DEDICATED TO HELPING BUSINESS ACHIEVE ITS HIGHEST GOALS.

NBAA

REDUCING BUSINESS AVIATION RUNWAY EXCURSIONS

How to mitigate the level of risk of runway excursions

TABLE OF CONTENTS

Introduction

The NBAA Safety Committee has developed this product with the objectives of raising the awareness level of runway excursions and identifying the common hazards associated with them. This guide will provide insights and suggestions to mitigate the level of risk of runway excursions as much as practical.

Flight departments of all shapes and sizes have the potential to benefit from the contents of this guide. It is written primarily to facilitate thought and discussion surrounding runway excursions, and therefore is a useful tool for flight department leadership; however, anyone can gain a better understanding of the latest runway excursion prevention methods by reading this guide.

Included in this guide are common hazards and common risks that contribute to runway excursions, as well as case studies highlighting real-life examples of these hazards and risks. Each case study includes suggestions for using them as learning opportunities for the entire flight department. Also included in this guide is a set of protocols the Safety Committee has created to allow operators to benchmark their runway excursion prevention efforts.

The data sources used by the committee to identify common hazards and common risks include the latest Flight Safety Foundation Report, "Reducing the Risk of Runway Excursions," FAA SAFO 06012 Landing Performance Assessments at Time of Arrival (Turbojets), FAA SAFO 15009 Turbojet Braking Performance on Wet Runways, FAA Advisory Circular (AC) 91-79A Mitigating the Risks of a Runway Overrun Upon Landing, IATA Runway Excursion Risk Reduction (RERR) Toolkit and the FAA Runway Excursion Support Tool.

If you are reading this and thinking about how you can use this information to make your flight department safer, then you are to be commended and should feel fortunate to be a part of a proactive flight department that enjoys a positive safety culture.

SECTION 1

Scope of the Issue

1.1. PURPOSE AND OBJECTIVE

1.11. Purpose: Identify the hazards and risks that lead to runway excursions. Share the lessons learned from past accidents.

1.12. Objective: Reduce the rate of runway excursions.

1.2. DEFINITIONS

Runway Excursion: When an aircraft departs the end or side of the runway surface. Runway excursions can occur on takeoff (18 percent of the time[1]) or landing (82 percent of the time[1]).

Veer Off: A runway excursion in which an aircraft departs the side of a runway.

Overrun: A runway excursion in which an aircraft departs the end of a runway.

1.3. ASSESSMENT OF YOUR FLIGHT DEPARTMENT'S LEVEL OF RISK

The first step to effectively reduce the potential for a runway excursion is to assess your department's level of exposure to the contributing risk factors. Some factors are general in nature while others are specific to takeoff or landing. The lists below represent the most common risks and hazards encountered but are not comprehensive – you must identify those risks that are unique to your operation .

1.31. General Risk Factors (Hazards)

a. Fatigue (compounds all other risk factors)

b. Pilot experience level (total time, time in type, crew pairs, etc.)

c. Airports used (characteristics)

i. Usable runway lengths, slopes, grooving, etc.

ii. Weather/runway condition reporting limitations

iii. Airspace congestion and complexity

d. Time of day/year

e. Airport operational restrictions

f. Instrument approach types

g. Preferred runway operations (allowable tailwinds, crosswinds, visibilities, closely spaced parallel approaches, etc.)

h. Aircraft performance/limitations

1.32. Most Common Risk Factors in Takeoff Excursions

a. Rejected takeoff above V1

b. Loss of pilot directional control

c. Rejected takeoff below V1

1.33. Most Common Risk Factors in Landing Excursions

a. Go-around not conducted

b. Long touchdown

c. Landing gear malfunction

d. Ineffective braking (e.g., hydroplaning, contamination)

1.34. Certification Versus Operations

a. Review and understand the conditions, criteria and operational procedures the manufacturer used to generate certificated takeoff, balanced field and landing distances

b. If you operate differently, or conditions are different (flap settings, speeds, braking, etc.), you will not experience the advertised distances

c. Review:

i. FAA SAFO 06012 Landing Performance Assessments at Time of Arrival (Turbojets)

ii. FAA Advisory Circular (AC) 91-79A Mitigating the Risks of a Runway Overrun Upon

iii. FAA SAFO 15009 Turbojet Braking Performance on Wet Runways

d. Review manufacturer's operational requirements, limitations and recommendations for all conditions

1.4. MITIGATING THE LEVEL OF RISKS

1.41. Review/develop your department guidance for mitigating risk. Section 6.2 (pages 12-13) of the FSF Report, Reducing the Risk of Runway Excursions, summarizes the suggested mitigation methods for operators.

a. Operational Guidance

i. Develop a Flight Risk Assessment Tool (FRAT) based on the factors that increase your risk exposure. Start with FSF Runway Excursion Risk Awareness Tool and AC 91-79A and modify to fit your unique operation. As risk levels increase, require documented mitigation or third-party review/approval to reduce risk

ii. Develop a list of "special" airports for your operation (one very high risk factor or numerous risk factors present)

iii. Develop preplanned mitigations for common situations that can be used as starting points, then refined for specific situations

1. Alternate sources of weather/runway conditions
2. Multiple alternates
3. Lower weights to improve performance
4. Restrictions on lower time/less experienced crew (lower max crosswind, no contamination, high minimums, two persons computing/comparing performance numbers, etc.)
5. Establish minimum runway length requirements for your operation. Consider all possibilities and be conservative! Read AC 91-79A and SAFO 15009

b. Operations (When you fly, are you practicing what you preach?)

i. Do you have written, stabilized approach criteria? Guidance for receiving Automatic Terminal Information Service (ATIS), computing performance inflight and completing approach/takeoff briefings and checklists to preclude rushing and trap errors?

ii. Do you collect data?

1. Review your completed FRATs and the mitigation used
2. Is Flight Operations Quality Assurance (FOQA) data available? Can you participate in the FAA Aviation Safety Information Analysis and Sharing (ASIAS) program?
3. Conduct periodic line checks of crew with complete, no-hazard debriefs and documentation
4. Require post-flight crew debriefs (documented) or personal debriefs (personal notes for single pilot)

c. Do you use your data to be proactive and spot trends, gauge effectiveness and drive training goals?

i. Identify what type of risks or undesired events are occurring

ii. Identify where risks or undesired events are occurring

iii. Identify why risks or undesired events are occurring

a. No procedure or guidance
b. Poor procedure or incomplete guidance
c. Non-standard procedures (workarounds) used
d. Poor understanding or misunderstanding by crew
e. Lack of training
f. Unrealistic training
g. Lack of proficiency

SECTION 2

Training

2.1. SIMULATOR

2.11. Treat the sim as the airplane. Use your checklists and accomplish all briefings. Make it a realistic learning experience, not a square filling exercise.

2.2. SUPPLEMENTAL

2.21. Ensure your training program includes training on the identified hazards that contribute to runway excursions. Supplemental topics can be added to your training program by using eLearning, attending industry safety seminars/ standdowns or holding in-house training sessions.

International Standards-Business Aviation Operations (IS-BAO) section 5.1.3 requires “any other training required to ensure a safe operation.” If a flight department’s Safety Management System indicates the need to develop a training plan to mitigate the risk level of runway excursions, that plan may include the topics listed below:

a. Aircraft Performance

b. Instrument Procedures

c. Crew Resource Management

d. Flight Discipline

e. Runway Excursions

f. Fatigue Management

2.22. In-house Opportunities

a. Case Studies – see appendix A

b. “Hangar fly” normal and abnormal scenarios for your “special” airports at safety or training meetings

- i. Practice them in the simulator
- ii. Make them realistic and evidence-based
- iii. Read AC 91-79A

c. “Hangar fly” and require simulator training to incorporate scenarios that include single and multiple higher risk factors identified in the FSF report

d. Practice normal and contaminated runway performance calculations

- i. 100 percent accuracy is required
- ii. Compare dry versus wet or contaminated runway performance (see appendix A for examples)
- iii. Review definitions for wet or contaminated runway performance in Airplane Flight Manual (AFM)

SECTION 3

Resources and Conclusion

3.1. RESOURCES FOR MORE INFORMATION

a. FAA Advisory Circular (AC) 91-79A

b. FAA Safety Alert for Operators (SAFO) 06012 – Landing Performance Assessments at Time of Arrival (Turbojets)

c. FAA Safety Alert for Operators (SAFO) 15009 – Turbojet Braking Performance on Wet Runways

d. Flight Safety Foundation (FSF) Reducing the Risk of Runway Excursions: Report of the Runway Safety Initiative

e. IATA Runway Excursion Risk Reduction (RERR) Toolkit

f. FAA Runway Excursion Support Tool

g. IBAC Business Aviation Safety Brief – Summary of Global Accident Statistics 2009-2013

3.2. CONCLUSION

Runway excursions continue to be the most common type of accident in business aviation. The first step in mitigating risk is to raise the level of awareness. The purpose of this document is to not only raise awareness of the common hazards and errors that lead to runway excursions, but to also provide an impetus for further discussion and/or training within flight departments.

All operators are different. The action one operator pursues to address the risk of runway excursions can be very different from the action another operator pursues to address the same risk. It is up to each operator to decide the most realistic and effective path that works for them.

APPENDIX A: CASE STUDIES

Case Study 1: MAC Runway Excursion

Arrival to MAC

During the preflight, the crew noticed that there were some rain showers over the airport in MAC and correctly anticipated the weather would improve before their arrival. Runway 28 at MAC is 4,694 feet long.

The crew relied on weather reports from Middle Georgia Regional Airport (MCN), 9 miles from MAC. Ten minutes prior to the accident, the weather at MCN was winds 180 at 6 knots, 11,000 broken and 7 miles visibility in light rain.

When the flight was about 11 miles from the airport, the flight crew visually acquired the airport, cancelled their IFR clearance with the Macon Radar Approach controller and proceeded to the airport visually.

The landing was within the first 1,000 feet of the runway and during the landing rollout, the airplane began to "hydroplane" since there was visible standing water on the runway and the water was "funneling into the middle." Maximum reverse thrust, braking and ground spoilers were deployed; however, both pilots reported a "pulsation" in the brake system. The airplane departed the end of the runway into the grass, went down an embankment, across a road, and into trees.

According to an eyewitness statement, a few minutes prior to the airplane landing, the airport experienced a rain shower with a "heavy downpour." The witness reported observing the airplane on approach, heard the engine thrust reverse and then observed the airplane "engulfed in a large ball of water vapor."

Performance

Airplane performance information provided by the manufacturer in the AFM and its supplements were used to determine landing distance. Radar data indicated that the landing was long and the airplane may have been 15 to 19 knots fast relative to a reference speed of 110 knots. About 1.25 nm from the runway, threshold radar data indicated that the airplane was aligned with the runway and flew an approximate 4° glide slope approach angle. Although radar data indicated that the ground speed was decreasing, the approximate speed while crossing the runway threshold was about 125 knots; however, due to uncertainty in the wind direction and speed, an exact speed could not be ascertained.

According to the performance chart titled "LANDING DISTANCE WET OR COMPACTED SNOW," which was located in the AFM in the section titled "Non-FAA Approved," the correlated approach reference speed for a 13,500 pound airplane would have been 110 knots. That chart revealed that the required landing distance at an approach speed of Vref would have been about 4,800 feet and a landing distance of about 6,100 feet if the approach speed was flown at Vref+10 knots.

The National Transportation Safety Board determined the probable cause of the accident was the pilot's failure to maintain proper airspeed, which resulted in the airplane touching down too fast on the wet runway with inadequate runway remaining to stop and the subsequent runway overrun.

Contributing to the landing overrun were the flight crewmembers' failure to correctly use the appropriate performance chart to calculate the runway required to stop on a contaminated runway and their general lack of proper crew resource management.

Questions for Reflection

1. Absent real-time weather information, including accurate runway condition reports, when would you apply wet runway landing performance numbers? Would your answer change if the runway was grooved or not?
2. In what ways does the certification landing profile, which is used to calculate the landing performance numbers in our AFM, differ from how you typically operate your aircraft?
3. We continue to see runway excursion accidents in business aviation. In your opinion what must we do differently to reverse this trend?

MAC Runway Excursion Facilitator's Guide

On September 18, 2012, about 1003 eastern daylight time (EDT), a Beech 400, N428JD, was substantially damaged when it overran runway 28 during landing at Macon Downtown Airport (MAC), Macon, Georgia. Visual meteorological conditions prevailed and an instrument flight rules (IFR) flight plan was filed. Both Airline Transport Pilots (ATP) and one passenger sustained minor injuries.

(Note: The information in this case study is extracted directly from the NTSB final report, but for additional information refer to the complete NTSB report.)

Arrival to MAC

During the preflight, the crew noticed that there were some rain showers over the airport in MAC and correctly anticipated the weather would improve before their arrival. Runway 28 at MAC is 4,694 feet long.

The crew relied on weather reports from Middle Georgia Regional Airport (MCN), 9 miles from MAC. Ten minutes prior to the accident, the weather at MCN was winds 180 at 6 knots, 11,000 broken and 7 miles visibility in light rain.

Additional questions for discussion with your group:

1. What are the minimum runway length requirements, if any, for your aircraft/company? Would your company risk management process allow for a departure to a 4694′ runway that may be wet at your estimated time of arrival? Would departure be based on any risk mitigation requirements like special briefings, landing techniques, alternates, etc.
2. What is your company policy, if any, related to the definition for a wet or contaminated runway to consider during preflight planning?

When the flight was about 11 miles from the airport, the flight crew visually acquired the airport, cancelled their IFR clearance with the Macon Radar Approach controller and proceeded to the airport visually.

> When you cancel IFR what additional pilot responsibilities are you assuming? [Special Use Airspace and TFR Avoidance, VFR Cloud Clearance, Minimum Safe Altitude for Terrain and Obstruction Clearance, Traffic Separation with IFR traffic]

The landing was within the first 1,000 feet of the runway and during the landing rollout, the airplane began to “hydroplane” since there was visible standing water on the runway and the water was “funneling into the middle.” Maximum reverse thrust, braking and ground spoilers were deployed; however, both pilots reported a “pulsation” in the brake system. The airplane departed the end of the runway into the grass, went down an embankment, across a road, and into trees.

> Discuss what you feel in the braking system when applying maximum braking effort with an anti-skid system. Pulsation is normal in this situation.

According to an eyewitness statement, a few minutes prior to the airplane landing, the airport experienced a rain shower with a “heavy downpour.” The witness reported observing the airplane on approach, heard the engine thrust reverse, and then observed the airplane “engulfed in a large ball of water vapor.”

> How should you risk manage a flight into an uncontrolled airport with either no weather reporting or automated weather reports? How should you assess runway conditions for landing performance?

Performance

Airplane performance information provided by the manufacturer in the AFM and its supplements were used to determine landing distance. Radar data indicated that the landing was long and the airplane may have been 15 to 19 knots fast relative to a reference speed of 110 knots. About 1.25 nm from the runway threshold radar data indicated that the airplane was aligned with the runway and flew an approximate 4° glide slope approach angle. Although radar data indicated that the ground speed was decreasing, the approximate speed while crossing the runway threshold was about 125 knots; however, due to uncertainty in the wind direction and speed, an exact speed could not be ascertained.

According to the performance chart titled “LANDING DISTANCE WET OR COMPACTED SNOW,” which was located in the AFM in the section titled “Non-FAA Approved,” the correlated approach reference speed for a 13,500 pound airplane would have been 110 knots. That chart revealed that the required landing distance at an approach speed of Vref would have been about 4,800 feet and a landing distance of about 6,100 feet if the approach speed was flown at Vref+10 knots.

The National Transportation Safety Board determined the probable cause of the accident was the pilot’s failure to maintain proper airspeed, which resulted in the airplane touching down too fast on the wet runway with inadequate runway remaining to stop and the subsequent runway overrun.

Contributing to the landing overrun were the flight crewmembers’ failure to correctly use the appropriate performance chart to calculate the runway required to stop on a contaminated runway and their general lack of proper crew resource management.

Questions for Reflection

1. Absent real-time weather information, including accurate runway condition reports, when would you apply wet runway landing performance numbers? Would your answer change if the runway was grooved or not?
2. In what ways does the certification landing profile, which is used to calculate the landing performance numbers in our AFM, differ from how you typically operate your aircraft?
3. We continue to see runway excursion accidents in business aviation. In your opinion what must we do differently to reverse this trend?

Case Study 2: OWA Runway Excursion

On July 31, 2008, about 0945 central daylight time, East Coast Jets flight 81, a Hawker Beechcraft Corporation 125-800A airplane, N818MV, crashed while attempting to go around after landing on runway 30 at Owatonna, Minnesota.

Arrival to OWA

The OWA AWOS reported calm winds and visibility of 10 miles in thunderstorms and rain, and the remarks indicated that lightning was detected in the distance in all quadrants.

During the descent, the controller asked the crew if they saw extreme precipitation 20 miles straight ahead. The first officer responded, "yeah, we're paintin' it here and…what is the bases (report)?" The controller responded that he did not know what the cloud bases were but did know that the cloud tops were "quite high." The controller added, "I don't recommend you go through it. I've had nobody go through it." The first officer responded that he would like to deviate to the right, and the controller approved the deviation.

The controller asked the crew to state their intentions and added, "I can't even give you a good recommendation right now." The captain replied, "I got it clear probably for another forty miles." The CVR recorded the captain saying, "I didn't really hear what he was sayin'…, all I care is above 10 [thousand feet] and we go fast so we can get around this…thing." The captain continued, "what do you mean what are my intentions? Get me around this…so I can go to the field…I ain't gonna turn around and go home." About the same time, the CVR recorded the sound of increased background noise consistent with rain impacting the windscreen.

About 0935, the pilots started the descent to 7,000 feet; however, according to the CVR recording, neither pilot commanded the initiation of the Descent checklist.

CRM

The presence of rain, changing winds and the controller's comments should have alerted the pilots to the fact that the weather was worse than anticipated and that they might experience difficulty during the landing; however, evidence indicates that the pilots did not consider these factors or reassess the landing situation.

The captain's failure to conduct an approach briefing is especially problematic given the unexpected adverse weather conditions, including the tailwind, that the flight encountered during the descent and approach. An approach briefing would have helped the captain and first officer develop a shared mental model of the coming landing operations, which would have encouraged the first officer's coordination and support in monitoring external factors such as weather and runway conditions, and would have mentally prepared the pilots to properly deal with an abnormal or emergency situation.

For example, the missed approach procedure would have been included in the approach briefing and clarified the captain's intended actions in the event of a go-around. If a PIC does not do this and a go-around becomes necessary, pilots might become confused about what actions to take. Further, a briefing on the expected runway conditions would have clarified whether the captain expected to land on a wet runway.

In addition, a well-briefed and coordinated flight crew should have realized that changing winds would be possible as a result of the weather conditions and, therefore, gotten more current wind information from the AWOS or the flight instruments after the Rochester approach controller indicated that the weather information he had provided the first officer was 20 minutes old. If the pilots had obtained current wind information, they would have been prepared for the possibility of landing on runway 12 with a headwind rather than landing on runway 30 with a tailwind.

The captain stated, "the sooner you get us there the better," and then the first officer stated, "why don't (they) just get us to the field?" These statements and those made earlier in the flight indicate that the pilots were impatient to land. Although no apparent reason existed for the pilots to feel rushed (for example, they landed nine minutes ahead of schedule and no evidence was found that the passengers or the company were placing undue pressure on the pilots to land early on the day of the accident), they repeatedly expressed impatience with ATC and the weather radar displays.

At 0938:50, the captain stated that the Approach checklist was complete and one second later, the first officer responded, "approaches are done," even though he had been interrupted about two minutes before making this statement and had not completed the checklist.

The CVR recorded the first officer trying to contact the FBO for nonessential reasons, such as asking about how to get fuel upon landing, with the captain's approval at a time when he should have been completing the Approach checklist and monitoring the flight instruments. These calls were further interrupted by more critical communications with the captain, radio calls and ATC. After the first officer talked to the FBO, he briefed the captain on the parking and fueling plan. At that point, the airplane was about two minutes from touchdown.

Both pilots repeatedly failed to conduct checklists appropriately and verify verbally that the checklists had been completed, demonstrating that neither was focused on proper checklist execution.

The first officer was treated as a trainee, delegated minor tasks such as contacting ground operations and resetting the transponder at critical times during the approach when both pilots should have been attentive to the landing.

The captain provided unorganized mentoring comments during short final approach rather than fully briefing his expectations during the required approach briefing and allowed a nonsterile cockpit environment to exist during the high workload phases of approach and landing.

Further, the captain performed many duties assigned to the first officer, serving as a single pilot without the full benefit of a second professional pilot who was able to monitor his actions and prevent risks.

Both pilots had excellent performance records as individual pilots but functioned less effectively as a crew.

Questions for Reflection

1. What were some filters to communication between the two pilots?

2. What expectation biases may have been present in this accident sequence?

3. The NTSB report refers to a shared mental model. How does that relate to Situational Awareness?

OWA Runway Excursion Facilitator's Guide

On July 31, 2008, about 0945 central daylight time, East Coast Jets flight 81, a Hawker Beechcraft Corporation 125-800A airplane, N818MV, crashed while attempting to go around after landing on runway 30 at Owatonna, Minnesota.

> The complete NTSB report is available at http://www.ntsb.gov/investigations/AccidentReports/Pages/AAR1101.aspx. The information in this case study is extracted directly from the NTSB final report. Additional information is available in the report.

Arrival to OWA

The OWA AWOS reported calm winds and visibility of 10 miles in thunderstorms and rain, and the remarks indicated that lightning was detected in the distance in all quadrants.

> The AWOS report indicated VMC conditions. With the report of a thunderstorm in the AWOS report, what additional risk mitigation efforts, if any, would you apply to landing at this airport?

During the descent, the controller asked the crew if they saw extreme precipitation 20 miles straight ahead. The first officer responded, "yeah, we're paintin' it here and…what is the bases (report)?" The controller responded that he did not know what the cloud bases were but did know that the cloud tops were "quite high." The controller added, "I don't recommend you go through it. I've had nobody go through it." The first officer responded that he would like to deviate to the right, and the controller approved the deviation.

> Note the terminology from the controller. Beginning in 2006, ATC uses only four terms, "light," "moderate," "heavy" and "extreme" to describe weather radar echoes.

The controller asked the crew to state their intentions and added, "I can't even give you a good recommendation right now." The captain replied, "I got it clear probably for another forty miles." The CVR recorded the captain saying, "I didn't really hear what he was sayin'…, all I care is above 10 [thousand feet] and we go fast so we can get around this…thing." The captain continued, "what do you mean what are my intentions? Get me around this…so I can go to the field…I ain't gonna turn around and go home." About the same time, the CVR recorded the sound of increased background noise consistent with rain impacting the windscreen.

About 0935, the pilots started the descent to 7,000 feet; however, according to the CVR recording, neither pilot commanded the initiation of the Descent checklist.

CRM

The presence of rain, changing winds and the controller's comments should have alerted the pilots to the fact that the weather was worse than anticipated and that they might experience difficulty during the landing; however, evidence indicates that the pilots did not consider these factors or reassess the landing situation.

The captain's failure to conduct an approach briefing is especially problematic given the unexpected adverse weather conditions, including the tailwind, that the flight encountered during the descent and approach. An approach briefing would have helped the captain and first officer develop a shared mental model of the coming landing operations, which would have encouraged the first officer's coordination and support in monitoring external factors such as weather and runway conditions, and would have mentally prepared the pilots to properly deal with an abnormal or emergency situation.

For example, the missed approach procedure would have been included in the approach briefing and clarified the captain's intended actions in the event of a go-around. If a PIC does not do this and a go-around becomes necessary, pilots might become confused about what actions to take. Further, briefing the expected runway conditions would have clarified whether the captain expected to land on a wet runway.

In addition, a well-briefed and coordinated flight crew should have realized that changing winds would

be possible as a result of the weather conditions and, therefore, gotten more current wind information from the AWOS or the flight instruments after the Rochester approach controller indicated that the weather information he had provided the first officer was 20 minutes old. If the pilots had obtained current wind information, they would have been prepared for the possibility of landing on runway 12 with a headwind rather than landing on runway 30 with a tailwind.

How often do you get an update of the AWOS weather while approaching an airport? Would the earlier AWOS report of a thunderstorm cue you into having the pilot monitoring get an updated AWOS report closer to the airport?

The captain stated,"the sooner you get us there the better," and then the first officer stated, "why don't (they) just get us to the field?" These statements and those made earlier in the flight indicate that the pilots were impatient to land. Although no apparent reason existed for the pilots to feel rushed (for example, they landed nine minutes ahead of schedule and no evidence was found that the passengers or the company were placing undue pressure on the pilots to land early on the day of the accident), they repeatedly expressed impatience with ATC and the weather radar displays.

At 0938:50, the captain stated that the Approach checklist was complete and one second later, the first officer responded, "approaches are done," even though he had been interrupted about two minutes before making this statement and had not completed the checklist.

The CVR recorded the first officer trying to contact the FBO for nonessential reasons, such as asking about how to get fuel upon landing, with the captain's approval at a time when he should have been completing the Approach checklist and monitoring the flight instruments. These calls were further interrupted by more critical communications with the captain, radio calls and ATC. After the first officer talked to the FBO, he briefed the captain on the parking and fueling plan. At that point, the airplane was about two minutes from touchdown.

What can you do to transfer workload from higher workload phases of flight like approach and landing to lower workload phases of flight? If you can't reach the FBO by UNICOM, do you use the flight phone to coordinate your arrive while still at cruise flight levels/altitudes?

Both pilots repeatedly failed to conduct checklists appropriately and verify verbally that the checklists had been completed, demonstrating that neither was focused on proper checklist execution.

Does your company have a checklist protocol? Do you use challenge/response or flows backed up by a checklist?

The first officer was treated as a trainee, delegated minor tasks such as contacting ground operations and resetting the transponder at critical times during the approach when both pilots should have been attentive to the landing.

The captain provided unorganized mentoring comments during short final approach rather than fully briefing his expectations during the required approach briefing and allowed a nonsterile cockpit environment to exist during the high workload phases of approach and landing.

Do you have a sterile cockpit rule (only essential communication) below 10,000 feet? Do you adhere to it?

Further, the captain performed many duties assigned to the first officer, serving as a single pilot without the full benefit of a second professional pilot who was able to monitor his actions and prevent risks.

Both pilots had excellent performance records as individual pilots but functioned less effectively as a crew.

Questions for Reflection

1. What were some filters to communication between the two pilots?

2. What expectation biases may have been present in this accident sequence?

3. The NTSB report refers to a shared mental model. How does that relate to Situational Awareness?

APPENDIX B: PERFORMANCE PROBLEM EXAMPLES

Example 1: Chance of Rain at AGO

You have a trip scheduled to land at Magnolia, AR (AGO) at 1600Z. You are conducting your preflight weather and performance planning. There is no weather reporting at AGO. Closest Terminal Forecast is at South Arkansas Regional Airport at Goodwin Field [KELD] 20nm E of AGO.

KELD 111139Z 1112/1212 18003KT P6SM FEW250 TEMPO 1112/1113 00000KT 3SM BR FM111400 VRB03KT 4SM BR FEW025 SCT250 TEMPO 1115/1118 VRB05KT 2SM -RA BKN020 FM111800 01005KT P6SM SCT040 SCT250 FM120000 02006KT P6SM VCTS BKN050CB BKN250

Area Forecast

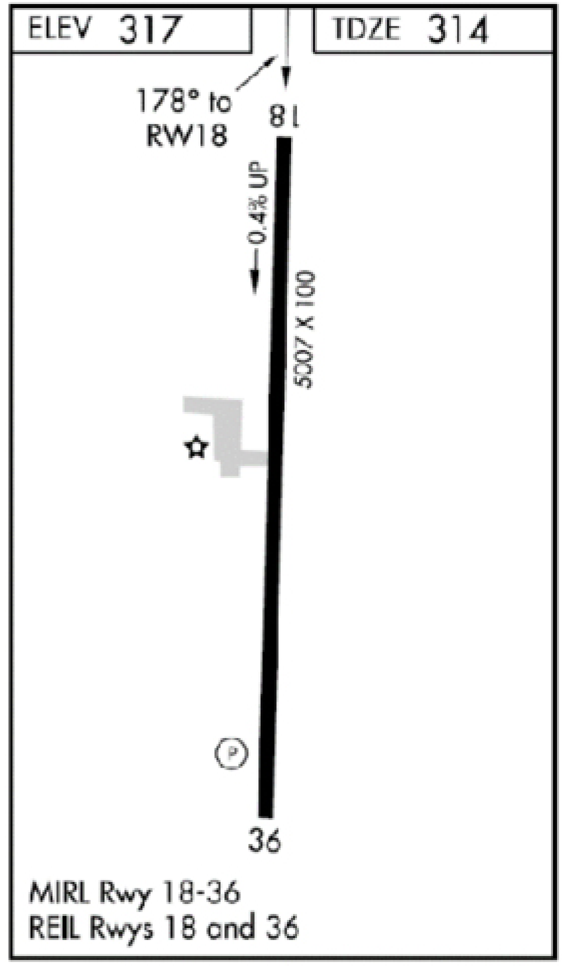
DFWC FA 110945
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 120400
CLDS/WX VALID UNTIL 112200...OTLK VALID 112200-120400
OK TX AR TN LA MS AL
.

SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN. TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.NON MSL HGTS DENOTED BY AGL OR CIG.
.

SYNOPSIS...10Z CDFNT OK-TX PNHDL. SCNDRY CDFNT NRN AL-CNTRL
MS-NRN LA-CNTRL TX. 04Z CDFNT ERN TN-NRN AL-CNTRL MS-NRN LA-CNTRL TX.
.

AR

N HLF...BKN050 TOP FL250. SCT -SHRA/-TSRA. CB TOP FL450. BECMG 1619 BKN060. WDLY SCT -SHRA/ISOL -TSRA. OTLK...VFR.
S HLF...SCT150 SCT CI. OCNL VIS 3SM BR. BECMG 1418 SCT040 BKN100
TOP FL250. OCNL VIS 2SM -RA. 18Z SCT -TSRA. OTLK...VFR TSRA.



MAGNOLIA MUNI (AGO)

1. Since there is no weather reporting for AGO, would you use the terminal forecast for KELD or the area forecast for your planning?
2. For preflight planning consideration, would you consider the runway wet when there is a chance of light rain showers in the forecast at your estimated time of arrival?
3. Would it affect your performance planning if the runway was grooved? How can you determine if the runway is grooved?
4. If you decided to depart for (AGO, how would you determine if you needed to apply wet runway performance data upon arrival?

Example 2: Snowing at TEB

You have a trip scheduled to land at Teterboro [TEB] at 1600Z. You are conducting your preflight weather and performance planning.

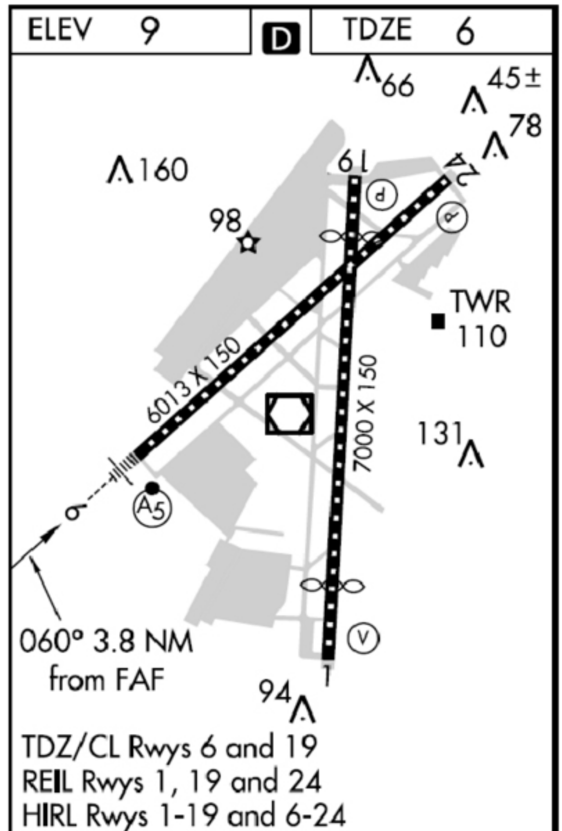
> KTEB 111139Z 1112/1212 29010KT 4SM –SN OVC025
> TEMPO 1112/1113 29015KT 2SM -SN FM111400
> 29014KT 2SM -SN OVC025 TEMPO 1115/1118 29018KT
> 1SM SN OVC012 FM111800 29015KT 1SM SN OVC010
> FM120000 29018KT 2SM –SN BKN015 OVC020

1. With the forecast for snow at your time of arrival, how do you determine landing distance? Does your aircraft type have performance charts for compacted or wet snow? If not, do you apply a factor to your dry landing distance numbers?

2. Do you have a maximum crosswind limit for landing on contaminated runways? If TEB was landing RWY 1 and braking action was reported as medium (fair) would you attempt to land at TEB?

3. How do you determine runway condition upon arrival?

4. How would reports of braking action good, medium, or poor affect your landing distance?



FAF to MAP 3.8 NM					
Knots	60	90	120	150	180
Min:Sec	3:48	2:32	1:54	1:31	1:16

TETERBORO (TEB)

APPENDIX C: RUNWAY EXCURSION PREVENTION PROTOCOL

The following protocol is designed to be used in conjunction with the 2015 IS-BAO Audit Forms, with each recommendation referenced under the relevant section. Each item should be incorporated as and where appropriate to ensure your operation has reduced the risk of runway excursions to as low as is reasonably practical.

Hazard Identification

1. Does the operator have an ongoing process to identify critical runways within their operations?

Risk Assessment and Mitigation

1. Does the operator have a process to actively monitor the level of risk during all takeoff and landing operations? (Consider incorporating a form of the Flight Safety Foundation Runway Excursion Risk Awareness Tool (RERAT), customized to your operation).
2. Does the operator provide flight crews with suggested/recommended risk mitigation plans for the common hazards that contribute to runway excursions?

Training Programs, Flight Crew Members

1. Does the operator have a process to ensure accurate takeoff and landing performance data is used during all operations?
2. Does the operator have a training program for takeoff and landing performance calculations?

Standard Operation Procedures

1. Does the operator have a process for the development and updating of SOPs based on the input of the flight crews?

Flight Planning and Pre-Flight Requirements

1. Do flight crews consider the factors affecting landing and takeoff distances, such as:
   a. Conditions conducive to hydroplaning
   b. Criteria upon which landing distance calculations are based
   c. Crosswind and wheel cornering issues
   d. Wind shear hazards
   e. Braking action, runway friction coefficient, runway condition index and maximum recommended cross wind component depending on runway condition
   f. Landing with a tailwind on a contaminated runway is not recommended

Operational Control

1. Does the operator have a process to ensure accurate weight-and-balance calculations are being accomplished, including error detection?

Piloting Competency in Key Safety Areas, Stabilized Approach

1. Does the operator define, publish and train the elements of a stabilized approach? (Flight crews should recognize that fast and high on approach, high at threshold and fast, long and hard touchdowns are major factors leading to landing excursions)
2. Does the operator define, publish and train required call-outs for a stabilized approach?
3. Does the operator have policies to:
   a. Discourage late runway changes, especially after the final approach fix?
   b. Prefer approaches with vertical guidance, especially at night or at the end of a duty period?
   c. Decline ATC speed control requests inside the final approach fix?

Piloting Competency in Key Safety Areas, Runway Excursion Prevention

1. Does the operator define and train for proper execution of the RTO decision?
2. Does the operator stress that CRM and adherence to SOPs are critical in RTOs?
3. Does the training program emphasize recognition of takeoff rejection issues, such as:
   a. Sudden loss or degradation of thrust?
   b. Tire and other mechanical failures?
   c. Flap and spoiler configuration issues?
   d. Crosswind operations?
   e. Directional control during deceleration?
4. Does the training program emphasize recognition of landing issues, such as:
   a. Critical runway operations?
   b. Go-around, including during flare and after touchdown (rejected landing), and bounced landing?
   c. Assessment of landing distance prior to every landing?
   d. Crosswind operations?
   e. Appropriate flare technique?
   f. Landing on wet, slippery or contaminated runways?

g. Using brakes, spoilers and thrust reversers as recommended by the manufacturer and maintaining their use until a safe taxi speed is assured?

h. Use of autobrake system and thrust reversers on wet and/or contaminated runways?

i. Use of rudder, differential braking and nose wheel steering for directional control during aircraft deceleration and runway exit?

j. Recognizing when there is a need for, and appropriate use of, all available deceleration devices to their maximum capability?

k. Runway condition reporting by flight crews?

5. Does the operator's training stress that thrust reversers have the potential to malfunction and deploy asymmetrically, increasing the risk of a runway excursion? (Reverse thrust is most effective at high speeds)

6. Does the operator's training stress that combination of risk factors (such as abnormal winds plus contaminated runways or unstable approaches plus thrust reverser issues) significantly increase the risk of runway excursions? (Flight crews should use a Runway Excursion Risk Awareness Tool for each landing to increase their awareness of the risks that may lead to a runway excursion)

Stabilized Approach

1. Does the operator have, train and support a no-fault go-around policy?

2. Does the operator define criteria that require a go-around?

3. Does the operator dictate a go-around if an approach does not meet the stabilized approach criteria?

NBAA
National Business Aviation Association
1200 G Street NW, Suite 1100
Washington, DC 20005
www.nbaa.org
(202) 783-9250 | ops@nbaa.org

ACKNOWLEDGMENTS

This NBAA publication was created by the NBAA Safety Committee in January 2016. Review the Top Safety Focus Areas identified by the committee at www.nbaa.org/safety-focus. Learn more about the NBAA Safety Committee at www.nbaa.org/committees.

ABOUT NBAA

Founded in 1947 and based in Washington, DC, the National Business Aviation Association (NBAA) is the leading organization for companies that rely on general aviation aircraft to help make their businesses more efficient, productive and successful. Contact NBAA at (800) FYI-NBAA or info@nbaa.org. Not a Member? Join today by visiting www.nbaa.org/join.