



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

September 4, 2018

### **Group Chairman's Factual Report**

# **OPERATIONAL FACTORS/HUMAN PERFORMANCE**

DCA18IA081

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## A. INCIDENT

Location: Pullman/Moscow Regional Airport, Pullman/Moscow, Washington  
 Date: December 29, 2017  
 Time: 1840 Pacific Standard Time (PST)<sup>1</sup> (0240 UTC)  
 Airplane: Bombardier DHC-8-402; Registration N412QX  
 Operator: Horizon Air

## B. SUMMARY

On December 29, 2017, about 1830 pacific standard time, Horizon Air flight 2184, a Bombardier DHC-8-402,<sup>2</sup> registration N412QX, landed on a taxiway parallel to runway 6 at Pullman/Moscow Regional Airport (PUW), Pullman, Washington. Weather at the time of landing was reported as wind from the southeast, light rain, overcast ceiling with 5 miles visibility. There were no injuries to the 4 crew members or 38 passengers, and there was no damage to the airplane. After the airplane landed, the flightcrew observed that the runway lights were inoperative. The passenger flight was operating under 14 *Code of Federal Regulation (CFR)* Part 121 on an instrument flight rules flight plan and instrument meteorological conditions (IMC) prevailed at the airport. The flight originated from Seattle/Tacoma International Airport (SEA), Seattle, Washington.

## C. OPERATIONAL FACTORS/HUMAN PERFORMANCE GROUP

Captain David Lawrence  
 Operational Factors Division (AS-30)  
 National Transportation Safety Board (NTSB)

Dr. Katherine Wilson  
 Human Performance and Survival Factors  
 Division (AS-60)  
 NTSB

<sup>1</sup> All times referenced in this Factual Report are pacific standard time, unless otherwise noted.

<sup>2</sup> References to the “Q400,” “Q-400,” and “DHC-8-402” in this Factual report indicate the identical airplane type.

Captain Jason Atterbury  
Manager, Flight Safety  
Horizon Air

Captain Dan Buckley<sup>3</sup>  
Q-400 Check Airman  
International Brotherhood of Teamsters (IBT)

Mr. Robert Hendrickson  
Aviation Safety Inspector, AVP-100  
Federal Aviation Administration (FAA)

## **D. DETAILS OF THE INVESTIGATION**

The Operations/Human Performance (Ops/HP) Group Chairmen did not launch to the incident. From January 30, 2018, to February 12, 2018, the NTSB requested and received documentation from Horizon Air related to the incident flight and pilots. FAA certification information was also requested.

On February 6, 2018, the Ops/HP group interviewed the incident captain and first officer (FO) via telephone.

On February 26, 2018, the Ops/HP group traveled to Seattle, Washington, and conducted Q-400 simulator observation work. In addition, the group conducted further interviews with Horizon Air instructors and check airmen, as well as interviewed Horizon Air safety management.

## **E. FACTUAL INFORMATION**

### **1.0 History of Flight**

The incident flight occurred on the second flight of the day for the flightcrew. Both pilots began their duty day at 1513 local time on December 29, 2017, in Missoula International Airport (MSO) Missoula, Montana. They flew a 2 hour and 10-minute flight from MSO to SEA, arriving in SEA at 1630.

According to the flight release for Horizon Air flight 2184, there were no NOTAMs<sup>4</sup> for the runway lights being out of service at PUW.<sup>5</sup> Horizon Air flight 2184 departed SEA at 1748 with 2 flight crewmembers, 2 flight attendants and 38 passengers for a planned 1 hour and 1-minute flight to PUW.

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<sup>3</sup> Captain Buckley participated in the investigation until May 2018 when he left Horizon Air.

<sup>4</sup> A Notice to Airmen or NOTAM is a notice containing information (not known sufficiently in advance to publicize by other means) concerning the establishment, condition, or change in any component (facility, service, or procedure of, or hazard in the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations. Source: FAA.

<sup>5</sup> See Attachment 2 - Flight Release and Weather Packet. According to Horizon Air, the flight release was printed out in SEA at 1700 PST on the day of the incident.

Horizon Air flight 2184 was cleared by air traffic control (ATC) for the RNAV<sup>6</sup> (RNP)<sup>7</sup> M instrument approach to runway 06 at PUW. The captain was the Pilot Flying (PF) and the FO was the Pilot Monitoring (PM) for the incident flight.<sup>8</sup>

Conditions at the PUW airport were wind from the southeast, light rain, overcast ceiling with 5 miles visibility, and the captain used the Head-up Guidance System (HGS) installed on the captain's side of the cockpit during the approach. According to interviews, the captain attempted to illuminate the PUW airport lighting via the Common Traffic Advisory Frequency (CTAF)<sup>9</sup> prior to the initial approach fix and prior to exiting the clouds.

Shortly after crossing the initial approach fix, the airplane exited the clouds and the captain stated that he observed what he believed was runway 06 and runway lights, though according to his interview he questioned whether the runway lights were on bright or dim.

The airplane subsequently landed to the left of runway 06 and on the parallel taxiway at PUW at 1840. According to both pilots, they attempted to change the illumination of the taxiway and runway lights via the CTAF during their 6-minute taxi to parking, observed the blue taxiway lights change illumination, but did not observe the runway lights illuminate.

There was no damage to the airplane and no injuries to the crew or passengers. According to the Executive Director of the Pullman-Moscow Regional Airport, after the incident PUW operations personnel found flooded electrical wiring vaults associated with the runway lighting system from heavy rains and snow that had occurred previously on the day of the incident.<sup>10</sup>

## **2.0 Flight Crew Information**

The incident flight involved two flight crewmembers; the captain and the FO. There were 2 flight attendants and 38 passengers (37 adults and one child) onboard. There was no one occupying the cockpit jumpseat.

The captain and FO had only previously flown together on two flight legs preceding the incident flight.

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<sup>6</sup> Area Navigation.

<sup>7</sup> Required Navigation Performance.

<sup>8</sup> According to the Horizon Air Q-400 Flight Standards Manual, page 3.1.7, during flight, the PF was responsible to fly the aircraft, navigate, and call for required checklists. The PM was responsible for ATC communication, aircraft systems management, and accomplish flight deck checklists. Both pilots were required to maintain awareness of the status of aircraft systems. According to the Horizon Air Flight Operations Manual, page 6.1.1, each Captain of an aircraft is, during flight time, in command of the aircraft and crew and is responsible for the safety of the passengers, crewmembers, cargo and airplane. Each Captain has full authority in the operation of the aircraft, without limitation, over other crewmembers and their duties during flight time, whether or not he holds valid certificate authorizing him to perform the duties of those crewmembers.

<sup>9</sup> According to FAA Advisory Circular 90-42F, the CTAF is "a designated frequency for the purpose of carrying out airport advisory practices while operating to or from an airport that does not have a control tower or an airport where the control tower is not operational. The CTAF is normally a UNICOM, MULTICOM, flight service station (FSS) frequency, or a tower frequency. CTAF will be identified in appropriate aeronautical publications."

<sup>10</sup> Source: Email sent to the NTSB Survival Factors Investigator on Friday, February 2, 2018 12:33 AM.

## 2.1 The Captain

The captain was 49 years old and resided in Sherwood, Oregon. He was based in Medford, Oregon as Q-400 Captain.

A review of the FAA Accident/Incident Data System, Enforcement Information System and PTRS<sup>11</sup> database showed no records or reports of any previous aviation incidents or accidents involving the captain.

### 2.1.1 The Captain's Pilot Certification Record<sup>12</sup>

Private Pilot – Airplane Single Engine Land (Night Flying Prohibited) certificate issued June 23, 1989.

Private Pilot – Airplane Single Engine Land certificate issued February 21, 1997.

Private Pilot – Airplane Single Engine Land, Instrument Airplane certificate issued September 3, 1997.

Commercial Pilot – Airplane Single Engine Land, Instrument Airplane certificate issued October 13, 1997.

Notice of Disapproval - Commercial Pilot – Airplane Single Engine and Multiengine Land, Instrument Airplane certificate issued October 25, 1997. Areas of reexamination: Traffic patterns, short field landing, emergency descent.

Commercial Pilot – Airplane Multiengine Land, Instrument Airplane certificate issued November 14, 1997.

Flight Instructor – Airplane Single and Multiengine Airplane certificate issued December 20, 1997.

Renewed: January 9, 1998.

Notice of Disapproval – Flight Instructor – Airplane Single Engine and Multiengine Instrument (First Failure) issued January 13, 1998. Areas of reexamination: Entire Practical Test.

Flight Instructor – Airplane Single Engine and Multiengine Instrument issued January 26, 1998.

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<sup>11</sup> The Program Tracking and Reporting Subsystem (PTRS) is a comprehensive information management and analysis system used in many Flight Standards Service (AFS) job functions. It provides the means for the collection, storage, retrieval, and analysis of data resulting from the many different job functions performed by Aviation Safety Inspectors (ASIs) in the field, the regions, and headquarters. This system provides managers and inspectors with the current data on airmen, air agencies, air operators, and many other facets of the air transportation system. Source: FAA.

<sup>12</sup> Source: FAA.

Airline Transport Pilot – Airplane Multiengine Land, Commercial Privileges Airplane Single Engine Land certificate issued December 21, 2001.

Airline Transport Pilot – Airplane Multiengine Land, CL-65 (SIC Privileges Only), Commercial Privileges Airplane Single Engine Land certificate issued April 26, 2006.

Airline Transport Pilot – Airplane Multiengine Land, DHC-8 (Circ Apch – VMC Only), CL-65 (SIC Privileges Only), Commercial Privileges Airplane Single Engine Land certificate issued June 3, 2007.

## **2.1.2 The Captain’s Pilot Certificates and Ratings Held at Time of the Incident**

Airline Transport Pilot (certificate issued November 25, 2015)<sup>13</sup>  
Airplane Multiengine Land; DHC-8 (Circ Apch – VMC Only), CL-65 (SIC Privileges Only)  
Commercial Privileges Airplane Single Engine Land

Medical Certificate - First Class (issued September 21, 2017)<sup>14</sup>  
Limitations: none

## **2.1.3 The Captain’s Training and Proficiency Checks Completed<sup>15</sup>**

|                                                          |                    |
|----------------------------------------------------------|--------------------|
| Date of Hire                                             | June 12, 2000      |
| Date Upgraded to Captain on Q-400                        | June 20, 2007      |
| Date of Most Recent Proficiency Training                 | September 5, 2017  |
| Date of Most Recent Proficiency Check (Q-400)            | September 18, 2017 |
| Date of Most Recent PIC <sup>16</sup> Line Check (Q-400) | November 28, 2017  |

## **2.1.4 The Captain’s Flight Times<sup>17</sup>**

The captain’s flight times, according to Horizon Air:

|                                  |        |
|----------------------------------|--------|
| Total pilot flying time          | 13,528 |
| Total PIC time                   | 8,079  |
| Total Q-400 series flying time   | 5,997  |
| Total flying time last 24 hours  | 4.60   |
| Total flying time last 30 days   | 67.9   |
| Total flying time last 90 days   | 117    |
| Total flying time last 12 months | 576.2  |

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<sup>13</sup> The captain’s ATP certificate was reissued for a change in address.

<sup>14</sup> There were no medications listed on his FAA medical.

<sup>15</sup> Source: Horizon Air.

<sup>16</sup> Pilot in Command.

<sup>17</sup> Source: Horizon Air.

### **2.1.5 The Captain's Recent Activities**

The captain's recent activities are summarized below as documented through interviews and company records.

The captain began flying a 3-day trip on December 25, 2017. The captain flew from Rogue Valley International-Medford Airport (MFR) to Reno/Tahoe International Airport (RNO) with a stop in SEA. His duty day began at 0445 and ended at 1200.

On December 26, 2017, he had a 0515 show at RNO and flew 5 legs followed by a deadhead to Mahlon Sweet Field Airport (EUG), Eugene, Oregon, for an overnight. His duty day ended at 1611. He did not recall anything of significance about the trip and did not recall what time he went to sleep, but knew he was trying to get to sleep early.

On December 27, 2017, he thought he woke up about 0400-0415. His duty day began at 0455. He flew 4 legs (EUG-SEA-MSO-SEA-MFR) with an overnight in Medford. His duty day ended at 1355. He was based in Medford, so he stayed at a hotel at his expense. He did routine activities during the day and was in bed between 2100-2300.

On December 28, 2017, he woke up between 0700-0900, asked for a late checkout of 1130 and had a 1207 show time. He flew 3 legs (MFR-SEA-RDM<sup>18</sup>-SEA) and was then paired with the incident FO for a flight from SEA to MSO. His duty day ended at 0012 MST on December 29. He thought he went to bed about 0100-0130.

On December 29, 2017, he and the incident FO had a show time of 1513 MST, with an hour prior van ride. He was up "way" before then but did not recall the specific time he woke up. He did not have any problems falling asleep the previous night and felt rested. He did routine activities during the day which included walking around outside and did not take a nap. The incident crew flew MSO to SEA, and then flew the incident flight from SEA to PUW. The incident occurred about 1830.

He had no changes in his health, personal or financial status in the previous 12 months; he rated his health as an 8.5-9 out of 10. He did not take any prescription or non-prescription medication in the 72 hours prior to the event that might have affected his performance. He had never been diagnosed with a sleep disorder.

## **2.2 The First Officer**

The FO was 38 years old and resided in Lodi, California. He was based in Medford, Oregon, as a Q-400 FO.

The FO's date of hire with Horizon Air was July 10, 2017, and according to Horizon Air records, he had accumulated 95.5 total hours in the Q-400. The Horizon Air Flight Operations Manual, page 5.1.4, Initial/Transition First Officer, stated the following in part:

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<sup>18</sup> Roberts Field, Redmond, Oregon

*First Officers with less than 100 hours in type in Company aircraft shall notify the Captain. Unless the Captain is a Check Airman, the Captain shall make all takeoffs and landings when:*

- *Flying to special airports*
- *Water, snow, slush, or other contaminants which affect aircraft performance are on the runway.*
- *Braking action is reported less than “Good.”*
- *The crosswind component is greater than 15 knots.*
- *Windshear is reported in the vicinity of the airport.*
- *The visibility is less than RVR 4000 or  $\frac{3}{4}$  sm.*
- *Any other condition in which the Captain determines it to be prudent to exercise his prerogative.*

A review of the FAA Accident/Incident Data System, Enforcement Information System and PTRS database showed no records or reports of any previous aviation incidents or accidents involving the FO.

### **2.2.1 The First Officer’s Pilot Certification Record<sup>19</sup>**

Private Pilot – Airplane Single Engine Land certificate issued October 28, 2007.

Private Pilot – Airplane Single Engine and Multiengine Land certificate issued January 18, 2008.

Notice of Disapproval – Private Pilot Instrument Airplane certificate issued March 6, 2008. Areas of reexamination: V. Navigation Systems, VI. Instrument Approach Procedures.

Private Pilot – Airplane Single Engine and Multiengine Land, Instrument Airplane certificate issued March 9, 2008.

Commercial Pilot – Airplane Multiengine Land, Instrument Airplane; Private Privileges Only – Airplane Single Engine Land certificate issued March 29, 2008.

Commercial Pilot – Airplane Single Engine Land, Multiengine Land, Instrument Airplane certificate issued May 18, 2008.

Notice of Disapproval – Flight Instructor – Airplane Multiengine (First Failure) issued April 10, 2008. Areas of reexamination: VI Task B, VII Task A, B, E, F, G; IX Task A; XII Task C, D; XIV Task E, Applicant not teaching, Special Emphasis Area #9.

Notice of Disapproval – Flight Instructor – Airplane Multiengine (Second Failure) issued May 29, 2008. Areas of reexamination: Takeoffs, Landings and Go-arounds.

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<sup>19</sup> Source: FAA.

Flight Instructor – Airplane Single Engine Airplane certificate issued October 28, 2008.

Flight Instructor – Airplane Single Engine Instrument Airplane certificate issued October 28, 2008.  
Reissued: September 23, 2010, September 14, 2012, September 3, 2014, September 16, 2016.

Ground Instructor – Instrument certificate issued December 21, 2009.

Airline Transport Pilot – Airplane Multiengine Land, DHC-8, Commercial Pilot Privileges – Airplane Single Engine Land ATP Circ Apch VMC Only; DHC- Circ Apch – VMC Only certificate issued October 27, 2017.

## **2.2.2 The First Officer’s Certificates and Ratings Held at Time of the Incident**

Ground Instructor (certificate issued December 21, 2009)  
Instrument

Flight Instructor (certificate issued October 28, 2008)  
Airplane Single Engine Instrument Airplane

Airline Transport Pilot (certificate issued October 27, 2017)  
Airplane Multiengine Land; DHC-8; Circ Apch VMC Only  
Commercial Privileges Airplane Single Engine Land

Medical Certificate First Class (issued October 30, 2017)<sup>20</sup>  
Limitations: none

## **2.2.3 The First Officer’s Training and Proficiency Checks Completed<sup>21</sup>**

|                                          |                   |
|------------------------------------------|-------------------|
| Date of Hire                             | July 10, 2017     |
| Date Transitioned to Q-400 FO            | December 24, 2017 |
| Date of Most Recent Proficiency Training | December 24, 2017 |
| Date of Most Recent Proficiency Check    | N/A               |

## **2.2.4 The First Officer’s Flight Times<sup>22</sup>**

The FO’s flight times, according to Trans-Pacific:

|                                |       |
|--------------------------------|-------|
| Total pilot flying time        | 1,582 |
| Total PIC time                 | 1,428 |
| Total Q-400 series flying time | 95.5  |

<sup>20</sup> There were no medications listed on his FAA medical.

<sup>21</sup> Source: Horizon Air.

<sup>22</sup> Source: Horizon Air.

|                                  |       |
|----------------------------------|-------|
| Total flying time last 24 hours  | 6.5   |
| Total flying time last 30 days   | 42.3  |
| Total flying time last 90 days   | 95.5  |
| Total flying time last 12 months | 371.2 |

### **2.2.5 The First Officer's Recent Activities**

The FO's recent activities are summarized below as documented through interviews and company records.

On Tuesday, December 26, 2017, he did not recall when he woke up. He thought he had commuted to work that day since he was scheduled to be on reserve for the 27<sup>th</sup> but did not recall specifics. He stayed at a hotel in Portland, Oregon, that night. He thought he went to bed about 2200.

On Wednesday, December 27, 2017, he thought he woke up about 0430 but possibly a little bit later because he thought he was on hotel reserve. He was on home reserve from 1030 until 1230 and airport reserve from 1230 until 2030. He did not get called to fly that day. He did not recall much of his activities but recalled he exercised. He did not take a nap. He thought he went to bed by 2100.

On Thursday, December 28, 2017, he thought he woke up about 0430 and was on airport reserve from 1030 until 1429. He sat in the crew room at the airport, walked laps around the airport, and did some people-watching. He did not get called to fly that day. He then deadheaded to SEA and flew from SEA to MSO with the incident captain. They went straight to the hotel and to bed about an hour after getting into the hotel. His duty day ended at 0012 MST on December 29. He was not sure the exact time he went to bed.

On Friday, December 29, 2017, he slept in and woke about 0900-1000. His activities that day included going to the gym, watching TV and preparing for the day's flights since he was still new to the company. He and the incident captain utilized the hotel van services for transportation, and those schedules were pre-arranged by the company. His duty day began at 1513 MST and the incident occurred about 1830. He felt fine that day.

He had no problems falling asleep at night, and he had never been diagnosed with a sleep disorder. He characterized his health as "pretty healthy," and he exercised "a lot". He had no major changes to his health, financial situation or personal life in the 12 months prior to the incident. He did not take any prescription or non-prescription medications in the 72 hours prior to the incident that could have affected his performance.

## **3.0 Pilot Training**

Horizon Air pilots were trained under an Advanced Qualification Program (AQP), per Operations Specifications (OpSpecs) A034. All the instruction and evaluation for Horizon Air Q-400 pilots was conducted by Horizon Air instructors and evaluators. Ground training was conducted at the

Horizon Air Operations Center in Portland Oregon, and simulator training were conducted at the FlightSafety training facilities in Seattle, Washington.

The captain successfully passed his Q-400 Qualification, Proficiency Check on June 3, 2007, LOFT (Line Oriented Flight Training) on June 4, 2007, and Line Check on June 20, 2007. He then transferred to the CRJ before returning to the Q-400, attending re-qualification training with a Q-400 Proficiency Check on November 8, 2010 and a Line Check on November 12, 2010. The captain successfully passed his most recent proficiency (Continuing Qualification – CQ) check on September 18, 2017. A review of the captain’s training history with Horizon Air indicated no substandard training events on the Q-400 dating back to October 19, 2011.<sup>23</sup>

The FO’s date of hire with Horizon Air was July 10, 2017, and he began Q-400 simulator training on August 23, 2017. During his simulator training, the FO received two unsatisfactory ratings (MV on October 11, 2017, and Line Check on December 5, 2017), and was the subject of three Training Review Board (TRB)<sup>24</sup> reviews of his training progress:

- TRB September 13, 2017
  - TRB Triggered by
    - Not being ready for Qualification MV after two extra sim sessions
  - Attendance
    - Union IBT EXCO Chairmen
    - Manager, Flight Training
    - Base Chief Pilot
  - Result
    - FO was scheduled for 2 additional 2-hour simulator lessons followed by MV
- TRB October 11, 2017
  - TRB Triggered by
    - Unsatisfactory Qual MV
  - Attendance
    - Union IBT EXCO Chairmen
    - Director, Flight Ops Training
    - Base Chief Pilot
  - Result
    - FO was scheduled for 2 additional 2-hour simulator lessons followed by a retake of MV.
- TRB December 13, 2017
  - TRB Triggered by

---

<sup>23</sup> See Attachment 4 - Captain Training History.

<sup>24</sup> According to Horizon Air, per the pilot union’s collective bargaining agreement (CBA) policy, Chief Pilot’s Office guidance, and the FAA approved AQP program, the TRB consists of the student pilot, Chief Pilot (or designee), Director of Training (or designee), and a Pilot Union Representative (IBT) to review and make recommendations on a Horizon pilot’s training and progress. Source: Horizon Air email to the NTSB, dated Tuesday, February 27, 2018, 1207.

- Unsatisfactory Qual Line check
- Attendance
  - Union IBT EXCO Chairmen
  - Manager, Ground Training
  - Base Chief Pilot
- Result
  - FO was scheduled for 12 additional legs of OE (operating experience) followed by another line check.

The FO satisfactorily completed his Q-400 Line Check with Horizon Air on December 24, 2017.<sup>25</sup> According to his interview, the trip that included the incident flight was the FO's first line trip following completion of OE, and he and the incident captain had flown one flight together the previous day (December 28, 2017), and one flight prior to flying into PUW on the December 29, 2017, on the incident flight.

#### 4.0 Medical and Pathological Information

Both pilots were drug tested the day following the incident with negative results.<sup>26</sup>

#### 5.0 Airplane Information



**Photo 1: Photo of incident airplane N412QX.**<sup>27</sup>

<sup>25</sup> See Attachment 5 - FO Training History.

<sup>26</sup> According to Horizon Air, the pilots were not able to get on-site drug testing within a 1-hour window following the incident. Attempts to get a qualified tester to Pullman were made immediately after incident notification to duty officer, without success. The pilots were flown to PDX the next day, all other testing requirements met the timeline. No alcohol testing was conducted. Source: Email from Horizon Air to NTSB, dated February 6, 2018.

<sup>27</sup> Source: <http://www.airliners.net/photo/Alaska-Airlines-Horizon-Air/Bombardier-DHC-8-401-Q400/3923861?gsp=eJwtjEEKwkAMRe%2BStZuquOhOL6ALLxAmn1qsnTEJ2KH07sbB3eM9eCulPDsWv9cC6snAmh60o8LKL6N%2BpSfqJ6sE03zs9u8lqmX1Sw0j7DinhOKQv7%2BqQH8JltpoiHEXAL01psMpvIxWJm4POI8TbdsXNBMuiQ%3D%3D>.

According to the FAA, the incident airplane was a Bombardier DHC-8-402, registration number N412QX, serial number 4059. It was a fixed wing multiengine aircraft with two Pratt and Whitney PW150A turbo-prop engines. The airplane was manufactured in 2002, and was registered to BCC Equipment Leasing Corporation in Seattle, Washington.

Per OpSpecs A001, Horizon Air was authorized to conduct operations under the provisions of 14 *CFR* 119.21(a)(1)-(3) for domestic, flag and supplemental operations. The incident airplane was listed on OpSpecs D085, issued to Horizon Air Certificate number QXEA002A, and authorized to conduct operations under 14 *CFR* Part 121.

There were no deferred maintenance items related to the avionics, navigation or head-up display on the incident flight.<sup>28</sup>

### 5.1 Weight and Balance<sup>29</sup>

According to the Horizon Air Flight Operations Manual, Horizon Air Central Load Planning (CLP) computed weight and balance using the SmartLOAD application. SmartLOAD received payload, fuel load, and aircraft performance information via electronic interface from:

- Dispatch: Provides aircraft information (tail); minimum (MT) and optimum (OP) fuel requirements; takeoff, enroute, and landing performance limitations.
- Flight crew; Provides fuel on board (FOB) and verification of MEL restrictions affecting the loading of the aircraft.
- Flight attendants: Provide Q-400 passenger seating distribution.
- Load Coordinator: Provides cargo compartment load information

A Load Manifest would be generated, and the flight would receive a load closeout report (LCR) via electronic interface or manual means that included a summary of the weight and balance information required by regulation to be carried onboard the aircraft to the destination.

According to Horizon Air, the following includes the weight and balance information for the incident flight:

| <b>WEIGHT &amp; BALANCE / PERFORMANCE</b> (maximum certificated weights in <b>bold</b> ) <sup>30</sup> |                                 |               |
|--------------------------------------------------------------------------------------------------------|---------------------------------|---------------|
|                                                                                                        | Basic Operating Weight          | 40,207        |
|                                                                                                        | Passenger Weight                | 7,302         |
|                                                                                                        | Baggage/Cargo Weight            | 1,560         |
|                                                                                                        | Zero Fuel Weight                | 49,069        |
|                                                                                                        | <b>Maximum Zero Fuel Weight</b> | <b>58,000</b> |
|                                                                                                        | Fuel Weight                     | 8,260         |

<sup>28</sup> The forward handrail on a lower strut was deferred on December 26, 2017 for a primer and top coat. See Attachment 3 - N412QX Maintenance Logbook.

<sup>29</sup> Source: Horizon Air.

<sup>30</sup> Weights are in pounds.

|                                                                |                                                                 |
|----------------------------------------------------------------|-----------------------------------------------------------------|
| Ramp Weight                                                    | 57,329                                                          |
| <b>Maximum Ramp Weight</b>                                     | <b>65,400</b>                                                   |
| Taxi Fuel Burn                                                 | 140                                                             |
| Actual Takeoff Weight                                          | 57,189                                                          |
| Maximum Takeoff Weight <sup>31</sup>                           | 63,866                                                          |
| Estimated Fuel Burn to Incident Site                           | 1,866                                                           |
| Estimated Landing Weight                                       | 55,323                                                          |
| <b>Maximum Landing Weight</b>                                  | <b>62,000</b>                                                   |
| CG (center of gravity)                                         | 31.12% MAC                                                      |
| CG Limits                                                      | TO FWD LIMIT 15.58%, TO AFT LIMIT 34.58%<br>MAC                 |
| Takeoff Stab Trim                                              | NA (Trim is centered for takeoff in the Q-400)                  |
| Takeoff Flap Setting                                           | 15                                                              |
| Takeoff Speeds (V <sub>1</sub> V <sub>R</sub> V <sub>2</sub> ) | V <sub>1</sub> - 106, V <sub>R</sub> – 111, V <sub>2</sub> -113 |
| Landing Flaps                                                  | 35                                                              |
| V <sub>REF</sub>                                               | V <sub>REF</sub> 114 <sup>32</sup>                              |

## 6.0 Meteorological Information

The incident occurred about 0240 UTC. METARs<sup>33</sup> for PUW valid at the time of the incident were as follows.

*SPECI<sup>34</sup> KPUW 300217Z AUTO 14009KT 5SM RA BR FEW018 BKN025 OVC032 03/02 A2988  
RMK AO2 P0004 T00330017=*

*METAR KPUW 300253Z AUTO 15010KT 5SM -RA BR FEW024 BKN030 OVC035 04/02 A2986  
RMK AO2 SLP128 60027 T00440022 58019=*

The TAF<sup>35</sup> for PUW in effect at time of departure was calling for IFR at time of landing, and recorded as follows:

*TAF KPUW 292322Z 3000/3024 07003KT 3SM RA BR BKN006 OVC012  
FM300900 24020G30KT P6SM BKN010  
FM301800 25016G25KT P6SM BKN030 BKN150=*

<sup>31</sup> Maximum Takeoff Weight was a landing weight limitation at PUW based on estimated fuel burn. Certificated maximum takeoff weight for the Q-400 was 65,200.

<sup>32</sup> According to interviews, the crew flew the approach with the Ref Speed Switch selected to INCR, and flew the approach at V<sub>REF</sub> Ice at 129 knots.

<sup>33</sup> Aviation routine weather report (METAR): Contains data for the temperature, dew point, wind speed & direction, precipitation, cloud cover & heights, visibility, and barometric pressure. Reports are typically generated once an hour.

<sup>34</sup> A METAR (SPECI) was a special report that could be given any time to update the METAR for rapidly changing weather conditions, aircraft mishaps, or other critical information. Source: FAA Handbook of Aeronautical Knowledge (FAA-H-8083-25A), Chapter 12, page 12-6.

<sup>35</sup> Terminal Aeronautical Forecast: Issued 4 times per day.

## 7.0 Airport Information<sup>36</sup>

Pullman/Moscow Regional Airport (PUW) was located three miles northeast of the central business district of Pullman, Washington, at an elevation of 2,554.9 feet and a latitude/longitude of 46-44-37.9000N / 117-06-34.5000W. The airport had two runways (06/24) and was not served by an ATC control tower (uncontrolled).<sup>37</sup>

Runway 06 had a length of 6,730 feet and was 100 feet wide with a 0.4% gradient.<sup>38</sup>

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<sup>36</sup> Source: <https://www.airnav.com/airport/KPUW>.

<sup>37</sup> Horizon Air was authorized to conduct operations at uncontrolled airports per OpSpecs C077-2.

<sup>38</sup> The taxiway at PUW was approximately 57 feet wide (as estimated using Google Earth). The wingspan of the Q400 was 93 feet 3 inches and the main wheelbase 28 feet 10 inches.

## 7.1 Airport Chart<sup>39</sup>

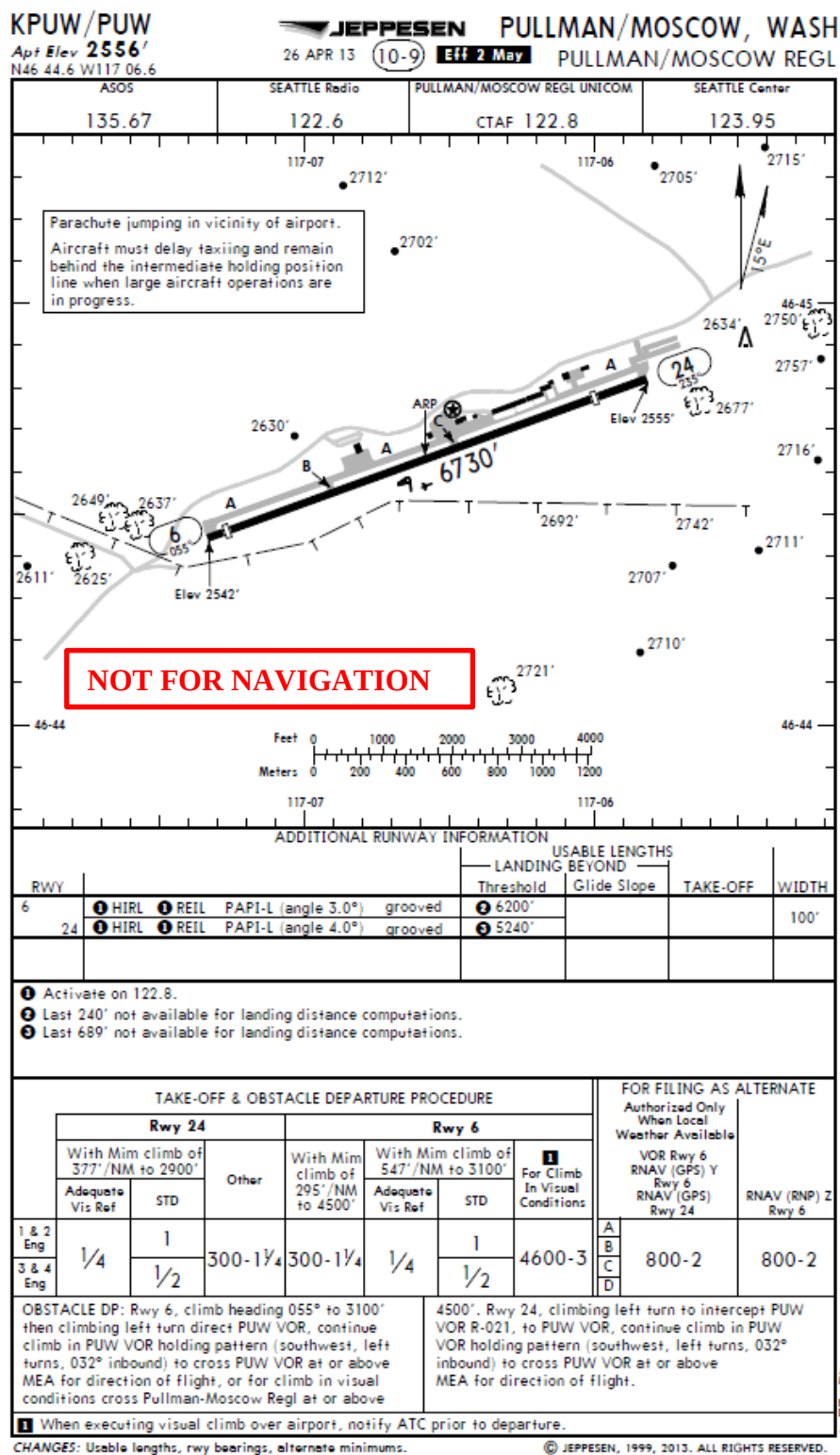


Figure 1: PUW Jeppesen 10-9 Airport Chart.<sup>40</sup>

## 7.2 PUW RNAV (RNP) M Runway 06<sup>41</sup>

The instrument approach used by the incident crew was the PUW RNAV (RNP) M approach to runway 06. According to the captain, he was not sure if he had flown that actual approach before, but pretty sure he had flown that at least once before. When asked how often he had landed at PUW, he said it “comes and goes,” but maybe about 5 or 6 times each year depending on his monthly schedule. He did not remember the last time he had landed at PUW.<sup>42</sup>

The approach chart was published by Jeppesen specifically for Horizon Air and Alaska Airlines utilizing proprietary RNP data from Alaska Airlines.<sup>43</sup> The PUW RNAV (RNP) M approach to runway 06 was a Special Instrument Approach authorized to be flown by Horizon Air using DHC-8-402 aircraft per Horizon Air OpSpecs C081. The UNS-1Ew Flight Management System (FMS) onboard the DHC-8-402 was approved for RNAV (RNP) approaches to an RNP level of:

- With Flight Director, 0.30 nm for approach,
- With Autopilot, 0.10 nm for approach, and
- Less than 1.0 for missed approach.<sup>44</sup>

The minimums for the PUW RNAV (RNP) M approach to runway 06 utilizing an RNP value of 0.11 was 2,858 feet, or 320 feet above the threshold of the runway, and the chart indicated that the RNAV glidepath would continue to bring the airplane to a TCH (threshold crossing height) of 57 feet above the threshold.

OFXEF was the initial approach fix (IAF) with a minimum crossing altitude of 5,400 feet msl [mean sea level], and located 11.8 miles from the end of the runway. FTEL was the final approach fix (FAF) with a minimum crossing altitude of 4,100 feet msl and located 4.7 miles from the end of the runway. The chart indicated that the runway had REIL lighting and a PAPI on the left side of runway 06, and pilot-controlled lighting, activated on the PUW Unicom frequency.

A note on the chart indicated that use of the procedure required specific authorization by FAA Flight Standards.<sup>45</sup>

The Horizon Air Q-400 Flight Standards Manual, page 3.1.11 stated the following in part:

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<sup>39</sup> Per OpSpecs A009, Horizon Air was authorized to use Jeppesen Charts and Services for airport aeronautical information to comply with 14 *CFR* 121.97(b).

<sup>40</sup> Source: Jeppesen.

<sup>41</sup> For additional information, see Attachment 10 - Horizon Air Q400 RNAV Approach Guidance.

<sup>42</sup> See Attachment 1 – Interview Summaries.

<sup>43</sup> According to FAA records, the PUW RNAV (RNP) M was subject to initial testing in 2000 and subsequent periodic testing, and recorded satisfactory results on each Flight Inspection Report reviewed.

<sup>44</sup> Required Navigation Performance (RNP) is similar to Area Navigation (RNAV); RNP requires on-board navigation performance monitoring and alerting capability to ensure that the aircraft stays within a specific containment area. There are several different levels of RNP. Examples of RNP levels used for approach include RNP 0.1, RNP 0.3, and RNP 1.0 (There are also RNP 4.0 and RNP 10.0 levels that apply in the en route environment). "A performance value of RNP 0.3, for example, assures that the aircraft has the capability of remaining within 0.3 of a nautical mile to the right or left side of the centerline 95 percent of the time." (Source: FAA Instrument Procedures Handbook, p. 5-12).

<sup>45</sup> Horizon Air Q-400 pilots received RNP AR (Authorization Required) training in accordance with OpSpecs C384.

## **Approaches**

### *Approaches with Vertical Guidance*

- *Except as provided below, only approaches with vertical guidance shall be used inside the FAF. Vertical guidance is provided by any ILS and by FMS VNAV on all approaches with a runway designated in the approach title (e.g., RNAV (GPS) Rwy 14, VOR 14).*
- *Approach selection should satisfy the minimums required for weather conditions, provide an optimal descent profile, and reduce track miles. Because of their efficiency, predictability, and stability, RNAV approaches are the preferred approaches. With these considerations, if practical, the following approach priority should be followed:*
  1. *RNAV (RNP) (RNP approaches provide the most stable approaches and are often the most efficient).*
  2. *RNAV (GPS).*
  3. *ILS.*
  4. *If an RNAV or ILS approach is not available to the intended runway, a LOC or VOR based approach may be flown via the FMS.*

## **7.3 High Intensity Runway Lights (HIRL)**

Runway 06 at PUW was equipped with runway edge lights used to outline the edges of the runways during periods of darkness or reduced visibilities. The PUW runway light system was an HIRL system, with colored white edge lights. The lights marking the ends of the runway emitted red light toward the runway to indicate the end of the runway to a departing aircraft and emit green light outward from the runway end to indicate the threshold to landing aircraft.<sup>46</sup>

Radio control of lighting was available at selected airports, like PUW, to provide airborne control of lights by keying the microphone.<sup>47</sup> All lighting systems which were radio-controlled at an airport, whether on a single runway or multiple runway, operated on the same radio frequency.

According to the captain, he keyed the radio in an attempt to illuminate the runway lights when just outside of OFXEF, and he believed he clicked on the CTAF to illuminate the field, even though they were still flying in the clouds. He stated that he was doing that to have the lights available when they broke out of the clouds. Shortly after crossing OFXEF, he had the runway in sight, and called the “runway in sight and landing.”<sup>48</sup> He said it was clear as day at that time, though it was night time. They proceeded inbound, and he questioned whether the lights were on bright or dim. He keyed the radio to “turn the brights” up more, but was unclear if they had changed intensity.<sup>49</sup>

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<sup>46</sup> Source: Aeronautical Information Manual (AIM) page 2-1-4.

<sup>47</sup> Radio controlled lighting is also known as Pilot Controlled Lighting (PCL).

<sup>48</sup> See Attachment 12 - Horizon Air Q400 SOPs for Landing.

<sup>49</sup> See Attachment 1 – Interview Summaries.

With FAA-approved systems, various combinations of approach lights, runway lights, taxiway lights, VASI [visual approach slope indicator] and/or REIL may be activated by radio control. Runways without approach lighting may provide radio-controlled intensity adjustments of the runway edge lights, and the taxiway lights may be controlled with the runway edge lights or controlled independently of the runway edge lights.<sup>50</sup>

According to the Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25A), page 13-8, HIRLs had variable intensity settings. At selected nontowered airports, the pilot may be able to control lighting by selecting a specified frequency and clicking the radio microphone.

**Runways Without Approach Lights**

| Lighting System                                                                                                                                                                                | No. of Int. Steps | Status During Nonuse Period | Intensity Step Selected Per No. of Mike Clicks |          |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------|------------------------------------------------|----------|----------|
|                                                                                                                                                                                                |                   |                             | 3 Clicks                                       | 5 Clicks | 7 Clicks |
| MIRL                                                                                                                                                                                           | 3                 | Off or Low                  | Low                                            | Med.     | High     |
| HIRL                                                                                                                                                                                           | 5                 | Off or Low                  | Step 1 or 2                                    | Step 3   | Step 5   |
| LIRL                                                                                                                                                                                           | 1                 | Off                         | On                                             | On       | On       |
| VASI★                                                                                                                                                                                          | 2                 | Off                         | ◆                                              | ◆        | ◆        |
| REIL★                                                                                                                                                                                          | 1                 | Off                         | Off                                            | On/Off   | On       |
| REIL★                                                                                                                                                                                          | 3                 | Off                         | Low                                            | Med.     | High     |
| <b>NOTES:</b> ◆ Low intensity for night use. High intensity for day use as determined by photocell control.<br>★ The control of VASI and/or REIL may be independent of other lighting systems. |                   |                             |                                                |          |          |

**Figure 2: Runways without Approach Lights chart.**<sup>51</sup> Source: AIM page 2-1-13.

Taxiway edge lights, like those installed at PUW, were used to outline the edges of taxiways during periods of darkness or restricted visibility conditions. Taxiway lights emitted blue lights, and the captain stated that all the taxiway lights appeared to be working after he landed on the taxiway.

The captain also stated that he did not believe the runway lights were as bright as they should have been. When he said he saw the runway surface, he thought he also saw lights on the side of the runway. When he looked down then up during the approach, he did not see any lights. He did not know if they were failed then or prior. He called the runway in sight to the FO, and thought he saw the actual runway, but landed on the taxiway. According to the FO, the captain tried to illuminate the runway lights with the microphone after landing, which increased the intensity of the taxiway lights, but no other lights increased. He did not know if the runway lights had shorted out or not.

Title 14 CFR 121.590(d) stated the following in part:

*(d) An air carrier, a commercial operator, and a pilot being used by the air carrier or the commercial operator - when conducting a passenger-carrying airplane operation under this part that is not a domestic type operation, a flag type operation, or a supplemental type operation - may operate at a land airport not certificated under part 139 of this chapter only when the following conditions are met:*

<sup>50</sup> Source: AIM 2-1-9.

<sup>51</sup> Runway 06 at PUW did not have an approach lighting system.

*(1) The airport is adequate for the proposed operation, considering such items as size, surface, obstructions, and lighting.*

*(2) For an airplane carrying passengers at night, the pilot may not take off from, or land at, an airport unless -*

*(i) The pilot has determined the wind direction from an illuminated wind direction indicator or local ground communications or, in the case of takeoff, that pilot's personal observations; and*

*(ii) The limits of the area to be used for landing or takeoff are clearly shown by boundary or runway marker lights. If the area to be used for takeoff or landing is marked by flare pots or lanterns, their use must be authorized by the Administrator.*

The Horizon Air Flight Operations Manual, page 2.3.16, stated the following in part:

***Pilot Controlled Lighting***

*Radio control of lighting is available at selected airports. Airborne control of lights is accomplished by keying the aircraft's microphone with the radio tuned to the designated frequency (usually the CTAF).*

*Suggested use is to always key the mike seven times (within five seconds); this assures that all controlled lights are turned on to the maximum available intensity. Adjustment can then be made, where the capability is provided, to a lower intensity (or REIL turned off) by keying five and/or three times. Fifteen minutes of lighting is available from the last keying event.*

***Unlighted Fields***

*Flights are not authorized to land or takeoff at night when all runway lights are inoperative or where there are no lights installed.*

*If a portion of the runway lights are inoperative for night operations but the remaining lights or runway marking provide adequate visual reference to continuously identify the runway surface and maintain directional control throughout the takeoff or landing run, operations on that runway may proceed.*

***NOTE:*** *Use of flare pots or lanterns in lieu of runway lights is not authorized.*

The Horizon Air OpSpecs C060-3(g) stated the following in part:

*g. Missed Approach Requirements. A missed approach shall be initiated when any of the following conditions exist:*

*(1) If the pilot determines that touchdown cannot be safely accomplished with the TDZ.*

*(2) When any of the required runway lighting elements becomes inoperative prior to arriving at the DH [decision height] or AH [alert height], or prior to touchdown for aircraft without a rollout system.<sup>52</sup>*

As previously stated, there were no NOTAMs indicating the runway lights were inoperative at the time the incident flight landed. After the incident, the following NOTAMs were issued at PUW:

PUW 12/220 PUW RWY 06/24 REDL OUT OF SERVICE 1712300323-1712310321  
CREATED: 30 Dec 2017 03:23:00 SOURCE: PUW

PUW 12/227 PUW RWY 06 RWY END ID LGT OUT OF SERVICE 1712300518-1801010518  
CREATED: 30 Dec 2017 05:19:00 SOURCE: PUW

#### **7.4 Runway End Identifier Lights (REIL)**

Runway End Identifier Lights (REIL) were installed on runway 06 at PUW to provide rapid and positive identification of the approach end the runway. The system consisted of a pair of synchronized flashing lights located laterally on each side of the runway threshold. REILs may be either omnidirectional or unidirectional facing the approach area. According to the AIM, REILs were effective for: identification of a runway surrounded by a preponderance of lighting, identification of a runway which lacks contrast with surrounding terrain, and identification of a runway during reduced visibility.<sup>53</sup>

#### **7.5 Precision Approach Path Indicator (PAPI)**

Runway 06 at PUW was equipped with a PAPI, located to the left of the approach end of the runway.<sup>54</sup> According to his interview, the captain stated that during the visual portion of the approach, he noticed the PAPI “pretty far out, and it was directly in front of them,” and he was aware that the PAPI should have been on the left of the runway but did not think about that aspect when he briefed the approach as PF. He further stated he thought he was on the PAPI, but could not remember the last time he observed the PAPI prior to the landing.<sup>55</sup>

According to the AIM, page 2-1-4, a PAPI used lights similar to the VASI but were installed in a single row of either two or four lights. These lights were visible from about 5 miles during the day and up to 20 miles at night. The visual glide path of the PAPI typically provided safe obstruction clearance within plus or minus 10 degrees of the extended centerline and to 4 statute miles from the runway threshold. Descent, using the PAPI, should not be initiated until the aircraft is visually aligned with the runway. Lateral guidance is provided by the runway or runway lights.

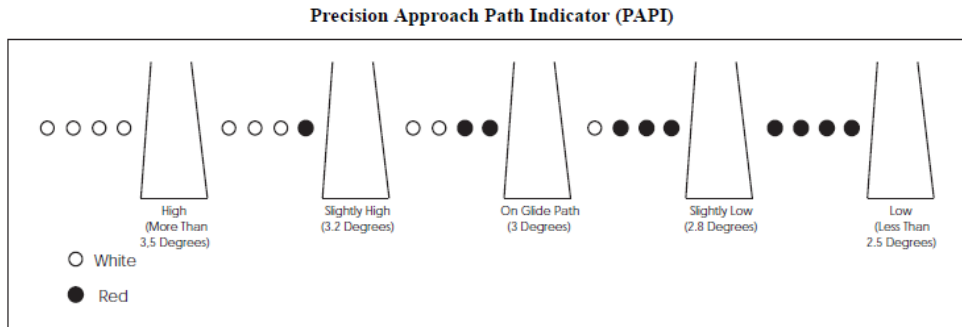
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<sup>52</sup> The Q-400 rollout system (RO) was available when the HGS was used in the AIII mode for low visibility landings. Source: Horizon Air Q400 System Description Manual, page 20.19.

<sup>53</sup> Source: AIM 2-1-3.

<sup>54</sup> The PUW PAPI was a 2-bar PAPI with a 3.00 degree glide path. Source: <https://www.airnav.com/airport/KPUW>.

<sup>55</sup> See Attachment 1 – Interview Summaries.



**Figure 3: Precision Approach Path Indicator (PAPI).** Source: AIM, Figure 2-1-5.

The Horizon Air Flight Operations Manual, page 10.1.6, stated in part that for visual approaches:

*When an electronic glideslope or FMS VPATH is available to the runway of intended landing, pilots shall tune, identify, and monitor the appropriate navigational aid. Pilots should fly the higher of: ILS glideslope, VPATH, VASI, PAPI or PLASI when available, using normal procedures and rates of descent, until a lower altitude is necessary for a landing within the touchdown zone.*

## 8.0 Company Information

Horizon Air was founded in September 1981 and was headquartered in Portland, Oregon, and Seattle, Washington. Alaska Airlines' holding company, Alaska Air Group, purchased Horizon Air in 1986. The company had 52 DHC-8-402 aircraft and 10 ERJ-170-200LR aircraft. Their crew bases were located in Anchorage, Alaska; Boise, Idaho; Medford and Portland, Oregon; Seattle and Spokane, Washington. The airline had 3,970 employees and 747 flight crewmembers. Horizon pilots were represented by the International Brotherhood of Teamsters (IBT).

According to the Director of Regulatory Compliance, Horizon Air had completed all levels of implementing Safety Management System (SMS).<sup>56</sup> Horizon Air also utilized a Flight Operational Quality Assurance (FOQA) program,<sup>57</sup> an Aviation Safety Action Program (ASAP) for flight operations, maintenance, inflight and dispatch,<sup>58</sup> and a Line Operations Safety Audit (LOSA) audit program.<sup>59</sup> Horizon Air also had a Fatigue Risk Management Program (FRMP) defined in

<sup>56</sup> According to the FAA, Advisory Circular (AC) 120-92B Safety Management Systems for Aviation Service Providers, provides information for Title 14 of the Code of Federal Regulations (14 CFR) part 121 air carriers that are required to implement Safety Management Systems (SMS) based on 14 CFR part 5. Specifically, this document provided a description of regulatory requirements, guidance, and methods of developing and implementing an SMS. An SMS is an organization-wide comprehensive and preventive approach to managing safety, and includes a safety policy, formal methods for identifying hazards and mitigating risk, and promotion of a positive safety culture. An SMS also provides assurance of the overall safety performance of an organization.

<sup>57</sup> FOQA is a voluntary safety program designed to improve aviation safety through the proactive use of flight recorded data. Source: FAA.

<sup>58</sup> ASAP is a safety program designed to encourage air carrier and repair station employees to voluntarily report safety information that may be critical to identifying potential precursors to accidents. Source: FAA Advisory Circular 120-66B "Aviation Safety Action Program (ASAP)."

<sup>59</sup> LOSA uses trained peer observers to collect data about flight crew behavior and situational factors on normal flights. The audits are no-jeopardy, and potential threats to safety, errors, and the crew's reactions as part of an overall CRM

OpSpecs A317, and an FAA-approved fatigue education and awareness training (FEAT) program defined in OpSpecs A319. The airline had been IOSA certified since 2008.<sup>60</sup>

## **9.0 Relevant Systems**

### **9.1 Head-up Guidance System<sup>61</sup>**

The Model 4100 Head-up Guidance System (HGS) was a high-integrity, wide field of view, holographic head-up display (HUD) system, and located on the captain's side of the Q-400 cockpit. The HGS was an electronic and optical system that displayed information in the captain's forward field of view, presenting flight and navigational data conformal to the real world.

The system consisted of an Overhead Unit (OHU) that projected an image onto a glass Holographic Combiner that folded down in the field of vision for the captain. The Combiner reflected a green color projected image by the OHU and allowed colors to pass through the glass, allowing wide field-of-view Combiner positions and focused the projected image to superimpose the symbology on the captain's view of the real world. The HGS system and displays were controlled by the HGS Control Panel (HCP), located on the aft/center pedestal in the cockpit. The HCP was used to select the various HGS operating modes and enter required approach data like glideslope angle, runway elevation and runway length. The system also contained an HGS Annunciator Panel (HAP), that was located on the FO's glareshield to provide status and warning annunciations when performing CATIII approaches and low visibility takeoffs.

The HGS had 5 modes of operation that controlled the display in the Combiner:

- TO (takeoff) – used for takeoff in low visibility conditions
- PRI (Primary) – used for all phases of flight from takeoff to landing
- AIII – used for CATIII approach and landing
- IMC – used for CATI coupled approaches using the Autopilot and Flight Director
- VMC – used for visual approaches

According to the captain, he set up the HUD for the approach, and he entered the TDZE and confirmed the glideslope angle matched the approach chart. The combiner was down for the approach and was set to primary mode (PRI). He thought he put the runway length in the HUD control panel, but he was not sure.

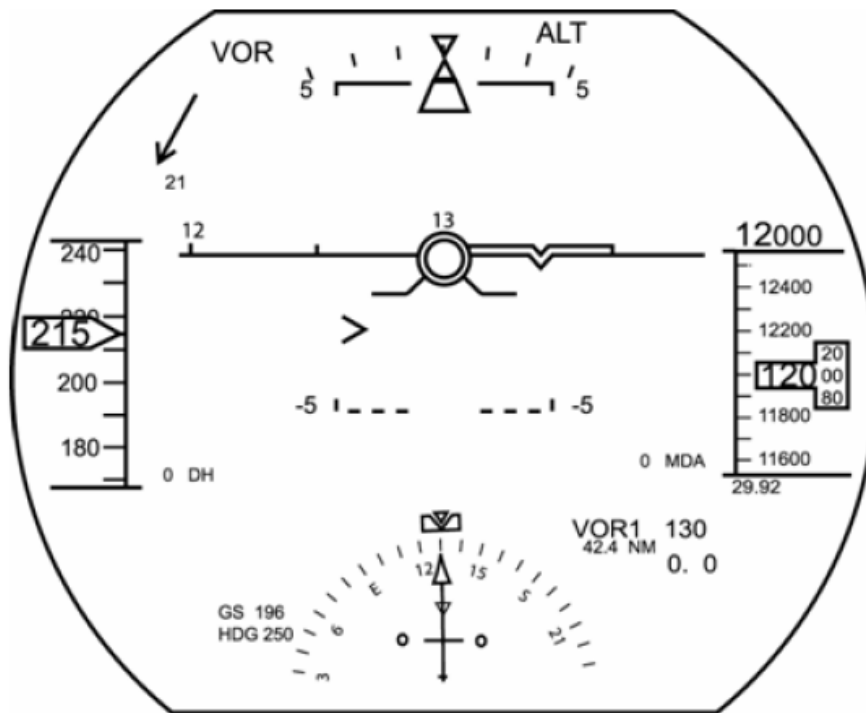
In Primary mode (PRI), the combiner will display an airspeed tape along the left side, a barometric altitude tape along the right side, and a sectorized Horizontal Situation Indicator (HSI) at the bottom center of the combiner. According to the Horizon Air Q-400 System Description Manual, page 20-13, the PRI display was very similar to the display format of a PFD.

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threat and error management review of the operation. Operator participation in LOSA is voluntary.

<sup>60</sup> The IATA Operational Safety Audit (IOSA) program is an internationally recognized and accepted evaluation system designed to assess the operational management and control systems of an airline. Source: <https://www.iata.org/whatwedo/safety/audit/iosa/Pages/index.aspx>.

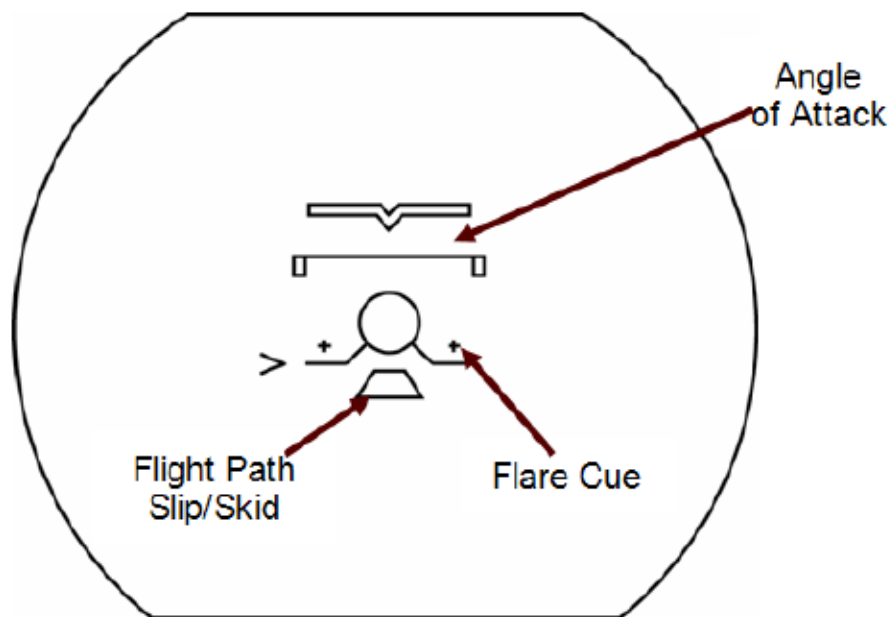
<sup>61</sup>Source: Horizon Air Q400 System Description Manual, Chapter 20.



**Figure 4: Primary Mode Symbolry (typical).** Source: Horizon Air Q-400 System Description Manual, Chapter 20.

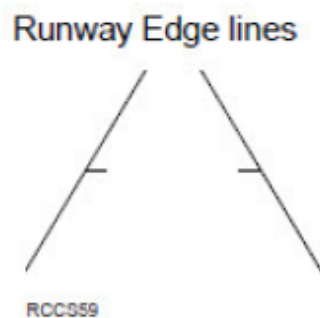
The PRI mode may be used during any conventional Flight Director Approach (including an RNAV approach), but no lower than for a CATI approach, for lateral and vertical navigation to the runway.

All Horizon Air Q-400 HGS had been upgraded with optional Autonomous Flare guidance. HGS Autonomous Flare guidance was available in PRI, VMC and IMC modes as supplemental information to aid the pilot in completing the visual segment of the approach. Autonomous Flare symbology appeared in the combiner during the flare segment of every landing, including visual approaches. Autonomous Flare symbology was based on RA (radio altitude), energy state, and inertial reference. If a failure occurred that inhibited Autonomous Flare, a NO FLARE message was displayed. To avoid two types of vertical information, the Flight Director Guidance Cue was removed from view below 80 feet AGL.



**Figure 5: HUD Flight Path Symbolology. Source: Horizon Air Q-400 System Description Manual, Chapter 20.**

Runway edge lines were also displayed between 300 feet AGL and 60 feet AGL. The aircraft's orientation to the runway was shown with the runway symbols in perspective to the real-world runway. The lateral position of the runway edge lines was set using the Course Select knob on the Flight Control Panel (FCP).



**Figure 6: Runway Edge Line Symbolology. Source: Horizon Air Q-400 System Description Manual, Chapter 20.**

## 10.0 Relevant Procedures

### 10.1 Q-400 Automation Policy

The Horizon Air policy regarding the use of the automation on the airplane was defined in the Horizon Air Q-400 Standards Manual, Normal Procedures – General, page 3.1.7, and stated the following in part:

*Consistent with Horizon Air's Philosophy of Automation, automation programming and briefings are accomplished during the most suitable phase of operation. Considerations for*

when these tasks are accomplished include the workload of the pilots and their ability to dedicate their attention to them together. Both crewmembers are expected to understand altitude, course, and intercept clearances given by ATC and the automation method used to comply. If either pilot suspects a discrepancy between an ATC clearance and the automation method used to comply, he will alert the other pilot and the discrepancy will be resolved in order to prevent any clearance or airspace violations.

The following general policy describes the use of automation in the Q400, consistent with the Automation Policy in FOM section 2, Policy. For detailed description of the Automatic Flight Control System (AFCS), HGS, and FMS procedures, refer to section 7, Supplementary Normal Procedures.

### **HGS**

*The Captain should use HGS below 10,000'.*

*Besides providing low-visibility takeoff and approach capability, the HGS is a significant asset for safety. The HGS optimizes symbology for full-flight regime use and includes inertial path and acceleration cues. HGS allows for extremely precise aircraft control while enhancing situational awareness and energy management. Use of HGS is considered standard operating procedure below 10,000' AFE [above field elevation].*

- *HGS is used for:*
  - *Monitoring the energy state of the aircraft, especially in adverse situations.*
  - *Tailstrike avoidance on takeoff and landing*
  - *Outside visual reference for traffic and TCAS RA guidance.*
  - *Glidepath reference on all approaches, including visual approaches.*
  - *Precision guidance during low visibility takeoffs, approaches, and landings.*
- *HGS modes used are:*
  - **PRI** mode for normal operations.
  - **IMC** mode may be used on any approach. On Cat I ILS approaches; it dampens localizer and glideslope fluctuations and provides HGS AIII guidance to minimums. The IMC mode may be used on any published glidepath, and any flap consideration.

Amplified checklist guidance was found in the Horizon Air Q-400 Flight Standards Manual,<sup>62</sup> and on page 3.15.2, for the captain's flightdeck flow in preparation for completing the Approach Checklist,<sup>63</sup> the following was stated in part:

#### **Captain 10,000 AFE Flow (10,000 AFE)**

##### **OVERHEAD PANEL**

- *HGS – Verify the combiner is down and the HGS display is set properly.*

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<sup>62</sup> See Attachment 13 - Q400 Approach Checklist.

<sup>63</sup> According to the Horizon Air Q-400 Flight Standards Manual, page 3.15.1, the PF calls for the Approach checklist as close as practical to 10,000 AFE after the Approach Flows had been accomplished.

## 10.2 Approach Briefing

The approach briefing for the Horizon Air Q-400 occurred as part of the Descent Checklist.<sup>64</sup> Approach briefing guidance was provided in the Horizon Air Flight Operations Manual, Descent/Approach/Landing, page 10.1.7, and stated the following in part:

### **Approach Briefing – General**

*When possible, the approach briefing shall be accomplished before beginning the descent from cruise altitude. The briefing shall be conducted in a thorough, unhurried manner. Both pilots shall have the appropriate chart displayed while the pilot who will be flying the approach briefs. (Whenever a Captain Monitored Approach will be flown, the First Officer shall conduct the approach briefing.) If the autopilot is not engaged, control of the aircraft shall be transferred to the other pilot. Transfer is not necessary if a visual approach briefing is conducted.*

*All flightdeck distractions shall be removed or managed properly prior to the approach briefing. Do not begin an approach briefing if flightdeck distractions are diverting the attention of either pilot.*

*NOTE: At pilot's discretion, crew should also brief familiarity items, including AIC,<sup>65</sup> hot spots, taxi/parking expectation, and restrictions.*

### **Approach Briefing Items**

*The following items shall be briefed:*

1. *Approach plate number and approach name, (e.g., 11-1; ILS 16).*
2. *FMS – Verify approach name:*
  - *Q400 – Flight Plan CLEARANCE page on both FMSs.*
  - *E175 – ACT RTE page on PF FMS.*
3. *Briefing Strip – approach frequency (except RNAV approaches); final approach course; glideslope intercept altitude or FAF altitude.*
4. *Visibility Requirements and Minimums: DA, RA, or MDA, as appropriate.*
  - *Brief 100' above TDZE MSL altitude (if Captain Monitored or where "continue" call is possible.*
5. *Missed approach procedures (MAP):*
  - *At a minimum, brief the initial MAP items in the briefing block. The full MAP may be briefed at Captains' discretion.*
  - *LNAV is the assumed nav source for the missed approach.*
    - *I LNAV is not used, brief nav source to be used and brief full MAP.*
6. *Operator Notes.*

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<sup>64</sup> See Attachment 9 – Horizon Air Q-400 Normal Checklist.

<sup>65</sup> Airport Information Charts (AIC) were charts that provided additional airport information to Horizon Air pilots. See Attachment 14 – PUW Airport Information Chart.

7. *Any other items considered pertinent to the safe conduct of the approach and landing.*
  - *FMS – If any approach procedure altitudes have been modified, verify FMS waypoints and altitudes to ensure compliance with published procedure.*

### **Visual Approach Briefing Items**

*Whenever planning a visual approach, the following shall be briefed:*

1. *Approach plate number and approach name of planned visual approach.*
2. *Approaches used for vertical guidance backup.*
3. *FMS – Verify backup approach name:*
  - *Q400 – flight Plan CLEARANCE page on both FMSs.*
  - *E175 = ACT RTE page on PF FMS.*
4. *Pattern altitude, entry, and any other items considered pertinent to the safe conduct of the visual approach and landing.*

*NOTE: Missed approach does not need briefed for a visual approach.*

## **10.3 Calling Airport in Sight**

Horizon Air Flight Operations Manual, Descent/Approach/Landing, page 10.1.8, stated the following in part:

*It is the Captain's decision on when to report the airport in sight for a visual approach clearance. Both pilots shall have the airport in sight. When accepting a visual approach, ensure that the flight can adhere to the requirement specified in the Visual Approaches, this section.*

## **10.4 Runway Alignment Verification**

Runway alignment verification guidance on landing was provided in the Horizon Air Flight Operations Manual, page 2.3.18, and stated in part:

*Prior to landing:*

- *The PF shall restate the landing clearance and runway after the PM acknowledges clearance from ATC.*
- *Both pilots observe the runway environment and verify (silently):*
  - *The runway is correct by reference to runway markings, navigational aids, HIS headings, etc.*
  - *The runway is clear of traffic.*

*Either pilot shall immediately state any discrepancy in ATC clearance, intended runway, or traffic threat.*

*NOTE: IMC conditions and reduced visibilities will hamper the ability to verify runway selection and that it is clear of traffic. As the runway comes into view on an instrument approach, both pilots shall verify, to the extent possible, it is clear of traffic conflicts.*

The Horizon Air OpSpecs C300-3(9) stated in part:

*Flightcrews are expected to maintain procedure centerline (CL), as depicted by onboard lateral deviation indicators, displays, and/or flight guidance, during all operations described in this operations specifications unless otherwise authorized to deviate by ATC in the instance of an emergency condition.*

## **10.5 Go-Around Policy**

Horizon Air had a No-Fault Go-around policy, defined in the Q-400 Flight Standards Manual, page 3.17.6, which stated the following:

### ***No Fault Go-around Policy***

*The importance of a stabilized approach and a safe touchdown in the touchdown zone for short field landings cannot be over-emphasized. If at any time during the approach and landing it becomes apparent that the flight path is too high, approach speed is excessive, or the aircraft will not touchdown by the 1,000'-point, the Captain SHALL initiate a missed approach. Either pilot may call "Missed approach."*

*It is also important that pilots should not be concerned about having their judgement questioned regarding their decision to go around. As such, the FOM no fault go-around policy applies particularly for short field landings. This policy applies to all types of approaches in any weather conditions. Pilots are encouraged to go around anytime the landing conditions are uncertain. Pilots will not be reprimanded or questioned for this action.*

The Horizon Air Flight Operations Manual, page 10.3.1, stated the following in part:

### ***Missed Approach Policy***

*If either the PF or PM believes an unsafe condition exists for landing, either pilot shall call "Missed approach," and the missed approach shall be executed. In all circumstances, the good judgement of the PF and PM is sufficient base for initiating a go-around/missed-approach. Horizon Air maintains a "no fault go-around" policy.*

The Horizon Air Q-400 Flight Standards Manual, page 3.16.1, stated the following in part:

### ***Missed Approach Requirements***

*A missed approach shall be accomplished for the following reasons:*

- *If the approach is not stabilized (see Descent and Approach in FOM, section 10, Descent/Approach/Landing) or if at any time during the approach or flare, the airplane becomes unstable, or a high rate of descent develops.*
- *If either the PF or PM believes an unsafe condition exists for landing (see Missed Approach in FOM, section 10, Descent/Approach/Landing) or if a successful landing in the touchdown zone becomes uncertain.*
- **Instrument Approach:**  
*Unless the visual references required to continue to the intended runway have been acquired and the aircraft is in a position to allow a safe continuation to a normal landing, a missed approach shall be initiated:*
  - *If any approach requirements are not met or exceeded (as appropriate to the approach flown).*
  - *On all instrument approaches, regardless of minimums, if a required approach equipment failure occurs at or below 500' AFE, or when the instrument crosscheck shows significant disagreement.*
  - *Upon reaching minimums*
- *Recovery from a high bounce.*

## 10.6 Stabilized Approach

Horizon Air stabilized approach criteria was defined in the Horizon Air Flight Operations Manual, page 10.1.1, and stated the following:

### **Q400 Stabilized Approach**

*A Q400 stabilized approach consists of:*

- *The airplane in approach configuration for the applicable approach profile IAW the FSM.<sup>66</sup>*  
*NOTE: Momentarily exceeding these limits does not require a go-around as long as prompt, positive correction is taken to return to a stabilized condition*
- *Instrument approach with vertical guidance (ILS or FMS VNAV):*
  - *Course deviation of one dot or less.*
  - *Glidepath up to one dot above or ½ below.*
- *Visual approach:*  
*If electronic course or glidepath information is available, no more than one dot deviation from course or glidepath.*
- *1,000 feet AFE:*

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<sup>66</sup> For the Horizon Air Q-400 RNAV approach profile, see Attachment 11 - Horizon Air Q-400 RNAV Approach Profile.

- Configured for landing as defined in the FSM.
- Rate of descent as necessary to maintain published glidepath or, if none available, not in excess of 1,000 fpm [feet per minute].
- Below 500' AFE
  - Bank angle 15° or less.
  - The aircraft on profile speed within -5/+10 knots of target speed.
- Deviations from stabilized approach:
  - PM shall call out any exceedance to these limits.
  - PF shall respond "Correcting" and shall correct the condition as necessary, in a timely manner, to establish or regain a stabilized approach.
  - If the approach is not stabilized or if a successful landing in the touchdown zone becomes uncertain, either pilot shall call "Missed approach" and the missed approach shall be executed. For example, "Airspeed – missed approach" or "Sink rate – missed approach." See Missed Approach later in this section for more information.

**WARNING:** Do not attempt to land from an unstabilized approach.

## 11.0 Radio Remote

According to the Horizon Air Services Manual, company specific air/ground communications (radio remote) were used at certain Horizon Air facilities specifically identified by the FAA. These stations generally lacked a control tower or flight service station for all or parts of the day. PUW was listed in the Horizon Air Flight Operations Manual as requiring a radio remote observer, and pilots arriving or departing PUW were required to monitor a separate radio remote frequency for advisories from the radio remote for observed aircraft on the ground at the airport.

The Horizon Air Flight Operations Manual, page 4.1.18, stated the following in part:

### **Radio Remote**

*Air/Ground communication (radio remote) is required for certain Horizon Air stations identified by the FAA. The list of cities requiring radio remote communication is listed in Authorizations, section 2, Policy.*

**NOTE:** Station personnel are not trained to serve in an ATC role and therefore do not provide air traffic separation advisories. This type of request is out of the scope of their duties. Crew can expect station personnel to provide ground and runway traffic advisories only.

*Arriving using radio remote communications:*

- Station personnel will monitor ground traffic of airport area and be available for radio contact ten minutes prior to estimated time of arrival.

- *Flight crew will contact station requesting ground traffic advisories when switching over to CTAF.*
- *Station personnel will continue observation and radio contact with flight crew until aircraft has landed and is clear of all active runways.*

According to the Horizon Air Services Manual, page 6.26, the following procedures were required to be followed by the radio remote observer:

- *Initiate traffic monitoring of airport area and be available for radio contact ten minutes before actual flight arrival.*
- *Viewpoint for observations should be the nearest elevated area available that will give the observer a clear, unobstructed view of the total runway and complete 360° view of the traffic pattern (roof, deicing tower, etc.)*
- *Observer will continue observation and radio contact with the incoming flight crew until the aircraft has landed and is clear of all active runways.*

According to the radio remote observer at PUW on the day of the incident, at 1825 the captain called the radio remote observer to advise they were 71 miles west of the airport and would be landing at 1840. About 1833, the flight called back for advisories, and the radio remote observer replied that there was no visible ground traffic at the airport. The radio remote observer noticed that about 1834, the only lights on the airport surface illuminated were the blue taxiway lights.

## **F. NTSB Safety Letter**

Following the January 12, 2014, incident involving Southwest Airlines flight 4013, a Boeing 737-7H4 landing at the wrong airport, and the November 21, 2013, incident involving a Boeing 747-400 LCG (Dreamlifter) which also landed at the wrong airport, the NTSB published Safety Alert “Landing at the Wrong Airport”<sup>67</sup> which provided suggestions for pilots to mitigate the risks of landing at the wrong airport.

On February 7, 2018, the NTSB sent a letter to the Horizon Air Director, Regulatory Compliance & Fleet Technology, along with the Safety Alert, with suggestions to increase pilot awareness with not only the airport of intended landing, but also with the runway aids available to the pilot, and applicability to verifying the correct airport and runway for landing.

On March 22, 2018, Horizon Air responded to the NTSB letter, and stated that a joint Horizon Air and Alaska Airlines review team that included representatives from both airline’s Flight Operations Compliance, Flight Standards and AAG (Alaska Air Group) Safety groups met and “unanimously agreed to proceed with the development of a new philosophy towards approach

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<sup>67</sup> The NTSB safety alert and others can be accessed from the NTSB’s Safety Alert web page at <http://www.nts.gov/safety/safety-alerts/Pages/default.aspx>.

briefing.” The letter indicted that both airlines would develop a policy to “incorporate approach and runway lighting as one of the relevant briefing items and emphasized in flight training.”

For additional information on the NTSB letter, and the Horizon Air response, see Attachment 17 – NTSB Safety Letter, and Attachment 18 – Horizon Air Response to NTSB Safety Letter.

## **G. LIST OF ATTACHMENTS**

Attachment 1 - Interview Summaries  
Attachment 2 – Flight Release and Weather Packet  
Attachment 3 - N412QX Maintenance Logbook  
Attachment 4 - Captain Training History  
Attachment 5 - FO Training History  
Attachment 6 - Captain Trip Pairing and Monthly Schedule  
Attachment 7 - FO Trip Pairing and Monthly Schedule  
Attachment 8 - Horizon Air Q400 Descent Flow  
Attachment 9 --Horizon Air Q400 Normal Checklist  
Attachment 10 – Horizon Air Q400 RNAV Approach Guidance  
Attachment 11 – Horizon Air Q400 RNAV Approach Profile  
Attachment 12 – Horizon Air Q400 SOPs for Landing  
Attachment 13 – Q400 Amplified Approach Checklist  
Attachment 14 – PUW Airport Information Chart  
Attachment 15 – SEA Simulator Observation  
Attachment 16 – Party Forms  
Attachment 17 – NTSB Safety Letter  
Attachment 18 – Horizon Air Response to NTSB Safety Letter  
Attachment 19 – Horizon Air CRM Policy

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