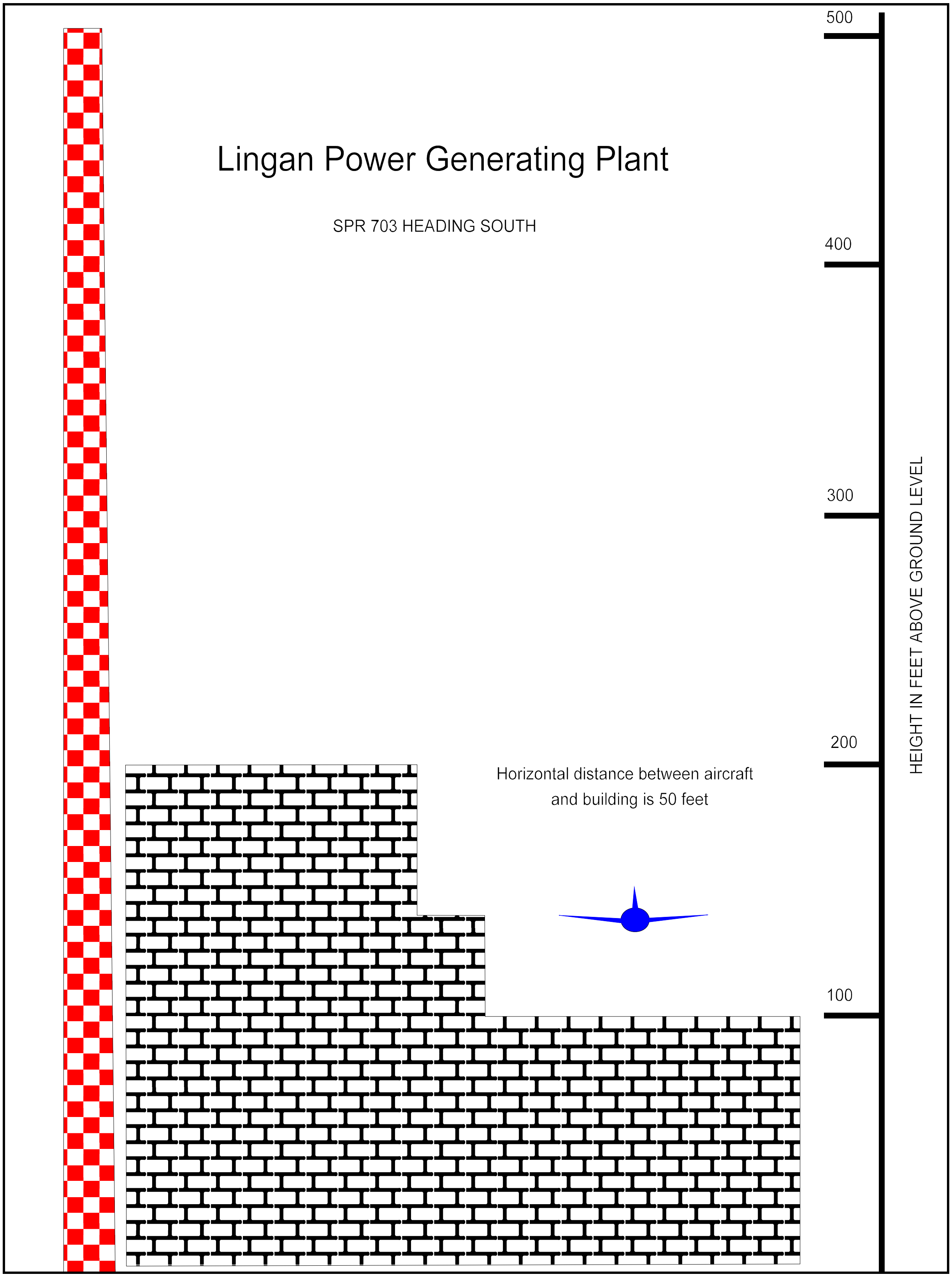
Appendix A - Flight Profile

See Appendix B for an explanation of the events

Appendix B - Events Legend

FLIGHT PROFILE - SPEED AIR 703		
POSITION	TIME	FLIGHT PROFILE
A	08:20:00	Moncton ACC advises SPR 703 that they are 10 nm from the November NDB. Radar shows the aircraft at 7,400 feet asl and descending; groundspeed 290 knots.
B	08:20:45	Moncton ACC advises SPR 703 that they are 6 nm from the November NDB. Radar shows the aircraft at 5,900 feet asl and descending; groundspeed 290 knots.
C	08:21:18	Moncton ACC advises SPR 703 that they are 3 nm from the localizer and asks if they will be able to get down. Radar shows the aircraft at 4,500 feet asl and descending; groundspeed 290 knots.
D	08:21:45	SPR 703 crosses the localizer at a 98 degree angle, 2 nm north of the FAF, at 3,000 feet asl; groundspeed 290 knots.
E	08:22:15	Moncton ACC gives SPR 703 a turn to the right to a heading of 240 degrees to intercept the localizer. Radar shows the aircraft at 2,100 feet asl and descending; groundspeed 290 knots.
F	08:22:51	Radar shows aircraft at 200 feet asl. Aircraft actually descends to about 140 feet asl in the immediate vicinity of the Lingan Power Generating Plant where a missed approach procedure was executed.

Appendix C - Flight Profile Rear View



Appendix D - Glossary

ACC	Area Control Centre
ADF	automatic direction finder
ADT	Atlantic daylight time
agl	above ground level
asl	above sea level
ATC	air traffic control
ATPL	Airline Transport Pilot Licence
ATS	Air Traffic Services
CFIT	controlled flight into terrain
CRM	crew resource management
DME	distance measuring equipment
FAF	final approach fix
fpm	feet per minute
FSS	Flight Service Station
GPS	global positioning system
hr	hour(s)
HSI	horizontal situation indicator
IFR	instrument flight rules
ILS	instrument landing system
in. Hg	inches of mercury
IPM	instrument procedures manual
KIAS	knots indicated airspeed
lb	pound(s)
MANOPS	Air Traffic Control Manual of Operations
MDA	minimum descent altitude
NDB	non-directional beacon
nm	nautical miles
PAL	Provincial Airlines Limited
PDM	pilot decision making
PF	pilot flying
PNF	pilot not flying
PPC	pilot proficiency check
SOP	standard operating procedures
TC	Transport Canada
TSB	Transportation Safety Board of Canada
V_{mo}	maximum operating speed
VOR	very high frequency omni-directional range
°	degrees
'	minutes
°M	degrees of the magnetic compass

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