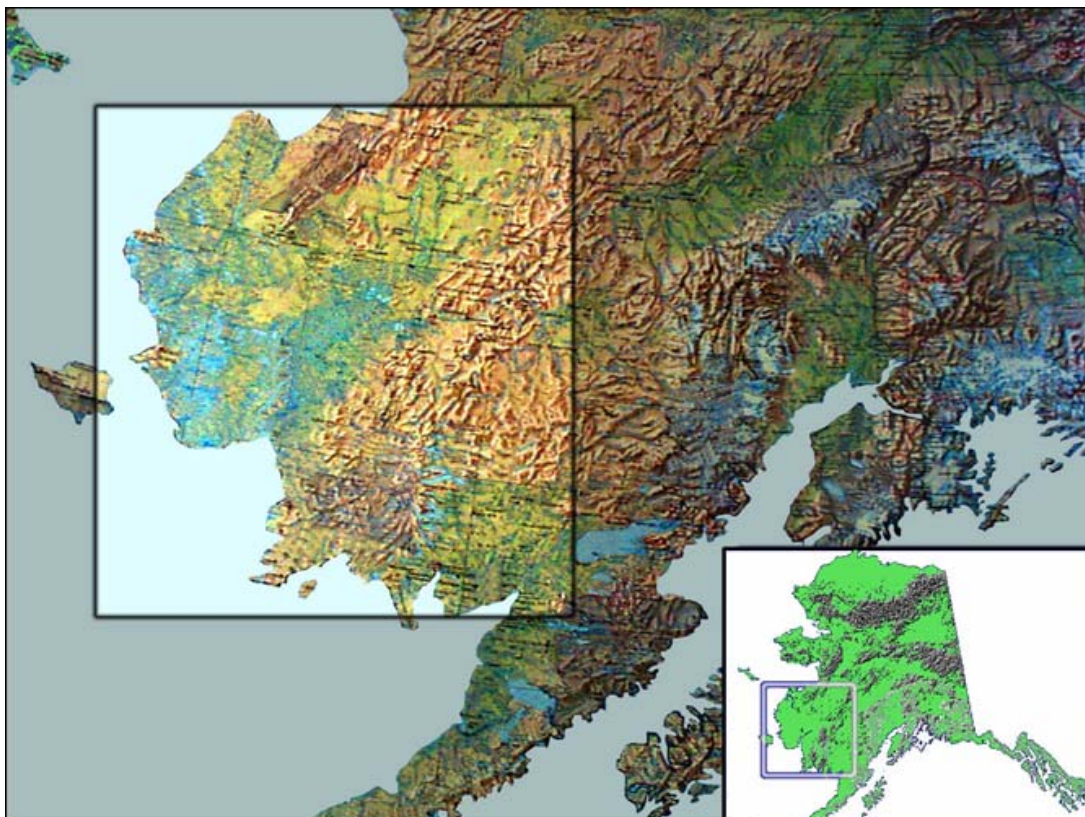


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# The Impact of Capstone Phase 1 Post-Transition Annual Report - 2005

July 2006



The MITRE Corporation's Center for  
Advanced Aviation System Development



UNIVERSITY of ALASKA ANCHORAGE

Aviation Technology Division

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# **The Impact of Capstone Phase 1 Post-Transition Annual Report – 2005**

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# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

1	Introduction.....	5
1.1	Capstone Phase 1 Program .....	5
1.2	Importance of Aviation in the Yukon-Kuskokwim Delta.....	6
1.3	Traffic in the Y-K Delta.....	6
1.4	Historical Accidents in the Y-K Delta .....	9
2	Capstone Program Background .....	13
2.1	Overview of the Technical Aspects of Phase 1 .....	13
3	Capstone Phase 1 Implementation and End of Program Transition .....	16
3.1	Overview.....	16
3.2	Approaches .....	16
3.3	AWOS.....	16
3.4	GBTs .....	17
3.5	Aircraft and Avionics.....	19
3.6	Air Traffic Control.....	20
	Radar-like Services .....	20
	Tower Services and Approach Control.....	20
	Flight Information .....	21
3.7	Flight Monitoring.....	21
4	Capstone Surveys and Interviews .....	22
4.1	Airline Management’s Viewpoint.....	22
4.2	Scheduling and Dispatch.....	26
4.3	Pilot Surveys .....	28
	Pilot Demographics.....	28
	Program Benefits .....	29
	Use, Usefulness and Usability .....	32
	Pilot Non-Use.....	34
	Pilot Safety Impact Rating.....	36
	Pilot Training .....	36
5	Aviation Services .....	38
5.1	Improved Access.....	38
6	Aviation Safety .....	40
6.1	Accidents in 2005 .....	40
6.2	Comparison of Accident Types to Projected Capstone Benefits .....	41
6.3	Comparison of Y-K Delta Accident Rates to Other Parts of Alaska.....	43
6.4	Comparison of Accident Rates Before, During, and After Equipage/Start of Services.....	45
6.5	Comparison of Accident Rates Between Operator and Operations Types .....	46
7	Other Y-K Delta Programs/Impacts.....	48
7.1	Changes in Operations Associated with Capstone.....	48
7.2	Medallion Program .....	48
8	Summary Conclusions .....	50
9	Appendices.....	52
9.1	Appendix A: Capstone Equipped Aircraft Accidents.....	52

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

9.2	Appendix B: Summarized Operating Data Tables.....	103
9.3	Appendix C: Participating Operator and Aircraft Tables .....	107
9.4	Appendix D: Airline Surveys.....	112
D.1	Pilot Responses .....	112
D.2	Management and Dispatch Responses.....	125
9.5	Appendix E: Acronyms.....	140

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

## **1 Introduction<sup>1</sup>**

### **1.1 Capstone Phase 1 Program**

In early 1997, the Federal Aviation Administration began developing a proposal entitled "Flight 2000." Flight 2000 was the precursor to the Safe Flight 21 program. That initiative envisioned rapid deployment and field demonstration of advanced avionics capabilities leading toward implementation of Free Flight. The FAA analysis indicated that there would be a 38% reduction in commercial aircraft accidents if the Flight 2000-envisioned avionics were installed in Alaska.<sup>2</sup> Within the Alaskan Region, Flight 2000 served as the "capstone" for many additional initiatives, providing a common umbrella for planning, coordination, focus, and direction with regard to development of the future NAS.

The Capstone project was proposed as an operational demonstration program for Alaska, installing and demonstrating ADS-B technology in the Bethel and Y-K Delta area initially. This became known as the Capstone Phase 1 program. Coordination and regular meetings were held with the Alaska Aviation Industry Council to develop and tailor the program to suit all parties. Ten airports were to be the focus of the program. The Capstone proposal was funded with \$11 million in Fiscal Year 1999.

Phase II, the Capstone program into Southeast Alaska, officially began in March of 2003. The FAA is currently conducting research and developing a plan for Phase III which would include the entire State of Alaska.

The Federal Aviation Administration's Capstone Phase 1 program officially completed the aircraft equipment and maintenance portion of the program at the end of 2004. Complete information concerning the program through 2004, *The Impact of the Capstone Phase 1 Program Final Report*, is available on the Capstone website: <http://www.alaska.faa.gov/capstone/docs/Phase%20I%20Final%20with%20appendices.pdf>. A total of 208 aircraft were outfitted with Capstone avionics during the Phase 1 program. Maintenance responsibility and the responsibility for further equipment was transitioned to the owners and operators in the Y-K Delta area at the end of 2004. The FAA maintains responsibility for the ground infrastructure, including 10 weather stations (associated with instrument approaches) and 10 ground based transceivers that communicate with the avionics.

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<sup>1</sup> The contents of this material reflect the views of the authors. Neither the Federal Aviation Administration nor the Department of Transportation, makes any warranty or guarantee, or promise, expressed or implied, concerning the content or accuracy of the views expressed herein.

<sup>2</sup> Economic Justification for FAA's Flight 2000 Program, September 23, 1997.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

This report provides continuing analysis of the Y-K Delta operations and accidents in this post-transition environment and tracks the changes in equipage and services following the completion of the program.

### **1.2 Importance of Aviation in the Yukon-Kuskokwim Delta**

Alaska relies on aviation more than any other state. Although Alaska covers 615,230<sup>3</sup> square miles, representing 16 percent of the total U.S. land area, it has only 13,628 miles of public roads.<sup>4</sup> Less than 10 percent of the state is accessible by road (the state capitol, Juneau, is accessible only by air or ferry), and river transport is possible only a few months of the year. As a result, aviation is the primary, and in most cases the only means of transport for Alaska's numerous remote villages. Unfortunately, most of these villages lack the aviation infrastructure found in the Lower 48. This, when added to the flying challenges posed by Alaska's mountainous terrain and fierce winter climate, has made safety the biggest concern for Alaska's aviation community.

The Y-K Delta area of Alaska is remote with only a few roads between villages and no road connections with any of Alaska's metropolitan centers. State of Alaska, in their Y-K Delta Transportation study, states that there are 54 villages in the Y-K Delta. Mekoryuk is not included in this Capstone Phase 1 Impact Study which considers only Bethel and the remaining 53 villages. As of 1999, there were 24,366 people living in the Y-K Delta: 22.5% of them live in Bethel and 39 of the villages (or 72%) have populations of less than 500 people. Transportation of goods and people takes place by water travel (where available) in the summer, snow travel in the winter and aviation travel year round. At some villages, there are many times during the year that aviation is the only means of transportation.

### **1.3 Traffic in the Y-K Delta**

Of the 53 villages in the Y-K Delta, 32 were served in 2005 by either air carriers operating from Anchorage, Fairbanks or Nome, or scheduled air carriers operating within the Y-K Delta. The scheduled air taxi routes are depicted in Figure 1.3-1 for airports with at least 52 scheduled flights per year. For the analyses in this report, any Y-K Delta accident or operation will have either its origin or destination at one of these 53 airports. The data supporting this figure can be found in Appendix B.

Bethel, the largest community in the Y-K Delta, is the aviation center and also the economic, governmental, and cultural center of the region. Aniak, to the northeast, and St. Mary's, to the northwest, serve as economic and mail distribution hubs. The hubs receive daily scheduled service from passenger and cargo carriers. The mainline passenger and cargo flights to Bethel originate in Anchorage, the largest hub airport in Alaska. These flights use Boeing 737 and Beech 1900 passenger aircraft and DC-6,

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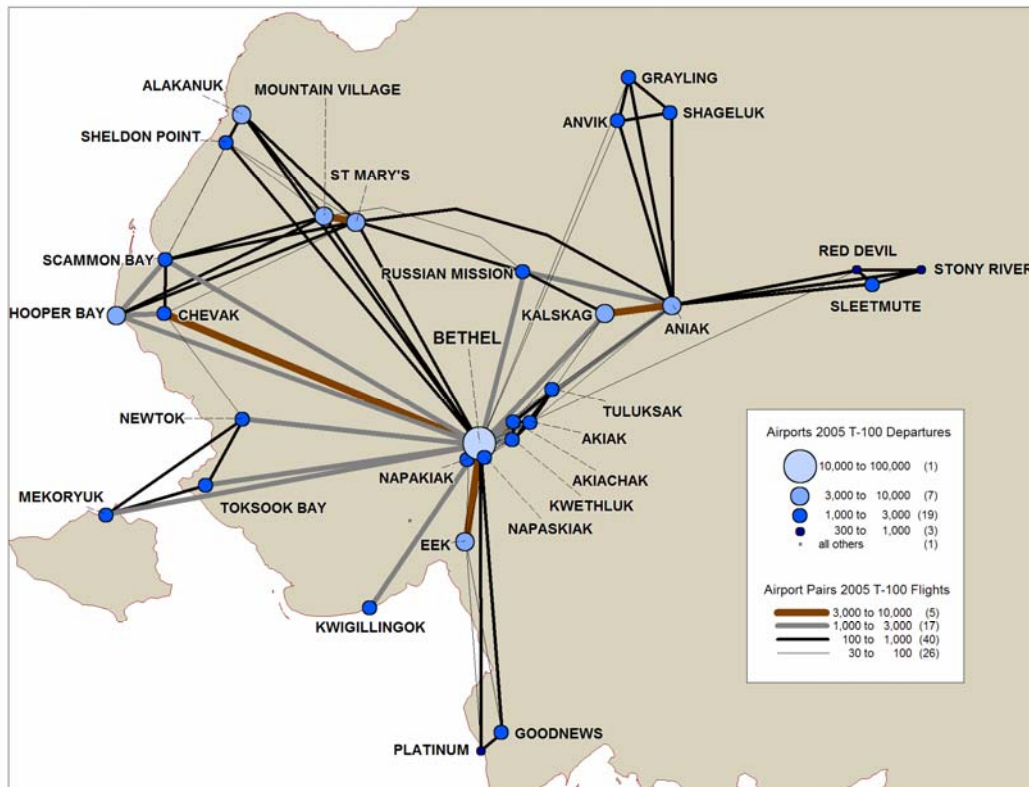
<sup>3</sup> Statistical Abstract of the United States, 2001, Table 343.

<sup>4</sup> Alaska DOT&PF, <http://www.dot.state.ak.us/stwdplng/highwaydata/pub/cprm/2001cprm.pdf>, Certified Public Road Mileage as of December 21, 2001. Excludes Marine Highway miles.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

Boeing 727, and EMB 120 Brasilia cargo aircraft. Since air is the only transportation mode that can operate in the region year-round, all passengers and 95 percent of all cargo arrive via scheduled air service. Bethel, Aniak, and, St. Marys are mail hubs for the smaller communities in the Y-K Delta. Single-engine and light twin-engine aircraft such as Cessna 207s, Cessna 208 Caravans, Cessna 172s, CASA 212s, and Twin Otters carry passengers and cargo to those smaller communities.



**Figure 1.3-1 Airport Departures and Route Traffic in the Yukon-Kuskokwim Delta**

In a typical scenario, an Alaska Airlines Boeing 737 flies from Anchorage to Bethel with 16,000 to 20,000 pounds of freight and mail and about 50 passengers. In Bethel, passengers, freight, and mail headed for other communities transfer to local carriers. For example, a Cessna 207 with 4 passengers and 300 pounds of mail might fly a circuit from Bethel to Hooper Bay, then Scammon Bay, and finally Chevak before returning to Bethel.

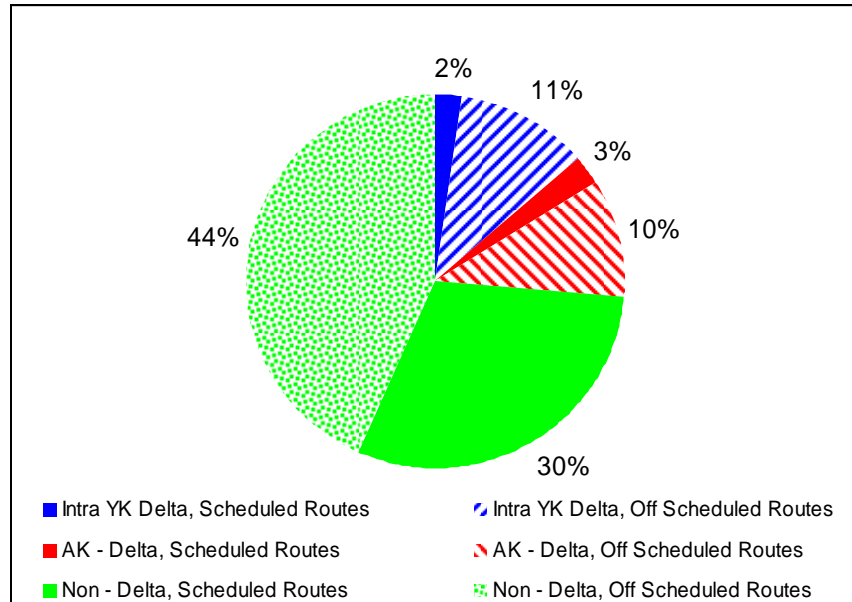
T-100 Segment Data maintained by the Department of Transportation's Bureau of Transportation Statistics is available for FAA operators certificated under FAR Part-135, Scheduled Operators. This information allows an in-depth analysis of Y-K Delta traffic distribution. Off Schedule routes are defined as flights conducted by a Scheduled

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

Operator that were not scheduled. Non-scheduled operators are not required to file T-100 data and therefore are not included in the analysis below.

Figure 1.3-2 shows the distribution of flights by scheduled operators within Alaska. Twenty-six percent of all Alaska operations from 2002 through 2005 are either Intra-Delta or fly between the Y-K Delta and other areas within Alaska. Intra-Delta flights account for 13 percent of all Alaska operations.



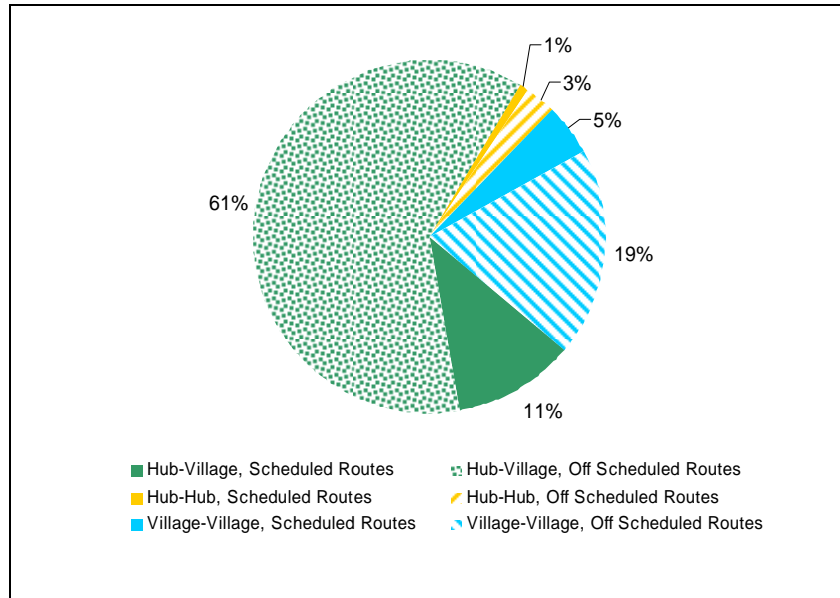
**Figure 1.3-2 Intra Alaska Flights by Scheduled Operators, 2002-2005**

Within the Y-K Delta the distribution of flights is primarily between hubs and villages, accounting for 72 percent of all operations. Traffic between villages account for 24 percent of all flights, and hub-to-hub operations make up only 4 percent. Figure 1.3-3 depicts this distribution.



# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005



**Figure 1.3-3 Distribution of Intra-Y-K Delta Flights by Scheduled Operators 2002-2005**

### 1.4 Historical Accidents in the Y-K Delta

Figure 1.4-1 depicts the types and causes of accidents prior to Capstone for commercial aircraft (operating under Federal Aviation Regulations Part-135) based in the Y-K Delta. These are the aircraft most directly affected by Capstone. Major categories (the inner pie slices) are explained below. Some accidents also fall within some special sub-category (outer pie segments) but many do not. The dark band and underlined categories and sub-categories identify causes of accidents that were originally targeted by Capstone prior to the start of the program. Since the program started, experience has shown that other areas have been impacted by Capstone, at least indirectly.

**Fuel Mismanagement:** Usually fuel exhaustion. Occasionally, failure to switch fuel tanks.

**Mechanical Failure:** Engine failure, inoperable control surfaces, failed landing gear, propeller or shaft failure. (There were no fatal accidents in this category by Y-K Delta based Part-135. In the Lower 48, 10% of mechanical accidents are fatal.)

**Flight Information:** Usually inadequate weather information, especially icing, but also visibility; rarely convective weather. (Surface winds contributing to take-off or landing accidents have been included under take-off or landing rather than here.) Occasionally, lack of information on changes in procedures or facility status.

**Navigation:** Usually Controlled Flight into Terrain (**CFIT**) while enroute, most often associated with reduced visibility. In the Y-K Delta, CFIT also occurs in nominal VFR conditions when “flat light” on snow-covered ground prevents recognition of terrain. Terrain Clearance Floor (**TCF**) warnings

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

are a Terrain Awareness and Warning System (TAWS) function planned for Capstone Phase 2 that addresses the 20%-30% of CFIT accidents on approach or departure. These are not directly addressed by Capstone Phase 1 avionics. Rarely, accidents are due to mislocation, which can be addressed by a GPS-**map** display.

**Traffic:**

Usually mid-air collisions between aircraft. Also includes accidents from last-moment avoidance of other aircraft.

**Flight Preparation:**

Failure to ensure cargo is tied-down and within the aircraft's **weight and balance** limits. Failure to check fuel for the presence of water. Failure to remove ice or snow from the aircraft – often resulting in serious or fatal accidents (rare in the Lower 48 but more common in the Y-K Delta)

**Take-off and Landing:**

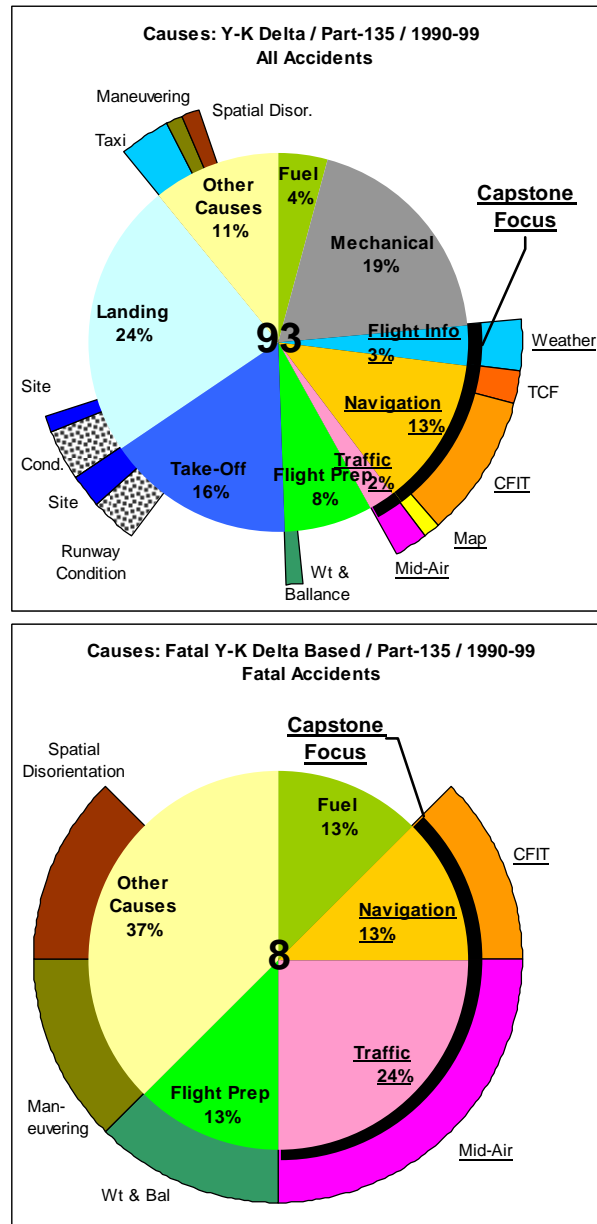
Failure to maintain control (especially in wind), improper airspeed, or inadequate care near vehicles or obstacles. The Y-K Delta also includes unusually high numbers of accidents from poor runway **conditions**, from hazards at an off-runway **site** such as beaches and gravel bars, and from obstacles in water that are struck by float-planes.

**Other:**

Taxi or airport vehicle accidents, low altitude maneuvering for game spotting or photography, spatial disorientation, improper carburetor heat, bird strikes.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005



**Figure 1.4-1 93 Accidents and 8 Fatal Accidents by Y-K Delta Part-135 Aircraft 1990-1999**

Causes of overall accidents and causes of fatal accidents had very different percentages. Many accidents were associated with take-off, landing and mechanical problems, but relatively few of these caused injuries and none caused fatalities. By contrast, accidents from inadequate flight preparation, fuel mismanagement, lack of flight information, collisions with other aircraft, and difficulty navigating were much more likely to cause injuries and fatalities. Differences such as these are consistent with accident studies<sup>5</sup> for

<sup>5</sup> Annual Nall Report, AOPA Air Safety Foundation.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

the US as a whole. The percentage of fatal accidents associated with traffic (collision or interaction with other aircraft) was higher than that in the Lower 48; the percentage associated with navigation was comparable. “Weather” accidents (which are split between several of the categories<sup>6</sup> used here) were often fatal in both the Lower 48 and Alaska. Capstone focuses on these more serious accident types.

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<sup>6</sup> Weather contributes to accidents associated with navigation, flight preparation, and spatial disorientation, which have a high fraction of fatal accidents. It also contributes to take-off and landing accidents that cause few fatalities in the Y-K Delta – none from 1990 to 1999. (In the Lower 48 take-off accidents have significant fatalities.)

# **The Impact of Capstone Phase 1 Post-Transition Annual Report – 2005**

## **2 Capstone Program Background**

### **2.1 *Overview of the Technical Aspects of Phase 1***

The capabilities of Capstone Phase 1 specifically target four serious safety problems in Alaska:

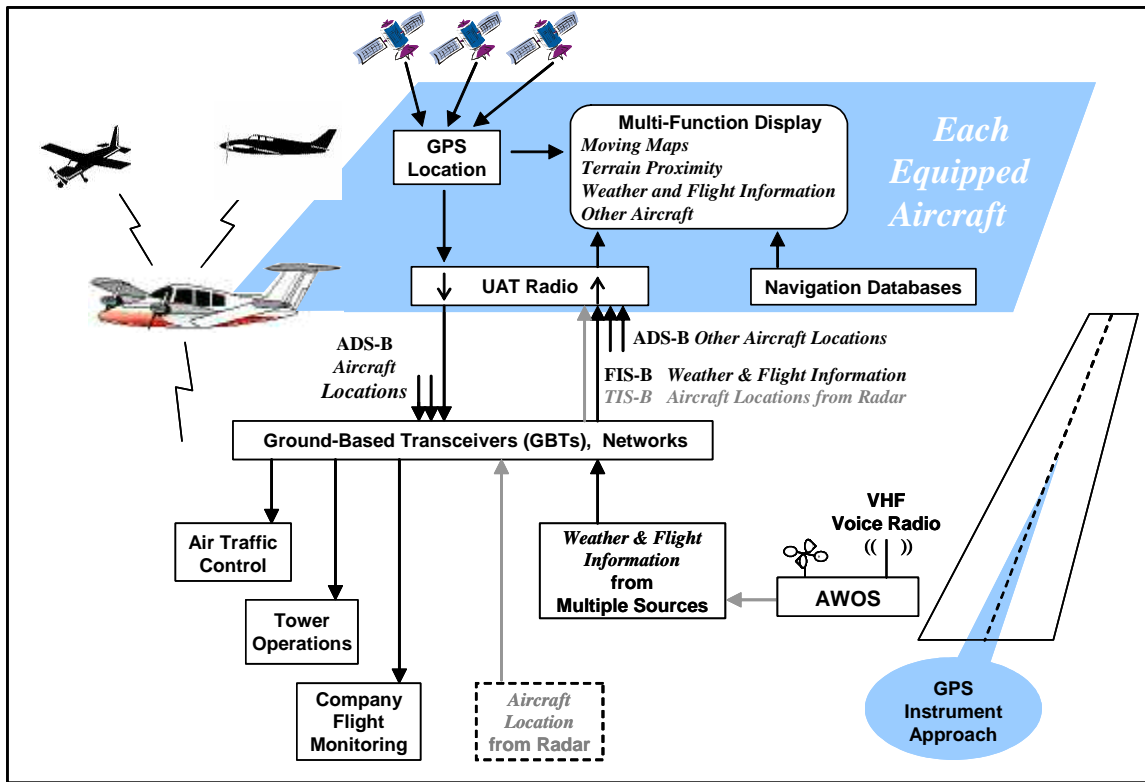
- CFIT accidents (within the navigation category)
- Accidents associated with aircraft traffic – especially mid-air collisions
- Inadequate flight information – especially weather information
- Inadequate infrastructure to support IFR operations

Capstone's Phase 1 capabilities can also affect operations efficiency. While efficiency is not the subject of this paper, it is important to recognize that there are safety consequences to landing delays and to flights that are unable to reach their intended destinations. These inefficiencies typically occur in marginal visibility when the potential for icing is higher than otherwise and when it is more difficult to see-and-avoid aircraft circling to wait for Special VFR (SVFR) clearance. Therefore, decreasing arrival delays or aborted flights (from radar-like services or increased IFR capability) seem likely to decrease accidents.

When Capstone was implemented in 2000/2001, many of the technologies for the capabilities had been available only recently or were being implemented for the first time. Figure 2.1-1 illustrates how Capstone works.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005



**Figure 2.1-1 Capstone Avionics, Ground Systems, and Capabilities**  
Capabilities not operational in 2005 are gray

- Accidents associated with *navigation* are addressed by showing pilots their location on a *moving map* on a Multi-Function Display (MFD). The location of the aircraft is derived from GPS/WAAS, and the map is stored as part of an onboard navigation database. *En route CFIT* is addressed using terrain elevations from the database. Nearby terrain is compared to the aircraft's altitude and GPS location and then color-coded on the MFD (yellow if close in altitude, red if immediately hazardous). The GPS unit also has programmable functions to aid en route flight planning and may reduce pilot navigation workload.
- Accidents associated with aircraft *traffic* are addressed by ATC radar-like services and by showing pilots the relative locations of other Capstone-equipped aircraft. This is derived from Automatic Dependent Surveillance Broadcast (ADS-B) messages transmitted via a Universal Access Transceiver (UAT) by other aircraft and received and processed to provide a Cockpit Display of Traffic Information (CDTI) – one of the functions of the MFD. CDTI also enhances pilot situational awareness and aids pilot-pilot coordination at non-towered airfields. In the future, locations of aircraft that are not Capstone equipped but are visible to ATC radar might be provided by Traffic Information Service Broadcast (TIS-B) from the network of Ground Based Transceivers (GBTs).

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

- ***Weather and flight information*** are provided by new Automated Weather Observing Systems (AWOS) at remote airports, and by Flight Information System Broadcast (FIS-B) of weather text and NEXRAD graphics. FIS-B is distributed by data network to Ground Based Transmitters (GBTs) that broadcast to equipped aircraft. Aircraft with Capstone avionics receive these broadcasts on a UAT and display them to pilots on the MFD.
- ***Increased IFR operation*** is supported at remote airfields by AWOS installations, which allow GPS instrument approaches to be approved for commercial operations. For qualified aircraft, this allows safe IFR operations in low visibility conditions that would be unsafe for VFR operations. IFR operations are improved and expanded by Air Traffic Control (ATC) use of ADS-B to support cost-effective ***radar-like services***. ADS-B takes an aircraft's location from GPS/WAAS and transmits it once per second over the UAT. GBTs receive these messages from all nearby Capstone equipped aircraft, and forward them to ATC computers where they are processed and the aircraft locations displayed much like aircraft locations from radar. This allows controllers to provide flight following and surveillance-based separation services in airspace that is not visible to radar. (Note - ADS-B applications may use or require other on-board navigation sources instead of or in addition to GPS. Capstone avionics in Phase 1 use GPS and barometric altimetry.)
- The *situational awareness* for **tower operations** at Bethel airport now includes information from a "BRITE" display of ADS-B targets. This helps them visually locate aircraft and better coordinate arrival sequencing.
- Also in 2002, managers in companies that operate Capstone-equipped aircraft began using *flight monitoring* from the developmental GBTs on PCs connected to the Internet to monitor the location of their aircraft. In 2004 with the beginning of the GBT transition to the operational network, flight monitoring became available to operators via commercial service providers, and Capstone provided subscriptions to the Flight Explorer product at no charge. Flight monitoring has the potential to significantly improve awareness of risks and to facilitate further improvements in safety posture.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **3 Capstone Phase 1 Implementation and End of Program Transition**

#### **3.1 Overview**

During 1999, the Capstone office was established and staffed, program planning was well underway, new routes and approaches were being developed and both flight and ground equipment specifications were being written. By late 1999, the Supplemental Type Certificate for installation of the flight avionics was approved and avionics were installed in the first two aircraft.

GBT and AWOS installations began in 2000. All GBT installations were completed by March 2002 and all AWOS installations were completed by September 2002. Software to process the ADS-B returns was installed in the Mirco-EARTS computer at the Anchorage Center in December 2000.

#### **3.2 Approaches**

One of the key elements of the Capstone Phase 1 program was to improve the approaches at a number of airports. During 1998 and early 1999, a list of ten airports that would receive new GPS non-precision instrument approaches was developed in collaboration with the Industry Council. Between December 1999 and December 2001, stand-alone GPS approaches were developed, approved and published at these ten airports. These airports were St. Michael, Mountain Village, Platinum, Holy Cross, Kalskag, Kipnuk, Koliganek, Russian Mission, Scammon Bay and Egegik. Pilot Point received a GPS approach in February, 2004.

There were no new GPS non-precision instrument approaches developed and certified in the Y-K Delta during 2005.

#### **3.3 AWOS**

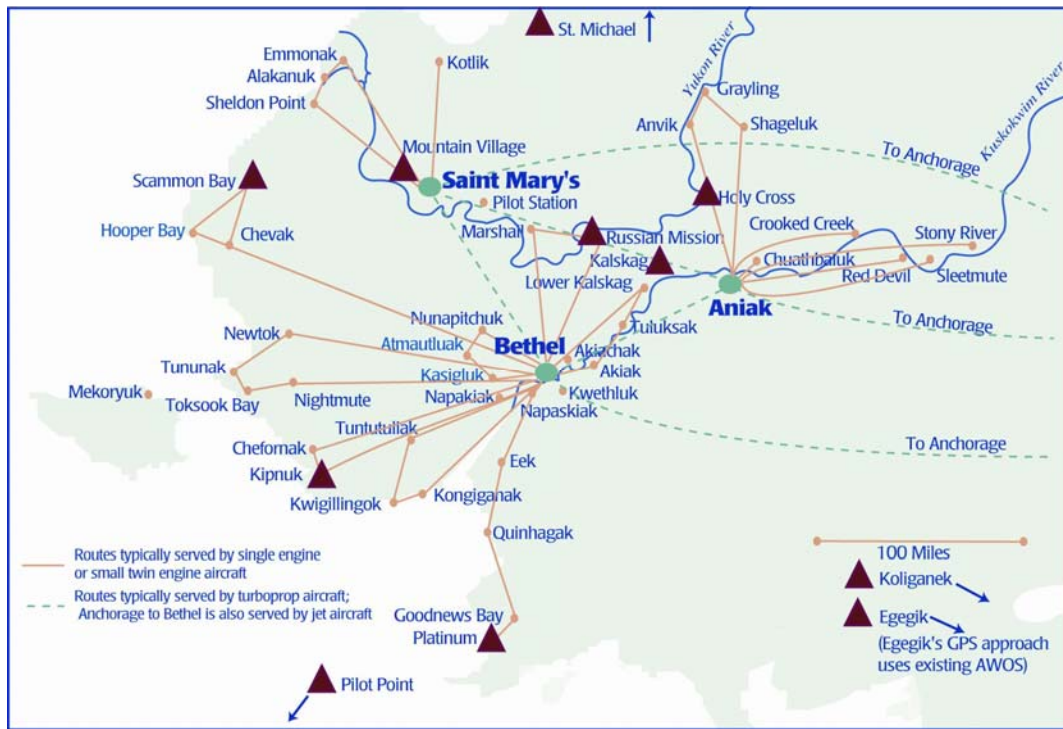
Ten airports have received AWOS stations associated with the GPS approaches under the Capstone Phase 1 Program. These airports; St. Michael, Mountain Village, Platinum, Holy Cross, Kalskag, Kipnuk, Koliganek, Russian Mission, Scammon Bay and Pilot Point; shown in Figure 3.3-1, had AWOS stations installed between June of 2000 and September of 2002. Egegik had a previously-installed AWOS that was included in the program. The new stations have more than doubled the number of full-time weather reporting sites in the Y-K Delta, reducing the distance between weather observations to less than 50 miles on most flight routes. Since these stations are not connected to the networks for national weather-data distribution, observations are not yet available on the MFD via FIS-B. Pilots can listen to vocalized current weather observations by phone prior to departure or by radio when flying near these sites.

No new AWOS stations were added to the Y-K Delta in 2005.



# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005



**Figure 3.3-1 Locations of AWOS and Non-Precision GPS Instrument Approaches**

### 3.4 GBTs

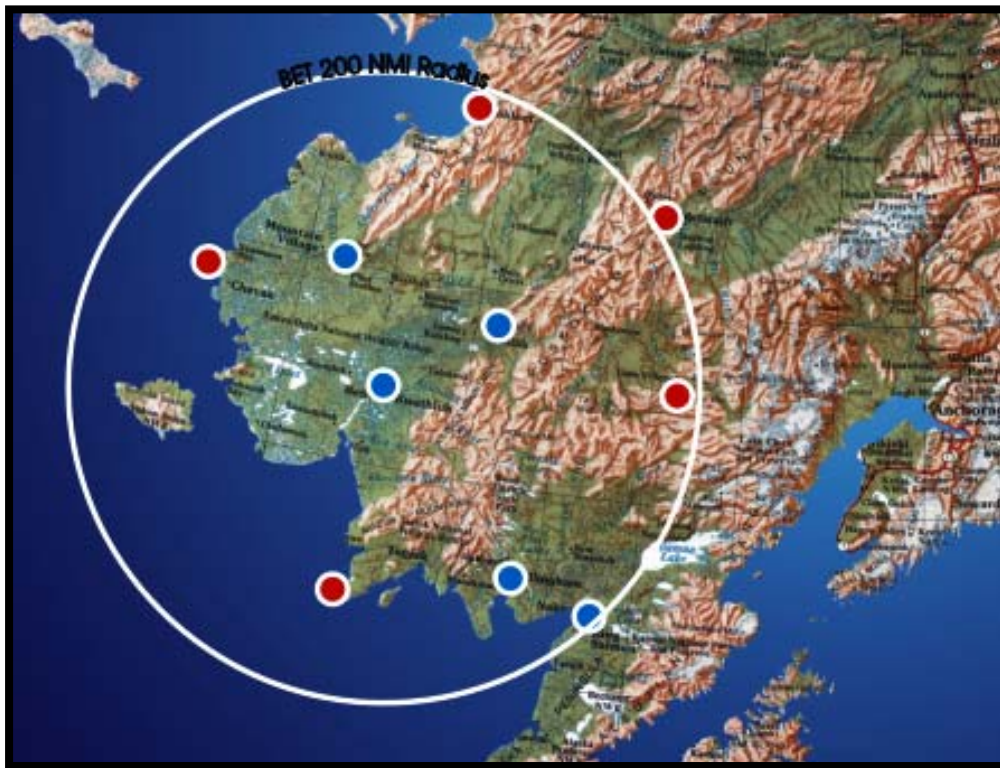
A total of 10 Ground Based Transmitters were installed in the Y-K-Delta. Capstone GBTs used the frequency of 966 MHz for the initial demonstration phase. This frequency belonged to the Department of Defense and was temporarily approved for use in Alaska and the Ohio Valley during ADS-B development. Capstone received approval for use of 981 MHz on a year to year basis in October of 2000 as an interim while a permanent frequency assignment was approved. The GBTs and UATs in the Capstone Phase 1 program all used this interim frequency. This allowed Capstone to start operations using this developmental network but did not allow for self equipage. A permanent frequency assignment of 978 MHz was assigned and transition to the new frequency is to take place in early 2005 following GBT certification of Minimum Operational Performance Specification (MOPS) compliance.

The initial GBTs that were installed in the Y-K Delta were designated as developmental because of their lack of technological maturity. The second generation of GBTs was designed to be more robust and they were designated as the operational GBTs. There is a difference in the reliability of the developmental GBTs and those that are on the operational system. The GBTs at most sites have redundant GBT pairs to minimize non-availability of surveillance.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

During 2005, the GBTs sited at Bethel, Aniak, St. Mary's, Dillingham and King Salmon transitioned onto the FAA's operational network. These GBTs are shown with blue circles on Figure 3.4-1 below. The remaining GBTs at Unalakleet, Sparrevohn, Tatalina, Cape Romanzof and Cape Newenham (shown in red below) were scheduled to transition early in 2006. On December 15, 2005, these five GBTs were taken off the developmental network and were scheduled to be returned to service in January 4, 2006 on the FAA's operational network. (In 2006, after the period covered by this report, the transition did not occur as scheduled, reducing the number of GBTs and coverage area available to five GBTs providing Surveillance and Flight Monitoring by the operators. On March 24, 2006, the FAA Air Traffic Organization removed all GBTs from service. They were incrementally returned to service later in 2006 and this will be documented in next year's report.)



**Figure 3.4-1 GBT Transitions in the Y-K Delta**

TIS-B not available in the Y-K Delta and is only available in the Anchorage area via the Site Summit GBT. Both CRABS and Flight Explorer flight monitoring data was available most of the year from either operational (Flight Explorer) or developmental (CRABS) GBTs. As each site transitions to the operational network, only Flight Explorer will be available for flight monitoring from the site. By the end of 2005 CRABS was available only from the single developmental GBT at Bethel.

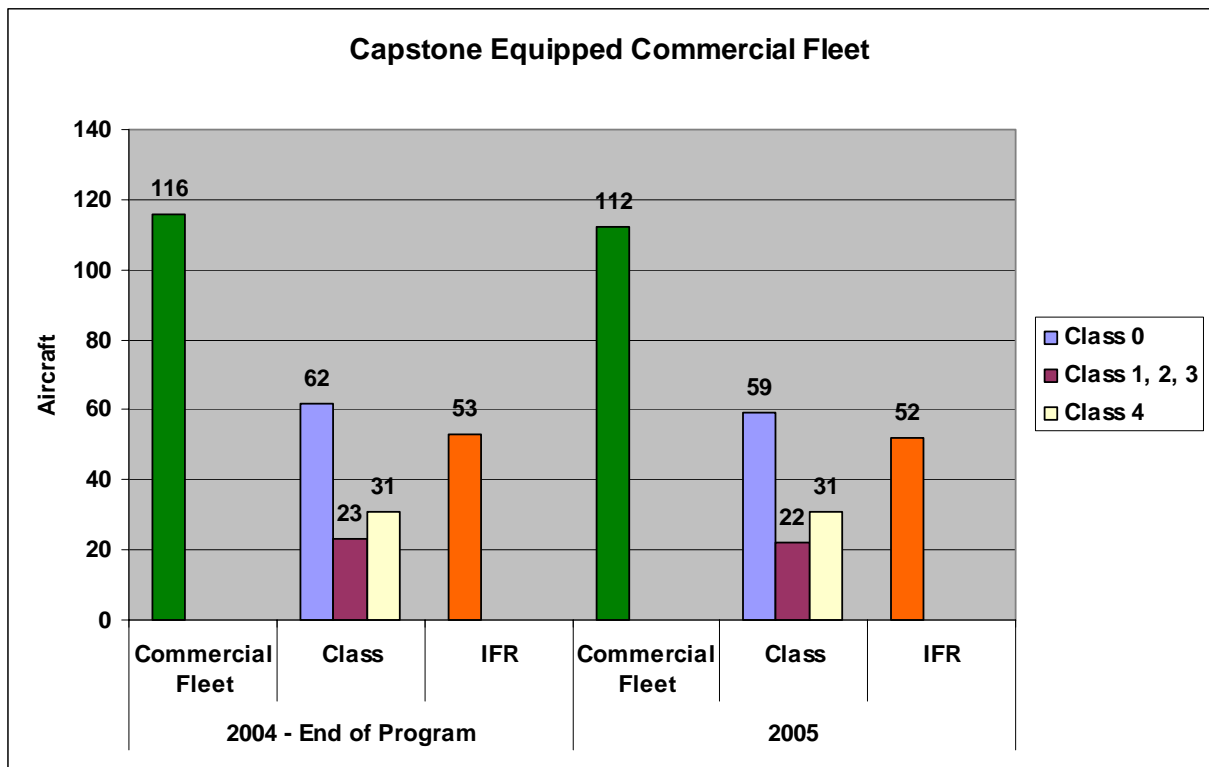
# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### 3.5 Aircraft and Avionics

A total of 208 aircraft were Capstone equipped during the equipage phase of the Capstone program. Of these, 189 were, at some point in the program, operated commercially under FAA Part 135. During the 5 year program the commercial operating fleet in the Y-K Delta decreased due to operators moving into and out of the area based on the market and operating economics, bankruptcies, competitive pressures and other factors. A November 2003 change in the US Postal Service contract had a major impact as several operators were not awarded postal service flights and ceased operations in the Y-K Delta. At the end of the equipage phase in 2004, there were 116 aircraft in the Y-K Delta commercial operating fleet and Capstone-equipped aircraft accounted for nearly 100% of operations by Part-135 aircraft based in the Y-K Delta. Non-equipped, non-jet aircraft accounted for only 0.9% of the operations.

During the first year since the transition, 7 Capstone equipped aircraft have left the Y-K Delta commercial fleet and operators have self-equipped 3 additional aircraft. The number of Capstone-equipped aircraft in the commercial operating fleet declined to 112.



**Figure 3.5-1 Capstone Equipped Commercial Fleet Changes since Program Transition**

Figure 3.5-1 shows that the current number of Capstone equipped aircraft in the Y-K Delta commercial fleet at the end of 2005. The fleet consists of 53% single engine piston

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

aircraft (Class 0), 28% turbine powered (Class 4) and the rest are light twins (Classes 1, 2, 3). IFR qualified aircraft remain at 46% of the current Capstone operating fleet.

There are also 3 additional unequipped aircraft, not included in the above total, that have moved into the Y-K Delta fleet in 2005 and two aircraft that were previously not equipped with Capstone type avionics bringing the total non-equipped aircraft to 5. The 2 operators of the aircraft stated that cost of equipment was a major factor in not equipping now.

### **3.6 Air Traffic Control**

#### **Radar-like Services**

Beginning in January 2001, air traffic control scopes at Anchorage Center began displaying Capstone-equipped aircraft near Bethel despite the fact that there is no radar coverage in the Bethel area below 5,000 feet. Use of ADS-B to provide “radar-like services” was the first of its kind in the world. The FAA divided the air traffic control sector over Bethel into high and low sectors to allow increased controller attention to the aircraft targets covered by ADS-B surveillance. However, the horizontal extent of the low sector is too large to allow the controller to read the data-blocks for the large number of targets that often appear very close to Bethel, and for this reason, ATC does not provide surveillance-based separation services to ADS-B traffic on approach or departure at Bethel. If the low sector had been created with a smaller extent to allow Bethel to be shown at a larger scale, it would have allowed the en route controllers to provide these services. Instead, more complete services for approach and departure are planned with establishment of a Bethel Approach Control, to be located in Fairbanks, but the target date for this has slipped from 2004 into 2007. (With the system shutdown in March, 2006 by the Air Traffic Organization, radar-like services were not available anywhere in the Y-K Delta, but they are subsequently being restored.)

#### **Tower Services and Approach Control**

The Bethel tower currently provides services for VFR and Special VFR (SVFR) traffic and coordinates with Anchorage Center on IFR traffic to and from the Bethel airport. Bethel controllers are now able to use a BRITE display to more easily acquire and track ADS-B-equipped aircraft and to enhance situational awareness of aircraft that are not yet within visual range. Controllers cannot broadcast displayed traffic calls with altitude since the BRITE display is yet to be certified for this purpose. The FAA continued to work on implementing ADS-B capability as part of an approach control system for Bethel. Approach control, which is planned, could potentially allow air traffic controllers located in Fairbanks to use Capstone technology to space and sequence IFR or SVFR aircraft landing at Bethel. The use of ADS-B as part of an approach control system may improve traffic flow in IFR and Marginal VFR (MVFR) conditions. Operators are eager

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

to see this capability in place, and the FAA is working through the complex regulatory and contractual issues.

### **Flight Information**

In addition to the AWOS capabilities described above, the network of GBTs provides FIS-B to Capstone aircraft in most of the Y-K Delta. The primary products available to pilots are Meteorological Aviation Reports (METARs), Terminal Area Forecasts (TAFs), AIRMET (Airman's Meteorological Information), Winds and Temperatures Aloft and NEXRAD graphics from the weather radar at Bethel. In the future, additional textual and graphical products will be delivered to the cockpit. For example, graphical icing products may become available, which would be much more effective in helping pilots avoid localized icing – of particular concern in Alaska.

### **3.7 *Flight Monitoring***

In 2002, the Applied Physics Laboratory at Johns Hopkins University developed software that runs a CRABS (Comprehensive Real-Time Assessment Broadcast System) display, allowing operators who sign up for the service to monitor the locations of their Capstone-equipped aircraft over the Internet. Capstone provided this service, at no cost, to all of the operators with equipped aircraft.

In 2004, with the beginning of the GBT transition to the operational network, flight monitoring became available to operators via commercial service providers and for 2005; Capstone provided the service from Flight Explorer at no charge. As can be seen in the airline management interview section of this report, the operators were not happy with this transition.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### 4 Capstone Surveys and Interviews

#### 4.1 Airline Management's Viewpoint

Interviews with 15 airline managers in Bethel indicate that Capstone has improved the safety of flying in the Y-K Delta. Below are some of the comments made during the interviews.

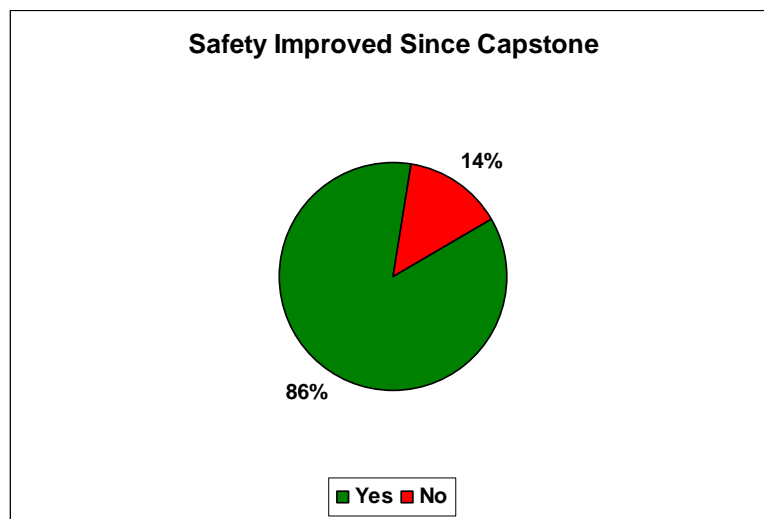
*“Aside from the capability the systems bring to the aviation community, its very existence helps to heighten safety awareness.”*

*“Safety culture and posture were already there, but they both have improved”.*

*“A combination of Capstone, Medallion and FAA policy emphasis combined to improve safety throughout the industry.”*

*“We think we see a greater awareness of general safety because of all the communications improvements and development of Capstone in our operation.”*

*“A key to really get things safe is to get this installed in every aircraft, so we can see each other.”*



**Figure 4.1-1 Management Assessment of Improved Safety**

Although most operators are very positive concerning the overall Capstone improvements, there are a number of areas where they expressed concern. Only 3 operators felt that the transition of the program from the FAA management went well. As stated earlier in the report, the cost of installing the equipment in new aircraft is a key issue. Most operators expressed concern over the lack of adequate information and communications before and during the transition, and the costs and the future use of the equipment. Examples of the comments on the transition are below.

*“There were no transition coordination meetings”.*

*“We were stuck with limited or no knowledge of the warranties, or lack there of, that we were signing for.”*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

*“We had to sign for and operate the system with a lot of unknowns, since the system has never been totally up and running.”*

*“It was a very large negative impact from the poorly choreographed changeover from the government to the operator. The addition of new ‘T-boxes’ after the change over created major expense at \$700 per antenna, replacement boxes from antenna problems, etc. The operators were put in a corner and signed for a ‘pig in a poke.’”*

*“Why is there not, nor has there been a Capstone focal point in Bethel – the heart of Phase I – to coordinate resolution of operational, maintenance, procedural problems?”*

Expenses were a big issue with the management. The 3 key issues were maintenance costs, software revisions and flight monitoring:

*“Cost of equipment, installation, and maintenance is prohibitive.”*

*“Revision updates are very expensive.”*

*The government program was a ‘tease’. Equipment was provided to show how good it could be, and when maintenance problems began to surface, signed it over to the operator.*

*“An avionics professional is badly needed at Bethel, not just for Capstone equipment. Big economic impact to have any avionics item returned to service after a problem.”*

*“CRABS info is more of what is needed. Before pay \$59/mo, info needs to be relevant.”*

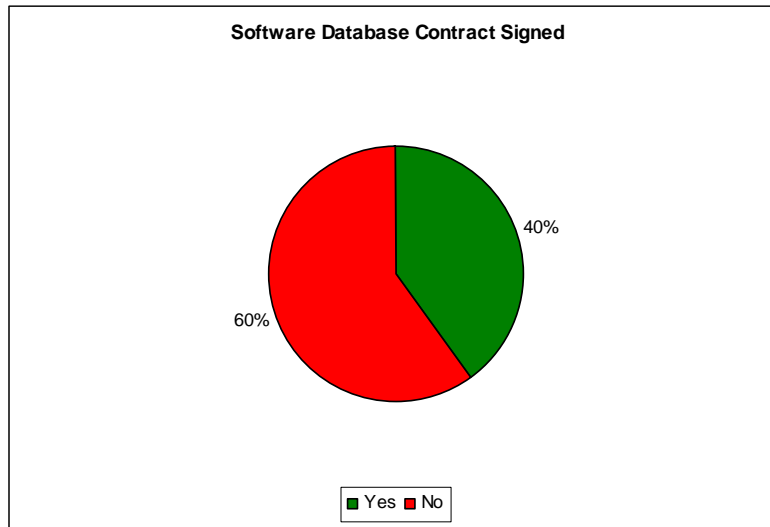
*“Using government contract through 31 Dec 05. CRAB’s provides the info needed - Flight Explorer does not, so we will not continue contract into 06.”*

The comments were also supported by the data from the survey questions. One indicator was the cost for maintaining and updating of the navigation databases. Sixty percent of those questioned do not have a contract for the maintenance of their databases as shown in Figure 4.1-2.



# The Impact of Capstone Phase 1

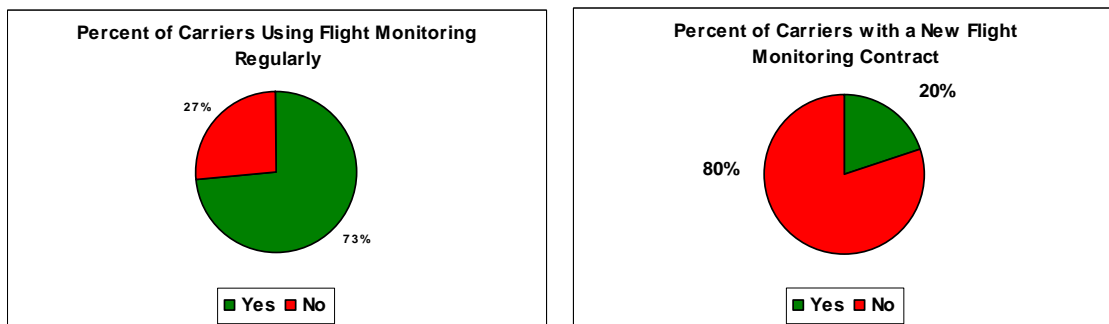
## Post-Transition Annual Report – 2005



**Figure 4.1-2 Software Database Revision Contracts Signed**

Because they predominantly operate VFR, there is a reluctance to pay for a contract for the monthly updates. To mitigate this impact, most stated they plan to purchase one database update each year or so and manually update information when it is convenient for each aircraft.

In past reports, Flight Monitoring has shown to be an effective part of the safety benefits that were derived from Capstone. The operators continue to use the CRABs software which was still available during most of 2005 and is now available only from the single Bethel GBT site. Capstone also provided the operators with a one year contract for use of commercial services from Flight Explorer during 2005. Figure 4.1-3 shows the disparity between operator use of Flight Monitoring and those that have signed a contract to continue use of those services. Although 73% of the operators stated the regularly use Flight Monitoring; only 20% have signed a contract to purchase Flight Monitoring services beginning in 2006.



**Figure 4.1-3 Comparison of Flight Monitoring Use and Contracts Signed**

The operators also expressed concerns regarding the services provided by Capstone in the Y-K Delta. One of the key concerns stems from the delayed implementation of



# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

surveillance-based separation services for approach – either by creating a TRACON or by defining a smaller-scale enroute sector for the immediate Bethel area. Without this, VFR and SVFR traffic must be excluded during IFR operations. Instead of improving the ability of Capstone equipped aircraft to return under SVFR conditions, the program attracted additional IFR operations into Bethel, forcing longer hold and delay times for Bethel based aircraft while the terminal area is restricted for IFR approaches. This was a common concern of nearly all operators. Some of the specific comments are below:

*“There has been a negative impact, as more and more IFR traffic pushes the non-IFR (VFR, SVFR, etc) traffic into longer and longer hold times, both in the air and on land”.*

*“SVFR more difficult than ever to coordinate.”*

*“Numerous instances of aircraft holding in marginal VFR for IFR traffic (which has increased since Capstone), resulting in a change from day marginal VFR to night marginal VFR – bottom line now going from normal operations to emergency operations.”*

*“The FAA has done nothing to change approach procedure to account for the new capabilities – e.g. IFR traffic still blocked large periods of time for a full approach. With the increase in IFR operators at Bethel, it is not uncommon for 20 VFR/SVFR aircraft to be holding while 4 IFR equipped aircraft take almost an hour to do their ‘full approach’.”*

*“If this ‘GPS base’ is the way of the future, why not have the IFR operators (e.g. Alaska Airlines) put the systems in their aircraft? Or, make them hold a couple of times – they will add the systems themselves.”*

*“To make the system work at Bethel, we need a true integration of the Capstone capability into the ATC of the area. All ‘commercials’ should have Capstone. ATC should use Capstone information. Procedures need to be updated to take advantage of the capabilities. If these things are not done, the concept will never ‘fly’ here or in the rest of the country.”*

Operators were concerned over the future of use of Capstone equipment:

*“With operators not forced to maintain the systems, Capstone may have created a more dangerous situation.”*

*“Uneasy feeling that others are operating with inoperative or malfunctioning equipment, so the traffic picture is incomplete.”*

*“Because of the cost of the software updates, if there is anything that would “kill” the program, it would be the updates. The ‘money managers’ find it difficult to justify. This may be better handled through government funding or at least a cost sharing.”*

*“Within 5 years expect less than half of current Capstone equipped aircraft will be Capstone capable due to cost.”*

*“Until all commercial aircraft have the Capstone equipment and capability, many of the promises of improved operations in the Bethel area (including help from Fairbanks ATC) can not be met.”*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **4.2 Scheduling and Dispatch**

Under FAA Part 135 the dispatch function does not require an FAA licensee and most of the operators in the Y-K Delta do not employ professional dispatchers. As shown earlier in Figure 4.1-3, 73% of dispatchers or those assigned similar duties regularly use flight monitoring during their duties. Those not using flight monitoring regularly are very small operators with limited staff. All of dispatchers interviewed are of the opinion that flight monitoring has improved the dispatch operation but the majority of the comments related negatively to the transition from CRABs to Flight Explorer. Details of the interviews can be found in Section 9, Appendix D.2.

*“Better able to predict ETAs for aircraft.”*

*“Saves phone calls when trying to contact aircrews that are on the road.”*

*“Vastly improves communications.”*

*“Better able to provide customers with information relative to flights.”*

*“Flight Explorer will be useful when it does what CRABS does and basically works when you turn it on.”*

*“Did not transition. CRABS is more useful for us. Flight Explorer does not provide useful information.”*

*“Not user friendly, so we leave it off (i.e. do not use it). Will not pay for at current level of use.”*

*“Moved back to CRABs because it provided the useful information. Would prefer to keep CRABs.”*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

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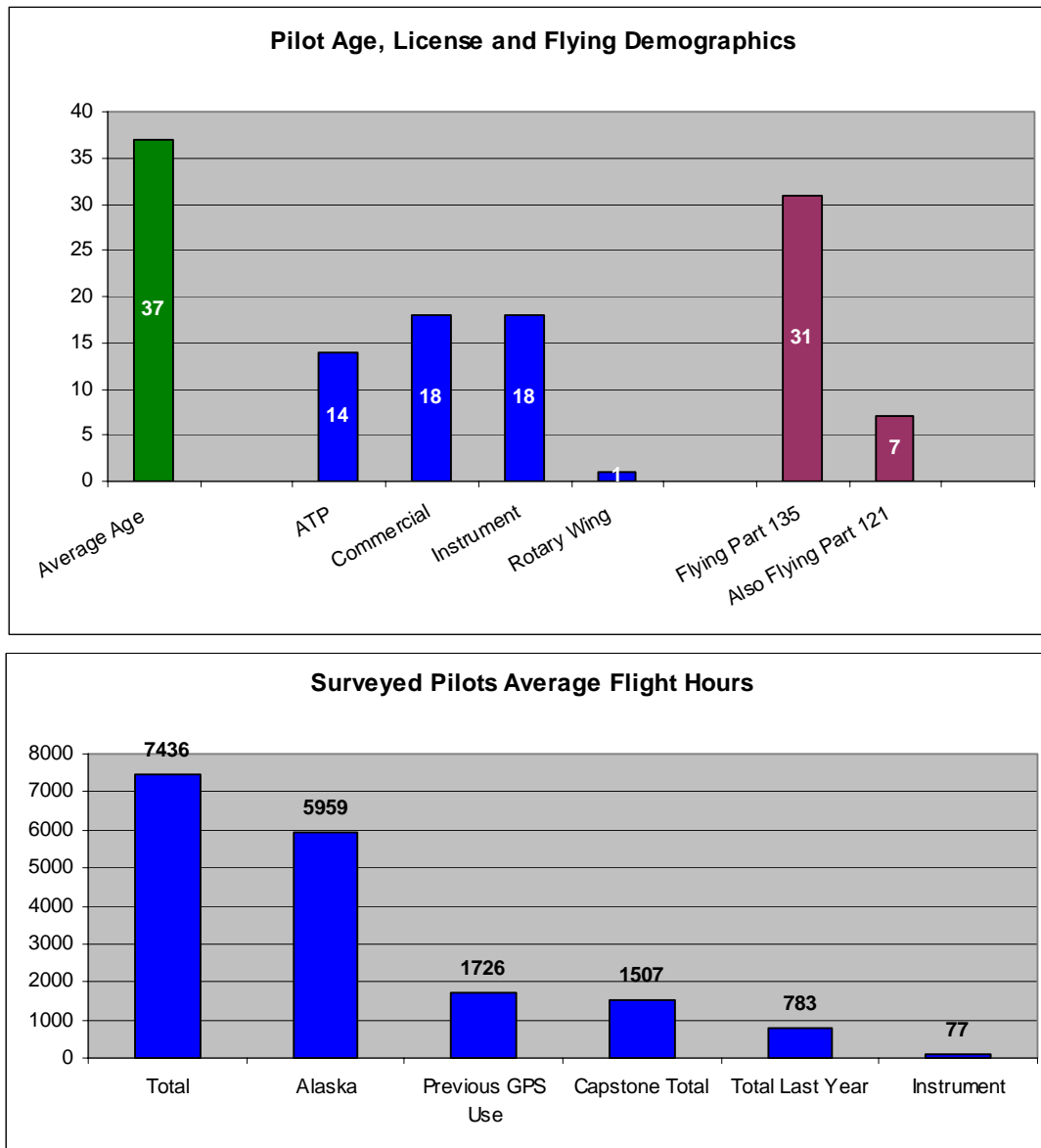
# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### 4.3 Pilot Surveys

#### Pilot Demographics

Pilots operating Capstone-equipped aircraft in the Y-K Delta were surveyed in winter of 2005/2006. Thirty-one pilots were interviewed in Bethel. The following graphs provide describe the survey group:



**Figure 4.3-1 Surveyed Pilots Demographics**

It is important to note that 7 of the pilots surveyed are now operating aircraft that have Chelton EFIS avionics used primarily in Phase II. The Chelton avionics provide TAWS

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

as required for Part 121 operations, but lacks the cockpit displays of traffic (ADS-B/CDTI) and weather (FIS-B). This impacted the interview results, because of the lack of these Capstone Phase 1 capabilities.

### **Program Benefits**

Pilots responded to questions concerning the benefits of the Capstone program and the distribution of those responses is shown in Figure 4.3-2. When asked about fewer cancellations at remote airports, the biggest response was negative (45%). While the new approaches do make it safer to get in under marginal VFR conditions, the aircraft and crews that are not IFR qualified can not use the new approaches under IFR conditions. As a result, if the weather is bad at the remote airport, they still cancel. Operations at remote airports were reported as safer, because of the presence of new instrument approaches and the orderly flow they enabled during marginal VFR weather. The same statement can be said for the benefit during marginal VFR conditions, with 78% of the pilots rating this area a significant or major benefit.

*“Excellent situational awareness.”*

Fifty-two percent rated the avoidance of near mid-air collisions as a significant or major benefit. Recalling that a portion of the pilots were in aircraft retrofitted with Chelton systems, one would assume that this rating would be higher if all aircraft had traffic displayed in the cockpit. Chelton equipped aircraft can not see other aircraft but can be seen by Garmin-equipped aircraft.

The availability of weather in the cockpit was not rated highly in terms as a benefit. This may be due to a large number of pilots flying short flights within the Y-K Delta. One pilot with access to weather made the following comment:

*“Weather radar uplink helps avoid moderate/severe icing.”*

Sixty percent of pilots surveyed found a significant or major benefit through improvement in Special VFR procedures as they, and the controllers, had better knowledge of aircraft positions.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

Based upon pilot ratings, the Capstone systems provide for easier enroute diversions and rerouting. Sixty-seven percent rated this capability a significant or major benefit. In a similar vein, 63% rated the Capstone benefit of more direct flights and time savings as significant or major.

Sixty percent of pilots either did not respond or rated improved communications with dispatch low. In the VFR flying environment of the Y-K Delta, the pilots tend to guard and shoulder their responsibility under the FARs to determine the conditions of flight and make the decision on continuation or return. Pilots see the potential benefit of the Capstone program for Search and Rescue. Their response has, however, been tempered by their perception that the technical recording and replay of flight profiles (ATC or Flight Service Station tracking of VFR aircraft) has not kept pace with the capabilities of the aircraft systems.

The ability to identify aircraft near an intended destination and thereby solicit flight or weather information is rated by 55% of the respondents as a significant or major benefit. One of the primary reasons this may not have been higher is the number of aircraft with Chelton equipment, which currently do not have the capability to display other aircraft.

Ranking at the top, along with safer minimum VFR condition benefits, is the reduction in navigation workload. Seventy percent rated this area as a significant or major benefit of the Capstone equipment. The terrain awareness benefits of Capstone are interesting from two standpoints. It ranks high in the area of significant and major response (63%), and it is the only proposed benefit that did not receive a response of “None”. This indicates Terrain Avoidance is the universally accepted benefit for the system.

With the emphasis on the new equipment and safety in the Y-K Delta, the negative responses by some pilots to the benefit of an improved safety culture could be a surprise. The negative responses come from two sources – those that previously had in-cockpit traffic displays and switched to Chelton and those that think it will not be safe until all aircraft are equipped. Most pilots felt that until all aircraft were modified, including Part 121 and General Aviation, the maximum safety benefits from Capstone would not be realized. Some of the comments are below.

*“Capstone I much safer VFR.”*

*“Capstone II much less safe VFR.”*

*“Our safety has deteriorated somewhat because we lost our TRAFFIC and WX when we switched from Capstone I to Capstone II.”*

*“Not all the planes have it, so if the rest of them had Capstone it would be a lot better.”*

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

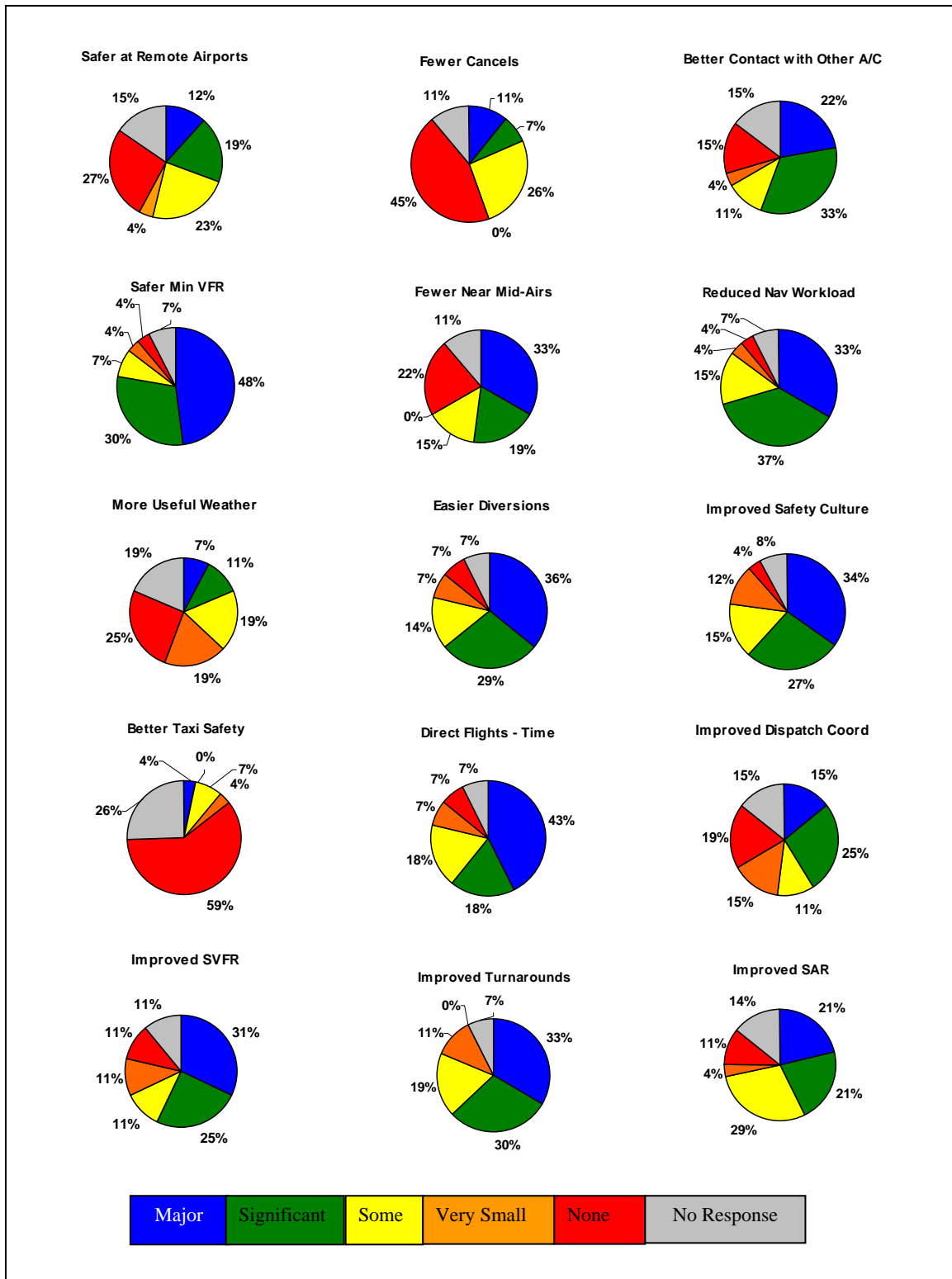


Figure 4.3-2 Pilot's Opinion on Capstone Safety Benefits

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **Use, Usefulness and Usability**

Surveys in late 2005 and early 2006 asked pilots how often they used the capabilities of Capstone Phase 1 avionics and ground systems, its ease of use (relative to other avionics with which they have familiarity), and its usefulness. The array of pie charts in Figure 4.3-3 summarizes pilot responses.

The results clearly show the high acceptance rate of the Capstone individual elements. Traffic Avoidance, Terrain Avoidance, Flight Planning and Navigation have been consistently throughout the program as being used most often and rated highly in usefulness.

Navigation ranks the highest in all 3 categories with a 96% rating for how often it is used, an 86% rating on its usefulness and 78% on ease of use.

Traffic Avoidance use dropped from 91% in last year's survey to 71% in the survey this year. The results were certainly impacted by the 7 pilots operating Chelton equipment. If those responses are removed, since they do not have the capability available, the response is 90% that routinely use Traffic Avoidance.

Flight Planning now is the third highest ranking in how often the element is used with 59% of the pilots stating that they routinely use the system. It also shows an increase of 14% over last year in use, usefulness and usability.

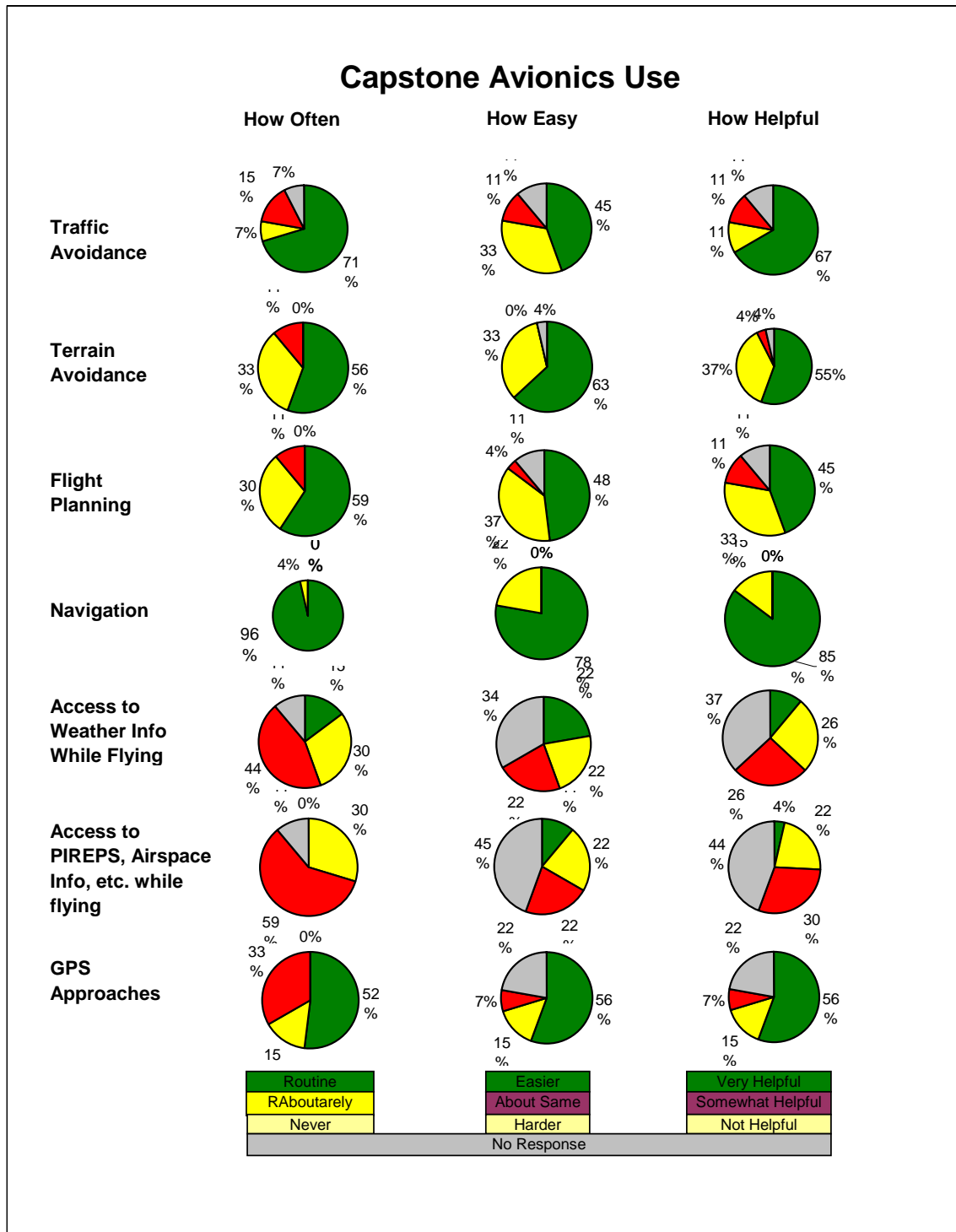
Terrain Avoidance showed little change from previous surveys. This year, GPS Approaches are being used more often than in past surveys. As noted in last year's report, weather in the Y-K Delta had been "better than normal" in 2003 and 2004, thus reducing the need for using GPS approaches. This year, the pilots stated that conditions had returned to a more normal state and therefore the use of GPS for approaches increased.

Access to both weather and other FIS-B products was not rated highly in this year's survey. This may have been impacted by two issues. As previously stated, seven of the pilots interviewed are flying Chelton equipped aircraft without that capability and the GBTs were in transition this year from the developmental network to the operational network. During this transition, FIS-B products were not always available.



# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005



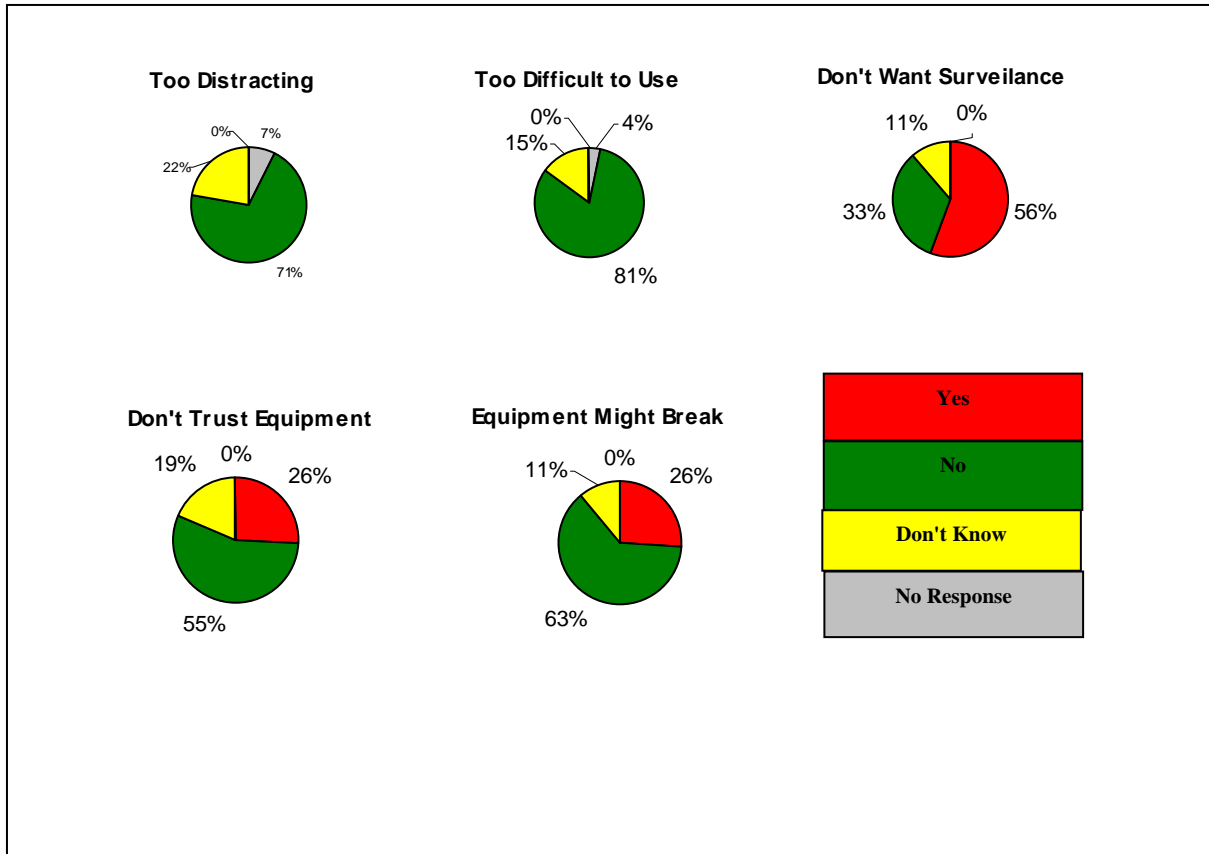
**Figure 4.3-3 Pilot Reported Use, Ease of Use, and Usefulness of Capstone Services and Capabilities**

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### Pilot Non-Use

The survey covered five areas or situations, shown in Figure 4.3-4, in which pilots think other pilots may choose not to use the Capstone equipment. Four of the five areas were of “little or no concern” to the responding pilots.



**Figure 4.3-4 Pilot Rating of Potential Reasons Other Pilots Might Not Use Capstone**

Only 7% thought that the equipment would be too distracting for pilots to use. Four percent thought it may be considered too difficult to use. At least part of this may be attributable to proficiency/familiarity with the equipment.

*“Familiarity with it – lots of people don’t want to change from what equipment they are comfortable with and use it.”*

By far, the highest rated area for reason of non-use is that of surveillance. At 56% this area is more than double that of any other “yes” response.

*“Some people don’t want others watching at all times.”*

*“Too easy for FAA to issue citation based upon incomplete information.”*

The final two areas tied in the number of “yes” ratings at 26%. First was trust of the equipment as related to inaccurate databases or missing data.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

*“Data base for remote runways is not up to date (appear in wrong location, sometimes up to 2 miles off).”*

*“Shooting a GPS approach and finding out at minimums that runway is off in the data base by ½ mile or more.*

*Just don’t trust information.”*

The second was the concern that the equipment may break down when relying on the system.

*“Reliability problems.”*

*“Poor maintenance.”*

*“Windows based software routinely crashes.”*

*“Capstone will not be maintained by operators over time.”*

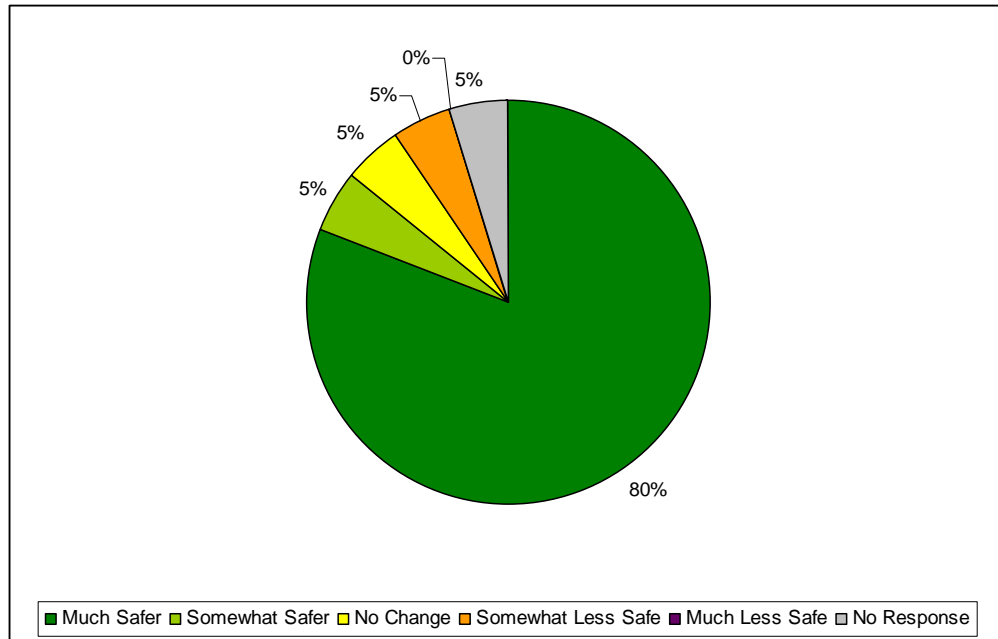
Two of the lessons to be taken from this discussion of potential non-use are the themes of “fear of surveillance” and “distrust of new technology” typically present with technological leaps. Each of these items has decreased over past surveys and, with time, pilot observed reliability of the systems, and lack of enforcement these ratings will likely change. The remaining question is the degree to which pilot’s actually use the systems. The vast majority (81%) “usually” or “always” use the capabilities. The remaining responsive group (15%) decline to use the system more than “sometimes,” for the reasons discussed above.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### Pilot Safety Impact Rating

Pilots rate the impact of Capstone on safety in the Yukon-Kuskokwim Delta area highly, with 85% rating it “safer” and none feeling that it was “much less safe.” Only 5 % see it as “less safe.”



**Figure 4.3-5 Pilot Rating of Capstone Safety Impact**

The fact that some rated the environment as “less safe” may seem surprising, but is backed by rational comments. The transition from traffic in the cockpit to “no traffic” in the cockpit left some pilots feeling less safe than they had been. In addition, several noted reliance on cockpit presentations without reference to the “outside” environment.

*“Unequipped aircraft more of a hazard because the Capstone equipped aircraft doesn’t look out for traffic.”*

*“Can’t see non-Capstone aircraft is a liability to all.”*

The safety impact of Capstone in the Y-K Delta can be summarized in the comments of two pilots.

*“Capstone equipment is the best safety enhancement tool that I have ever used.”*

*“Not all the planes have it, so if the rest of them had Capstone it would be a lot better.”*

### Pilot Training

Commercial pilots using Capstone are trained by their companies, often using training materials, videotapes, simulators, and assistance with instruction made available through

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

the University of Alaska Anchorage. UAA conducted all of the training of operator's trainers early in the program and UAA did not conduct any new training classes in Y-K Delta during 2005. Each of the organizations conducts initial training for their newly hired pilots. Half of the organizations primarily use classroom training, averaging about 4 hours, with Capstone program tapes. The other half uses a combination of classroom training and desktop Capstone simulators, averaging 10 hours. In each of the companies, additional Capstone training is also conducted during initial route training.

The survey indicated that 73% of the operators hired new pilots during 2005. All of these pilots received initial training from their respective companies. Eight-two percent of the pilots interviewed rated the quality of the initial training and 56% rated the Recurrent training as good or excellent. A majority rated the quantity as just the right amount.

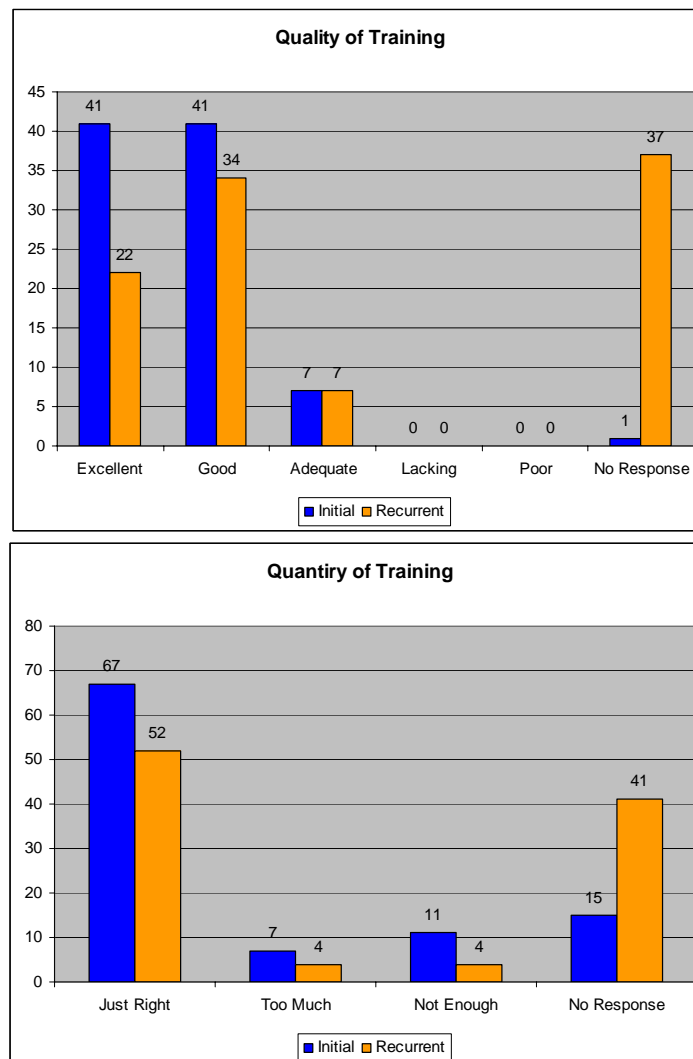


Figure 4.3-6 Training on Capstone Equipment by Operators

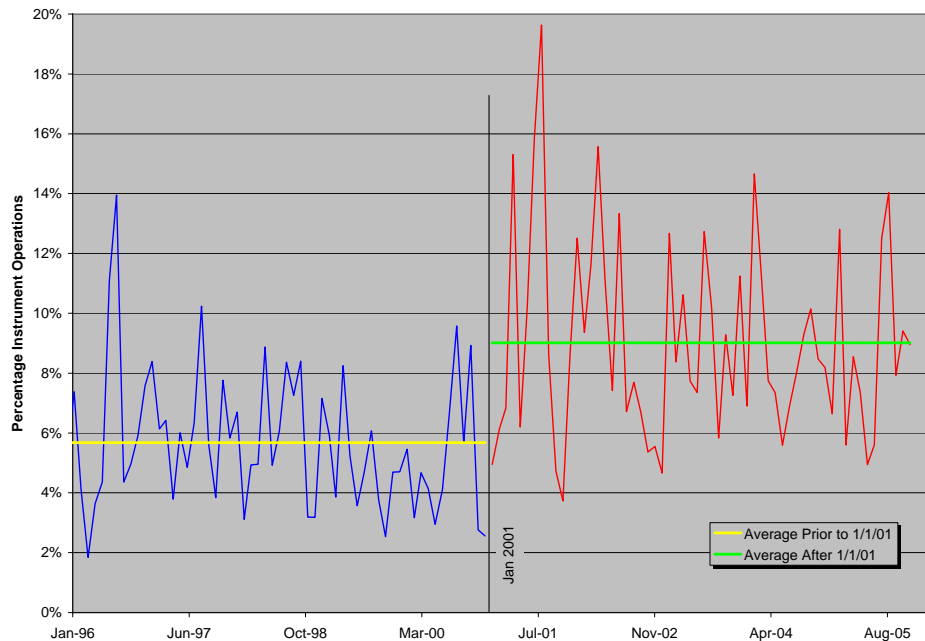
# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### 5 Aviation Services

#### 5.1 Improved Access

As more ATC services are offered to those flying under an IFR flight plan in the Y-K Delta we would expect more operators to equip their aircraft to fly IFR. Flying IFR implies that the pilots have more training and higher skills than those flying VFR. This should increase the safety of operations. As seen above, the percentage of IFR aircraft initially outfitted has increased. The operators may upgrade to IFR or downgrade from IFR on the Part-135 fleet after the aircraft were modified with Capstone. Furthermore, it does appear from the traffic counts at the Bethel tower that a greater percentage of the operations were conducted under IFR after Anchorage Center controllers started using ADS-B surveillance data in January 2001. This is shown in Figure 5.1-1. It should be noted that it was indicated during pilot interviews that the pilots perceived the weather during 2003 and 2004 as better than in previous years and they would be less likely to file IFR with good weather. Therefore, it is possible that the average shown below for after 1/1/01 would be higher than shown.

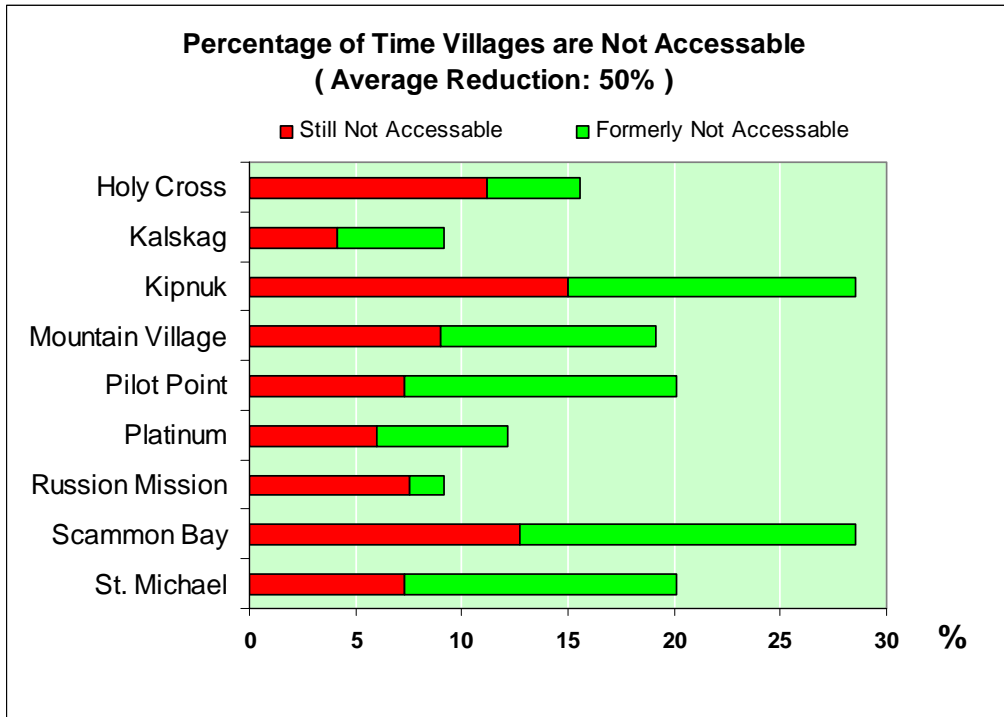


**Figure 5.1-1 Percentage Instrument Ops by Air Taxis at Bethel**

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

Also of great significance is the improvement in village access offered by the new instrument approaches. A comparison of nearby weather patterns to the minimum ceiling and visibility for approach under Visual Flight Rules finds airports such as Kipnuk and Scammon Bay were inaccessible nearly 30% of the time. IFR operations enabled by the instrument approaches are reducing the time that the villages are inaccessible by an average of 50% as shown in Figure 5.1-2.



**Figure 5.1-2 Reductions in the Percentage of Time Villages are without Air Transportation<sup>7</sup>**

<sup>7</sup> This data is from *The Impact of Capstone Phase 1 Final Report*, dated September 2005, and is unchanged.

# The Impact of Capstone Phase 1

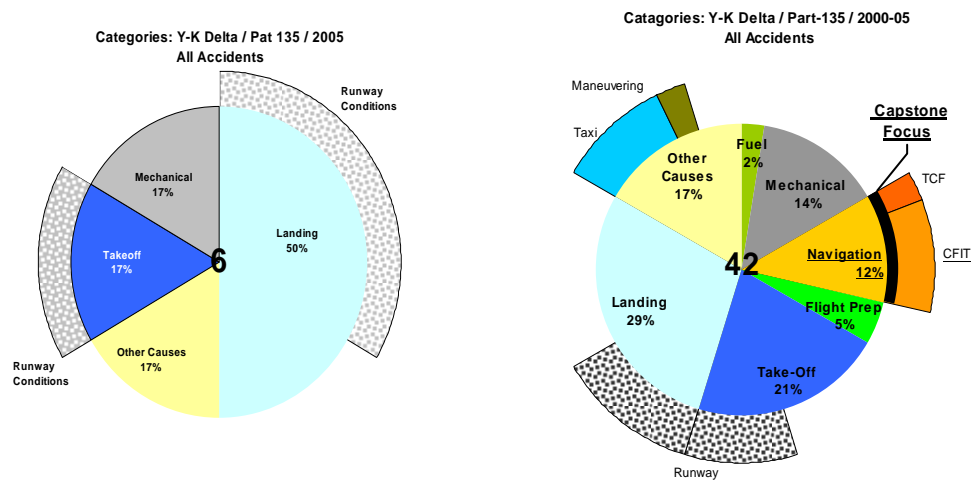
## Post-Transition Annual Report – 2005

### 6 Aviation Safety

This section characterizes numbers and rates of accidents in the Y-K Delta. First, it classifies accidents in 2005 and in the 2000-2005 Capstone period and compares types of accidents between Capstone-equipped and non-equipped aircraft. Second, it compares rate changes of specific types of accidents targeted by Capstone to what we should expect if the capabilities work as hoped and progress on implementation is as we have described. The third analysis compares overall accident rates between commercial aircraft in the Y-K Delta and other parts of Alaska. It also compares overall accident rates between aircraft prior to equipage and after equipage. The final analysis compares accident counts between operator and operation types before and during the Capstone period.

#### 6.1 Accidents in 2005

The left side of Figure 6.1-1 shows the accident categories of Y-K Delta Part-135 aircraft involved in accidents in 2005. The right side of the figure shows all Part-135 accidents in the Y-K Delta since Capstone implementation began.



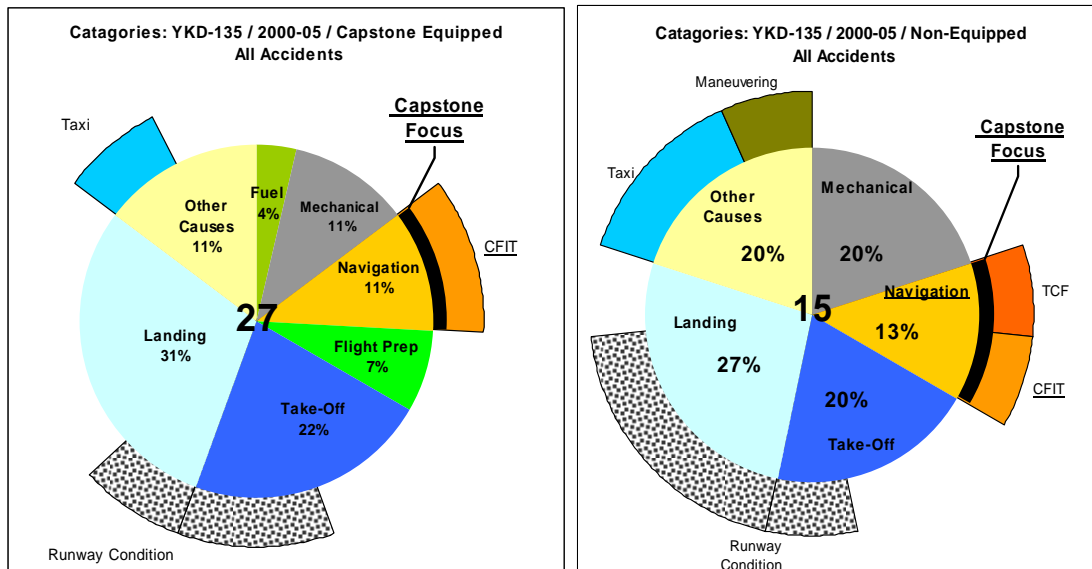
**Figure 6.1-1 Categories of Accidents in 2005 and Since Capstone Implementation**

Figure 6.1-2 shows accident categories for Capstone non-equipped and equipped aircraft since 2000. The breakdowns of accidents by major category are essentially similar and within the levels of variation one should expect for this number of occurrences. Details of the Capstone equipped accidents can be found in Section 9.1, Appendix A.



# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005



**Figure 6.1-2 Categories of Accidents by Non-Equipped and Capstone-Equipped Aircraft 2000—2005**

### 6.2 Comparison of Accident Types to Projected Capstone Benefits

The safety benefit expected from Capstone depends on the types (and rates of occurrence) of accidents before Capstone, the projected effectiveness of a complete implementation, and the progress on implementation that Capstone has actually made. Since the safety impact of Capstone is best quantified over time, we expect to see changes from increased IFR capability, changes in safety posture from Capstone and other causes, and changes in operations from using Capstone capabilities in ways not predicted. As of this report, we can quantify expectations for only two of the accident types that are the direct focus of Capstone: accidents associated with navigation/CFIT and those associated with traffic.

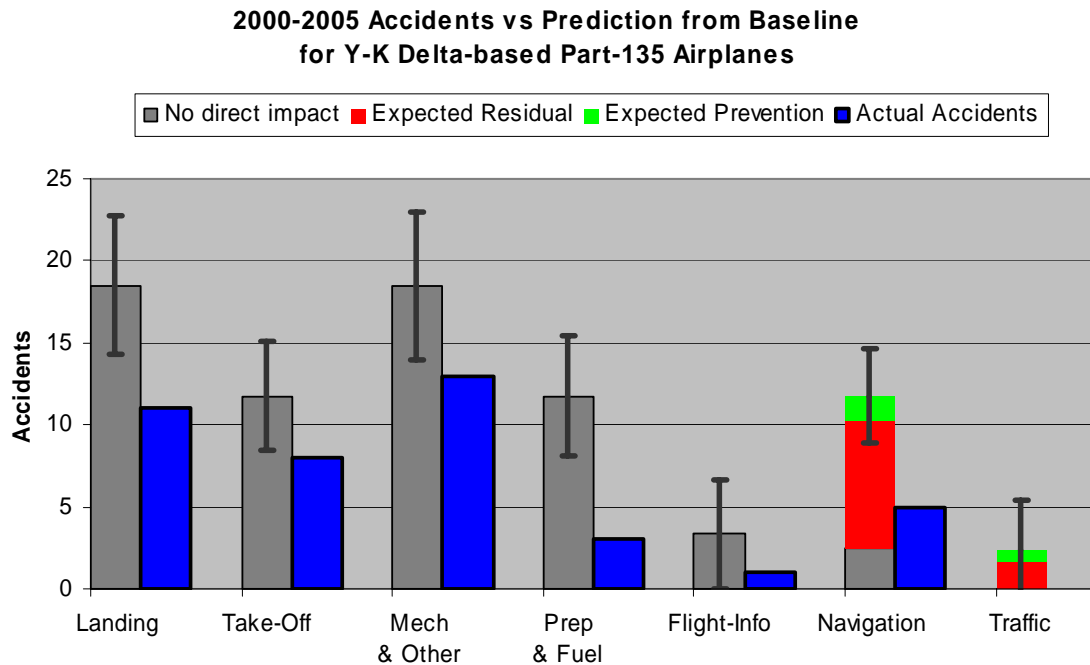
The level of Capstone equipage and the effectiveness of Capstone training have had a positive impact on the prevention of navigation/CFIT accidents. From 2000 through 2005 an average of 78% of Y-K Delta-based Part-135 flight operations were equipped, and the average effectiveness of pilots using Capstone avionics was assessed to be 57%. For 2000-2005 we estimate 44% of preventable CFIT and 30% of the preventable navigation accidents should have been avoidable as a result of Capstone. Since warnings on Terrain Clearance Floor violations are not included in Phase 1 avionics (they are included in Phase 2), collisions with terrain during approach are not directly affected. For en route CFIT the full-implementation effectiveness was assumed to be 90%.

Progress on implementation affects traffic/mid-air accidents differently. While an average of 78% of Part-135 flight operations from 2000 through 2005 were equipped, only about 2/3 of all flights are Part-135 (the remainder are mostly Part-91 and public use). On average, if a Part-135 aircraft was at risk of a mid-air collision with a second aircraft, the

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

chance they were both Capstone-equipped was only 52%. Even limited training levels can reduce this further. In 2000-2005 we estimate that 30% of mid-air accidents would be avoided as a result of Capstone (assuming a full-implementation effectiveness of 100%).



**Figure 6.2-1 2000-2005 Accidents vs Prediction from Baselinefor Y-K Delta based Part-135 Aircraft**

Figure 6.2-1 uses these estimated safety benefits for Navigation and Traffic accidents to project the number of accidents we should expect in 2000-2005 for Part-135 aircraft based in the Y-K Delta and compares this to the number that actually occurred. The projection uses the types and rates of accidents from 1990-99 scaled-up for observed growth in operations. The figure also shows error bars for the numbers of accidents that should be expected from history. This is the standard deviation for five-year periods scaled for growth. If there were no underlying changes in accident rates, the chance of observing a number in this range would be about 67%. For small numbers such as these, this variability is large compared to the average value (this is particularly true for fatal accidents, which are only about one tenth as numerous). In many cases, observing zero accidents is well within typical variations, and a gap in accidents will need to persist for several years before we can be certain it is significant. The estimated navigation and traffic accidents prevented by Capstone in 2000-2005 are comparable to these expected random variations. This means that further time will be needed at high levels of equipage and training before reductions of specific types of accidents can become statistically significant.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

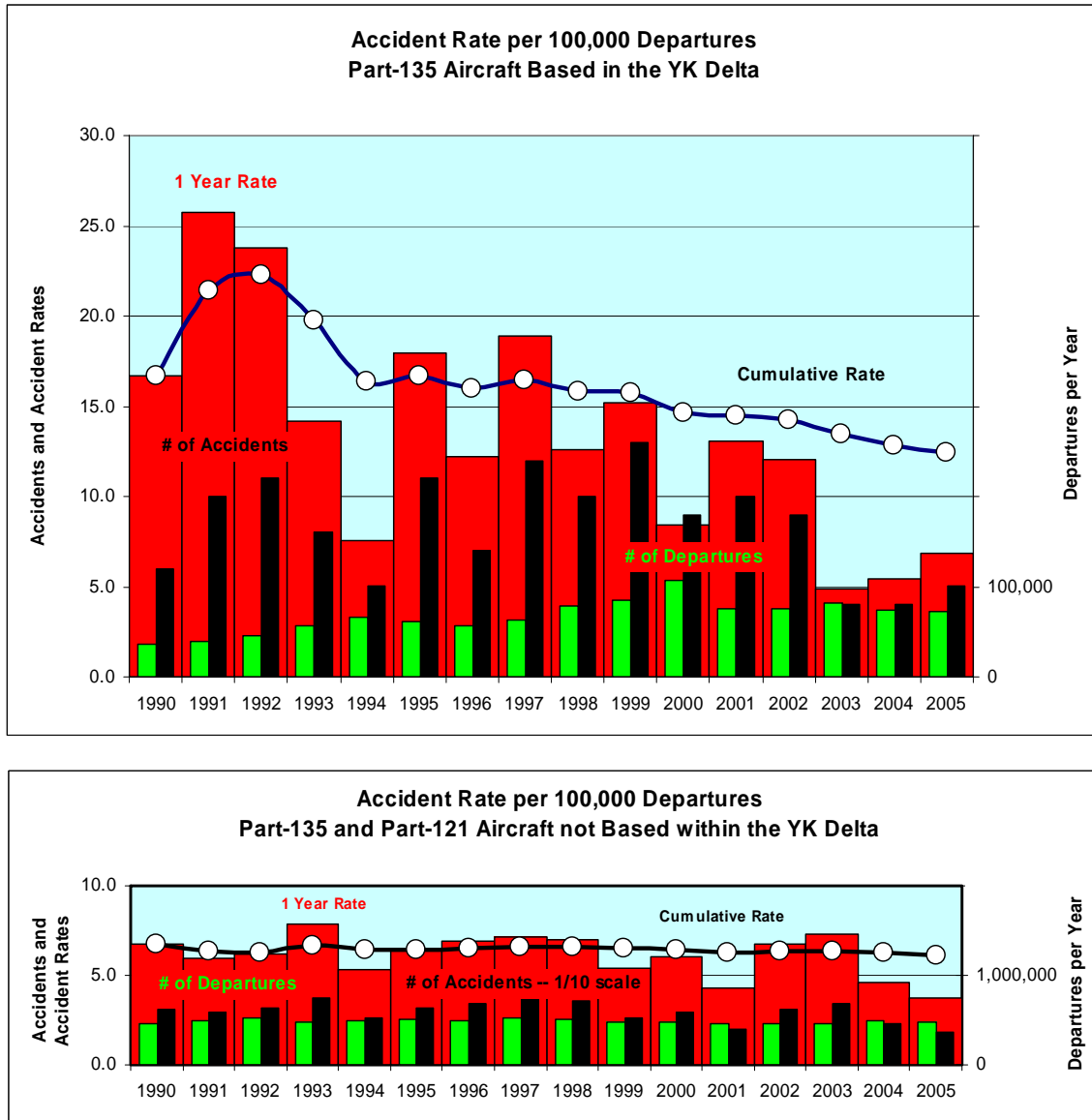
### **6.3 Comparison of Y-K Delta Accident Rates to Other Parts of Alaska**

Until recently, lack of data on aircraft flight hours and operations counts has constrained evaluation of accident rates in rural Alaska. Beginning in 2002, the Bureau of Transportation Statistics began archiving additional data on *scheduled* small carriers. In the Y-K Delta, some further information on hours flown by *unscheduled charter* operators (as a percentage relative to flight hours by scheduled operators) is also derivable from the flight-monitoring data archived by CRABS. Current and historical operations data and the methods by which we estimate historical operations counts are described in the appendices.

Figure 6.3-1 shows departure count, accident count, and accidents per 100,000 departures for Part-135 and Part-121 aircraft within the Y-K Delta and for all other flights in Alaska. The scale for accident rates (the wide red bars) is the same in both the upper and lower sections of the figure, indicating that over time the accident rate within the Y-K Delta has been two to four times the rate for other parts of Alaska. From year to year, the accident rate in the Delta is also much more variable than in the remainder of Alaska.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005



**Figure 6.3-1 Accident Rates for Y-K Delta Part-135 Aircraft and Those Based Elsewhere in Alaska**

The continuous curve (black line with white dots) on each chart represents the cumulative total rate of accidents per departure from 1990 through 2005. For other parts of Alaska, this cumulative rate has been quite stable. For operations in the Y-K Delta, there was a substantially higher rate of accidents in the early '90s from which the cumulative average has been slowly falling. The figure also shows that the accident rate for the years 2003 and 2004 for commercial flights in the Y-K Delta, all of which were Capstone-equipped, was the lowest it has been since the beginning of our accident baseline in 1990. The accident rate in the Delta fell below the rate for the rest of the state for the first time in 2003, and has remained comparable to the rest of the state in 2004. In 2005 the accident rate increased in the Y-K Delta. It should be noted that two of those five accidents

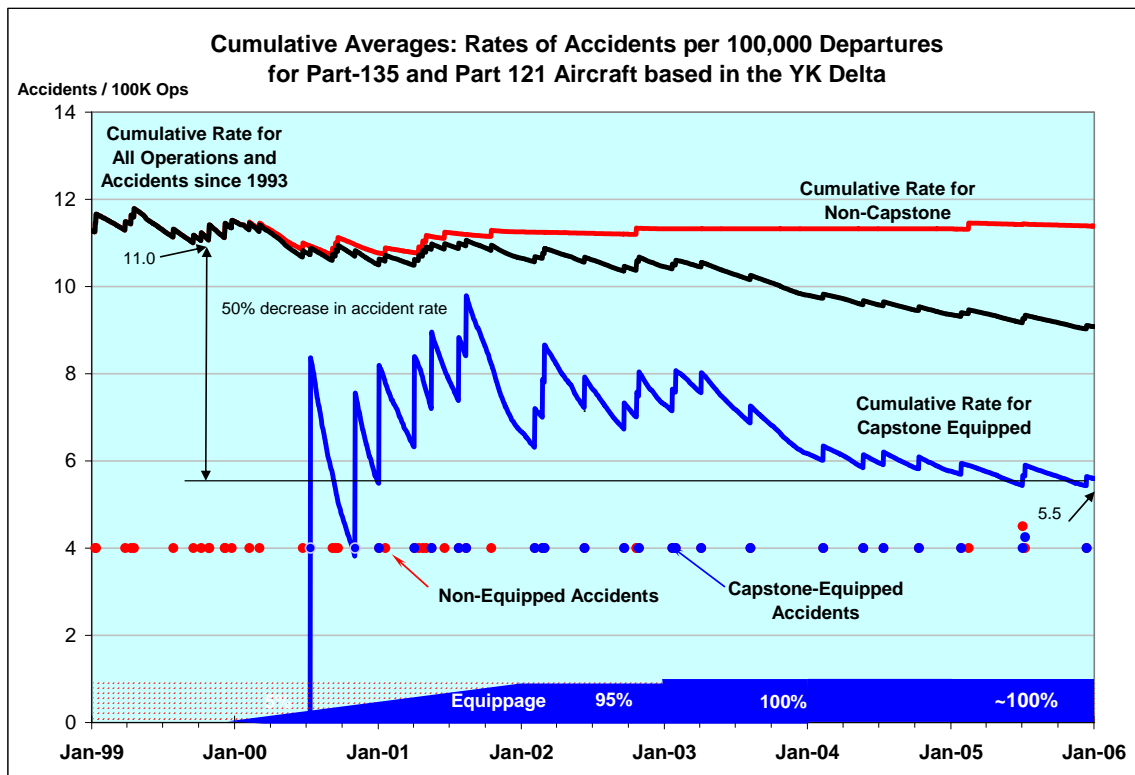
# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

involved non-equipped Y-K Delta-based aircraft which account for only 0.9% of the operation.

### 6.4 Comparison of Accident Rates Before, During, and After Equipage/Start of Services

The relative stability of Part-135 accident rates in the Y-K Delta since 1993 extends through the end of 2005 for aircraft not equipped with Capstone. A time-magnified view from 1999 through January, 2006 (using daily data), is shown in red on Figure 6.4-1.



**Figure 6.4-1 Relative Accident Rates for Y-K Delta Commercial Aircraft Without and With Capstone Avionics**

The blue line is the equivalent curve for Capstone-equipped aircraft. There were no accidents and few operations before July '00 for Capstone-equipped aircraft, so this curve is more erratic because it is averaged over fewer operations. Nevertheless, the Capstone-equipped accident rate has trended strongly towards stability at a rate significantly below that for non-equipped aircraft. The rate of accidents by Capstone-equipped aircraft is significantly lower than that for non-equipped aircraft. The percentage improvement in the accident rate from 2000 through 2005 is 50%. These results do not determine whether the improvement is due to safety benefits of the specific Capstone capabilities or to a heightened attention to safety on the part of pilots and companies flying Capstone-equipped aircraft.

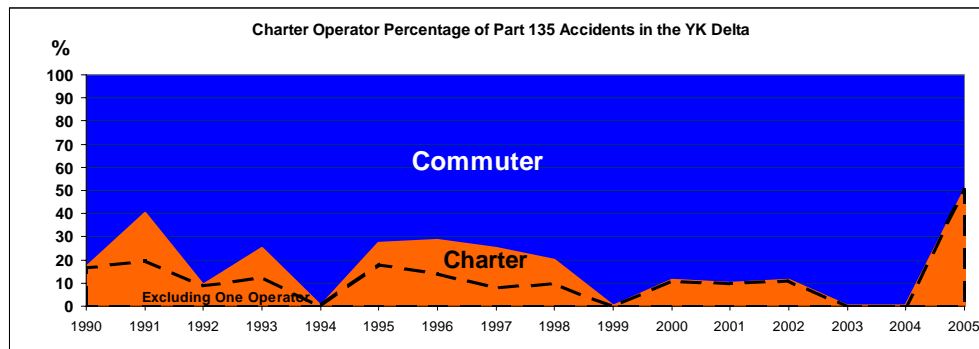
# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### 6.5 Comparison of Accident Rates Between Operator and Operations Types

Public aviation transport in the Y-K Delta relies on three major carrier types: Part-121 Air Transport operations, which fly larger, more capable aircraft with multiple crew members and have comparatively few accidents in the Delta (or anywhere else in the US); Part-135 Commuter operators whose operations include at least some scheduled service; and, Part-135 Charters who are not scheduled. Reporting requirements (and hence, available operations data) are very different between the two Part-135 types. Fortunately, CRABS' flight monitoring ability has provided data with which we could determine that charter flight time has averaged approximately 10% of carrier operations.

Accident rates for scheduled commuters and unscheduled charters are comparable. Figure 6.5-1 shows the variation of the percentage of accidents by charters over time. The orange area indicates that the charter accident rate has in fact been somewhat higher than that for commuters, but if accidents are omitted from one frequent-accident charter operator, the remaining rate is clearly at or less than charters' 10% share of flight time.



**Figure 6.5-1 Relative Accident Rates for Scheduled/Unscheduled Operators in the Y-K Delta**

Both types of Part-135 operators use non-revenue flights to ferry or position aircraft and for testing or training. In addition, commuter operators often fly unscheduled as well as scheduled flights. Figures 6.5-2 and 6.5-3 show the breakdown of historical and Capstone-era accidents for these operations types.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

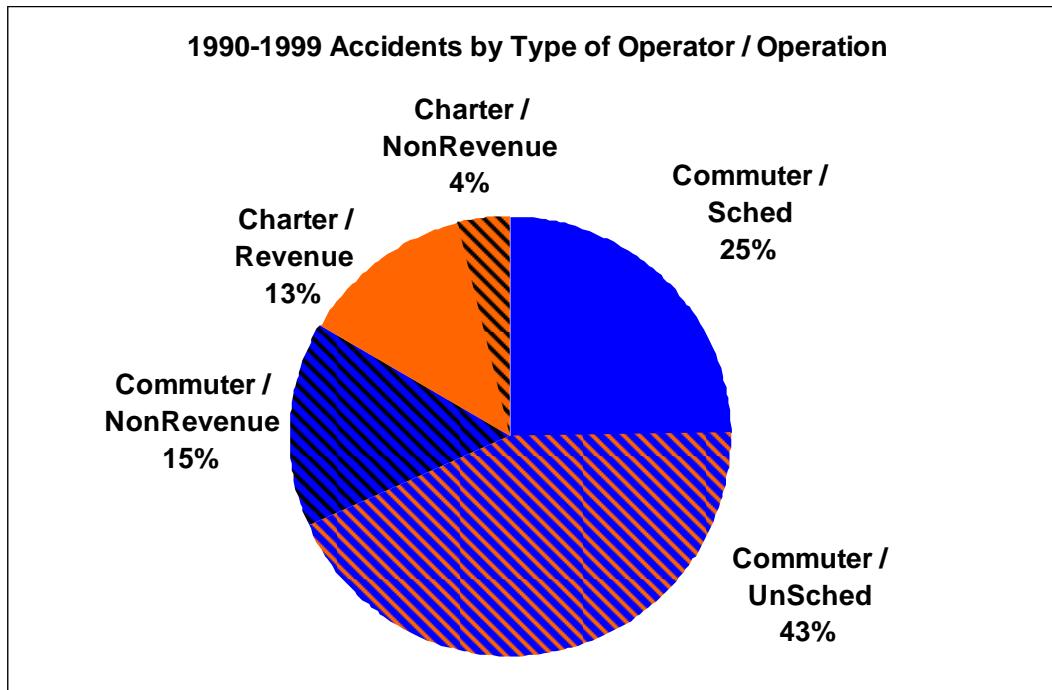


Figure 6.5-2 Historical Proportions of Accidents by Operator/Operations Types in the Y-K Delta

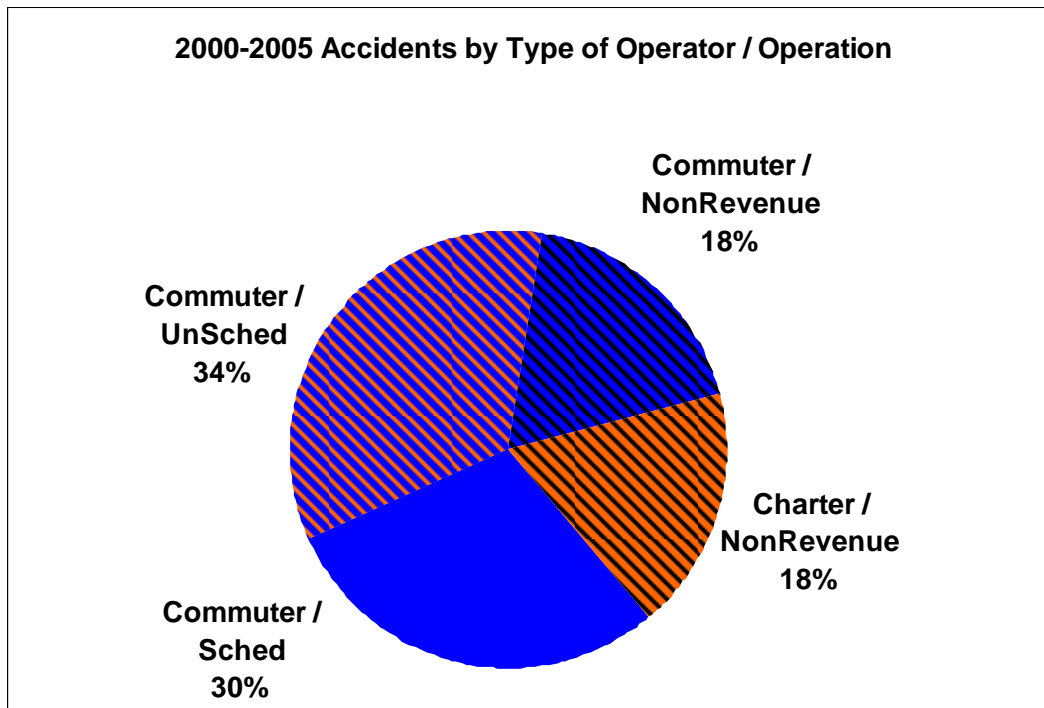


Figure 6.5-3. Proportions of Accidents by Operator/Operations Type Since Capstone

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### 7 Other Y-K Delta Programs/Impacts

#### 7.1 *Changes in Operations Associated with Capstone*

Most of the Y-K Delta operators are small companies certified under Part-135 and their required quality assurance programs and records keeping are more limited than Part-121 operators. Using surveys provides some indication of improvements in the general safety structure of the operators, as shown in Figure 7.1-1. A number of respondents stated that they had done safety audits and set safety goals as part of their association with the Medallion Foundation. Eighty-six percent of the respondents indicated they believed that the safety posture of the operators had improved since the beginning of the Capstone program.

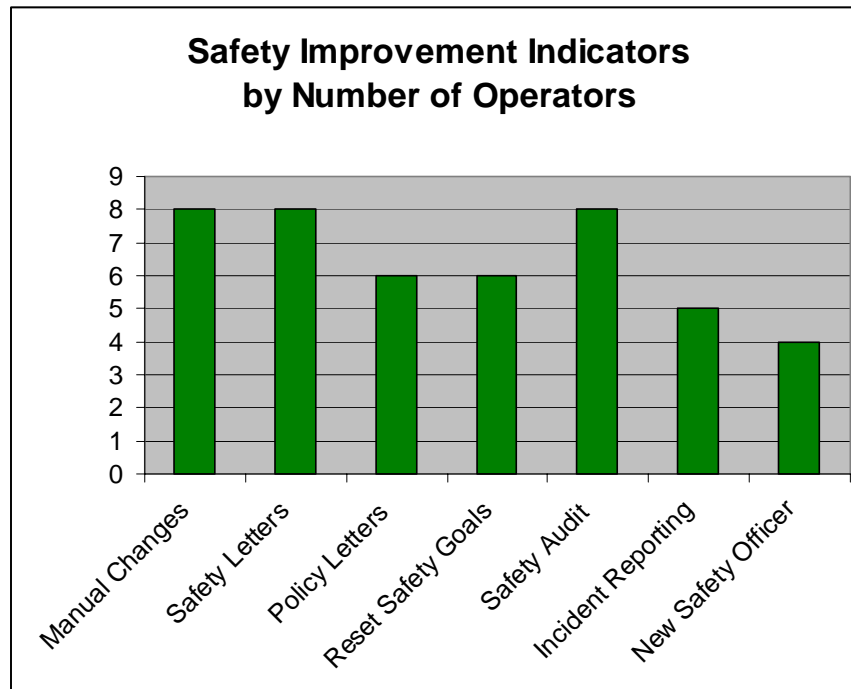


Figure 7.1-1. Indications of Safety Posture Improvement

#### 7.2 *Medallion Program*

The Medallion Foundation, created in 2001, is one of the more important flight safety programs in Alaska. Although program membership is voluntary, the prestige that comes with earning a Medallion Shield has proven to be a powerful incentive for Y-K Delta carriers to join. To earn the Shield, air carriers must complete all program goals (Stars) designed to increase safety awareness and improve safety practices. At the end of 2005, all but one of the Capstone-equipped commercial carriers now operating in the Y-K Delta, representing 95% of the Capstone-equipped fleet, have joined the Medallion program. Six carriers have earned Medallion Stars for meeting at least one of the program goals. Those with a Shield or Stars operate 60% of the aircraft and 52% of the departures in the Y-K Delta. Figure 7.2-1 also shows this is a significant improvement from

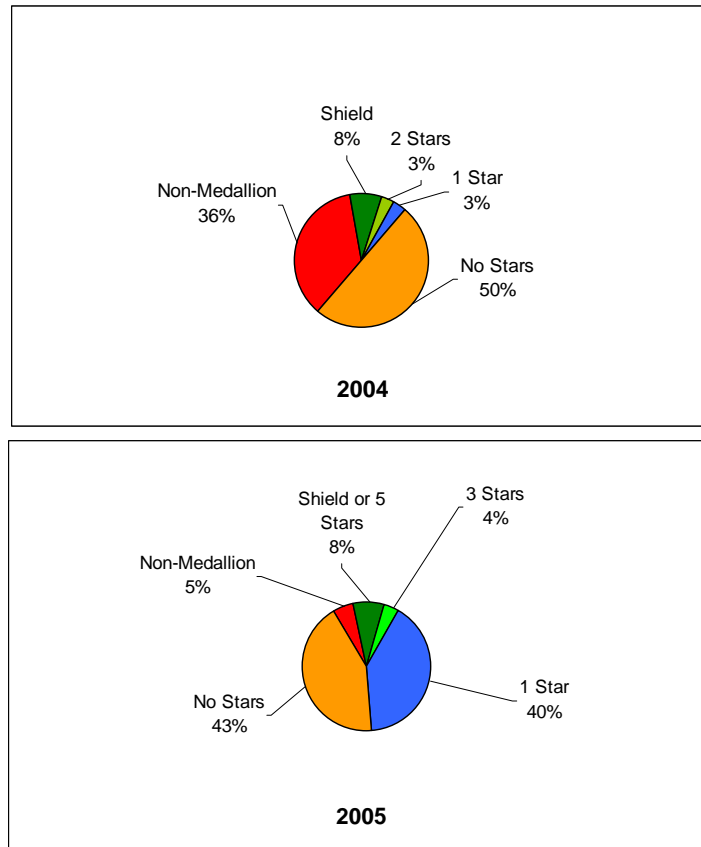


# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

2004 in the percentage of flights operated by Medallion carriers with at least 1 Star, due primarily to one large operator achieving its first Star this year.

One of those carriers has earned the Medallion Shield, meaning that the carrier met all Medallion Program goals. One carrier has achieved 5 Stars; one has achieved 3 Stars; and 3 carriers have a single Star. Four of the operators have yet to earn Medallion Stars and account for 43% of operations.



**Figure 7.1-1 Percent of Operations by Medallion Program Stars, 2004/2005**

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **8 Summary Conclusions**

The Capstone Phase 1 program provided the Y-K Delta a significant technological improvement that in turn produced safer operations in the area. In the Y-K Delta Phase 1 population, Capstone-equipped aircraft have had a consistently lower accident rate than all aircraft prior to Capstone and non-equipped aircraft during Capstone. From 2000 through the end of 2005 this rate of accidents for Capstone-equipped aircraft was lower by 50%. Historically the rate of Part-135 accidents within the Y-K Delta has been two to four times higher than that for the rest of Alaska. In 2003, the accident rate for the Delta was less than that of the rest of the state for the first time, and in 2004, the accident rate remained comparable to that in the rest of the state. In 2005, the accident rate increased for the Y-K Delta while the accident rate for the rest of the state decreased. All of this increase (33%) was due to newly introduced non-Capstone equipped aircraft that accounted for only 0.9% of the operations.

The transition program plan from FAA to owner and operator responsibility maintenance and further equipage of the aircraft was not well communicated to the operators leaving them most with a feeling that the transition did not go well. There are a number of indicators that the cost of equipping (which will have a long term impact on safety) and maintaining Capstone type equipment and services (which will have a short term impact on safety) may only be done by operators with sufficient extra capital or those heavily committed to safety. Sixty percent of the operators have not contracted to receive updates to their mapping and navigation databases.

Aircraft accident rates by Capstone equipped aircraft remained stable in 2005. Three new aircraft were added to the commercial operating fleet this year and equipped by the operators and 3 non-equipped were added, bringing the total non-equipped commercial operating aircraft in the Y-K Delta fleet to 5. Two of the 4 accidents during 2005 were by non-equipped aircraft. If the trend in non-equipage continues or increases, this could impact safety in the area. One operator removed the Capstone Phase 1 avionics and installed Capstone Phase II Chelton avionics that does not currently have traffic and weather available in the cockpit.

Flight monitoring was affected this year by the transition to the FAA's operational network. Operators surveyed indicated that they did not want to transition to the commercial Flight Explorer product and preferred the CRABs program that was on the operations network which is currently only available from the Bethel GBT. Only 20% of the operators have signed a contract to continue to receive flight monitoring via Flight Explorer due to the cost of these services and satisfaction with the product.

Five GBTs continued on the FAA's operational network in 2005. The remaining 5 were removed from the FAA's developmental network in December 2005 but were not activated on the operational network as scheduled. (In March, 2006, all

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

operational GBTs were taken out of service by the FAA Air Traffic Organization and returned to service on June 15, 2006. These and subsequent changes are beyond the time period covered in this report.)

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **9 Appendices**

#### **9.1 Appendix A: Capstone Equipped Aircraft Accidents**

The tables below summarize the accidents involving aircraft in the Y-K Delta from 1990 through 2005. The tables are separated into Capstone equipped aircraft, accidents since the start of the Capstone program to non-equipped aircraft and pre-Capstone program aircraft accidents.

The Table A-1 summarizes the accidents involving Capstone equipped aircraft from 2000 through 2005. The NTSB accident narratives for these accidents follow the tables.

Cause category explanations are listed below, with the abbreviations used in the table in parentheses.

**Mechanical** Engine failure, inoperable control surfaces, failed landing gear, propeller or shaft failure.

**Navigation** Usually Controlled Flight into Terrain (CFIT) while en route, most often associated with reduced visibility. In the Y-K Delta, CFIT also occurs in nominal VFR conditions when “flat light” on snow-covered ground prevents recognition of terrain. Terrain Clearance Floor (TCF) warnings are a Terrain Awareness and Warning System (TAWS) function planned for Capstone Phase 2 that addresses the 20%-30% of CFIT accidents on approach or departure. These are not directly addressed by Capstone Phase 1 avionics. Rarely, accidents are due to disorientation, which can be addressed by a GPS-map display.

**Traffic** Usually mid-air collisions or near mid-air collisions (NMACs) between aircraft. Also includes accidents from last-moment avoidance of other aircraft and from jet blast on airport surface.

**Flight Information (Weather, Ice, IMC)**

Usually inadequate weather information, especially icing, but also visibility; rarely convective weather. (Surface winds contributing to take-off or landing accidents have been included under take-off or landing rather than here.) Occasionally, lack of information on changes in procedures or facility status.

**Fuel** Usually fuel exhaustion. Occasionally, failure to switch fuel tanks.

**Flight Preparation**

Failure to ensure cargo is tied-down and within the aircraft’s weight and balance limits. Failure to check fuel for the presence of water. Rare in the lower 48 but significant in the Y-K Delta is failure to remove ice or snow from the aircraft – often resulting in serious or fatal accidents.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **Take-off and Landing**

Failure to maintain control (especially in wind), improper airspeed, or inadequate care near vehicles or obstacles. The Y-K Delta also includes unusually high numbers of accidents due to poor **runway conditions**, hazards at off-runway sites such as beaches and gravel bars, and submerged obstacles struck by float-planes.

### **Other**

Includes unusual causes such as bird strikes or collisions with ground vehicles.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

**Table A-1 Accidents Involving Capstone Equipped Aircraft in the YK Delta  
Flying Under Part-135 or Part-121 from 2000 through 2005**

NTSB Report Number	Date	Injury Level	Cause
<a href="#">ANC00LA086</a>	12-Jul-2000	NONE	Landing
<a href="#">ANC01LA017</a>	03-Nov-2000	NONE	Takeoff
<a href="#">ANC01LA028</a>	03-Jan-2001	NONE	Landing
<a href="#">ANC01LA046</a>	03-Apr-2001	SERIOUS	CFIT
<a href="#">ANC01LA117</a>	25-Jul-2001	NONE	Takeoff
<a href="#">ANC01LA108</a>	13-Aug-2001	NONE	Takeoff
<a href="#">DCA02MA003</a>	10-Oct-2001	FATAL	Pre-Flight
<a href="#">ANC02FA014</a>	04-Feb-2002	FATAL	CFIT
<a href="#">ANC02LA016</a>	24-Feb-2002	NONE	Taxi-RwyCond
<a href="#">ANC02LA019</a>	01-Mar-2002	NONE	Landing
<a href="#">ANC02LA047</a>	11-Jun-2002	NONE	Landing
<a href="#">ANC02LA066</a>	30-Jun-2002	NONE	Landing
<a href="#">ANC02LA123</a>	20-Sep-2002	NONE	Pre-Flight
<a href="#">ANC03LA005B</a>	22-Oct-2002	NONE	Taxi
<a href="#">ANC03LA007</a>	28-Oct-2002	SERIOUS	CFIT
<a href="#">ANC03LA024</a>	21-Jan-2003	NONE	Landing-RwyCond
<a href="#">ANC03LA030</a>	30-Jan-2003	NONE	Pre-Flight
<a href="#">ANC03LA091</a>	08-Aug-2003	NONE	Mechanical
<a href="#">ANC04LA032</a>	10-Feb-2004	NONE	Takeoff-RwyCond
<a href="#">ANC04LA059</a>	22-May-2004	NONE	Takeoff-RwyCond
<a href="#">ANC04LA078</a>	13-Jul-2004	NONE	Mechanical
<a href="#">ANC05LA005</a>	11-Oct-2004	NONE	Other
ANC05LA025	27-Jan-2005	NONE	Landing
ANC05CA095	3-Jul-2005	NONE	Other
ANC05CA099	9-Jul-2005	NONE	Landing
ANC06CA011	13-Dec-2005	NONE	Takeoff-RwyCond

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC00LA086

On July 12, 2000, about 1300 Alaska daylight time, a wheel equipped Cessna 207 airplane, N1549U, sustained substantial damage during a hard landing at the New Kotlik Airport, Kotlik, Alaska. The flight was being conducted under Title 14, CFR Part 135 as an on-demand cargo flight, when the accident occurred. The airplane was operated by Larry's Flying Service, Inc., Fairbanks, Alaska. The solo commercial pilot was not injured. Visual meteorological conditions prevailed, and a company flight plan was in effect. The flight originated at the Emmonak Airport, Emmonak, Alaska, about 1230.

During a telephone conversation with the National Transportation Safety Board investigator-in-charge on July 13, and in her NTSB Pilot/Operator report, the pilot reported she misjudged the landing, and landed hard in a nose low attitude. She said the nose wheel hit first, then the airplane rocked back and the main wheels and tail cone contacted the runway surface. The tail cone and empennage sustained substantial damage. The pilot estimated there was 1,000 pounds of cargo, and the fuel tanks were about 1/2 full. She indicated there were no preaccident mechanical anomalies with the airplane.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC01LA017

On November 3, 2000, about 1345 Alaska standard time, a wheel equipped Cessna 207A airplane, N7336U, sustained substantial damage during an aborted takeoff from the Bethel Airport, Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) on-demand cargo flight transporting mail under Title 14, CFR Part 135, when the accident occurred. The airplane was owned by Flight Alaska, Inc., doing business as Yute Air Alaska. The solo commercial pilot was not injured. Visual meteorological conditions prevailed, and company visual flight rules (VFR) flight following procedures were in effect for the flight to Kongiganak, Alaska.

During a telephone conversation with the National Transportation Safety Board investigator-in-charge on November 3, the pilot reported that while taxiing from the parking apron, en route to the departure runway, the Bethel Air Traffic Control Tower (ATCT) advised him that an immediate departure would be possible if he was able to accept another runway, runway 29. The pilot said that after accepting the alternate runway, he taxied onto runway 29 at intersection Echo. He said runway 29 was a gravel runway that had a light accumulation of heavy, wet snow/slush, and estimated that he would have about 1,500 feet of runway remaining from intersection Echo. The pilot said while departing runway 29, the airplane veered to the left, and he applied full right rudder to correct the veer. He said that he was unable to correct the veer, so he closed the throttle, aborted the takeoff, and applied maximum braking. The airplane ran off the end of the runway, down an embankment, and struck a chain link fence. The airplane sustained substantial damage to both wings.

Bethel tower personnel reported that when departing runway 29 from intersection Echo, the published usable remaining runway is 1,350 feet. In addition, published usable full-length of runway 29, is 1,850 feet.

The closest weather observation station is Bethel. On November 3, at 1353, an Aviation Routine Weather Report (METAR) was reporting in part: Sky conditions and ceiling, 4,000 feet broken, 10,000 feet broken, 14,000 feet overcast; visibility, 10 statute miles; wind, 093 degrees (magnetic) at 9 knots; temperature, 37 degrees F; dew point, 33 degrees F; altimeter, 29.84.

The pilot submitted a written report to the NTSB dated November 4. In his written report, the pilot wrote, in part: "After a few hundred feet I could feel the right main gear grabbing. I let off of the right rudder and it still continued. I began to drift from centerline, and found myself using more left rudder than right. Realizing that the right main gear was stuck or frozen, I thrust my right foot on the right break in hopes of breaking it free. This maneuver failed so I immediately applied breaks and pulled the throttle to idle."



# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

On November 15, the operator reported that there were no postaccident mechanical anomalies noted with the accident airplane's engine, flight controls, or brakes.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC01LA028

On January 3, 2001, about 1740 Alaska standard time, a wheel-equipped Cessna 172 airplane, N19771, sustained substantial damage during landing at the Atmautluak Airport, Atmautluak, Alaska. The airplane was being operated as a visual flight rules (VFR) on-demand passenger flight under Title 14, CFR Part 135, when the accident occurred. The airplane was registered to, and operated by, Village Aviation, Inc., Bethel, Alaska. The certificated commercial pilot, and the two passengers aboard, were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect. The flight originated at the Bethel Airport, Bethel, about 1730.

During a telephone conversation with the National Transportation Safety Board investigator-in-charge on January 4, the pilot stated that while on final approach to runway 33, he inadvertently allowed the airplane to descend below his intended glide path. He said that in an attempt to arrest the descent he applied full engine power, but the airplane continued to descend. The airplane inadvertently touched down on the snow-covered approach end of the runway, about 15 yards short of the runway surface. He said that as he attempted to abort the landing, the airplane become airborne, drifted to the left of the runway, and settled into an area of soft snow. During the second touchdown, the nose wheel collapsed at the firewall bulkhead. The airplane sustained substantial damage to the engine firewall. The pilot reported that wind conditions at the time of the accident were from the northeast at 5 knots.

The pilot indicated that there were no preaccident mechanical anomalies with the airplane.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC01LA046

On April 3, 2001, about 1745 Alaska daylight time, a wheel-equipped Cessna 207 airplane, N1581U, sustained substantial damage after colliding with terrain, about eight miles north of Nightmute, Alaska. The airplane was being operated as a visual flight rules (VFR) scheduled domestic passenger flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated as Flight 262 by Grant Aviation Inc., Anchorage, Alaska. The commercial certificated pilot and one passenger received serious injuries, two passengers received minor injuries, and three passengers were not injured. Visual meteorological conditions prevailed in the area of the accident, and VFR company flight following procedures were in effect. The accident flight originated at the Nightmute Airport, about 1730. The intended routing of Flight 262 was from Bethel, Alaska, to Toksook Bay, Alaska, to Nightmute, to Newtok, Alaska, and then a return to Bethel.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on April 3rd, the director of operations for the operator reported that the flight had crashed, and search and rescue operations were underway. On April 6, 2001, the NTSB IIC interviewed the pilot who stated that while he was en route to Toksook Bay, he contacted the village agent via radio. The weather conditions were reported by the agent as 800 feet overcast, visibility 5 miles, with a light wind from the southeast. Before departing Nightmute, the pilot said he set the airplane's altimeter to the field elevation (15 feet msl). After departure, he proceeded toward Newtok, but skirted an area of low hills by flying toward the east before turning toward Newtok. He said he was flying about 450 feet above the ground. About 10 minutes after departure, the pilot said the horizon began to become obscured and the area ahead of the airplane turned white. He said there was no precipitation, rather the ground and sky became indistinguishable. He began a right turn toward the east, but about 2 seconds after beginning the turn, the airplane suddenly collided with snow-covered terrain.

In the Pilot/Operator report (NTSB Form 6120.1/2), the director of operations reported the weather conditions at the accident site as an estimated indefinite ceiling of 500 to 600 feet agl, and the visibility was estimated as two miles in haze/whiteout with no precipitation.

On September 13, 2001, in a telephone conversation with the NTSB IIC, the right front seat passenger reported that as the flight progressed toward Newtok, the visibility was about one mile under gray sky conditions. Just prior the accident, the visibility began to decrease, and the airplane then collided with the snow. The passenger did not report any precipitation.

The airplane came to rest on its right side. The engine and propeller were torn off the airframe. The pilot provided emergency care for the passengers, and contacted an over-

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

flying jet airplane on a hand-held radio. Emergency personnel arrived by helicopter about 2 hours later.

The airplane was equipped with an avionics package provided by the Federal Aviation Administration's Capstone Program. The Capstone Program is a joint industry/FAA demonstration program that features, among others, global positioning system (GPS) avionics, weather and traffic information provided through automatic dependent surveillance-broadcast (ADS-B), traffic information service-broadcast (TIS-B) equipment, and terrain information depicted on a multifunction display (MFD) installed in the cockpit. The Capstone program provides radar-like services to participating air carrier aircraft operating in a non-radar environment of Western Alaska. At the time of the accident, position information from Capstone equipped airplanes, to the Anchorage Air Route Traffic Control Center (ARTCC), Anchorage, Alaska, is provided by the ADS-B equipment in the airplane, and requires ground based radio repeater sites to facilitate the transmittal of position data. The area of the accident was not within radio coverage of a currently established repeater site.

Terrain depiction information, based on GPS data, is one of several visual display options available to the pilot. Other options include custom maps, VFR sectional charts with topographical features, IFR charts, flight plan and traffic information, and weather data. The airplane's position can be displayed in relation to its location over the terrain, and may include bearing and distance information to selected points. Selection of the terrain mode for display, provides the pilot with color shading, depicting areas of terrain that are black (2,000 feet below the aircraft), green (between 2,000 and 700 feet below the aircraft), yellow (between 700 and 300 feet below the aircraft), and red (at or within 300 feet of the aircraft). Accurate depiction of terrain (in the terrain mode) requires the pilot to manually set a barometric pressure setting in the multifunction display menu. The Capstone avionics equipment does not automatically receive barometric pressure data from the aircraft's altimeter. Selection of the map mode does not provide any terrain warning/awareness information.

During the interview with the NTSB IIC, the pilot said that he received training in the use of the Capstone equipment from the University of Alaska, Anchorage, and from his company. He also said that during the accident flight, he selected the moving map display with a five mile scale. He did not observe any warning flags illuminated on the multifunction display. He did not manually enter any barometric pressure data into the Capstone equipment. The pilot said that he routinely utilized his own personal GPS receiver that has a color moving map display. He said he is more familiar with his own GPS, and had it installed on the top of the instrument panel glare shield. He said that since the terrain in Western Alaska is usually quite flat, he routinely utilized the Capstone map mode with the GPS "go to" function for each leg/destination of a route, not the terrain mode.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

The closest official weather observation station to the accident site is Hooper Bay, Alaska, which is located 71 nautical miles northwest of the accident site. On April 3, at 1835, an Aviation Routine Weather Report (METAR) was reporting in part: Wind, 140 degrees (true) at 9 knots; visibility, 9 statute miles; clouds and sky condition, 800 feet broken, 1,200 feet broken, 3,100 feet overcast; temperature, 32 degrees F; dew point, 28 degrees F; altimeter, 28.92 inHg.

On April 3, at 1753, a METAR from Bethel, located 81 nautical miles east of the accident site, was reporting in part: Wind, 160 degrees (true) at 18 knots, gust to 24 knots; visibility, 10 statute miles; clouds and sky condition, 1,900 feet broken, 2,600 feet overcast; temperature, 35 degrees F; dew point, 32 degrees F; altimeter, 28.94 inHg.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC01LA117

On July 25, 2001, about 1310 Alaska daylight time, a Cessna 207 airplane, N9973M, operated by Grant Aviation as a scheduled commuter flight under 14 CFR Part 135, received substantial damage when it collided with a tree shortly after takeoff from the Kalskag Airport, Kalskag, Alaska. The solo commercial pilot was not injured. The flight was en route to Emmonak, Alaska, and operated in visual meteorological conditions. A company flight plan was in effect.

According to a letter dated July 27, 2001, from the director of operations for Grant Aviation and addressed to an Anchorage, Alaska, Flight Standards District Office air safety inspector, the accident airplane's left wingtip collided with a tree while in a low altitude turn shortly after takeoff. The pilot reportedly thought it was bird strike, and he elected to continue to his destination of Emmonak.

Postaccident inspection of the airplane disclosed a damaged wingtip, a crushed outboard nose rib, and a damaged leading edge. Repairs made to the airplane included a replacement nose rib, a new wingtip, and a new segment of leading edge skin, which required riveting to the semi-monocoque wing structure.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC01LA108

On August 13, 2001, about 1154 Alaska daylight time, a wheel-equipped Cessna 207 airplane, N562CT, operated by Grant Aviation, Bethel, Alaska, as scheduled commuter Flight 2202, under 14 CFR Part 135, sustained substantial damage during an attempted takeoff from the Akiachak Airport, Akiachak, Alaska. The commercial pilot and the six passengers reported no injuries. The flight operated in visual meteorological conditions, and a company flight plan was in effect. The flight departed Bethel about 1110, and Akiachak was an intermediate stop prior to returning to Bethel.

According to witnesses and passengers, the pilot began the takeoff on runway 29, after a back-taxi to use the full length of the 1,625 feet long gravel runway. During the takeoff roll, the airplane lifted off the runway two times, and each time settled onto the runway. At the end of the runway, the airplane lifted off again, bounced hard on the tundra, and continued to fly a short distance before coming to rest, about 1,300 feet from the departure end of runway 29. The witnesses and passengers all noted that the engine appeared to be operating normally at a high power setting. Four ground witnesses said the airplane took off downwind, and estimated the wind to be about 10 miles per hour.

An Alaska State Trooper/pilot flew his airplane to Akiachak to ascertain if there had been injury or loss of life. He stated to the NTSB investigator-in-charge on August 14, that he landed on runway 11 about 20 minutes after the accident. He said he estimated the wind to be approximately from 135 degrees magnetic, at 10 to 12 knots. He said he interviewed another air taxi pilot who landed immediately after the accident. According to the trooper, the air taxi pilot saw the accident airplane taxi to the end of runway 29, and then start a takeoff roll downwind. The trooper stated he talked with the accident pilot, and asked the pilot how he determined the wind direction. The pilot reportedly said he looked at the wind sock from the ramp area prior to departure. At the time of the interview with the pilot, the trooper and the pilot were at the ramp area. The trooper said the wind sock is not visible from the ramp due to high willows and brush. The trooper also said he interviewed four other witnesses, and they all indicated the engine sounded like it was operating at a high power setting, and that the airplane's takeoff run was downwind. According to the trooper, he looked at the airplane's logbooks and associated paperwork. He said he could find no current weight and balance calculations by the pilot for the accident flight, although there were weight and balance calculations for flights conducted days earlier. The trooper also related that the cargo in the back of the airplane had not been secured, although a tie-down cargo net was available.

Akiachak is approximately 17 miles northwest of Bethel. At 1153, the Bethel METAR weather report indicated the surface wind was 153 degrees magnetic at 13 knots.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

DCA02MA003

### **HISTORY OF FLIGHT**

On October 10, 2001, about 0926 Alaska daylight time (all times in this brief are Alaska daylight time based on a 24-hour clock), Peninsula Airways, Inc. (PenAir) flight 350, a Cessna CE-208 Caravan, N9530F, crashed shortly after takeoff from the Dillingham Airport (DLG), Dillingham, Alaska. The pilot and nine passengers were killed, and the airplane was destroyed. (One passenger was evacuated to Anchorage, Alaska, but died the next day.) There was no fire. The impact site was located about 0.7 nautical miles (nm) northeast of the departure end of runway 01 at DLG. The accident occurred during daylight hours, and visual meteorological conditions prevailed at the time of the accident. The flight was operated by PenAir as a visual flight rules flight in accordance with Title 14 Code of Federal Regulations (CFR) Part 135 of the Federal Aviation Regulations (FAR). Flight 350 was bound from DLG to King Salmon, Alaska.

The pilot of the accident airplane arrived for duty at DLG about 0800 the morning of the accident. The flight coordinator informed the pilot that he would fly N9530F to King Salmon, Alaska, with nine passengers.

The airplane had been parked outside on the ramp overnight, and flight 350 was to be its first flight of the day. DLG had experienced light rain and mist for most of the day before the accident. This precipitation turned to light snow and mist about 2016 and continued until about midnight as the first major winter weather of the season passed through the Dillingham area. Temperatures dropped steadily to about -4 degrees C (24 degrees F).

Several pilots whose airplanes were also parked outside overnight were interviewed about the snow accumulation on their airplanes the morning of the accident. A PenAir check airman who was scheduled to fly a Cherokee to King Salmon, Alaska, with the overflow passengers from PenAir flight 350 described the contamination on his airplane as "like epoxy" and said that he observed that the snow/ice on his airplane and on the accident airplane were the same. Another PenAir pilot reported that his airplane had 1/8-inch-thick icy patches covered by about 1/4 inch of snow. Another pilot on the field stated that his airplane was covered with 1/4 to 1/2 inch of clear ice with snow/frost on top.

Between about 0830 and 0840, a pilot from another operator on the field observed the accident pilot conducting a preflight check of the accident airplane. The accident airplane had not yet been deiced.

The PenAir ramp supervisor reported that, sometime before 0900, the accident pilot asked him to fuel the accident airplane with 60 gallons of Jet A fuel (30 gallons in each wing tank). The ramp supervisor told the pilot that his airplane would need deicing. The pilot did not acknowledge this comment. While returning to the flight office, the pilot met



# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

the PenAir check airman and asked what the deicing procedures were in Dillingham. The check airman told Safety Board investigators that he did not think the pilot's question was unusual because the pilot had not deiced at Dillingham previously. He told the pilot that the deicing procedures were the same as for a Cherokee and that the pilot should make sure that his airplane was thoroughly deiced that morning.

The PenAir ramp employee who fueled the accident airplane said that he had trouble removing the accident airplane's left fuel cap due to what he described as "1/4 inch of frost with maybe ice underneath." He reported that he had to use a tool to remove the fuel cap.

After the fueling was complete, the ramp supervisor sprayed deicing fluid on the accident airplane. The PenAir ramp employee who had fueled the airplane drove the forklift with the deicing equipment attached. The supervisor described the accident airplane as having 1/8 inch of frost that covered the entire airplane. He said that he did not physically touch the surfaces of the wing after the deicing process because he believed that the upper surface of the wing was clear of ice. The ramp employee driving the forklift said that he could not see the accident airplane's wing after deicing but that "a lot of glycol" had been applied. The pilot was not present during the deicing.

About 0850, the PenAir check airman flying the Cherokee to King Salmon was on the ramp and watched as the accident airplane was deiced. He stated that he saw the accident airplane deiced one time and that the process was completed in about 20 minutes. The same crew and equipment that deiced the accident airplane deiced his airplane.

No witnesses were found who could verify whether, after the fueling and deicing of the accident airplane was complete, the accident captain climbed a ladder or used any other means to check that the fuel caps were replaced properly or that the upper wing surfaces were clear of ice, snow, or frost. A PenAir customer service manager did state that he saw glycol on the accident pilot's coat prior to the accident airplane's departure. In addition, the PenAir check airman reported that, when he looked at the accident airplane from the ground and again from the wing of his own airplane, the accident airplane appeared to be free of snow.

About 0920, as he taxied the Cherokee out to the runway, the check airman observed the accident airplane's takeoff roll. He said that the accident airplane used the normal amount of runway. After aligning the Cherokee with the centerline of runway 01, the check airman looked up and saw the accident airplane make the standard 45-degree right turn to depart the local airport traffic pattern. The check airman reported that everything appeared normal about the accident airplane at that time. A pilot doing a preflight check on his airplane on the north end of the field said that he glanced up and saw the accident airplane during takeoff, about 50 feet above the Bravo intersection.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

A private pilot who was talking on the telephone in his office less than 1 mile from the accident site watched as the accident airplane took off. This witness said that the airplane was traveling from left to right and was moving slightly away from him. The airplane appeared to be straight and level and at an altitude of less than 1000 feet above ground level. The sound of the engine was normal and gradually dissipated as the airplane traveled across his field of view. This witness stated further that the flight appeared to be normal until the airplane abruptly pitched up, rolled more than 90 degrees to the left, and yawed to the left, "back towards the airport," when he was able to see the entire top of the airplane. The witness reported that the nose of the airplane then dropped until the nose pointed directly down as the airplane rolled to the right. The airplane did not spin. The airplane finally disappeared behind a small hill in a nose-down attitude. The witness immediately hung up the telephone, dialed 911, and left for the accident site. When he arrived, fire and rescue personnel were already on scene.

### **PILOT INFORMATION**

The pilot, age 41, held a commercial pilot certificate with an airplane single-engine and multi-engine land, and instrument rating; he also held an airframe and powerplant mechanic certificate. His most recent second-class medical certificate was issued on February 9, 2001, with the limitation, "The holder shall wear corrective lenses."

PenAir hired the accident pilot on October 16, 2000, and he had accrued 869 hours of total flight experience since that time. PenAir records also indicate that, at the time of the accident, the pilot's total flight experience consisted of about 3,100 hours. In the 90 days, 30 days, and 24 hours prior to the accident, PenAir records show that the pilot had accrued a total of 271, 86, and 4.4 hours, respectively.

PenAir records show further that the pilot had accrued a total of about 74 hours in the Cessna CE-208 Caravan, the same airplane make and model as the accident airplane. Records also show that the pilot's initial flight training in the CE-208 occurred on June 4, 2001, that his last CE-208 FAR 135.293 competency check and FAR 135.299 line check prior to the accident also occurred on June 4, 2001, and that his initial operating experience in the CE-208 occurred on August 11, 2001. PenAir's records indicate that the accident pilot was also qualified in the Piper PA-32.

### **AIRPLANE INFORMATION**

The accident airplane, a Cessna Caravan CE-208, N9530F, S/N 20800088, was manufactured in 1986. The airplane had accumulated 10,080 hours since it was manufactured. The most recent inspection was accomplished on October 5, 2001, 12.4 hours before the accident.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

The airplane was equipped with a Pratt & Whitney Canada (PW&C) PT6A-114 turbopropeller engine and a three-bladed Hartzell Propeller, model number HC-B3MN-3, with M10083K composite blades. The engine had accumulated 10,984 hours.

The airplane's weight and balance were within the normal operating range. A review of the airplane and engine logbooks revealed no discrepancies and no deferred items for the accident flight.

### **METEOROLOGICAL INFORMATION**

At 0851, the on-field Federal Aviation Administration (FAA) flight service station reported the DLG weather as follows: wind, from 260 degrees at 5 knots; visibility, 10 statute miles with a few clouds at 2,000 feet; temperature, -4 degrees C (24.8 degrees F); dew point temperature, -10 degrees C; and altimeter, 29.40 inches of Hg.

### **AIRPORT INFORMATION**

Dillingham airport is an uncontrolled airport with a part-time FAA Flight Service Station located on the field. The airport has one grooved asphalt runway, 01/19, which is 6,404 feet long. No radar services are available locally.

### **WRECKAGE AND IMPACT INFORMATION**

The airplane came to rest in a level attitude approximately 0.7 nm northeast of the departure end of runway 01 at approximately N59°03.15' latitude and W158°28.41' longitude. The entire debris field stretched along a magnetic heading of 059 degrees for approximately 163 feet and was approximately 118 feet wide. Based on tree strikes and initial impact marks in the soft tundra, the flight path angle was estimated to be equal to or greater than 40 degrees down.

The entire airplane structure was found within the impact area. There was no fire, but the crash site did have a strong smell of jet fuel. The fuselage came to rest approximately 121 feet from the initial impact crater with the nose of the airplane pointing almost perpendicular to the wreckage path. The fuselage exhibited significant vertical compression with little longitudinal compression. The empennage structure was separated from the fuselage but remained connected by pushrods and cables.

Both wings sustained significant leading edge impact damage near the wing root. The right wing had separated from the fuselage and was found upside down and slightly ahead of the fuselage. The left wing remained attached to the fuselage, but the front spar web was fractured outboard of the wing root.

All flight control surfaces (ailerons, spoilers, elevators, and trim tabs) were found attached to their respective hinge attach points except for the outboard half of the left

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

elevator, which was found in the wreckage field. Control system continuity was verified in the rudder and elevator control systems. The elevator trim actuator was measured to be at 0-degree deflection. The rudder gust lock handle was found in the unlocked position. The left aileron control cables were continuous. The right aileron control cables were found separated at the wing root and exhibited a "broom straw" appearance.

The flap selector handle was found positioned against the 10-degree stop. The flap indicator was positioned at approximately 2 degrees but was free to move. The left flap surface was attached to the left wing in the retracted position. The right flap surface was attached to the right wing in an extended position. The flap jackscrew and transmission assembly (part of the flap gearbox) and the flap actuator tube assembly were attached to the right wing. The wing flap actuator jackscrew was intact and was attached to the fuselage mount, but the fuselage mount was ripped from the fuselage. Measurements indicated by the position of the gearbox were considered unreliable because the gearbox was separated from the transmission assembly and was free to rotate around the jackscrew. The entire flap mechanical control system linkage was inspected, and no preexisting failures were noted that would indicate an asymmetric flap existed at impact.

Examination of the cockpit area revealed that both the pilot's and copilot's control yokes were broken free of their respective attaching mounts and were fractured at nearly the same length, indicating approximately full airplane nose-up elevator. The pilot's seat was found locked and positioned in the sixth hole forward of the aft stop pin.

The left pitot/static tube was broken from its structural wing attach point but remained connected by electrical wires. No damage was observed to the stall detector, and the tab (vane) was unrestricted and free to move. The right pitot/static tube remained intact, and the tubing was free of any obstruction.

The left and right fuel tank selector knobs were found in the OFF position. The left fuel tank shutoff valve handles in the left wing tanks were both in the OPEN position against the mechanical stops. The right fuel tank aft shutoff valve handle was found in the OPEN position, and the right fuel tank forward shutoff valve handle was found between the OPEN and CLOSED positions. Examination of right and left wing integral fuel tanks revealed a significant amount of fuel.

Examination of the PT6A-114 turbopropeller engine revealed that the compressor section had ingested tundra and that all compressor and turbine blades exhibited blade tip rub of varying degrees. All three propeller blades were found at the wreckage site and were fractured in about the same lengthwise location, just outboard of the blade butt.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **MEDICAL AND PATHOLOGICAL INFORMATION**

A postmortem examination of the pilot was conducted under the authority of the Alaska State Medical Examiner, Anchorage, Alaska, on October 12, 2001. The cause of death for the pilot was reported to be multiple blunt force injuries.

A toxicological test performed by the FAA's Civil Aeromedical Institute was negative for ethanol and drugs.

### **TESTS AND RESEARCH**

The engine, engine controls, and propeller were sent to the PW&C facility in Montreal, Quebec, Canada, where they were disassembled and examined. No preexisting defects or anomalies were found that would have prevented normal engine or propeller operation. All internal damage was consistent with that of an engine that was operating at impact. Spinner damage showed that the propeller's blade angle was in the normal operating range at the time of the impact.

The accident airplane was equipped with a TrendCheck Engine Monitor, which was removed from the accident engine. Its data were downloaded at the manufacturer's facility in Norwood, Massachusetts. No anomalous events were recorded that would indicate engine stoppage prior to impact. Parameters recorded for the accident flight included an engine run duration of 509 seconds and a maximum pressure altitude of 1021 feet (651 feet mean sea level).

The Cessna CE-208 Caravan is equipped with a warning system that activates if one or both tank selector knobs are placed in the OFF position and/or if the fuel level in the reservoir tank or wing tanks becomes low. The system includes annunciator lights in the cockpit annunciator panel (CAP) and redundant warning horns. The CAP, various cockpit gauges, and stall heat and pitot/static heat switches were examined at the Safety Board's Materials Laboratory. None of the CAP bulb filaments showed any evidence of hot filament stretching, and none of the cockpit gauge faceplates displayed any needle contact marks. Internal examination of both heat switches confirmed that they were in the OFF position at impact.

An airplane performance study was conducted using data obtained during the investigation, including data from the engine monitor. However, because no radar data was available, the study was inconclusive. The report is contained in the Airplane Performance Study Report, which is included in the public docket.

Fuel samples from both wings and the fueling truck were sent to CT&E Environmental Services, Inc., Anchorage, Alaska, for testing. No anomalies were noted in any of the fuel samples. The deicing fluid was determined to be 70.8 percent water.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **ADDITIONAL INFORMATION**

#### **PenAir Deicing/Anti-icing Equipment and Procedures**

PenAir uses a portable 300-gallon deicing unit with an operator bucket attached. Electrical power is used to keep the deicing fluid heated to an operational temperature within the unit. Before each use, the outside air temperature, freeze point of the fluid, and fluid temperature are documented. When airplane deicing is required, one ground employee picks up the deicing unit with a forklift and positions it at the airplane for the deicing process. Another ground employee stands in the bucket atop the unit and sprays the airplane with deicing fluid.

According to the PenAir ramp supervisor, the company receives large plastic containers with 100 percent freeze point depressant fluid. (It was reported that the fluid was Union Carbide type 1 fluid and was 92 percent ethylene glycol, 7.5 percent water, and 0.5 percent processing additives.) He reported that they drain half the mixture into another plastic container and then fill both containers with water to create a 50 percent fluid mixture (50 percent glycol and 50 percent water). PenAir's FAA-approved deicing/anti-icing program requires the deicing mixture to be 50 percent glycol, which has a freeze point of about -28 degrees C.

The supervisor stated that the deice machine had been operationally ready since October 1, 2001, and contained 300 gallons of heated 50 percent water/glycol mixture. On the morning of the accident, the outside air temperature, freeze point of the fluid, and fluid temperature were recorded as 32 degrees F, 0 degrees F, and 140 degrees F, respectively. A sample of the deice fluid was also sent to CT&E Environmental Services, Inc., for testing. The deicing fluid was determined to be 70.8 percent water. According to FAA advisory material, the freeze point of a 70 percent glycol/water mixture is approximately 5 degrees F (accepted industry practice is for the freeze point of deice fluid to be at least 18 degrees F below the outside air temperature).

At the time of the accident, PenAir's deicing/anti-icing program stated the following in part:

A pretakeoff check is a check of the "representative aircraft" to make sure other critical surfaces are free of frost, ice and snow. This check must be conducted within five minutes prior to beginning the takeoff. It must be accomplished from outside the aircraft unless an alternate procedure is used.

PenAir's alternate procedure was defined as follows:

When deicing/anti-icing fluid has been applied, the flight crew will make a visual check of the inboard leading edge of both wings prior to taking the active runway for departure.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

The visual check will verify that contaminants have not built up on the aircraft during the holdover period.

PenAir's deicing/anti-icing program did not require pilots or ramp personnel to physically check their airplanes' critical surfaces after deicing. The pilot's preflight walk around in the PenAir C-208 Company Flight Manual states in part, "Warning: It is essential in cold weather to remove even small accumulations of frost, ice or snow from the wing and control surfaces." PenAir personnel stated that after deicing, operational procedures called for the pilot to visually check the airplane. PenAir did have ladders available at DLG so that pilots could check the upper surfaces of their airplanes if they thought such a check was necessary.

While on scene, Safety Board investigators inspected another PenAir CE-208B and found that, due to the airplane's high-wing configuration, a pilot would have to stand about 10 to 15 feet behind the airplane in order to see most of the upper surface of the wing.

### **Technical and Advisory Information**

Safety Board staff questioned the FAA's Chief Scientific and Technical Advisor for Flight Environmental Icing about airplane deicing. He stated that the heat of the glycol/water fluid de-bonds the frozen contamination from the aircraft surface and the force of the fluid jet drives/flushes the de-bonded frozen contamination from the surface. The glycol in the fluid acts as a freeze point depressant and keeps the fluid mixture from refreezing.

The advisor also stated that clear ice, a form of glaze ice, is difficult to see and has a high adhesion strength. He also stated that the density of glaze ice inhibits penetration by deicing fluids, making it difficult to remove.

### **Icing Advisory Material**

Title 14 CFR 135.227 prohibits airplanes from taking off when snow, ice, or frost is adhering to the airplanes' wings, propellers, or control surfaces. FAA Advisory Circular (AC) 20-117, Hazards Following Ground Deicing and Ground Operations in Conditions Conducive to Aircraft Icing (3/29/88), states that testing has shown that ice formations on various aircraft components can have significant and sometimes devastating effects on airplane flight characteristics. The AC further states that surface roughness on the afterbody of a wing can have an effect approximately equal to the effect of similar surface roughness on the leading edges of some airfoils. One of these effects can be to decrease the stall angle of attack, possibly before activation of stall warning devices.

The Society of Automotive Engineers report ARP4737, Rev. E, "Aircraft Deicing/Anti-icing Methods," addresses several precautions concerning clear ice, including the following:

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

- Clear ice can form on aircraft surfaces below a layer of snow or slush. It is, therefore, important that surfaces are closely examined following each deicing operation, in order to ensure that all deposits have been removed.
- Clear ice formation is extremely difficult to detect. Therefore, when [clear icing] conditions prevail, or when there is otherwise any doubt that clear ice may have formed, a close examination shall be made prior to departure, in order to ensure that all frozen deposits have been removed.



# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC02FA014

### **HISTORY OF FLIGHT**

On February 4, 2002, about 1042 Alaska standard time, a wheel-equipped Cessna 206 airplane, N756HL, was destroyed when the airplane collided with remote, snow-covered terrain, during cruise flight, about 80 nautical miles northwest of Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) on-demand cargo/U.S. mail flight under Title 14, CFR Part 135, when the accident occurred. The airplane was registered to a private individual, and operated by Flight Alaska, Inc., dba: Yute Air Alaska. The solo certificated commercial pilot received fatal injuries. Visual meteorological conditions prevailed at the departure airport, and no flight plan was filed. The flight originated at the Bethel Airport, Bethel, at 1004, and was en route to Chevak, Alaska.

According to the company's director of operations, when the flight failed to return to Bethel by 1430, company personnel initiated a phone search, and discovered that the flight had never reached Chevak. The flight was officially reported overdue to the Federal Aviation Administration (FAA) about 1545.

About 1209, an emergency locator transmitter (ELT) signal was received by a search and rescue satellite. Personnel from the Bethel wing of the Civil Air Patrol were dispatched to conduct an aerial search, and determine the source of the ELT signal. The Civil Air Patrol personnel reported that they were unable to complete the mission due to low clouds, low visibility, and icing conditions. At 1605, an Alaska Army National Guard HH-60 helicopter was dispatched from Bethel to begin an aerial search. The helicopter crew located the wreckage about 1650, about 70 miles east of Chevak, along the accident airplane's anticipated route of flight.

### **CREW INFORMATION**

The pilot held a commercial pilot certificate with airplane single-engine land, single engine sea, and instrument airplane ratings. The most recent second-class medical certificate was issued to the pilot on April 6, 2001, and contained no limitations. No personal flight records were located for the pilot. According to company records, the pilot's total aeronautical experience consisted of 7,800 hours, of which 200 hours were accrued in the accident airplane make and model. In the preceding 90 and 30 days prior to the accident, the company listed the pilot's flight time as 20 and 10 hours, respectively. The operator hired the pilot on May 7, 2001. According to the operator's director of operations, prior to joining the company, the accident pilot had accrued extensive 14 CFR Part 135 experience flying in Alaska. The pilot completed an airman competency/proficiency check flight under Title 14 CFR Part 135.293 (Initial and Recurrent Testing), and 135.299 (Pilot-in-Command Line Check), with the chief pilot for the operator in a Cessna 207 airplane on April 25, 2001. In the remarks section of FAA

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

form number 8410-3 (airman competency/proficiency check form), the chief pilot wrote: "Demonstrated instrument proficiency."

The accident flight was the pilot's first flight of the day.

### **AIRCRAFT INFORMATION**

The airplane had accumulated a total time in service of 10,607.2 hours. The most recent 100 hour inspection was accomplished on November 29, 2001, 46.2 hours before the accident.

The engine had accrued a total time in service of 5,337.1 hours, and 844.5 hours since overhaul.

### **METEOROLOGICAL INFORMATION**

According to the company's director of operations, the pilot obtained current weather information for Chevak from the flight-planning desk located at the operator's base of operation in Bethel. The director of operations reported that company operations personnel in Bethel collect this weather information by calling each village agent in the villages serviced by the operator.

In a written statement provided to the National Transportation Safety Board, the employee who prepared the weather information prior to the accident flight's departure, said that he called the village agent in Chevak about 0900, and requested the current weather conditions. He added that weather information and aircraft loading calculations were relayed to the accident pilot prior to his departure. According to company records provided by the operator, the 0900 weather for Chevak was reported as: Sky conditions and ceiling, 5,000 feet overcast; visibility, 20 statute miles; wind from the northeast at 10 knots.

The closest weather observation station to the accident site is Hooper Bay, Alaska, which is located about 60 nautical miles west of the accident site. On February 4, at 1035, an unaugmented AWOS was reporting, in part: Wind, 190 degrees (true) at 6 knots; visibility, missing; clouds, 100 feet overcast; temperature, 19 degrees F; dew point, 17 degrees F; altimeter, 28.93 inHg.

Bethel is located about 80 nautical miles southeast of the accident site. At 1053 an Aviation Routine Weather Report (METAR) was reporting, in part: Sky conditions and ceiling, 3,900 feet broken; visibility, 10 statute miles; wind, 050 degrees at 13 knots; temperature, 10 degrees F; dew point, minus 6 degrees F; altimeter, 28.90.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

An area forecast for the Yukon-Kuskokwim Delta, issued on February 4, 2002, at 0545, and valid until 1800, was forecasting, in part: Clouds and weather, 2,000 feet scattered, 5,000 feet broken, tops at 8,000 feet, with layers above 26,000 feet.

An AIRMET valid until 0000, was forecasting mountain obscuration in clouds and precipitation along the pilot's planned route of flight, with occasional moderate rime icing conditions in the clouds from 1,200 feet to 10,000 feet.

A pilot who departed from Chevak about 1043 en route to Bethel, characterized the weather conditions between Bethel and the accident site as overcast with ceilings ranging between 1,000 and 1,300 feet. He said that as his flight progressed, and as he approached the site where the wreckage was eventually discovered, he encountered momentary visibility restrictions due to fog and light snow. He added that flat light conditions made it very difficult to discern any topographic features among the featureless, snow-covered terrain. The pilot stated that he changed his route in order to avoid worsening weather conditions.

A pilot who departed Bethel about 25 minutes before the accident airplane's departure, also en route to Chevak, characterized the weather conditions along the accident airplane's route as "low visibility with light snow squalls moving through the area." He added that flat light conditions made it very difficult to discern any topographic features. He said that with satisfactory weather conditions, and given the intended destination of the accident airplane, the standard route of flight would be directly over the flat, featureless area where the accident occurred.

### **COMMUNICATIONS**

Review of the air-ground radio communications tapes maintained by the FAA at the Bethel Flight Service Station (FSS) facility, revealed that just before takeoff from Bethel, the pilot communicated with the local ground and tower control positions. After departure, no further communications were received from the accident airplane.

A transcript of the air to ground communications between the airplane and Bethel local control is included in the public docket for this accident.

### **WRECKAGE AND IMPACT INFORMATION**

The National Transportation Safety Board (NTSB) investigator-in-charge, along with an additional NTSB investigator, and the operator's chief pilot, examined the wreckage at the accident site on February 6, 2002. About 2 inches of snow had fallen at the wreckage site since the accident. A depression in the snow, followed by a path of wreckage debris to the main wreckage point of rest, was observed on a magnetic heading of approximately 095 degrees, consistent with the airplane impacting the ground on a southeasterly heading (opposite of the on-course heading for the intended flight).

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

The first observed point of impact was the semi-circular depression noted above. It was about four feet wide and eight feet long. Two smaller impressions were observed on either side of the main depression. The first portion of the airplane located along the wreckage path was the right-side fuselage step. The step was located within the initial impact depression. About 20 feet beyond the depression was the aft section of the airplane's right-side cargo door. Additional portions of the airplane were found along the wreckage path, and included, in the order observed: right elevator, portions of the upper engine cowlings, the right wingtip fairing, the nose wheel strut, the right main landing gear leg, the forward section of the right-side cargo door, fragments of the engine mount, nose cargo door and nose wheel, portions of the nose/engine keel structure, and propeller.

The main wreckage came to rest about 250 feet from the initial impact depression. The airplane was lying inverted. Both wings remained attached to the fuselage.

Both wing lift struts were attached to the wing, but separated from the fuselage. Both wings displayed extensive aft crushing of the leading edges.

The empennage, just forward of the vertical stabilizer attach point, was twisted and buckled to the left. The empennage came to rest in an upright position. Both horizontal stabilizers sustained extensive aft crushing of the leading edges. The vertical stabilizer and rudder were free of any major damage.

The flap jackscrew actuator was in the retracted position. According to the airplane manufacturer, the flap jackscrew extension corresponded to a zero flap condition.

The propeller hub assembly separated from the engine at the engine crankshaft propeller flange. The propeller was located about 204 feet from the initial observed point of impact. All six bolts attaching the propeller to the crankshaft flange were sheared. All three propeller blades were retained in the hub, but were loose and rotated within the hub. The first propeller blade had about 90 degree aft bending and aft curling at the tip. The leading edge had file marks, and a gouge about 10 inches inboard from the tip, but was generally free of damage. Minor paint removal was evident about 8 inches inboard from the tip, with minor scuffing along the upper surface of the blade. The second blade had an aft 90 degree bend, about 10 inches inboard from the tip. Spanwise scuffing and scratching were observed about two inches inboard from the tip. The third blade had an aft 90 degree bend, about 8 inches inboard from the tip. The blade had significant torsional twisting, and minor scuffing at the tip. The leading edge had file marks, but no chordwise scratching or gouging.

The engine separated from the fuselage, and was located about 5 feet from the fuselage, and about 245 feet from the initial observed point of impact. It sustained impact damage to the underside, and front portion of the engine oil sump. The exhaust tubes had minor bending and denting without sharp creases. The muffler tube extensions were crushed and flattened. The creases and folds of the metal were not cracked or broken.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

Flight control system cable continuity was established from each control surface to the point of impact-related damage.

### **MEDICAL AND PATHOLOGICAL INFORMATION**

A postmortem examination of the pilot was conducted under the authority of the Alaska State Medical Examiner, 4500 South Boniface Parkway, Anchorage, Alaska, on, February 6, 2002. The cause of death was attributed to multiple impact injuries.

A toxicological examination was conducted by the FAA's Civil Aero medical Institute (CAMI) on March 21, 2002, and was negative for drugs or alcohol.

### **TEST AND RESEARCH**

On March 5, 2002, under the supervision of the NTSB investigator-in-charge, an engine teardown and inspection was conducted at Alaskan Aircraft Engines, Inc., Anchorage, Alaska. No evidence of any preimpact engine anomalies was discovered.

### **ADDITIONAL INFORMATION**

The airplane was equipped with an avionics package provided by the Federal Aviation Administration's Capstone Program. The Capstone Program is a joint industry/FAA demonstration program that features, among others, global positioning system (GPS) avionics, weather and traffic information provided through automatic dependent surveillance-broadcast (ADS-B), traffic information service-broadcast (TIS-B) equipment, and terrain information depicted on a multifunction display (MFD) installed in the cockpit. The Capstone program can provide radar-like services to participating air carrier aircraft operating in a non-radar environment of Western Alaska. At the time of the accident, position information from Capstone equipped airplanes, to the Anchorage Air Route Traffic Control Center (ARTCC), Anchorage, Alaska, was provided by the ADS-B equipment in the airplane, and required ground based radio repeater sites to facilitate the transmittal of position data.

Terrain depiction information, based on GPS data, is one of several visual display options available to the pilot on the MFD. Other options include custom maps, VFR sectional charts with topographical features, IFR charts, flight plan and traffic information, and weather data. The airplane's position can be displayed in relation to its location over the terrain, and may include bearing and distance information to selected points. Selection of the terrain mode for display, provides the pilot with color shading, depicting areas of terrain that are black (2,000 feet below the aircraft), green (between 2,000 and 700 feet below the aircraft), yellow (between 700 and 300 feet below the aircraft), and red (at or within 300 feet of the aircraft). Accurate depiction of terrain (in the terrain mode) requires the pilot to manually set a barometric pressure setting in the multifunction display menu. The Capstone avionics equipment does not automatically receive

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

barometric pressure data from the aircraft's altimeter. Selection of the map mode does not provide any terrain warning/awareness information. Damage to the accident airplane's MFD precluded a determination of the visual display option selected at the time of the accident.

The recorded ARTCC data were reviewed by National Transportation Safety Board investigators to determine the flight track of the accident airplane. The radar-like track from the accident airplane, identified as Yute 6HL, depicted the accident airplane's departure from the Bethel Airport area on a heading of approximately 300 degrees. While en route to Chevak, the airplane climbed to an altitude of about 1,800 feet msl. As the track continued in a northwesterly direction and approached the accident site, a gradual descent was noted. The radar-like track stopped at approximately 1040, about 1.8 miles east of the accident site, with a ground speed of approximately 108 knots, and an altitude of 1,475 feet msl. The accident site elevation was 42 feet msl.

### **WRECKAGE RELEASE**

The Safety Board released the airplane wreckage to the owner's representative on February 6, 2002. On August 7, 2002, the FAA owned Capstone Program equipment, consisting of an Apollo GX-60 GPS, a Multifunction Display (MFD), and a Universal Access Transceiver (UAT), was returned to the Capstone Program office located in Anchorage, Alaska.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC02LA016

On February 24, 2002, about 1830 Alaska standard time, a wheel-equipped Cessna 208B airplane, N454SF, sustained substantial damage during taxi, after landing at the Tununak Airport, Tununak, Alaska. The airplane was being operated as a visual flight rules (VFR) cargo flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated by Grant Aviation, Inc. of Anchorage, Alaska. The solo certificated airline transport pilot was not injured. The flight originated at the Bethel Airport, Bethel, Alaska, about 1750.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on February 25, the director of operations for the operator reported that while en route to the Tununak airport the pilot had received a pilot report, stating that only half of the length of the 2,010 foot runway was plowed. When the pilot braked to a stop on the runway, the nose wheel of the airplane stopped on a snowdrift crossing the runway. When he released the brakes, the airplane started to roll backward off the snowdrift. When he reapplied the brakes to stop the roll, the airplane rocked rearward, pivoting on the main landing gear, and the tail struck the snow-covered ground. The pilot inspected the airplane and found that the tail tie down ring and the aft fuselage bulkhead were damaged.

During a telephone conversation with the IIC on March 4, the director of maintenance reported that the two furthest-aft fuselage bulkheads (Station 474.4 and 475.88), and the tail tie down ring and doublers, were replaced due to the damage received in the accident. He said the airplane had no known mechanical problems or damage prior to the accident.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC02LA019

On March 1, 2002, about 1435 Alaska standard time, a Cessna 207A airplane, N7373U, sustained substantial damage during landing at the Kotlik Airport, Kotlik, Alaska. The airplane was being operated as a visual flight rules (VFR) scheduled domestic passenger flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated as Flight 408, by Hageland Aviation Services Inc., Anchorage, Alaska. The commercial certificated pilot, and the four passengers, were not injured. Visual meteorological conditions prevailed. VFR company flight following procedures were in effect. The flight originated at the Mountain Village Airport, Mountain Village, Alaska, at 1338.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC) on March 1, the director of operations for the operator reported the pilot told him that he was on final approach for landing on runway 19 at Kotlik. The airplane was about 300 feet above the ground, with 15 degrees of flaps, and an airspeed of about 80 knots. The pilot said that the airplane's airspeed seemed too fast, so he reduced engine power. The airplane's airspeed then became too slow, so he increased engine power, but the airplane collided with terrain short of the runway threshold. The airplane received damage to the nose gear, propeller, and left wing.

Runway 19 at Kotlik has a gravel surface, and is 4,422 feet long, by 100 feet wide. The remarks section of the airport facility directory/Alaska Supplement for Kotlik states, in part: "Unattended. Runway condition not monitored, recommend visual inspection prior to landing. ...Runway 01-19 marked with reflective cones."



# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC02LA047

On June 11, 2002, about 1235 Alaska daylight time, a wheel-equipped Cessna 172 airplane, N7564G, sustained substantial damage when the right wing struck the paved runway during landing at the Bethel Airport, Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) cross-country positioning flight under Title 14, CFR Part 91, when the accident occurred. The airplane was operated by Hageland Aviation Services Inc., Anchorage, Alaska. The commercial certificated pilot, the sole occupant, was not injured. Visual meteorological conditions prevailed. VFR company flight following procedures were in effect. The flight originated at the Tuluksak Airport, Tuluksak, Alaska, about 1220.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on June 11, the pilot reported that he was landing on runway 18 at Bethel (runway 18 is paved, 6,398 feet long by 150 feet wide). The pilot said that during the landing roll, as he applied the airplane's brakes, the airplane suddenly veered to the left, and the right wingtip struck the runway surface. The airplane departed off the left edge of the runway. The pilot said the weather conditions at Bethel were clear, and the winds were light and variable. The airplane received damage to the right wingtip, the outboard wing nose rib, and the leading edge of the wing.

On June 20, the director of maintenance for the operator reported that the repair of the wing entailed replacement of the wingtip, nose rib, and the leading edge of the wing between wing stations 190 and 208. No mechanical malfunction was reported by the director of maintenance, or the pilot.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC02LA066

On June 30, 2002, about 1450 Alaska daylight time, a wheel-equipped Cessna 207 airplane, N7384U, sustained substantial damage when it landed short of the intended runway at the Chevak Airport, Chevak, Alaska. The airplane was being operated as a visual flight rules (VFR) nonscheduled domestic cargo flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated by Flight Alaska Inc., Anchorage, Alaska. The airline transport certificated pilot, and the sole passenger, were not injured. Visual meteorological conditions prevailed, and a VFR flight plan was filed. The flight originated at the Newtok Airport, Newtok, Alaska, about 1424.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on July 1, 2002, the director of operations for the operator reported the pilot was landing on runway 32 at Chevak. The pilot told the director of operations that the airplane encountered a downdraft during the landing approach. The airplane landed short of the gravel runway threshold. The nose landing gear assembly was torn off the airplane, and the left main landing gear was folded aft.

In the Pilot/Operator Aircraft Accident Report (NTSB form 6120.1/2) submitted by the pilot, the pilot indicated the weather conditions as clear with light turbulence. He reported the wind was 290 degrees at 8 to 10 knots.

The FAA's Airport Facility Directory/Alaska Supplement for Chevak, lists the runway as a gravel surface, 2,610 feet long by 40 feet wide. The remarks section of the directory states, in part: "Unattended. Caution: Runway condition not monitored. ...Caution: Strong crosswinds at this location. ...Runway is trough shaped, low in center and high at both ends."

Airport personnel at Chevak reported the airplane collided with the lip of the runway at the approach end of runway 32.

The closest official weather observation station is Hooper Bay, Alaska, which is located 16 nautical miles west of the accident site. At 1455, an automated weather observation system (AWOS) was reporting in part: Wind, 300 degrees (true) at 11 knots; visibility, 10 statute miles; clouds and sky condition, clear; temperature, 52 degrees F; dew point, 39 degrees F; altimeter, 29.88 inHg.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC02LA123

On September 20, 2002, about 0815 Alaska daylight time, a float-equipped de Havilland DHC-2 airplane, N144Q, sustained substantial damage during an in-flight collision with tundra-covered terrain during takeoff from a remote lake, located about 1 mile north of Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) local area instructional flight under Title 14, CFR Part 91, when the accident occurred. The airplane was being operated by Ptarmigan Air, Anchorage, Alaska. The first pilot, an airline transport certificated pilot/certificated flight instructor, seated in the right seat, and the second pilot, a commercial certificated pilot, seated in the left seat, were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect. The flight originated at the accident lake, about 0810.

During a telephone conversation with a National Transportation Safety Board investigator on September 20, the first pilot reported that he was providing flight instruction/familiarization training to the second pilot. The first pilot said that just after takeoff, as the airplane climbed to about 50 feet above the water, the airplane began to buffet, and the right wing dropped. The airplane descended and subsequently struck an area of tundra-covered marshy terrain. The airplane sustained substantial damage to the wings, fuselage, and empennage.

The first pilot reported that the accident flight was the first flight of the day. He added that a postaccident inspection of the airplane revealed an accumulation of frost on the wings.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC03LA005B

On October 22, 2002, about 1415 Alaska daylight time, a Piper PA-32 airplane, N76RL, collided with another Piper PA-32, N31657, as both airplanes were taxiing on the ramp area of the Bethel Airport, Bethel, Alaska. N76RL was being operated as a visual flight rules (VFR) cargo flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated by Bellair Inc., Fairbanks, Alaska, as Flight 400 from Bethel to Eek, Alaska, and received minor damage to the propeller and engine cowling. The airline transport certificated pilot, the sole occupant, was not injured. N31657 was operated by Larry's Flying Service Inc., Fairbanks, Alaska, as a VFR on-demand passenger flight under Title 14, CFR Part 135, from Russian Mission, Alaska, to Bethel. The airplane received substantial damage to the left wing. The commercial pilot and the four passengers were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect for both flights.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on October 22, a Federal Aviation Administration (FAA) inspector, Anchorage Flight Standards District Office (FSDO), reported that N31657 was taxiing from runway 03 toward its parking spot on the west ramp of the Bethel Airport. He said the two operators involved in this accident have loading areas adjacent to each other on the ramp, and that each pilot's view was blocked by a fuel truck that was positioned in front of N76RL. As N31657 was approaching its parking spot, the pilot began a right turn. The fuel truck pulled away, revealing N76RL beginning to taxi forward away from its parking spot. The pilot of N31657 tightened the right turn, but the propeller of N76RL sliced into the leading edge of N31657's left wing.

In the Pilot/Operator Aircraft Accident Report (NTSB Form 6120.1) submitted by the pilot of N76RL, the pilot indicated that he did not see the second airplane taxiing because the nose of his airplane was higher than his line of sight.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC03LA007

On October 28, 2002, about 2000 Alaska standard time, a Cessna 207 airplane, N91090, sustained substantial damage when it collided with terrain during cruise flight, about four miles southeast of Marshall, Alaska. The airplane was being operated by Grant Aviation Inc., Anchorage, Alaska, as a visual flight rules (VFR) positioning flight under Title 14, CFR Part 91, at the time of the accident. The solo commercial pilot received serious injuries. Night visual meteorological conditions prevailed, and company flight following procedures were in effect. The flight originated at the Marshall Airport about 1955, and was bound for Bethel, Alaska.

The accident airplane departed the 'new' Marshall airport (MLL). The 'old' Marshall airport (MLL) was decommissioned several days earlier. The new airport is 3 miles east-northeast of the old airport, and was not yet depicted on current navigation charts, nor listed in the current United States Government Flight Information Publication, Alaska Supplement.

When the flight failed to arrive at Bethel, a search was initiated. On October 29, about 0100, search personnel located the wreckage about 4 miles southeast of Marshall. The airplane was located about 1,200 feet msl, on the north side of a ridgeline that runs generally east to west. The ridge has a summit elevation of 1,714 feet msl.

The airplane was equipped with Capstone navigation and terrain avoidance avionics. The Capstone equipment uses GPS mapping technology and aircraft position information, in conjunction with a multifunction display in the instrument panel, to graphically represent the aircraft's position relative to terrain. Terrain that comes within set parameters for altitude and horizontal distance is displayed in color bands. Terrain depicted within the red color band is intended to warn the pilot of the close proximity of terrain to the aircraft.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on November 4, the pilot said he departed Marshall on runway 07, and made a climbing right turn at 80 knots indicated airspeed toward Bethel. He said the vertical speed indicator read in excess of 1,000 feet per minute rate of climb, that it was a very dark night, and there were no visible horizon or ground references discernible. He said his route was direct to Bethel at 1,200 to 1,400 feet msl, and that upon reaching his cruise altitude, there was a strong headwind and turbulence. He said just prior to impacting the terrain, his vertical speed indicator showed a high rate of descent, and his Capstone display was almost completely red. He further stated the airplane's GPS had not been reprogrammed to reflect the location changes for the old Marshall airport and the new Marshall airport. The pilot said he had made one flight into the old Marshall airport, and this was his second flight into the new Marshall airport. This was the first flight when he departed either airport after dark. He said there were no preimpact mechanical anomalies with the airplane.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

Direct flight from either Marshall airport to Bethel requires crossing an east-west ridgeline on the north side of the Yukon River. The direct route from the old Marshall airport to Bethel crosses the western foot of the ridgeline at a point with an elevation of less than 500 feet msl. The direct route from the new airport to Bethel crosses the ridge at a point where the elevation of the ridge exceeds 1,200 feet msl.

During a telephone conversation with the NTSB IIC on November 6, the pilot of the Army helicopter that located the accident airplane said their initial attempts to locate the missing airplane were futile. He said they then flew to the new Marshall airport and attempted to recreate the accident flight by taking off into the wind, conducting a right down wind departure replicating the performance of the Cessna 207, and heading direct to Bethel. He said when they reached the ridgeline on the north side of the Yukon River they headed east up the ridge toward the summit (1,704 msl). They located the accident airplane within minutes at 1,200 feet msl. He said the airplane impacted near the crest of the ridge, with a shallow angle of attack. He also stated that all the major airframe components sustained substantial damage, and the engine had separated from the airplane. The helicopter pilot said after they landed he noted that the wind was strong out of the northeast, with gusts above 40 knots. He said during the time they were searching for the accident airplane they did not encounter turbulence.

The weather forecast for the Yukon/Kuskokwim Delta area at the time of the accident was scattered clouds at 3,500 feet msl, occasional broken clouds at 3,500 to 6,000 feet msl, with an outlook for VFR and windy conditions. The freezing level was at 1,500 feet msl, and no turbulence was forecast.

During the accident sequence the emergency locator transmitter (ELT) did not activate. The injured pilot removed the ELT from its holder, and took it with him into the empennage where he sheltered himself from the weather. He was not aware the ELT was not transmitting. Rescue personnel recovered the pilot and the ELT. The ELT was released to the operator who proceeded to functionally test the ELT until it activated. It is unknown why the ELT did not operate upon impact.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC03LA024

On January 21, 2003, about 1000 Alaska standard time, a wheel-equipped de Havilland DHC-6-200 airplane, N206EH, sustained substantial damage to the lower fuselage when it collided with a snow berm during the landing roll at the Kipnuk Airport, Kipnuk, Alaska. The Title 14, CFR Part 121 passenger flight was operated by Era Aviation, Incorporated, Anchorage, Alaska, as Flight 863, and departed Bethel, Alaska, en route to Kipnuk, about 0920. Neither the captain, the first officer, or any of the eight passengers, reported any injuries. Day visual meteorological conditions prevailed, and a visual flight rules flight plan was in effect.

According to the operator's director of safety, the captain related that he was landing the airplane on runway 33 during daylight conditions with a 15-knot crosswind from his right (about 050 degrees magnetic). During the landing roll, the airplane drifted too far to the left on the ice and frost-covered runway and encountered a snow berm. The collision with the snow berm fractured the nose wheel fork, and a portion of the fork subsequently damaged the fuselage just aft of the nose wheel. Field repairs were made at Kipnuk with the replacement of the nose wheel fork assembly, and the airplane was ferried to the operator's main repair base in Anchorage, Alaska.

The NTSB investigator-in-charge (IIC), another NTSB air safety investigator, the operator's director of safety, and the operator's chief maintenance inspector, inspected the airplane in Anchorage on January 24. Inspection disclosed substantial damage to several stringers and a longeron in the lower fuselage structure immediately aft of the nose wheel. Additionally, the radar dome, nose baggage door, and adjoining nose cone structure were damaged. The operator's chief maintenance inspector noted that the damage to the cone and baggage door would be repaired by replacing the entire nose cone, which is about 6 feet in length.

The captain was interviewed by the IIC on February 11 at the Anchorage NTSB office. He related that he was the pilot flying, and he made an uneventful approach and touchdown on runway 33. He said the touchdown was within the first 500 feet of the runway, and there was nearly a direct crosswind from the northeast at 15 to 20 knots. He described the landing surface of the 2,120 feet long by 35 feet wide runway as hard-packed gravel, covered mostly by ice and frost. During the landing, he said the first officer fully deflected the ailerons into the crosswind, while he manipulated the rudders, propellers, power to the engines, and nose wheel steering. He said as the airplane slowed, the rudder effectiveness diminished, and, in addition to right rudder input, he attempted to keep the airplane tracking straight on the runway by applying nose wheel steering to the right. He indicated the airplane did not respond to the steering inputs, and went toward the left side of the runway. The left main landing gear tire subsequently encountered snow left piled alongside the runway by a snowplow. The encounter with the snow berm pulled the airplane to the left, and into the snow-covered area outside the runway environment. During the excursion from the runway, the nose wheel became mired in the

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

snow, the nose wheel fork fractured, and the airplane nosed down. The captain noted that the nose wheel steering tiller did not seem to rotate to the right as far as it should, and he was not certain the nose wheel was capable of full travel to the right. He said he did mention his concerns about the tiller to company management personnel sometime after the accident, but he did not make a postaccident entry into the airplane's flight log about the tiller movement, nor did he initially include his concerns in a postaccident written statement which was given to company management and the NTSB IIC.

On February 24, the captain contacted the NTSB IIC and gave him an additional written statement which outlined his concerns about a possible mechanical defect in the nose wheel steering mechanism. He also reiterated information from the previous interview about a lack of a winter area familiarization flight review that he feels should have been provided by the company. He said he had considerable experience flying the accident type airplane, but all of his recent winter flight experience had been to large, hard-surfaced runways at major terminals. He said his last area familiarization flight in the Bethel-Kipnuk area was June, 2002. The captain said the company should have provided him with a winter-specific familiarization flight in the Bethel area prior to assigning him to fly to short, narrow, and icy runways. The captain also amended a portion of his original written report submitted to the operator and the NTSB. The original statement read, in part: "At approximately 30 knots it appeared that the A/C was drifting left. Nose wheel steering had no effect as it was slowly applied to the right, the A/C continued drifting left." The captain amended the word "drifting" in the two preceding sentences to "sliding."

The first officer had a telephone interview with the NTSB IIC on March 6. He related that the captain was the flying pilot, and that the approach and touchdown at the accident site were uneventful. He described the gravel runway conditions as normal winter conditions, somewhat slick, with a roughed-up, ice-coated surface. He said he had flown the same airplane to the same site the day before, and the runway conditions were nearly identical. After touchdown, at the captain's direction, he compensated for the crosswind condition by turning the ailerons completely to the right, into the crosswind. He said the airplane began to drift to the left, and he waited for the captain to make a correction. The airplane continued to drift left, and the left main landing gear tire ran into the snow berm alongside the runway, which pulled the airplane off the runway into a snow field, where the nose wheel fork fractured. When asked if he was aware of any mechanical problems with the airplane that might have precipitated the accident, he said "no." He indicated that he thought the captain delayed his correction for the drift, and that the captain should have used the rudders sooner and more aggressively, instead of attempting to primarily steer the airplane back to the centerline with the nose wheel tiller. The first officer was asked by the NTSB IIC if he was aware of any concerns the captain had about the hydraulically-actuated nose wheel steering not operating satisfactorily. He responded that the captain noted later on, sometime after they had deplaned, that the tiller didn't seem to be working right. He said that the tiller is located only at the captain's station on the left side of the airplane, but that to him, it seemed to be working fine, that the captain he had



# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

flown with the day before did not complain about it, and there were no mechanical discrepancies noted in the airplane's daily maintenance logs in any previous flights. He noted that his preflight inspection of the accident airplane before departure from Bethel, discovered no hydraulic leaks near the nose wheel, or anywhere on the airplane, nor had he seen any hydraulic leaks on this particular airplane recently.

On May 7, the NTSB IIC contacted the company captain who was assigned to ferry parts to repair the accident airplane to Kipnuk, and to return the accident airplane to Bethel. He said he arrived about an hour after the accident, and walked the runway several times, looking at the tire tracks from the accident airplane and for anything unusual. When asked if he had discovered anything, such as any signs of hydraulic fluid, he said he saw none at all, and that it was his impression from looking at the tire tracks on the runway, that the wheels had been skidding, and that the nose wheel was deflected fully to the right.

The IIC also had a telephone interview on May 7 with the captain who flew the accident airplane the day before the accident. He was asked if he was aware of any mechanical problems with the airplane, and in particular, the nose wheel steering. He said he had flown the airplane frequently in the week or so preceding the accident, including the day before, and had not noticed any problems with the steering. He noted that the tiller always felt "a bit spongy" on the accident airplane, but that the nose wheel had always responded quickly, and completely, to a full 60 degree deflection. He also said that the accident captain would have had to made a hard, 90 degree right turn out of the ramp area at the beginning of the accident flight, and should have noticed any problem then.

The nose wheel steering mechanism of the accident airplane is hydraulically actuated. A tiller bar is located only at the captain's station (left seat). The tiller bar is connected via cable to the nose wheel steering actuator. The tiller bar normally rotates through approximately 90 degrees each direction from the horizontal, i.e., the tiller is centered at the nine o'clock position, and should rotate approximately to the twelve o'clock and six o'clock positions, with the twelve o'clock commanding a full right turn of the nose wheel (60 degrees from center), and the six o'clock a full left turn (also 60 degrees from center).

The airplane is maintained on a continuous airworthiness program (CAP). The IIC reviewed the airplane's maintenance records and flight logs for the previous 30 days. The airplane had completed a CAP 20 inspection on January 9, 2003. During the inspection, the hydraulic system, hydraulic system pressure accumulator, hydraulic system fittings, lines, and nose wheel actuator were tested, adjusted, and repaired as necessary. The airplane was also subjected to other routine inspections. The two most recent inspections prior to the accident flight occurred on January 15 and 18. During these inspections, the hydraulic accumulator pressure and hydraulic system fluid levels were checked, and determined to be within the manufacturer's specifications. No hydraulic fluid was added to the system, no leaks were detected, and no pressure was added to the accumulator.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

A review of the flight and maintenance logs completed by the flight crews after each duty day, disclosed no mechanical discrepancies of any kind with the accident airplane during the month of January preceding the accident flight.

The nose wheel fork assembly and the nose wheel actuator were examined and bench tested by company maintenance personnel on March 4. The nose wheel actuator was found to extend and retract to full extension, but slightly faster than recommended specifications. The nose wheel steering actuator was sent to Avitech Engineering Corporation, Hayward, California, for overhaul.

On May 6, the IIC contacted the chief inspector, along with the vice president-general manager at Avitech via telephone. They said the nose wheel unit was initially tested as received from the operator prior to overhaul. They noted that although the nose wheel steering actuator was marginally outside of the acceptable test parameters in two categories, the unit functioned normally in its extension and retraction cycles, and moved full travel without impedance.

The IIC reviewed the operator's training practices and records, and discussed the first pilot's concerns about not receiving a winter familiarization flight, with the operator's director of safety, and the FAA's aviation safety inspector assigned as the company's principal operations inspector (POI). Both the POI and director of safety noted that the accident captain had met all requirements to act as pilot-in-command of the accident airplane at the time of the accident. They also noted that while not a regulatory requirement, a winter familiarization flight for pilots who did not have recent experience in the unique winter operating environment of the Bethel area would be desirable.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC03LA030

On January 30, 2003, about 0330 Alaska standard time, a Cessna 208B airplane, N1276P, sustained substantial damage when the airplane's tail impacted the ground during passenger loading at the Russian Mission Airport, Russian Mission, Alaska. The airplane was being operated as an instrument flight rules (IFR) medical patient transfer flight under Title 14, CFR Part 135, by Grant Aviation, Inc. of Anchorage, Alaska. The airline transport pilot, patient, and the three medical attendants were not injured. The intended destination was Bethel, Alaska.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on March 3, an FAA aviation safety inspector from the Anchorage Flight Standards District Office, said he was inspecting maintenance records at Grant Aviation, when he noticed a major airframe repair for unreported damage had been completed on the accident airplane.

During a telephone conversation with the IIC on March 3, the director of operations for the operator said the accident pilot told him that he (the pilot) did not place the tail stand under the tail of the airplane while loading a medical patient at Russian Mission on the morning of the accident. The pilot told him the tail of the airplane went down on the tail tie down ring because too many people were in the aft section of the airplane while loading the patient. The pilot said it was dark, and he did not see the damage to the tail section, and flew the airplane to Bethel.

In a telephone conversation with the IIC on March 5, a mechanic for the operator said the FS 427.88 bulkhead and tie down assembly were replaced due to the damage.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC03LA091

On August 8, 2003, about 1253 Alaska daylight time, a wheel-equipped Cessna 207A airplane, N6439H, sustained substantial damage when it nosed over during a forced landing following a loss of engine power about 8 miles northwest of Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) non-scheduled domestic cargo flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated as Flight 10-1 by Hageland Aviation Inc., Anchorage, Alaska. The commercial certificated pilot, and the sole passenger, who is the director of training for the operator, were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect. The flight originated at the Tuluksak Airport, Tuluksak, Alaska, about 1245, with a planned destination of Atmautluak, Alaska.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on August 8, the director of operations for the operator reported the airplane was carrying mail, and was in cruise flight about 1,000 feet agl. He said the pilot reported a complete loss of engine power, and made a forced landing in rough, tundra-covered terrain. During the landing, the airplane nosed over.

At 1253, an Aviation Routine Weather Report (METAR) at Bethel was reporting, in part: Wind, light and variable; visibility, 10 statute miles; clouds and sky condition, few at 6,000 feet, 20,000 feet scattered; temperature, 70 degrees F; dew point, 59 degrees F; altimeter, 30.27 inHg.

Examination of the engine maintenance records revealed that the engine was overhauled on July 18, 2002, by Aero Recip, Anchorage, Alaska. During the overhaul process, the engine case was reportedly welded by Divco Inc., Tulsa, Oklahoma, on March 28, 2002. The engine case was rebored to match original engine case specifications, and released as serviceable. The engine was then installed by the operator in the accident airplane.

At the time of the accident, the engine had accrued 4557.3 total service hours, 1090.9 hours since the overhaul, and 1 hour since its most recent approved airworthiness inspection program (AAIP) inspection. The engine also received a top overhaul in May, 2003, during which all 6 engine cylinders were replaced. The engine then accrued 279.9 hours before the accident.

On September 9, a postaccident examination of the engine revealed that the engine case was fractured under the left magneto. A portion of the number 2 piston connecting rod was visible, protruding through the case. Removal of the engine cylinders and separation of the engine case halves revealed that the lower half of the number 2 connecting rod cap and bearing had separated from the upper half. The connecting rod cap bolts were stretched and broken. The number 1 main bearing was deformed in its bearing saddle. Portions of the number 2 main bearing were deformed, flattened, fractured and fragmented, and were found in the engine case. The number 2 bearing saddle was

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

extensively distorted and gouged. The engine crankshaft had a transverse shear fracture at the aft fillet radius of the number 2 main bearing, and the number 3 crankshaft cheek, adjacent to the main bearing surface. The fracture surface had areas of deep blue discoloration, and beach marks radiating inward from the outer edge of the crankshaft surface. The area of the number 2 engine bearing saddle, under the bearing insert, had several areas of cracking and exfoliation of the case material along the edges of the oil supply channel. No evidence of engine case fretting was observed during the examination. The oil filter contained numerous metal fragments.

On December 8, 2003, the engine case was examined by the manufacturer's metallurgical personnel at Teledyne Continental Motors, Mobile, Alabama. The report of examination stated that the case contained no signs of lubrication distress on the journals. The metallurgist stated that a determination of a weld repair at the number 2 main bearing support could not be made with a high degree of certainty, although there were several work order stamps on the crankcase indicating that it had been reworked.

Following the examination at Teledyne Continental Motors, the engine case was released to the owner's representatives on January 22, 2004.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC04LA032

On February 10, 2004, about 1652 Alaska standard time, a wheel-equipped Cessna 208B airplane, N1276P, sustained substantial damage when it collided with snow-covered terrain after it departed the runway and nosed over during the takeoff roll at the Toksook Bay Airport, Toksook Bay, Alaska. The airplane was being operated as a visual flight rules (VFR) scheduled passenger flight to Newtok, Alaska, under Title 14, CFR Part 135, when the accident occurred. The airplane was operated as Flight 2821 by Grant Aviation Inc., Anchorage, Alaska. The commercial certificated pilot, and the 6 passengers, were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on February 12, the director of operations for the operator reported that the pilot was departing on runway 34. The runway surface had areas of packed snow and ice, and the director of operations indicated that he had received reports that a right crosswind was blowing from 070 degrees between 15 to 25 knots. According to the director of operations, the pilot said that about 300 feet after beginning the takeoff roll, between 30 to 50 knots airspeed, the airplane began to drift to the left, which he was unable to correct. The airplane departed off the left side of the runway and nosed over. The airplane received damage to the wings, fuselage, and empennage.

Runway 34 at Toksook Bay is 3,200 feet long and 60 feet wide.

According to the accident airplane's information manual, the maximum demonstrated crosswind velocity, takeoff or landing, is 20 knots.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC04LA059

On May 22, 2004, about 1605 Alaska daylight time, a Piper PA-31-350 airplane, N4105D, sustained substantial damage when it encountered severe turbulence while in cruise flight, about 5 miles west of Goodnews, Alaska. The airplane was being operated as a visual flight rules (VFR) cross-country positioning flight under Title 14, CFR Part 91, when the accident occurred. The airplane was operated by Grant Aviation Inc., Anchorage, Alaska. The airline transport certificated pilot, the sole occupant, was not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect. The flight originated at the Goodnews Airport at 1600, and was en route to Bethel, Alaska.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on June 2, 2004, the director of operations for the operator reported that the pilot was returning to Bethel without any passengers or cargo after delivering mail to Goodnews, which is located on the coast of the Bering Sea. When the pilot arrived in Bethel, he informed the director of maintenance that during the flight, the airplane encountered turbulence and the appeared to have received damage to the wings.

On June 3, the director of maintenance reported that the airplane received structural damage that consisted of wrinkling and rippling of both of the upper wing surfaces, extending about 8 feet outboard from each engine nacelle. In addition, the elevator had wrinkling that extended about 6 inches inboard from each of the outboard hinge attach points. Due to the damage, the company removed the airplane from service.

During a telephone conversation with the NTSB IIC on June 3, the pilot reported that during his flight to Goodnews, the wind conditions were about 070 degrees magnetic at 25 knots, with gusts to 30 knots, and the airplane encountered turbulence over an area of low hills that are north of the airport. When the pilot departed on the accident flight, he said he utilized runway 05 and began a right turn over the bay. He initially climbed the airplane to about 1,200 feet, but as he approached an area of low hills west of the airport, he descended to about 700 feet. At an indicated airspeed of about 185 knots, the pilot said that the airplane encountered severe turbulence for about 30 seconds, during which his radio headset was dislodged. He continued toward the coast and then turned northbound toward Bethel. After arrival in Bethel, he noticed the damaged wing surfaces.

The closest official weather observation station is Cape Newenham Long Range Radar Station, which is located about 32 nautical miles south of the accident site. At 1555, an automated weather observation system (AWOS) was reporting in part: Wind, 110 degrees (true) at 17 knots, gusts to 27 knots; visibility, 7 statute miles; clouds and sky condition, 1,200 feet overcast; temperature, 52 degrees F; dew point, 46 degrees F; altimeter, 29.76 inHg.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC04IA078

On July 13, 2004, about 1630 Alaska daylight time, a Cessna 172M airplane, N1453V, sustained minor damage during an in-flight collision with terrain following a total loss of engine power during cruise flight, about 4 miles northwest of Aniak, Alaska. The airplane was being operated by Inland Aviation Services of Aniak as a visual flight rules (VFR) air taxi flight under Title 14, CFR Part 135 when the accident occurred. The airline transport pilot and sole passenger were not injured. Visual meteorological conditions prevailed, and company flight following procedures were in effect. The flight departed Holy Cross, Alaska, about 1610.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC) on July 13, the director of operations for the operator said when the airplane did not return from Holy Cross, an airplane was sent to look for it. He said the pilot of the search plane located the accident airplane on the tundra. The director of operations reported that the search pilot made radio contact with the pilot of the accident airplane who told him his engine had quit, necessitating an emergency landing.

During a telephone conversation with the NTSB IIC on July 16, an FAA aviation safety inspector who went to the crash site said the accident airplane's fuel system was intact showing no signs of leakage or spills. No fuel was found in the right wing tank, about two gallons of fuel were found in the left wing tank, and about 1/4 cup of fuel was found in the fuel lines and carburetor. The Pilot Operating Handbook (POH) indicates there is about 1.5 gallons of unusable fuel in each wing tank. The FAA inspector said the fuselage sustained minor damage during the emergency landing.

The flight consisted of takeoff and landings at three airports, and a return to the departure airport, or four total takeoffs and landings. The total distance covered by the flight was about 165 miles. The operator's fuel log indicated the pilot added 13.9 gallons of fuel to the tanks prior to the flight. The FAA inspector who went to the accident site and interviewed the pilot, said the pilot told him he looked in the tanks prior to adding fuel, but did not "dip" the tanks to ascertain the quantity of fuel remaining in the tanks. He also said the pilot told him he flight-planned the airplane's fuel burn at 5.5 gallons per hour (gph) for the trip. According to the airplane's POH, depending on the variables of runup, taxi, takeoff, and time to climb, the pilot should plan on the engine using an additional 1.0 to 2.6 gallons per takeoff. The POH indicates that the fuel burn at 65% cruise rpm, below 2,500 feet msl, is 7.2 gph, and at 75% cruise power, 8.2 gph. According to the POH, the cruise airspeed at 65% power below 2,500 feet msl, is 117 mph true airspeed (TAS), and at 75% power, 126 mph TAS. Accordingly, depending on the cruise power selected, for a distance of 165 miles with four takeoffs and landings in a no wind condition, the pilot should expect the engine to use between 14.1 and 21.1 gallons of fuel for the flight.



# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

The FAA inspector said after the airplane was recovered, the engine was started and operated without difficulty. The pilot did not indicate any preincident mechanical anomalies with the airplane in the NTSB Pilot/Operator Aircraft Accident/Incident Report.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC05CA005

On October 11, 2004, about 0919 Alaska daylight time, a wheel-equipped Cessna 207 airplane, N5277J, operated by Hageland Aviation Services under Title 14, CFR Part 135 as scheduled commuter Flight 63, sustained substantial damage when it struck a bird while on final approach to land at the Chefnak airport, Chefnak, Alaska. The commercial pilot and two passengers were not injured. The flight departed Kipnuk, Alaska, about 0900, and was en route to Chefnak. Visual meteorological conditions prevailed, and a VFR flight plan was in effect.

During a telephone conversation with the operator's director of operations on October 14, he related that the accident pilot reported that a large bird, possibly a Ptarmigan, struck and penetrated the airplane's windshield. The pilot was able to continue the landing approach, and made an uneventful landing. The director of operations reported that due to the bird strike, the windshield had to be replaced.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC05LA025

On January 27, 2005, about 1015 Alaska standard time, a wheel-equipped deHavilland DHC-6-200 airplane, N201EH, sustained substantial damage when the airplane slid off the runway during the landing roll, and its nose gear collapsed at the Toksook Bay Airport, Toksook Bay, Alaska. The airplane was being operated by Era Aviation, of Anchorage, Alaska, as an instrument flight rules (IFR) scheduled domestic passenger flight under Title 14, CFR Part 121, when the accident occurred. The airline transport certificated captain, the first officer, and the six passengers, were not injured. Visual meteorological conditions prevailed, and an instrument flight plan was filed. The flight originated at the Tununak Airport, Tununak, Alaska, about 1008.

In a written statement dated January 27, 2005, the pilot reported about 500 feet into the landing roll on runway 16, a gust of wind "blew us sideways." He wrote, "I could not straighten the aircraft, and we started to drift off the edge." He reported he had started to add power to initiate an aborted landing, but as he did so, he thought the airplane struck a runway light, and he reduced power and continued the landing roll. Exiting the right side of the runway the nose gear strut broke off, and the right main landing gear ran over the runway edge embankment. The airplane came to rest on the nose and right wing.

The airport at Toksook Bay is unattended, and there is no official weather reporting station. There is however, a digital weather camera, which updates the picture every 10 minutes. The camera is located in a ramp area and looks northwest toward the approach end of runway 16. Coincidentally the camera took a picture of the accident airplane on short final to runway 16 at 1916, and again sitting on the side of the runway at 1926. In both pictures the windsock and segmented circle are clearly visible in the foreground, and indicated a crosswind from the left.

In a written statement dated January 27, the pilot reported that he believed the wind speed was about 20-25 knots.

During an examination of the airplane on February 3, the NTSB investigator-in-charge observed structural damage to the fuselage and the right wing.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC05CA095

On July 3, 2005, about 1245 Alaska daylight time, a Cessna 207 airplane, N48CF, sustained structural damage as a result of a bird strike while in cruise flight between Bethel, Alaska, and Nightmute, Alaska. The airplane was being operated by Grant Aviation, Inc., of Emmonak, Alaska, as a visual flight rules (VFR) positioning flight under Title 14, CFR Part 91, at the time of the accident. The solo commercial pilot was not injured. Visual meteorological conditions prevailed, and a company flight plan was in effect.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC) on July 6, the operator's director of operations reported that after departing from Bethel, while in level cruise flight at 1,000 feet agl, the pilot noted a large bird heading towards the airplane. The director of operations said that the pilot tried to avoid the collision by turning the airplane to the right, but the bird subsequently struck the left wing of the airplane. A postaccident inspection revealed structural damage to the airplane's left wing spar.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC05CA099

On July 9, 2005, about 1330 Alaska daylight time, a Cessna 172 airplane, N73788, sustained substantial damage when it encountered terrain during an aborted landing at the Akiachak Airport, Akiachak, Alaska. The airplane was being operated as a visual flight rules (VFR) on-demand air taxi flight by Inland Aviation, Aniak, Alaska, under Title 14, CFR Part 135 when the accident occurred. The commercial certificated pilot and the three passengers were not injured. Visual meteorological conditions prevailed, and company flight following procedures were in effect. The flight departed Bethel, Alaska, about 1300.

In a written statement to the National Transportation Safety Board (NTSB) dated July 12, the pilot reported that he carried extra speed on landing to compensate for gusty wind conditions. He wrote that after touching down he realized he could not stop on the remaining runway, and aborted the landing. The airplane did not become airborne, ran off the end of the runway onto rough terrain, and nosed over. The pilot reported that the airplane sustained structural damage to the left wing.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

ANC06CA011

The airline transport certificated pilot of the Title 14, CFR Part 135 flight was taking off on runway 33, when a gust of wind blew the airplane to the left edge of the runway where it encountered a snow berm. The pilot reported the runway was ice-covered, and the wind was from 060 degrees at 20 knots, with gusts to 25 knots. The airplane exited the runway, the nose gear collapsed, and the left wing struck the ground. According to the director of operations for the operator, there were no known mechanical anomalies with the airplane prior to the accident. He said the airplane sustained damage to the left wing, nose gear and propeller during the accident.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **9.2 Appendix B: Summarized Operating Data Tables**

The operational data used in this report comes from several sources. These sources are the Department of Transportation's T-100 data bank, and the FAA's Air Traffic Activity Data System (ATADS).

The detailed origin and destination data within the Y-K Delta comes from the Department of Transportation's Bureau of Transportation Statistics Air Carrier Statistics data. This is also known as the T-100 data bank. The T-100 data bank contains domestic and international airline market and segment data on certificated air carriers. The U.S. air carriers report monthly air carrier traffic information using Form T-100. Foreign carriers having at least one point of service in the United States or one of its territories report monthly air carrier traffic information using Form T-100(f). This report has used the domestic segment reports. In Alaska only those operators with any scheduled operations are required to file monthly T-100 reports. This means that a charter operator operating under FAR Part-135 with no scheduled operations is not required to file a T-100 report.

The ATADS is the official FAA source of historical air traffic operations for center, airport, instrument and approach counts. Daily, monthly and annual counts are available by facility, state, region, or nationally. In Alaska there is one center (the Anchorage Center) and 8 airports that are covered by ATADS. Operation counts at the other 600+ airports and seaplane bases are not reported.

The following tables and figures are presented as examples of the data that can be retrieved from these databases. Table B-1 is from the T-100 database listing the numbers of commercial flights between the Y-K Delta airports in 2005. Only those origin-destination pairs with more than 52 flights in a year are listed. Table B-2 lists the number of commercial departures from the Y-K Delta airports in 2005.

From the ATADS database one can retrieve data on tower counts and instrument operations. Table B-3 shows the 2005 tower counts for the eight airports in Alaska that report these counts. Table B-4 shows the number of instrument operations in 2005 at the six towers and one TRACON that conducts instrument approaches.

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

**Table B-1 Commercial Flights in the Y-K Delta in 2005**

Airport 1	Airport 2	Flights	Airport 1	Airport 2	Flights
MOU	KSM	4385	KWT	KKI	495
KLG	ANI	4059	WNA	PKA	442
EEK	BET	3535	KWT	AKI	433
VAK	BET	3230	VAK	SCM	417
KKI	BET	3172	MLL	KSM	408
KWT	BET	2923	TLT	KKI	388
HPB	BET	2891	SRV	ANI	365
BET	AKI	2802	BET	AUK	361
OOK	BET	2364	SHX	ANV	338
TLT	BET	2361	TLT	KWT	316
SCM	BET	2346	KSM	KOT	312
KWK	BET	2295	SXP	BET	311
MLL	BET	2070	RDV	ANI	308
WNA	BET	2063	PTU	BET	272
PKA	BET	2024	SCM	MOU	231
WWT	BET	1790	SCM	KSM	221
VAK	HPB	1756	MOU	KOT	215
SCM	HPB	1603	KSM	HPB	204
KLG	BET	1376	SXP	KOT	186
RSH	BET	1091	RSH	KSM	180
BET	ANI	1075	MOU	MLL	164
RSH	ANI	1066	MOU	HPB	156
MOU	BET	972	KSM	AUK	141
RSH	MLL	895	MOU	AUK	130
SXP	AUK	876	SRV	RDV	122
SHX	ANI	844	TLT	ANI	95
SHX	KGX	842	MLL	ANI	88
RSH	KLG	831	GNU	EEK	88
KOT	BET	829	VAK	KSM	87
KGX	ANV	825	SXP	MOU	86
KSM	ANI	793	RSH	MOU	85
GNU	BET	764	PKA	KWT	82
TLT	AKI	737	WNA	EEK	79
SLQ	ANI	676	SXP	KSM	75
PTU	GNU	673	WWT	VAK	71
KKI	AKI	656	WNA	KWT	70
KGX	ANI	652	BET	BET	66
ANV	ANI	594	SXP	SCM	66
WWT	OOK	584	PKA	KKI	63
SLQ	RDV	567	ANI	AKI	57
KOT	AUK	518	PTU	EEK	55
KSM	BET	509	PKA	AKI	52
SRV	SLQ	509	SCM	AUK	52



# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

**Table B-2. Commercial Departures in the YK Delta in 2005**

AIRPORT	DEPARTURES
BET	40635
ANI	9894
KSM	5925
MOU	3983
HPB	3467
KLG	3286
EEK	3249
KOT	3154
AUK	3073
KWK	2995
VAK	2922
OOK	2908
SCM	2610
KKI	2525
AKI	2510
KWT	2283
RSH	2138
MLL	2084
TLT	2077
WWT	1689
WNA	1590
PKA	1511
SXP	1467
KGX	1385
SHX	1299
ANV	1274
GNU	1127
SLQ	1093
RDV	844
PTU	744
SRV	626
OAK	273

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

**Table B-3. Alaska Tower Counts (2005)**

Airport	AirCarrier	Air Taxi	GA	Military	Local GA	Local Military	Totals
ADQ	1,460	15,429	1,382	2,528	1,471	11,588	33,858
AKN	1,472	26,755	7,555	609	898	1,323	38,612
ANC	133,314	87,761	82,274	5,982	6,895	16	316,242
BET	3,732	89,405	7,372	216	3,085	14	103,824
ENA	656	19,708	11,142	467	15,472	6,380	53,825
FAI	15,287	40,973	26,774	1,187	28,367	172	112,760
JNU	9,369	74,860	12,633	516	7,386	404	105,168
MRI	0	15,080	73,762	103	101,607	264	190,816
<b>Totals</b>	<b>165,290</b>	<b>369,971</b>	<b>222,894</b>	<b>11,608</b>	<b>165,181</b>	<b>20,161</b>	<b>955,105</b>

**Table B-4. Alaska Instrument Operations (2005)**

	PRIMARY				SECONDARY				OVERFLIGHTS				TOTAL
	AC	AT	GA	MIL	AC	AT	GA	MIL	AC	AT	GA	MIL	
A11	134,180	66,788	21,439	2,987	795	19,022	51,894	24,621	3	50	827	101	322,707
ADQ	1,393	4,411	418	1,148	0	0	0	0	0	0	0	0	7,370
AKN	1,433	5,939	539	388	0	0	0	0	0	0	0	0	8,299
BET	3,621	7,645	420	120	0	0	0	0	0	0	0	0	11,806
ENA	145	6,113	676	276	0	0	0	0	0	0	0	0	7,210
FAI	15,462	40,876	22,051	1,063	237	3,855	5,397	17,806	6	93	180	248	107,274
JNU	9,245	1,297	991	142	0	0	0	0	0	0	0	0	11,675
<b>Totals</b>	<b>165,479</b>	<b>133,069</b>	<b>46,534</b>	<b>6,124</b>	<b>1,032</b>	<b>22,877</b>	<b>57,291</b>	<b>42,427</b>	<b>9</b>	<b>143</b>	<b>1,007</b>	<b>349</b>	<b>476,341</b>

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### 9.3 Appendix C: Participating Operator and Aircraft Tables

**Table C-1 Capstone Phase 1 Operator and Aircraft List**

Operator	Type	N #	Status
Alaska Central Express	C207A	N9874M	Sold
Alaska Central Express	C207A	N9957M	Complete
Alaska Island Air	PA-32-300	N9304K	Complete
Alaska Island Air	PA-32-301	N8374T	Complete
Arctic Circle Air	C208	N5187B	Complete
Arctic Circle Air	C207	N9936M	Complete
Arctic Circle Air	C207	N6480H	Complete
Arctic Circle Air	C207	N9965M	Complete
Arctic Circle Air	C207	N73467	Complete
Arctic Circle Air	C207	N7305U	Complete
Arctic Circle Air	SC-7 Skyvan	N2088Z	Complete
Arctic Circle Air	C206	N456TA	sold
Arctic Circle Air	SC-7 Skyvan	N1906	Complete
Arctic Circle Air	SC-7 Skyvan	N101WA	Complete
Arctic Circle Air	C207	N916AC	Sold
Arctic Circle Air	C207	N917AC	Complete
Arctic Circle Air	C402C	N402ET	Complete
Arctic Circle Air	C402C	N419RC	Complete
Arctic Circle Air	C402C	N4630N	Complete
Arctic Circle Air	C402C	N6790B	Complete
Arctic Transportation Services	Casa212	N424CA	Complete
Arctic Transportation Services	Casa212	N437CA	Complete
Arctic Transportation Services	C207	N73217	Complete
Arctic Transportation Services	C207	N9475M	Complete
Arctic Transportation Services	C207	N26TA	Complete
Arctic Transportation Services	C207	N7605U	Complete
Arctic Transportation Services	Casa212	N287MA	Complete
Arctic Transportation Services	C207	N9829M	Complete
Arctic Transportation Services	C207	N73503	Complete
Arctic Transportation Services	C207	N9736M	Complete
Arctic Transportation Services	C207	N73789	Complete
Arctic Transportation Services	C402	N2719A	Complete
AvAlaska	C172	N813SP	INACTIVE
Baum Air	PA-18	N6996D	INACTIVE
BellAir	PA32-300	N4130R	Complete
BellAir	C-180	N2353C	Complete
BellAir	BE C45H	N401CK	inactive
BellAir	BE-D18S	N502CK	Complete
BellAir	PA-31-350	N31PR	Complete

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

Operator	Type	N #	Status
BellAir	PA-32-300	N107TA	Complete
BRANDON LEARY	C-170B	N8325A	Complete
Bristol Bay Air	C207A	N9943M	Complete
Cape Smythe Air	PA-31-350	N3516A	Complete
Carl McIntyre Jr.	C172	N19771	Complete
Civil Air Patrol	C182	N9803H	Complete
Civil Air Patrol	C182	N9484X	Complete
Craig Air	C172	N20109	Complete
Craig Air	C207	N91170	Complete
Craig Air	C182	N6736M	Complete
Craig Air	C207	N91190	Complete
Craig Air	C207	N90193	Complete
Craig Air	C185	N1598H	Complete
Cub Drivers	C185	N2658S	Complete
ERA Aviation	DHC-6	N203EH	Complete
ERA Aviation	DHC-6	N201EH	Complete
ERA Aviation	DHC-6	N302EH	Complete
ERA Aviation	DHC-6	N206EH	Complete
ERA Aviation	DHC-6	N885EA	Complete
Flight Alaska	Casa212	N203FN	Transferred
Flight Alaska	Casa212	N202FN	Transferred
Flight Alaska	C207	N7394U	Complete
Flight Alaska	C207	N7336U	Complete
Flight Alaska	C207	N1704U	Complete
Flight Alaska	C206	N756HL	INACTIVE
Flight Alaska	C207	N6470H	Complete
Flight Alaska	C207	N7384U	INACTIVE
Flight Alaska	Casa212	N205FN	Complete
Flight Alaska	Casa212	N204FN	Transferred
Flight Alaska	C207	N775AB	Complete
Frontier Flying Service	PA-31-350	N3536B	Complete
Frontier Flying Service	C207	N1785U	Complete
Frontier Flying Service	PA-31-350	N4301C	Complete
Frontier Flying Service	PA-31-350	N4501B	Complete
Frontier Flying Service	PA-31-350	N200AK	Complete
G&L Air Service	C185	N1576H	Complete
Grant Aviaiton	C207	N54GV	Complete
Grant Aviation	C207	N1581U	INACTIVE
Grant Aviation	C207	N9651M	Complete
Grant Aviation	C172	N12721	Complete
Grant Aviation	C207	N91090	INACTIVE
Grant Aviation	C207	N8NZ	Complete
Grant Aviation	C207	N562CT	INACTIVE
Grant Aviation	PA-31-350	N77HV	Complete
Grant Aviation	C172	N4265Q	Complete

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

Operator	Type	N #	Status
Grant Aviation	C208B	N454SF	Complete
Grant Aviation	C208	N1276P	INACTIVE
Grant Aviation	C207	N9973M	Complete
Grant Aviation	PA-31-350	N4105D	Complete
Grant Aviation	C207	N48CF	Complete
Grant Aviation	PA-31-350	N78GA	Complete
Grant Aviation	C207	N207EX	Complete
Grant Aviation	C207	N207DF	Complete
Grant Aviation	C207	N2162C	Complete
Grant Aviation	C207	N9728M	Complete
Grant Aviation	C208	N1229C	Complete
Grant Aviation	C207	N207VA	Complete
Grant Aviation	PA-31-350	N417PM	Complete
Grant Aviation	BE65A901	N70841	Complete
Guardian Flight	PA32	N8698N	Complete
Hageland	C207	N7389U	Complete
Hageland	C207	N1668U	Complete
Hageland	C207	N7320U	Complete
Hageland	C207	N6314H	Complete
Hageland Aviation	C402	N402QA	Complete
Hageland Aviation	C208	N410GV	Complete
Hageland Aviation	C207	N747SQ	Complete
Hageland Aviation	C207	N6207H	Complete
Hageland Aviation	C208	N1232Y	Complete
Hageland Aviation	C208	N411GV	Complete
Hageland Aviation	C207	N9869M	Complete
Hageland Aviation	C207	N23CF	Complete
Hageland Aviation	C208	N303GV	Complete
Hageland Aviation	C207	N7373U	Complete
Hageland Aviation	C207	N327CT	Complete
Hageland Aviation	C207	N17GN	Complete
Hageland Aviation	C207	N7340U	Complete
Hageland Aviation	C207	N5277J	Complete
Hageland Aviation	C207	N6439H	sold
Hageland Aviation	C207	N73067	Complete
Hageland Aviation	C207	N207SE	INACTIVE
Hageland Aviation	C207	N104K	Complete
Hageland Aviation	C208	N407GV	Complete
Hageland Aviation	C207	N9400M	Complete
Hageland Aviation	C208	N715HE	Complete
Hageland Aviation	C172	N7564G	Complete
Hageland Aviation	F406	N6591L	INACTIVE
Hageland Aviation	F406	N6591R	Complete
Hageland Aviation	C207	N9399M	Complete
Hageland Aviation	F406	N406GV	Complete

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

Operator	Type	N #	Status
Hageland Aviation	F406	N6590Y	Complete
Hageland Aviation	C-180	N91361	Complete
Hageland Aviation	C208B	N717PA	Complete
Hageland Aviation	208B	N1275N	Complete
Hageland Aviation	C207	N7384U	Complete
Husky Aviation	A-1B	N711HY	Complete
Inland Aviation	C207	N91099	Complete
Inland Aviation	C207	N91002	Complete
Inland Aviation	C207	N1754U	Complete
Inland Aviation	C207	N1701U	Complete
Inland Aviation	C172	N1453V	Complete
Inland Aviation	C172	N73788	Complete
Inland Aviation	C207	N1673U	Complete
JAMES CHARLES	C172N	N7348E	Complete
Johnson Services	PA-31-350	N4466T	Sold
Johnson Services, LLC	C207	N73036	Complete
Larry's Flying Service	C207	N1824Q	Complete
Larry's Flying Service	C207	N9996M	Complete
Larry's Flying Service	PA-32-300	N31657	Complete
Larry's Flying Service	PA-32-300	N27501	Complete
Larry's Flying Service	PA-32-301	N9243K	Complete
Larry's Flying Service	C172	N739PD	Complete
LJ DAVIS	C-180G	N180YP	Complete
M.A.R.C.	PA-31-310	N16SC	Complete
M.A.R.C.	PA-31-310	N62MR	Complete
M.A.R.C.	PA-31-310	N65MR	Complete
MIKE HOFFMAN	C-185F	N53032	Complete
MIKE REARDON	C-180H	N2722X	Complete
MYRON ANGSTMAN	C172K	N758TG	Complete
Neitz Aviation	C185	N4710Q	Complete
Nelson Air	PA-31-350	N888YA	Complete
North Star Aviation	PA18	N8976D	Complete
Northern Air Cargo	DC-6	N1377K	Complete
Northern Air Cargo	DC-6	N779TA	Complete
Northern Air Cargo	DC-6	N43872	Complete
Northern Air Cargo	DC-6	N2907F	Complete
Northern Air Cargo	DC-6	N867TA	INACTIVE
Northern Air Cargo	DC-6	N99330	Complete
Paklook Air	PA-31-350	N509FN	Complete
PAUL O'BRIEN	C206	N9123M	Complete
Peninsular Airways	C208B	N444FA	Complete
Peninsula Airways	PA32	N8259V	Complete
Peninsula Airways	PA31	N27987	Sold
Peninsula Airways	C208	N9530F	INACTIVE
Peninsula Airways	PA32	N82455	Complete

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

Operator	Type	N #	Status
Peninsula Airways	C208B	N750PA	Complete
Peninsula Airways	PA-31-350	N28KE	Complete
Peninsula Airways	C208B	N9820F	Complete
Peninsula Airways	C208B	N9304F	Complete
Peninsula Airways	PA-31-350	N15PR	Complete
Peninsula Airways	C208	N9481F	Complete
Poe Air	PA-32-300	N43551	Complete
Poe Air	PA32	N4811T	Complete
Ptarmigan Air	DHC-2	N734Q	Complete
Shannons Air Taxi	C207	N1549U	Complete
Smokey Bay Air	C206	N7353Q	Complete
SONNY HOFFMAN	C185F	N4870C	Complete
Talkeetna Air Taxi	DHC-2	N144Q	Complete
Tanana Air Service	PA32	N4798S	Complete
Tanana Air Service	PA32	N4803S	Complete
Tanana Air Service	PA32	N97CR	Complete
Tanana Air Service	PA32	N7748J	Complete
Tanana Air Service	PA31-350	N316HA	Complete
Tanana Air Service	PA32-300	N31606	Complete
Tanana Air Service	PA32	N8506F	Complete
Tom Lapp	C172	N79169	Complete
University of Alaska	C180	N4UA	Complete
US Fish & Wildlife	C185	N9344N	Complete
US Fish & Wildlife	C206	N740	Complete
US Fish & Wildlife	C185	N1055F	Complete
Village Aviation	Casa212	N393DF	Complete
Village Aviation	Casa212	N316ST	Complete
Wade Renfro	PA18	N7513K	Complete
Yukon Aviation	C185	N29970	Complete
Yukon Aviation	C207	N91060	Complete
Yukon Aviation	C207	N7318U	Complete
Yukon Aviation	C172	N5246D	Complete
Yukon Aviation	C172	N4810G	Complete
Yukon Aviation	Bell 206B3	N150HH	Complete

# **The Impact of Capstone Phase 1 Post-Transition Annual Report – 2005**

## **9.4 Appendix D: Airline Surveys**

### **D.1 Pilot Responses**

#### **Introduction**

This survey was part of a larger effort to collect information about qualifications, practices and attitudes of pilots, aviation operators, business leaders, city officials and village leaders in the Y-K Delta region towards the installation and operation of Capstone equipment on the ground and in the cockpit.

The survey population is relatively small and homogenous. For example, pilots generally fly for airlines of similar size and equipage and within the same geographic area and face the same weather, terrain, and other challenges. Given the small size and homogeneity of the population, surveyors did not use random sampling techniques. Instead surveyors traveled several times to Bethel, the transportation and economic hub of the region, to interview as many subjects as possible. Initially, some subjects were asked to complete a questionnaire and return it when convenient, but the response rate was very low. As a result, the vast majority of questionnaires were completed during one-on-one interviews.

The initial set of surveys was administered by the Institute of Social and Economic Research (ISER) of the University of Alaska Anchorage. The development of the questions and the methodology is described in their 2001 report.<sup>8</sup> Follow-up surveys were made in 2003 and 2004 to gauge any change in the knowledge or acceptance of the Capstone equipment. These follow-up surveys were administered by Aviation Technology Division of the Community and Technical College of the University of Alaska Anchorage.

#### **Interviews**

The following were the interview questions to (1) determine the changes in Safety Posture (or Safety Culture) at the Capstone operators and (2) more general questions for the operators and customers regarding improvements overall, such as economic, business practices, etc, since the start of the Capstone Program. The number in *Italic* represents the number of respondents. Where comments are presented they are in *Italic* as well. Not all interviewees responded to every question. The following is a composite of the Pilot Survey questions and responses:

### **Phase 1 Capstone Follow-up Module– Pilots**

Conducted by UAA Community and Technical College

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<sup>8</sup> Capstone Phase 1 Interim Safety Study 2000/2001, Institute of Social and Economic Research, University of Alaska Anchorage, December 2002.

<http://www.alaska.faa.gov/capstone/docs/2001%20UAA%20report.pdf>



# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

Thank you for agreeing to complete this survey! The purpose of gathering this information is to evaluate the effectiveness of the FAA's Capstone Program in improving safety in the Y-K Delta area. Results will be published only in aggregate form; your individual answers will be kept confidential, and not released in any form that they could be identified as yours. **All information you have provided is confidential and cannot be used for enforcement purposes.**

CPRRepeat. Have you completed this survey before?

No➔

Yes: When? \_\_\_\_\_

Demog1. Are you                      25      Male                      2      Female

Demog2. How old are you:   37  

Demog3. Please check below all the pilot ratings that you hold:

18	Commercial	14	ATP
18	Instrument	1	Rotary Wing

Please check below all the FAR parts under which you *routinely* fly:

9	Part 91	7	Part 121
18	Part 135		Other (specify) _____

FltHrTot. Please estimate your **total** flight time:   7437   hours

FltHrAk. How many hours have you flown in **Alaska**:   5959   hours

FltHrYr: How many hours have you flown **in the last 12 months**?   783   hours?

FltHrIFR. How many **instrument** hours have you flown in the last 12 months?   77  

FltHrCap. About how many hours have you flown **Capstone-equipped aircraft**?

  1507   hours

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

FltHrGPS About how many hours had you flown using other GPS equipment for aerial navigation before Capstone? Hours ? 1726.

CapEqpt Were those hours mostly with handheld GPS devices or panel mounted GPS devices? ( Handheld    Panel)

CapEqpt Did the GPS device include a moving map? (Yes, No)

CP1. Have you received formal training to use the Capstone equipment? (Include all training, initial, recurrent, etc.)

3 No → Skip to Question CP3

23 Yes (One no response)  
↓

CP2. For each type of Capstone training, please write how many hours you received and check who provided the training.

Type of Training <b><u>INITIAL</u></b>	Hours	Training was taught by		
		UAA personnel	Someone in your company	Someone else (please specify)
a. Classroom no simulator		1	2	3 _____
b. Classroom with desktop Capstone simulator		1	2	3 _____
c. Flight or Capstone-equipped flight simulator (C-208)		1	2	3 _____

Type of Training <b><u>RECURRENT</u></b>	Hours	Training was taught by		
		UAA personnel	Someone in your company	Someone else (please specify)
a. Classroom no simulator		1	2	3 _____
b. Classroom with desktop Capstone simulator		1	2	3 _____
c. Flight or Capstone-equipped flight simulator (C-208)		1	2	3 _____

CP2 (a)

If you have received formal training on the Capstone equipment, how would you rate the **quality** of the initial training? (excellent, good, adequate, lacking in some areas, poor)

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

11      11      2              0              0

No Response    3

If you have received formal training on the Capstone equipment, how would you rate the **quality** of the recurrent training? (excellent, good, adequate, lacking in some areas, poor)

6              9              2              0              0

No Response    10

If you received formal training on the Capstone equipment, how would you rate the amount of time spent during initial training? (too much, just right, not enough, no response)

2              18              3              3

If you received formal recurrent training on the Capstone equipment, how would you rate the amount of time spent recurrent training? (too much, just right, not enough, no reply)

1              14              1              11

What changes would you like to see in your training program?

- *Need more recurrent and Better instrument.*
- *Capstone proficiency training certification especially when used in conjunction with Bethel special holds.*
- *More hands on less classroom.*
- *Longer actual flight training.*
- *Just a bit more time, maybe split into shorter sessions. Seemed like just a bit of information overload.*
- *I would like to see recurrent training more available within the companies that use it.*

CP3. How useful is each feature of the Capstone equipment?

	Very useful	Somewhat useful	Not useful
GPS	24	3	0
MFD	26	1	0
ADS-B	16	8	3

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

CP4rev. For each of the functions of Capstone avionics listed below, please tell us how often you use that feature, how easy it is to use, and how helpful it is to you.

	<b>CP4_1. How often</b> do you use this feature?		<b>CP4_2. Compared to</b> other avionics you use, <b>how easy</b> is this feature to use?		<b>CP4_3. How helpful</b> has this feature been to you as a pilot?	
a. Traffic Avoidance	19	Routinely	12	Easier	18	Not helpful
	2	Rarely	9	About the same	3	Somewhat helpful
	4	Never	3	Harder	3	Very Helpful
b. Terrain Avoidance	15	Routinely	17	Easier	15	Not helpful
	9	Rarely	9	About the same	10	Somewhat helpful
	3	Never	0	Harder	1	Very Helpful
c. Flight Planning	16	Routinely	13	Easier	12	Not helpful
	8	Rarely	10	About the same	9	Somewhat helpful
	3	Never	1	Harder	3	Very Helpful
d. Navigation	26	Routinely	21	Easier	23	Not helpful
	1	Rarely	6	About the same	4	Somewhat helpful
	0	Never	0	Harder	0	Very Helpful
e. Access to weather info while flying	4	Routinely	6	Easier	3	Not helpful
	8	Rarely	6	About the same	7	Somewhat helpful
	12	Never	6	Harder	7	Very Helpful
f. Access to PIREPs, airspace info etc., while flying	0	Routinely	3	Easier	1	Not helpful
	8	Rarely	6	About the same	6	Somewhat helpful
	16	Never	6	Harder	8	Very Helpful
g. GPS approaches	14	Routinely	15	Easier	15	Not helpful
	4	Rarely	4	About the same	4	Somewhat helpful
	9	Never	2	Harder	2	Very Helpful

CP5. What functions do you like best about Capstone avionics? Why?

- *VFR approaches making marginal weather easier to land plane.*
- *Weather radar uplink helps avoid moderate/severe icing.*
- *Real time presentation of info, orientation, flight monitoring.*
- *I would like to see METAR info made available.*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

- *Map for Nav, IFR page for airways and intersections, Traffic Page for ID aircraft.*
- *Traffic, Navigation.*
- *Traffic Info.*
- *Traffic Display.*
- *Its great.*
- *Nav/Traffic Avoidance.*
- *Setting up approaches very easy.*
- *Very precise navigation.*
- *User friendly interface.*
- *Excellent situational awareness.*
- *Approaches, terrain features, traffic avoidance.*
- *Like the airport information available.*
- *Would like to be able to pull up w/x, but unable to in our region of flying (Nome).*
- *Situational Awareness.*

CP6. What do you dislike the most about Capstone avionics? Why?

- *Too much reliance on equipment. Other pilots rely on Capstone too much and don't look outside aircraft to avoid traffic.*
- *Not able to pan around the map on the MFD.*
- *Currently no weather or traffic information.*
- *Data base for remote runways is not up to date (appear in wrong location, sometimes up to 2 miles off).*
- *Terrain information on the MFD is not available on the whole screen when zoomed out past 20 NM.*
- *Would like to see a 15 NM scale on the MFD.*
- *HSI needs to be bigger on the PFD.*
- *The dog gone ADSB transponder function takes way too long to set in the code.*
- *Nothing.*
- *Make it easier to put in a squak code.*
- *Weather Info.*
- *Cannot see transponder equipped aircraft in non-radar areas.*
- *Reliability Problems.*
- *Reduced situational awareness.*
- *Too much pilot reliance in the other plane.*
- *No hold button If you are on an ILS and they put you in a hold at Kuskum you have to go to GPS function then obs then auto scroll TOO MUCH WORK!!!*
- *Flight path marker ghosting during approach is somewhat distracting and hard to see HIS.*
- *Localizer and glide slope indicators must get bigger. Very difficult to see in low light situations with turbulence and for large crosswinds. Bigger/wider brighter.*

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

- *Ghost path marker becomes confusing on approach when marker enters caution area i.e. yellow.*
- *Fear of enforcement.*
- *Unable to pull up weather.*
- *Pilots get too reliant upon it.*
- *I dislike the Appolo GX50 & 60. No continuous display of selected OBS gearing and the approach data base is cumbersome compared to the King KLN90B.*

RLS1. Are you familiar with the capabilities of “Radar-Like Services” available for Capstone-equipped aircraft?

No ➔ *describe with standard definition, below and skip RLS2*  
Yes

Capstone’s ADS-B transmits the aircraft’s location to ground stations, which forwards it to Air Traffic Control computers. Those computers display the locations along with aircraft locations from radar and transponders. This allows controllers to provide flight-following and surveillance-based separation services in the Y-K Delta.

RLS2. Do you know how to obtain those services?

No (Skip to CP8)  
Yes

RLS3. On how many flights in the last 12 months have you requested radar-like services?

- *1/4 of flights asked and received*
  - *get RLS unrequested all the time*
- 

RLS3b. On how many of these flights have you received the requested radar-like services?

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# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

CP8. What benefits have you experienced from the Capstone program in the Bethel area?

	No Benefit	Very Small Benefit	Some Benefit	Significant Benefit	A Major Benefit
<b>a. Fewer cancelled flights due to new instrument approaches at remote airports</b>	12	0	7	2	3
<b>b. Safer operations at remote airports due to new instrument approaches</b>	7	1	6	6	3
<b>c. Safer flying in minimum legal VFR conditions</b>	1	1	2	8	13
<b>d. Fewer near mid-air collisions</b>	6	0	4	5	9
<b>e. More useful weather information</b>	7	5	5	3	2
<b>f. Better knowledge of other aircraft and ground vehicle locations when taxiing</b>	16	1	2	0	1
<b>g. Improved SVFR procedures due to better pilot and controller knowledge of aircraft locations</b>	3	3	2	7	9
<b>h. Easier in-flight diversions or re-routes</b>	2	1	4	8	10
<b>i. Time savings from more direct flight routes</b>	2	1	5	5	12
<b>j. Improved terrain awareness for pilots</b>	0	3	5	8	9
<b>k. Improved search and rescue capabilities</b>	3	1	7	6	6
<b>l. Better condition information enabled by soliciting info from pilots identified on the traffic display near destination</b>	4	1	3	9	6
<b>m. Reduced navigation workload, enabling more attention to primary flying tasks</b>	1	1	4	10	9
<b>n. Improved collaboration with Dispatch on continuation decisions</b>	5	4	3	7	4
<b>o. Improved overall Safety Culture</b>	1	3	4	8	9

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

CP9. If there are other benefits you believe that Capstone provides, please list them.

CP10. What problems have you experienced with the Capstone program in the Bethel area?

	No Problem	Very Small Problem	Minor Problem	Significant Problem	Major Problem
<b>a. Less heads-up time</b>	10	5	5	2	3
<b>b. Heavier workload in the cockpit</b>	10	10	3	2	0
<b>c. More aircraft flying in the same airspace because they are using GPS point-to-point routing</b>	6	4	9	6	0
<b>d. More complexity than needed for VFR flight</b>	13	7	3	1	1

CP11. Please list any other problems you believe that Capstone may cause or add to.

- *Newer pilots to area might rely on equipment too much and not use other equipment like VOR and NDB.*
- *Absolutely need traffic and weather information.*
- *Need updated data base for airports, runways are off.*
- *Added time and aggravation of setting 2 transponders in a IFR environment is simply ridiculous.*
- *Pilots forget to look out window.*
- *Relateration – traffic awareness/only a few aircraft are GPS Capstone equipped. Ro see the rest are T-CAS.*
- *GPS approaches are great/however still unable to legally do them due to no ground based w/x reporting.*
- *The terrain database has inaccuracies.*



# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

CP12. When you fly under Part 135, how often is the aircraft Capstone equipped?

14 Always      8 Usually      3 Sometimes      0 Rarely      1 Never



- Only on charters

**Skip to Question CP 15, next page**

CP14(Rev).How much does the capability of the Capstone equipment help you to make go/no go and diversions or re-routing decisions ?

	Not at all	A small amount	A great deal	Don't know
a. Go/No Go Decisions	14	10	1	0
b. Diversions/Re-outing Decisions	9	12	4	1

CP15. For what reasons might pilots choose not to use some Capstone equipment?

	Yes	No	Don't Know/ No Opinion
a. Too distracting	2	19	6
b. Too difficult to use	1	22	4
c. Don't want others watching aircraft location at all times	15	9	3
d. Don't trust equipment to provide reliable information	7	15	5
e. Concerned that equipment might break	7	17	3

CP15b. If you answered yes, above, please explain:

- Some pilots may get lower than need be.

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

- *There were times that we intentionally flew towards terrain to see if the terrain avoidance alert would sound, and it didn't. If we had been in the clouds or flying at night, we would have hit it.*
- *Shooting a GPS approach and finding out at min. that runway is off in the data base by ½ mile or more.*
- *Why incriminate yourself?*
- *Some people don't want others watching at all times.*
- *Big Brother.*
- *Just don't trust information.*
- *Poor maintenance.*
- *Fear of enforcement.*
- *Enforcement.*
- *Reliability.*
- *Self explanatory (Don't want others watching).*
- *The radar altimeter is not accurate.*
- *Watch Capstone too much, replace all instruments.*
- *Too easy for FAA to issue citation based upon incomplete information.*
- *Alaska is a difficult place to fly and sometimes may have to do things for the safety of flight may be in a grey area of legality.*
- *Windows based software routinely crashes.*

CP16. Please list any other reasons you believe pilots might choose not to use some Capstone equipment.

- *Training.*
- *No traffic or weather information.*
- *PFD and MFD screens won't come on line in temperatures of -30 or less in a timely manner. Approximately 5 min of idling before screen comes up.*
- *Too dependent upon the avionics technology, and loss of basic navigation skills other, better IFR GPS on board.*
- *Too dependent upon the avionics technology, and loss of basic navigation skills*
- *Warm up time.*
- *Familiarity with it – lots of people don't want to change from what equipment they are comfortable with and use it.*

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

The next five questions ask about potentially dangerous situations that pilots sometimes encounter. Capstone equipment might be helpful in preventing or coping with these particular problems. Therefore, we're interested in how often pilots in the Yukon Kuskokwim delta encounter these problems. For each situation, think about how often in the last 12 months you've encountered it.

	Daily	Weekly	Monthly	Less often than monthly	Never
CP17. How many times during the past year have inaccurate weather forecasts caused you to encounter instrument meteorological conditions when you didn't expect to?	2	4	4	10	6
CP18. How many times during the past year have deteriorating ceilings or visibility made you unsure of your own position relative to the surrounding terrain?	0	1	2	4	19
CP19. During the past year, how many times have you unexpectedly seen other aircraft close enough to you that you felt it created a collision hazard?	1	1	3	16	5
CP 20. During the past year, how many times have you been cleared into SVFR when the separation between aircraft in the pattern made you uncomfortable?	0	1	2	7	16
CP21. During the past year, how many times might your go/no go or routing decisions have been improved if you would have had access to real time weather or Special Use Airspace status?	3	4	2	9	8

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

CP22. How much do you think the Capstone program has affected the safety of flight in the YK Delta?

0	Much less	1	Somewhat	1	No change	7	Somewhat	17	Much
	safer								
	safe		less safe		in flight		safer		

- *Capstone I much safer VFR*
- *Capstone II much less safe VFR*
- *Capstone II much safer IFR*

CP23. Please add your comments about the relationship of Capstone to aviation safety, or about the safety challenges of flying in the YK Delta.

- *After time, the pilots stopped looking for traffic and started saying they have traffic on the box when advised by tower. I think that it gets too relied upon but makes safer for those who have Capstone. But makes unequipped aircraft more of a hazard because the Capstone equipped aircraft doesn't look out for traffic.*
- *For ERA aircraft, our safety has deteriorate somewhat because we lost our TRAFFIC and WX when we switched from Capstone I to Capstone II.*
- *Some of our airports aren't where they're supposed to be.*
- *With traffic & terrain awareness, it frees up a lot of time for other safety related tasks.*
- *I don't fly in the YK Delta.*
- *Capstone equipment is the best safety enhancement tool that I have ever used.*
- *Not all the planes have it, so if the rest of them had Capstone it would be a lot better.*
- *Putting a non-Capstone equipped aircraft in a VFR hold with other aircraft is crazy.*
- *Capstone will not be maintained by operators over time.*
- *Pilots rely too much on Capstone and don't give altitude in position reports.*
- *Can't see non-Capstone aircraft is a liability to all.*
- *With all operations/aircraft equipped with Capstone makes flying marg. Weather much easier/safe.*
- *Terrain and position awareness is wonderful as well as traffic avoidance if Capstone could detect all aircraft.*
- *20x10 mile section of terrain not in database near White Mountain.*
- *Situational awareness via the MFD can reduce the cross check mentally and reduces stress and fatigue over a 14 hour duty day.*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

**Thank you for your time. All information you have provided is confidential and cannot be used for enforcement purposes.**

### **D.2 Management and Dispatch Responses**

#### **Methodology**

Researchers conducted surveys and interviews of pilots, airline managers and owners, airline dispatchers, business leaders and employees, city officials, and village leaders. The survey population is relatively small and homogenous. For example, pilots generally fly for airlines of similar size and equipage and within the same geographic area and face the same weather, terrain, and other challenges. Village and business leaders in the Y-K Delta all face common challenges relating to aviation in managing their civil area or business.

Given the small size and homogeneity of the population, surveyors did not use random sampling techniques. Instead surveyors traveled several times during the year to Bethel to interview as many subjects as possible. Initially, some subjects were asked to complete a questionnaire and return it when convenient, but the response rate was very low. As a result, the vast majority of questionnaires were completed during one-on-one interviews. Many of the most useful comments cited in the report were the result of follow-on questions asked during these interviews.

#### **Interviews**

The following were the interview questions to (1) determine the changes in Safety Posture (or Safety Culture) at the Capstone operators and (2) more general questions for the operators and customers regarding improvements overall, such as economic, business practices, etc, since the start of the Capstone Program. The number in *Italic* represents the number of respondents. Where comments are presented they are in *Italic* as well. Not all interviewees responded to every question. The following is a composite of the Management and Dispatch Survey questions and responses:

### **PHASE 1: TRANSITION SURVEY QUESTIONS**

#### **Management and Dispatch**

#### **Questions for Senior Management (the Owner/General Manager/Chief Pilot)**

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### Transition Questions:

1. During the past year, have you added any new or additional aircraft to your fleet?
  - a. 8 Yes
  - b. 7 No
2. If yes to item 1 above, was the aircraft equipped with “Capstone” capabilities?  
(If more than one aircraft, please indicate the number in each applicable category below)
  - a. 3 Aircraft will not be equipped
  - b. 1 Aircraft is not currently equipped but will be in the future
  - c. 1 Aircraft was equipped when purchased
  - d.      Installed newly purchased “Capstone” equipment (from the manufacturer)
  - e.      Installed used equipment from another aircraft removed from my fleet
  - f.      Installed used equipment purchased from another operator
3. If yes to item 1 above, please list the make/models of the aircraft added and if IFR certified.
  - CE-207 N1653U IFR capable.
  - C-208 N169LJ (was 169BJ) IFR equipped.
  - C-208 N12373 IFR Equipped.
  - C-207 N6314H VFR Equipped.
  - Dash-8-106.
  - CE-207 N36CF VFR equipped.
  - CE-207 N9935M VFR equipped.
  - VFR aircraft, all operated outside the Phase I area.
  - Purchased certificate with two aircraft to initiate service.
    - PA-31-350 N316HA IFR capable.
    - PA-32 N31606 VFR capable.
    - Also own PA 32 N4352F VFR capable.
4. If new or additional aircraft were added but not equipped with “Capstone” capabilities, please describe the reason you chose not to equip the aircraft.
  - Cost of equipment, installation, and maintenance is prohibitive.
  - Within 5 years expect less than half of current Capstone equipped aircraft will be Capstone capable due to costs.
  - Garmin is expensive.
  - Aircraft was a temporary lease and has been returned.
  - Equipment not available (Part 25 A/C).
  - Funds are stopping us from equipping for now, but plan to pursue in the future

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

*Too expensive to outfit with systems that are operating outside the Phase I area and not supported by GBTs and other Phase I systems. Will consider Phase III equipment when that comes to the operating area.*

- *Plan to remove Capstone from N316HA and place in N4352F.*
- *Plan to upgrade N316HA to GPS/IFR.*

5. Have you removed any Capstone equipped aircraft from your fleet in the past year?
  - a. 8 Yes
  - b. 7 No
  - *Two aircraft in rebuild*
6. If yes to item 5 above, what was the disposition of the aircraft?
  - a. 1 Aircraft crashed or retired from service
  - b. 3 Aircraft sold to another operator (a.) \_\_\_inside or (b.) \_\_\_outside the Y-K Delta with the Capstone equipment still installed
  - c. 4 Aircraft sold to another operator (a.) \_\_\_inside or (b.) \_\_\_outside the Y-K Delta with the Capstone equipment removed
  - *One fleet Replaced with phase II equipment Capstone I equipment returned to Capstone office.*
7. If yes to item 5 above and if the Capstone equipment was removed, what was the disposition of the Capstone equipment?
  - a. \_\_\_ Aircraft crashed and the equipment was rendered unsalvageable
  - b. 2 The Capstone equipment was removed and installed on another aircraft in my fleet
  - c. 1 The Capstone equipment was removed and is being used as spares
  - d. \_\_\_ The Capstone equipment was removed and sold to another operator in the Y-K Delta
8. If yes to item 5 above, please list the make/models of the aircraft removed and if IFR certified.
  - *CE-208\_\_N9481F was removed from service. It is a leased aircraft. Negotiations are ongoing to return it to the owning company. CAPSTONE equipment will not be removed prior to its return.*
  - *CE-208 N444FA was reregistered as N9310F.*
  - *CE-207 N9874M sold and equipment returned to Capstone program.*
  - *CE-207 N9874M sold and equipment returned to Capstone program.*
  - *All DHC-6 Aircraft.*
  - *C212 N205FN IFR certified UAT was saved. MX20 and GX50 sold with aircraft. Sold by new owner of firm before significance of the equipment was understood.*
  - *C-207 N2480H VFR.*
  - *C-207 N9965M VFR.*

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

9. Do you have a contract in place for database updates?

a. 6 Yes

b. 9 No

- *Will only update once/year due to cost.*
- *Too costly and no requirement.*
- *Of note are the few places where the data bases are not correct as issued. E.g. Eek, where the runway has been moved and a tower built where the data base shows a runway – this is an accident waiting to happen.*

10. Have you hired any new pilots this year that were not previously trained on Capstone capabilities?

a. 10 Yes

b. 5 No

- *Hired but already trained*

11. If yes to question 10, have you conducted initial training for these pilots?

a. 10 Yes

b.      No

12. If yes to question 11, what type of training, by whom and how many hours of training were given?

Type of Training	Aver. Hours	Training was taught by		
		UAA personnel	Someone in your company	Someone else (please specify)
a. Classroom no simulator	3.75		4	_____
b. Classroom with desktop Capstone simulator	8.8		5	_____
c. Flight or Capstone-equipped flight simulator	4		1	_____

*Many also included follow on training during company check flights.*

13. Do you have a contract in place with Flight Explorer or other flight information service company to provide flight monitoring?

a. 12 Yes

b. 3 No

- *CRABS info more of what is needed. Before pay \$59/mo, info needs to be relevant.*



# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

- *Using govt contract through 31 Dec 05. CRABS provides info needed. Flight Explorer does not, so will not continue contract into 06. Flight explorer does well for large, high, IFR aircraft, but does not meet the needs in Bethel.*
- *Lots of problems because not user friendly.*
- *But rely on CRABS.*
- *CRABS works great.*
- *Not operating in Phase I area.*
- *Computer crashed with CRABS data and never reinstalled a flight following program.*

14. Has the economics of your operation changed since the end of the Capstone program?

If so, how?

- a. 11 Yes
- b. 4 No

- *There has been a negative impact, as more and more IFR traffic pushes the non IFR (VFR, SVFR, etc) traffic into longer and longer hold times, both in the air and on land.*
- *Very large negative impact from poorly choreographed changeover from the government to the operator. The addition of new "T-boxes" after the change over created major expense at \$700 per antenna, replacement boxes from antenna problems, etc. The operators were put in a corner and signed for a "pig in a poke".*
- *There were no transition coordination meetings.*
- *We were stuck with limited or no knowledge of the warranties, or lack there of, that we were signing for.*
- *Revision updates are very expensive.*
- *MX20 maintenance problems costing the company.*
- *Direct flight capability offset some of rising fuels costs.*
- *Maintenance and data updates are added costs, but effective and worth doing.*
- *Fundamentally there was no change over the year.*
- *We think we see a greater awareness of general safety because of all the communications and development of Capstone in our operation.*
- *Better route reliability.*
- *More costly for maintenance, but not excessive yet.*
- *Marine radios interfere with GPS Systems – this may be an antennae placement problem.*
- *Very marginal in providing for more effective operations.*
- *SVFR more difficult than ever to coordinate.*
- *Numerous instances of aircraft holding in marginal VFR for IFR traffic (which has increased since Capstone), resulting in a change from day marginal VFR to night marginal VFR – bottom line now going from normal operations to emergency operations.*
- *Rural Service Improvement eliminated 60% of competition (mail).*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

- *Transition was smooth though, had initial difficulties getting updates on line.*
- *Route reliability has improved (fewer cancellations).*
- *New routes have been developed.*
- *New approaches enable better probability of success.*
- *RSIP caused loss of revenue and required significant down sizing of operation, eliminating airframes and pilots.*
- *Maintenance costs up.*
- *Data base fees.*
- *Complete a higher percentage of missions with the Capstone equipped aircraft. Non-equipped aircraft have had to scrub or return more often than Capstone aircraft.*
- *Easier to get the job done in marginal VFR conditions.*

15. Do you have additional comments on the transition from the Capstone managed program to the industry based program?

- *We had to sign for and operate the system with a lot of unknowns, since the system has never been totally up and running.*
- *The tower can not/does not use Capstone for anything. Will they catch up?*
- *The FAA has done nothing to change approach procedure to account for the new capabilities – e.g. IFR traffic still blocked large periods of time for a full approach. With the increase in IFR operators at Bethel, it is not uncommon for 20 VFR/SVFR aircraft to be holding while 4 IFR equipped aircraft take almost an hour to do their “full approach”.*
- *If this “GPS base” is the way of the future, why not have the IFR operators (e.g. Alaska) put the systems in their aircraft. Or, make them hold a couple of times – they will add the systems themselves.*
- *Garmin MFD asks every 30 minutes whether you want to reset your altimeter. In doing so, it covers up what you have set, making it difficult to determine if you want to reset. So, have the flag come up on the other side.*
- *CRABS staff very helpful and responsive. They work the issues and fix the problems. Great!*
- *We were told we would be able to watch, flight follow, and dispatch from a PC – it didn’t happen.*
- *Flight explorer will be useful when it does what CRABS does and basically works when you turn it on.*
- *Bethel is a very busy, mixed, commercial aviation airport. High traffic, widely changing weather, high aircrew turnover. We have seen some improvement in CTAFs for area. We are still waiting for approach control and sector split improvements. It is almost as though the people who need to make things happen have left and the new crew is once again unfamiliar with the challenges of Bethel.*
- *To make the system work at Bethel, we need a true integration of the Capstone capability into the ATC of the area. All “commercials” should have Capstone.*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

*ATC should use Capstone information. Procedures need to be updated to take advantage of the capabilities. If these things are not done, the concept will never “fly” here or in the rest of the country.*

- *Transition went smoothly – as advertised.*
- *There have been conflicts between the transponders and the Capstone boxes that continually cause time and effort to resolve between the organization and ATC.*
- *Because of the cost of the software updates, if there is anything that would “kill” the program, it would be the updates. The “money managers” find it difficult to justify. This may be better handled through government funding or at least a cost sharing.*
- *Transition went smoothly.*
- *Given the challenges and multi tasking required, I think the whole thing was managed well. The technical hardware, software, and labor issues were not fully unexpected even if some of them might have been avoidable. This project was not done before; so it would be miraculous not to have a bump or two. Nonetheless, we all have the hindsight from experience to help us in the future.*
- *The equipment on an aircraft now becomes very important in the decision on which aircraft to dispatch when the weather is marginal.*
- *In marginal VFR, pilots have been known to use Capstone equipment displays to “confirm contact” with a preceding aircraft to speed the SVFR process*
- *Equipment works 90% of time and it is great when it works.*
- *We need 121 operators to get involved with the program, so all the “commercial operators” will know where each other are.*
- *Uneasy feeling that others are operating with inop or malfunctioning equipment, so the traffic picture is incomplete.*
- *An avionics professional is badly needed at Bethel, not just for Capstone Equipment. Big economic impact to have any avionics item returned to service after a problem.*
- *The government program was a “tease”. Equipment was provided to show how good it could be, and when maintenance problems began to surface, signed it over to the operator. There are companies operating with problems that are not being fixed, as highlighted by no target, no altitude, no ID, etc. Flying with broken equipment is a problem – perhaps unsafe.*
- *In the mix of equipped and unequipped aircraft, we find pilots with heads in cockpit, believing that all targets are on the screen. Need to look outside more.*
- *Dollars put against NDB and other outdated systems for additions or improvements are wasting valuable assets in a time of tight purses.*
- *Why is there not, nor has there been a Capstone focal point in Bethel – the heart of Phase I – to coordinate resolution of operational, maintenance, procedural problems.*
- *Until all commercial aircraft have the Capstone equipment and capability, many of the promises of improved operations in the Bethel area (including help from Fairbanks ATC) can not be met.*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

- *With operators not forced to maintain the systems, Capstone may have created a more dangerous situation.*
- *The mapping capability is great.*
- *ATC was advertised as going to hold IFR approaches during the last 20 minutes prior to civil twilight to aid in recovery of SVFR aircraft. It has not been done. Just the opposite, forcing SVFR into night.*
- *AWAS capabilities not up to speed, but getting better.*
- *GX60 too complicated and not supportable. MX20 good.*
- *The terrain data base has been found lacking in areas of the southwest – along the peninsula and islands. There are islands and other items of terrain that are missing, but must be accurately portrayed if the CAPSTONE system is to be relied upon for IFR or VFR situational awareness.*
- *Promised long time ago - been waiting 3 years for installations in the rest of the fleet. Stopped corporate upgrade of avionics based upon promise, so now upgrades are at a standstill.*
- *At this point prefer Capstone II installations, as we are beginning operations into the southeast.*
- *Capstone I equipment was great for the 207's that we are selling.*
- *Miscommunication on at least one revision to the Capstone manuals, as we only found out about the revision through another operators and had to ask. We recommend that the manuals be updated by the creator, given to the FAA, who provides to the POI. The POI then issues to their operators.*
- *Phenomenal stuff!*
- *FAA not well informed among themselves on the equipment. The POIs and PMIs do not appear to have any information on the equipment or its use.*
- *We are participating in Phase II using Chelton equipment. Since we do not have ADS-B servers on the aircraft, it is hard to quantify any changes in our program transitioning out of Phase I to Phase II.*
- *As features are added or changed to fix problems –e.g. the traffic alert conflicts with ATC – who takes care of fixing and who pays?*
- *Great system!*
- *Who is responsible for changes in hardware and software?*
- *I would like to be able to set codes on the mad page rather than the traffic page. As it is, it is buried and may be a contributing cause of the conflict alerts.*
- *Heads are not in the cockpit as much as I expected.*
- *Installation funding a great help.*
- *A good tool not an infringement (“big brother”).*
- *We tested the display vs. the actual. Fairly decent results.*
- *MX20 is a wonderful thing.*
- *A big confidence builder if VFR on top.*
- *Reliability is good.*
- *Pilot confidence is up with Capstone.*
- *Stevens' initiatives to force passenger prices down are working for now, but at the expense of the loss of companies. The current practice of carrying*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

*passengers below cost will eventually lead to pinching the pennies elsewhere (e.g. maintenance). May not be a good situation. When enough companies are forced out of business, the passenger price will come back up.*

- *A big killer in aviation is complacency.*
- *Skeptical when the Program came out. Thought there would be too much heads down (there has not been), Thought the reliability would be poor (it has not been), and thought it would encourage too many pilots to take a chance (it hasn't).*
- *It need to be used as a tool, not to cheat on weather.*
- *Our Capstone aircraft had hardware and software upgrades in Apr 05.*
- *Excellent for smokey days during the summer season.*
- *Used in Iditarod – excellent with the passes.*
- *Amazing system – The GPS makes a great tool for comparison to charts for navigation.*
- *The accuracy of the system is impressive.*
- *No.*
- *One section of chart between Aniak and Kalskap shows water where there is land.*

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### Safety Questions:

1. Since the end of the Capstone Program, has your company made changes to its overall programs, procedures or operations to distinctly improve safety awareness or improvement?
  - *Already in place and working well.*
  - *Yes: not necessarily directly related to Capstone. Also doing risk assessments and hazard identification under Medallion Program.*
  - *Our safety program was in place prior to Capstone and remains strong.*
  - *No, already in place.*
  - *Yes developed internal procedures for updating system in between purchase of annual updates.*
  - *Following mandates of the Medallion Foundation programs has changed programs, though we have always had simulators.*
  - *Not specifically attributable to CAPSTONE.*
  - *Yes – updated CFIT avoidance training with the MX20 and Medallion requirements.*
  - *We do this daily as a 121 operator. We are still participating in the program in Phase II.*
  - *Yes – as with other organizations we change as “incidents or accidents” take place, as equipment/software changes, etc.*
  - *Yes, we more actively oversee our operations. Started Medallion program, but dropped it – though it is a good program.*
  - *No.*
2. Since the end of the Capstone Program, has your company revised, issued or done any of the following for the purpose of improving safety or safety awareness?
  - a. Policy Manual Revisions regarding safety 8
  - b. All employee (or all specific group) safety letters 8
  - c. Written a safety policy document 6
  - d. Set or revised safety goals 6
  - e. Conducted a safety review or audit 8
  - *Done as a result of Medallion participation.*
  - f. Established a hazard, accident or incident reporting program 5
  - g. Developed a specific safety program or assigned a Safety Officer 4
  - *Already in place and working well.*
  - *Modified an existing program.*
  - *Other items in place with on going safety program.*
  - *Was, is, will be done. We already had a director of safety.*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

3. In your opinion, has the company's Safety Posture or Safety Culture improved during the Capstone Program?

a. 12 Yes

b. 2 No

- *Primarily as a result of CRABS flight following.*
- *We can see more traffic on CRABS.*
- *New GPS Navigation training.*
- *The very presence of the system promotes safety discussions.*
- *In the past operations were accomplished in marginal weather with little to no instrument help. We are now able to accomplish our missions completely within the rules, using the best equipment available.*
- *A combination of Capstone, Medallion and FAA policy emphasis combined to improve safety throughout the industry.*
- *Aside from the capability the systems bring to the aviation community, its very existence helps to heighten safety awareness.*
- *Presence of new equipment helped emphasize.*
- *It is easier to navigate.*
- *Culture and posture were already there, but they both have improved.*
- *Stopped scheduled and on demand over mountain flights for single engine operations.*
- *Medallion and Capstone would like to claim the importance of their programs on safety in Alaska, and they are important. However the insurance industry is the biggest driver – “you crash, you are out of business.”*
- *Learning something new brings pilots together and promotes more internal communication.*
- *Dedicated aircrew safety meetings every month.*
- *Pro-active chief pilot with, more hands on.*
- *As a result of the new equipment.*
- *Fantastic stuff for guys who haven't been around this country before.*

4. Please provide any comments you wish regarding changes in the company that have had an impact on safety since the end of the Capstone program.

- *The new Medallion Foundation simulator at Bethel has provided for better holding and approach training – enhancing safety.*
- *Basic pilotage skills have become “a little rusty.”*
- *Initial pilot checkouts now emphasize MX20 Capstone equipment.*
- *All recurrent pilot checks emphasize basic pilot skill and “fail” the Capstone equipment except for one GPS approach.*
- *Capstone lead to company reevaluation of avionics upgrades for the improvement of safety.*
- *We think we see a greater awareness of general safety because of all the communications improvements and development of Capstone in our operation.*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

- *Our check rides focus on situational awareness with and without the Capstone equipment and the management of time spent focused inside and outside of the cockpit.*
- *Some continuing “conflicts” with ATC pertaining to Capstone and Transponder settings.*
- *Marine radios are used for long range communications. The older versions impact the Capstone systems. Newer radios do not appear to have the same interference problem, but also do not “fit the same hole” as the older radios. An internal problem, but still needs solution in a “packed” cockpit.*
- *Radar altimeters could be a “victim” of the Capstone program, but they continue to be an important safety tool.*
- *Human factors are affected. Changes in the way and number of times that “codes” must be set reset have occurred. The splitting of time between eyes inside and outside of the cockpit must be managed more closely.*
- *With the obvious belt tightening there are numerous aviation safety programs that, while they enhance safety, compete for funds. A relook at the funding may want to focus on those items that provide both a long term improvement and an immediate benefit. Specifically, the Capstone program’s addition of GBTs and other programs through the phases brings an immediate improvement to the route structure in Alaska and provides for the long term advancement of Safety in Alaska. The weather cams provide an interesting long term potential for improved safety, but no real immediate improvement. The ability to put cameras in remote spots is now proven. Until this information can be provided in the cockpit, the “cam” value for safety is negligible. Too much time lapses between looking at the web cam in the office/home/? and the arrival at the pass, airport, or wherever the web cam may be. This program may be a candidate for “coasting” rather than adding more locations at this time. Legacy system costs may also be of interest in review e.g. NDBs have been a subject of discussion and new systems are not favorable pursued. If they are not worth adding more, perhaps it is time to plan, program, and execute a plan to eliminate them.*
- *Use the map function regularly.*
- *Need better heaters for the “90” in cold weather. Constant error messages after start, probably due to temp of system.*
- *GDL antennas too expensive at \$700 per.*
- *Encoder problems – one example in shop twice in first 30 hours.*
- *Bad “think through” of program when you modify static systems by adding systems, and then do not do a static system check – leaving it to the operators.*
- *Provides pilots with a false sense of security. Used to be experienced pilots pushing the limits in marginal conditions, now the inexperienced pilots are pushing the limits.*
- *Some fiddle with buttons when they should be looking outside (running into thing on the ground).*
- *We have a stabilized pilot force, and are considering moving more towards a twin engine, IFR capability from our current mix of singles and twins.*



# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

- *40 years of experience in the arctic can now be learned in 4 days with Capstone, but beware if it quits.*
- *Unreliable annunciator panel – needs LEDs – and it is not field repairable*
- *GX60 not in production – supportability?*
- *The labels wear off quickly, making dials, buttons, etc. difficult to impossible to read.*
- *Initial training was outstanding. Recurrent is done in-house with desk top sim.*
- *Newer hired pilots appear to come with a higher dependence on GPS than was previously the case. These, and other assigned pilots develop a higher level of dependence upon CAPSTONE equipment. This manifests itself in a reduced proficiency in basic pilotage skills.*
- *Reliance on CAPSTONE equipment tends to put “heads in cockpit” too much, especially in a high traffic VFR environment.*
- *Some develop a mindset that “all aircraft” are displayed on the cockpit display, forgetting that only CAPSTONE equipped aircraft do so.*
- *The transition to the Chelton equipment (Phase II) left the group of Bethel pilots feeling “naked” due to no traffic info. Should be resolved this summer.*
- *We do not use terrain mode, as we do not like the blanking of details by the “red” when below 300 feet.*
- *We have to fight the tendency of the pilots to rely on the electronics vs. the Sectional Chart. We want the new equipment to be “a” tool and not a crutch.*
- *KISS principle – our goal is to make the best VFR pilots in the world rather than trying to split skills between VFR and IFR. This and the cost of IFR equipment, training, etc. will keep us 100% VFR for the foreseeable future.*
- *A key to really get things safe is to get this installed in every aircraft, so we can see each other.*
- *No*

# The Impact of Capstone Phase 1

## Post-Transition Annual Report – 2005

### Questions for Dispatchers

- *Section is N/A as we have received no CRABS of Flight Explorer.*
  - *Do not have*
1. Has the transition from CRABS to Flight Explorer (or other program) changed or improved your process for dispatching or releasing flights?
    - a. 6 Yes
    - b. 5 No
    - *Did not transition. CRABS more useful for us. Flight explorer does not provide useful information.*
    - *In place prior to Capstone. GPS tracking is a plus. Company primarily uses system as an in-flight supplement to VFR, not for flight following.*
    - *Difficult to delineate. Our procedures are unchanged, but the process itself is better because we have better information. Also, the flight explorer does not go all the way to the surface.*
    - *Changed, but not improved. Flight explorer is less useful than CRABS, so use the CRABS.*
    - *Not user friendly, so we leave it off. Will not pay for at current level of use.*
    - *Moved back to CRABS because it provided the useful information. Would prefer to keep CRABS.*
    - *Same as CRABS.*
  2. If yes to 1 above, please check the appropriate boxes for areas that have improved
    - a. Weather data *1*
    - b. Weather Cams *1*
    - c. Flight Monitoring/Flight Following *6*
    - d. Communication with other aircraft that are in the area you of your aircraft dispatch *3*
    - e. Fuel or load planning
    - f. Selecting Alternate Airports *1*
  3. If yes to 1 above, please check the appropriate boxes for areas that have deteriorated
    - a. Weather data *1 (with flight explorer)*
    - b. Weather Cams
    - c. Flight Monitoring/Flight Following *2*
    - d. Communication with other aircraft that are in the area you of your aircraft dispatch
    - e. Fuel or load planning
    - f. Selecting Alternate Airports
  4. Do you use the Flight Monitoring capabilities now available on a regular basis?
    - a. 11 Yes

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

- *Use CRABS for all flights every day.*
- *too cumbersome for our short trips. Don't have a computer to dedicate to the software.*
- *CRABS.*
- *We are all IFR now.*

b. 4 No

5. Please provide any comments you wish regarding changes or improvements in Dispatch or Flight Following since the end of the Capstone Program.

- *Flight explorer not useful for our operation.- Keep CRABS.*
- *GPS would appear to be the way of the future. Radar good some places, but GPS is good in most places.*
- *Now, because of the high turnover in the Bethel area, most of the company's pilots have never operated without the Capstone equipment.*
- *Like what they see, interested in Phase II and or III equipment once they make long term aircraft equipage decisions.*
- *Integrated the following of our IFR and VFR flights.*
- *Better with Capstone.*
- *Use flight following to determine where aircraft are operating (where weather is OK.*
- *Use CRABS, better than the previous radio flight following.*
- *Ask others about conditions at airports and enroute.*
- *Better able to predict ETAs for aircraft.*
- *Better able to provide customers with information relative to flights.*
- *Great capability with CRABS, wish it could be continued.*
- *Saves a lot of aggravation concerning where aircraft are Saves phone calls when trying to contact aircrews that are on the road.*
- *Vastly improves communications.*
- *Was good to have the VFR and IFR picture for all our aircraft when we had the VFR operations and Capstone equipped aircraft. Would like to continue with Capstone on rest of fleet, but still waiting.*
- *Like CRABS system.*
- *It is difficult to identify the Capstone aircraft on the commercial system.*
- *The commercial system is not user friendly – also expensive to operate.*
- *We keep track of our aircraft procedurally and only use CRABS or Flight Explorer as a backup.*
- *More complicated than CRABS.*
- *A lot of unnecessary information.*

# **The Impact of Capstone Phase 1**

## **Post-Transition Annual Report – 2005**

### **9.5 Appendix E: Acronyms**

ADS-A	Automatic Dependence Surveillance-Addressed
ADS-B	Automatic Dependence Surveillance-Broadcast
AF	Airways Facilities
AIM	Aeronautical Information Manual
ANICS	Alaska NAS Interfacility Communications System
AOPA	Aircraft Owners and Pilots Association
ARINC	Aeronautical Radio Inc.
ARTCC	Air Route Traffic Control Center
AT	Air Traffic
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
AWOS	Automated Weather Observation System
CCCS	Capstone Communication Control Server
CDTI	Cockpit Display of Traffic Information
CNS	Communications, Navigation, and Surveillance
CSSPP	Capstone System Safety Program Plan
CSSWG	Capstone System Safety Working Group
DT&E	Developmental Test and Evaluation
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FDN	Functional Description Narrative
FIS-B	Flight Information Services-Broadcast
GBT	Ground Broadcast Transceiver
GPS	Global Positioning System
HBAT	Handbook Bulletin for Air Transportation
HBAW	Handbook Bulletin for Air Transportation and Continuous Airworthiness
ICD	Interface Control Document
IDS	Interim Design Specification
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
IOC	Initial Operational Capability
LMATM	Lockheed Martin Air Traffic Management
MASPS	Minimum Aviation System Performance Standards
MFD	Multi Function Display
Micro-EARTS	Micro Enroute Automated Radar Tracking System
MOPS	Minimum Operational Performance Standards
MOU	Memorandum of Understanding
MSAW	Minimum Safe Altitude Warning
NAS	National Airspace System
NATCA	National Air Traffic Controllers Association
NCP	NAS Change Proposal
NOTAM	Notice to Airmen

# **The Impact of Capstone Phase 1**

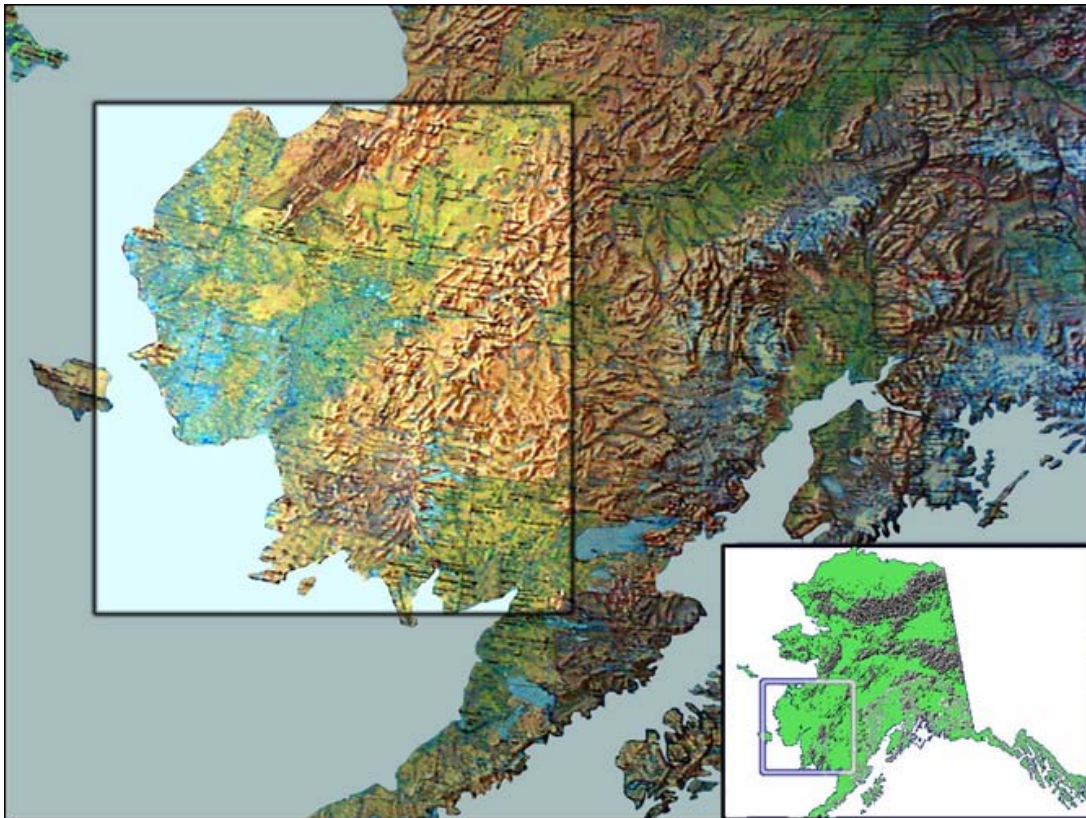
## **Post-Transition Annual Report – 2005**

NTSB	National Transportation Safety Board
OT&E	Operational Test and Evaluation
PHA	Preliminary Hazard Assessment
PTRS	Problem Trouble Reporting System
SER	Safety Engineering Report
SF21	Safe Flight 21
STC	Supplemental Type Certificate
TEMP	Test and Evaluation Master Plan
TIS-B	Traffic Information Services-Broadcast
TSO	Technical Standard Order
UAA	University of Alaska-Anchorage
UAT	Universal Access Transceiver
UPS AT	United Parcel Service Aviation Technologies
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
WJHTC	William J. Hughes Technical Center
Y-K	Yukon-Kuskokwim
ZAN	Anchorage Air Route Traffic Control Center

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# The Impact of Capstone Phase 1 Post-Transition Summary Report - 2005

July 2006



The MITRE Corporation's Center for  
Advanced Aviation System Development



UNIVERSITY of ALASKA ANCHORAGE

Aviation Technology Division

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## Highlights of the Summary Report through 2005

- In the Y-K Delta Phase 1 population, Capstone-equipped aircraft have had a consistently lower accident rate than all aircraft prior to Capstone and non-equipped aircraft during Capstone. From 2000 through the end of 2005 this rate of accidents for Capstone-equipped aircraft was lower by 50%.
- Historically the rate of Part-135 accidents within the Y-K Delta has been two to four times higher than that for the rest of Alaska. In 2003, the accident rate for the Delta was less than that of the rest of the state for the first time, and in 2004, the accident rate remained comparable to that in the rest of the state. **In 2005, the accident rate increased for the Y-K Delta while the accident rate for the rest of the state decreased. All of this increase (33%) was due to newly introduced non-Capstone equipped aircraft that accounted for only 0.9% of the operations.**
- Maintenance and equipage responsibility for Capstone equipment transitioned to the aircraft owners and operators in the Y-K Delta at the end of 2004. Only 3 of the 15 operators interviewed felt that the transition went well. The cost of installing the equipment is a key long term issue. Most operators also expressed concern over the additional costs of data and maintenance which may have more safety impact in the short term.
- Commercial operators have installed Capstone type avionics equipment in 3 aircraft since the transition and 3 non-equipped aircraft have been added by the operators, bringing to total non-equipped aircraft to 5. Seven Capstone equipped aircraft that were previously operating in the Y-K Delta have been sold or are no longer operating in the area.
- One operator has changed the avionics to Capstone Phase II Chelton avionics. These avionics do not currently support in-cockpit display of traffic or weather and pilots have identified this as substantially less safe in VFR conditions.
- Five GBTs continued on the FAA's operational network in 2005. The remaining 5 were removed from the FAA's developmental network in December 2005 but were not activated on the operational network as scheduled. (In March, 2006, all operational GBTs were taken out of service by the FAA Air Traffic Organization and returned to service on June 15, 2006. These and subsequent changes are beyond the time period covered in this report.)
- Operators preferred the use of the original Capstone provided Comprehensive Real-Time Assessment Broadcast System (CRABs) Flight Monitoring program over the commercial product that was distributed to them by Capstone during 2005. Although 73% of operators had reported using Flight Monitoring for all or most of their flights, 80% of operators indicated that they have not signed a contract to continue or replace these services with the commercial provider due to the cost of these services and satisfaction with the product.
- Sixty percent of the operators have not signed a contract for software updating services for the maps and terrain databases for their avionics. Interviews indicate this is primarily due to the cost of these services.
- Traffic display, navigation, terrain avoidance and flight planning features of the Capstone program equipment are the best regarded and most used by the pilots. Routine use (52%) and usefulness (56%) of GPS approaches were reported by pilots this year, an increase over previous years.



- Eighty-six percent of the interviewed airline managers indicate they perceive an overall improvement in safety since the Capstone program began and most have added or revised safety programs in their operation.

# The Impact of Capstone Phase 1

## Post-Transition Summary Report through 2005<sup>1</sup>

Capstone is a joint initiative by the FAA Alaska Region and the aviation industry to improve aviation safety and efficiency in Alaska by using new technologies. Phase 1 of Capstone took place in the watershed of the Yukon and Kuskokwim rivers in Southwest Alaska – the Y-K Delta – which is relatively isolated, and historically has had limited infrastructure and a high rate of aviation accidents. Capstone has installed new avionics in virtually all Part-135 aircraft based in the Delta. Phase 1 added new ground-based capabilities, expanded services and training, and information gathering on the safety of Y-K Delta aviation.

The Federal Aviation Administration's Capstone Phase 1 program officially completed the aircraft equipage and maintenance portion of the program at the end of 2004. Complete information concerning the program through 2004, *The Impact of the Capstone Phase 1 Program Final Report*, is available on the Capstone website:

<http://www.alaska.faa.gov/capstone/docs/Phase%201%20Final%20with%20appendices.pdf>. A total of 208 aircraft were outfitted with Capstone avionics during the Phase 1 program. Maintenance responsibility and responsibility for further equipage was transitioned to the owners and operators in the Y-K Delta area at the end of 2004. The FAA maintains responsibility for the ground infrastructure, including 10 weather stations (associated with the new instrument approaches) and 10 ground based transceivers that communicate with the avionics.

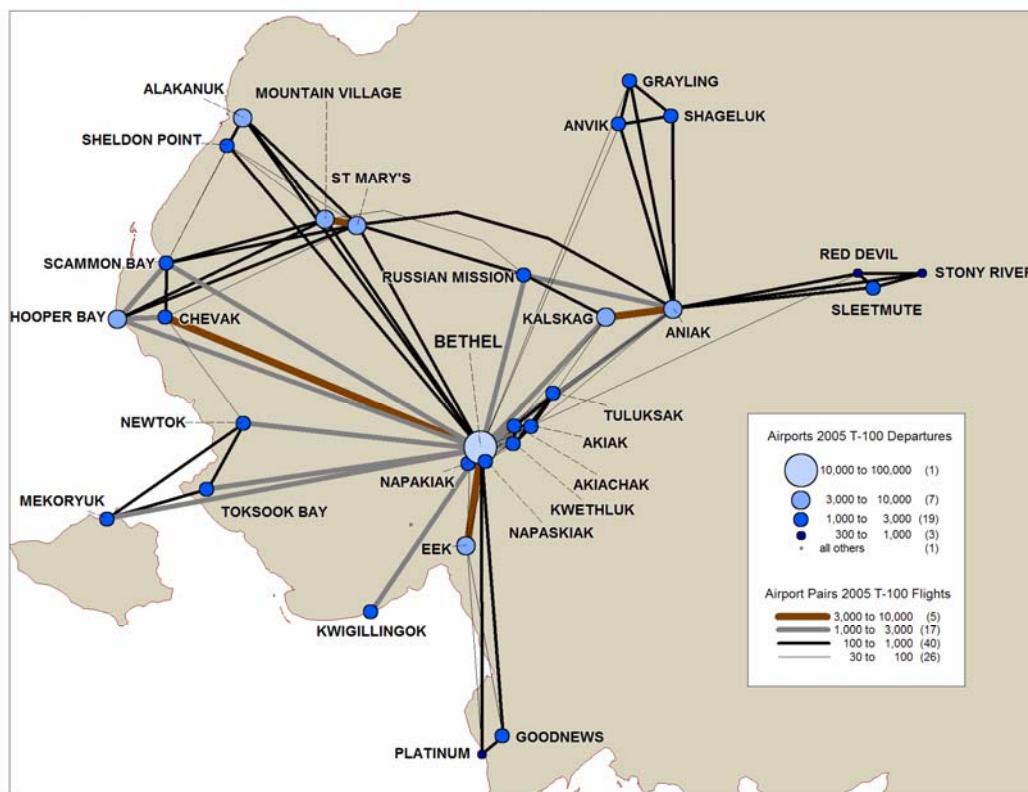
This report summarizes continuing analysis of the Y-K Delta operations and accidents in this post-transition environment and tracks changes in the equipage and services following the completion of the program. Full information can be found in the *Impact of Capstone Phase 1, Post-Transition Annual Report – 2005*.

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<sup>1</sup> The contents of this material reflect the views of the authors. Neither the Federal Aviation Administration nor the Department of Transportation, makes any warranty or guarantee, or promise, expressed or implied, concerning the content or accuracy of the views expressed herein.

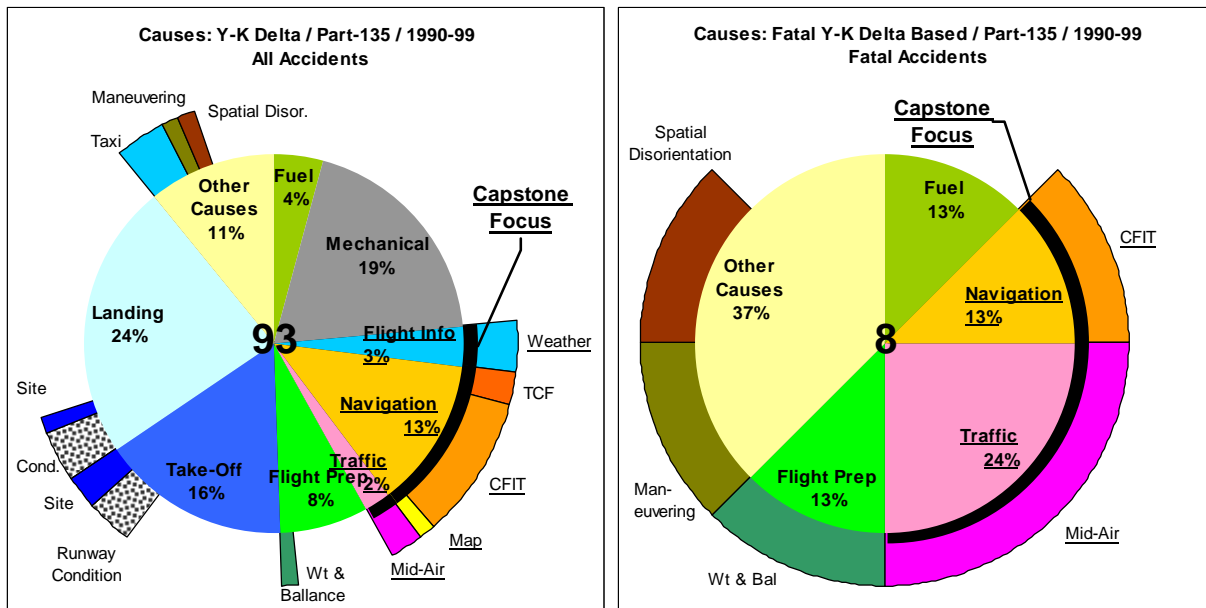
## Background: The Y-K Delta and Historical Accidents

Historically, accident rates in the Y-K Delta have been two to four times higher than that for the rest of Alaska. Essentially all passengers and 95% of all cargo arrive in the Y-K Delta by scheduled air service through Bethel or through smaller hubs at Aniak and St Mary's. Of the 53 villages in the Y-K Delta, 32 are served by either air carriers operating from Anchorage, Fairbanks or Nome, or scheduled carriers based within the Y-K Delta. The scheduled air routes in the Y-K Delta are depicted in Figure 1 for airports with at least 52 scheduled flights per year. Service between Bethel and Anchorage is provided by larger turbine and jet aircraft, but service to Y-K Delta villages is provided by small single-engine or light-twin aircraft that, prior to Capstone, were limited to visual operations. Pilots for these flights often face weather hazards – fog, ice-fog, white-out or flat-light conditions that can be localized and change rapidly – and weather information has been limited. There are few navigational aids. Radar coverage is largely unavailable below 5000 feet, while icing concerns and short flight distances often keep operations below 2000 feet. Runways are short, mostly gravel or dirt, and are damaged regularly by freeze/thaw and water.



**Figure 1 Airport Departures and Route Traffic in the Yukon-Kuskokwim Delta**

The types and causes of accidents prior to Capstone for commercial aircraft (operating under Federal Aviation Regulations Part-135) based in the Y-K Delta are depicted below. These are the aircraft most directly affected by Capstone. Major categories (the inner pie slices) are explained in the following paragraph. Some accidents also fall within some special sub-category (outer pie segments) but many do not. The dark band and underlined categories and sub-categories identify causes of accidents that were originally targeted by Capstone, though experience has shown reduction in accidents beyond these categories.



**Figure 2 93 Accidents and 8 Fatal Accidents by Y-K Delta Part-135 Aircraft 1990-1999**

<b>Fuel Mismanagement:</b>	Usually fuel exhaustion. Occasionally, failure to switch fuel tanks.
<b>Mechanical Failure:</b>	Engine failure, inoperable control surfaces, failed landing gear, propeller or shaft failure. (There were no fatal accidents in this category by Y-K Delta based Part-135. In the Lower 48, 10% of mechanical accidents are fatal.)
<b><u>Flight Information:</u></b>	Usually inadequate weather information, especially icing, but also visibility; rarely convective weather. (Surface winds contributing to take-off or landing accidents have been included under take-off or landing rather than here.) Occasionally, lack of information on changes in procedures or facility status.
<b><u>Navigation:</u></b>	Usually Controlled Flight into Terrain ( <b>CFIT</b> ) while enroute, most often associated with reduced visibility. In the Y-K Delta, CFIT also occurs in nominal VFR conditions when “flat light” on snow-covered ground prevents recognition of terrain. Terrain Clearance Floor ( <b>TCF</b> ) warnings are a Terrain Awareness and Warning System (TAWS) function planned for Capstone Phase 2 that addresses the 20%-30% of CFIT accidents on approach or departure. These are not directly addressed by Capstone Phase 1 avionics. Rarely, accidents are due to mislocation, which can be addressed by a GPS- <b>map</b> display.
<b><u>Traffic:</u></b>	Usually mid-air collisions between aircraft. Also includes accidents from last-moment avoidance of other aircraft.
<b>Flight Preparation:</b>	Failure to ensure cargo is tied-down and within the aircraft’s <b>weight and balance</b> limits. Failure to check fuel for the presence of water. Failure to remove ice or snow from the aircraft – often resulting in serious or fatal accidents (rare in the Lower 48 but more common in the Y-K Delta).
<b>Take-off and Landing:</b>	Failure to maintain control (especially in wind), improper airspeed, or inadequate care near vehicles or obstacles. The Y-K Delta also includes unusually high numbers of accidents from poor runway <b>conditions</b> , from hazards at an off-runway <b>site</b> such as beaches and gravel bars, and from obstacles in water that are struck by float-planes.
<b>Other:</b>	Taxi or airport vehicle accidents, low altitude maneuvering for game spotting or photography, spatial disorientation, improper carburetor heat, bird strikes.



The GPS unit also has programmable functions to aid enroute flight planning and may reduce pilot navigation workload.

- Capstone addresses accidents associated with aircraft **traffic** through ATC radar-like services (described below) and by display of relative locations of other Capstone-equipped aircraft. Aircraft locations are derived from Automatic Dependent Surveillance Broadcast (ADS-B) messages transmitted via a Universal Access Transceiver (UAT) by other aircraft and received and processed to provide a Cockpit Display of Traffic Information (CDTI) – one of the functions of the MFD. CDTI also enhances pilot situational awareness and aids pilot-to-pilot coordination at non-towered airfields. In the future, locations of aircraft that are not Capstone-equipped but are visible to ATC radar might be provided by Traffic Information Service Broadcast (TIS-B) from the network of Ground Based Transceivers (GBTs).
- **Weather and flight information** are provided by new Automated Weather Observing Systems (AWOS) at remote airports and by Flight Information System Broadcast (FIS-B) of weather text and NEXRAD<sup>2</sup> graphics. FIS-B is distributed by data-network to GBTs that broadcast to equipped aircraft. Aircraft with Capstone avionics receive these broadcasts on a UAT and are displayed on the MFD.
- **Increased IFR operation** is supported at remote airfields by AWOS installations, which allow GPS instrument approaches to be approved for commercial operations. For qualified aircraft, this allows safe IFR operations in low visibility conditions that would be unsafe for VFR operations. IFR operations are improved and expanded by Air Traffic Control (ATC) use of ADS-B to support cost-effective **radar-like services**. ADS-B takes an aircraft's location from GPS/WAAS<sup>3</sup> and transmits it once per second over the UAT. GBTs receive these messages from all nearby Capstone-equipped aircraft, and forward them to ATC where aircraft locations are processed and displayed much like aircraft locations from radar. This allows controllers to provide flight following and surveillance-based separation services in airspace that is not visible to radar.
- Late in 2002, tower operators at Bethel airport began regular use of a “Brite” display of ADS-B targets to help them visually locate aircraft and better coordinate arrival sequencing.
- Also in 2002, managers in companies that operate Capstone-equipped aircraft began using **flight monitoring** from the developmental GBTs on PCs connected to the Internet to monitor the location of their aircraft. In 2004 with the beginning of the GBT transition to the operational network, flight monitoring became available to operators via commercial service providers, and Capstone provided subscriptions to the Flight Explorer product at no charge. Flight monitoring has the potential to significantly improve awareness of risks and to facilitate further improvements in safety posture.

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<sup>2</sup> Next Generation Weather Radar

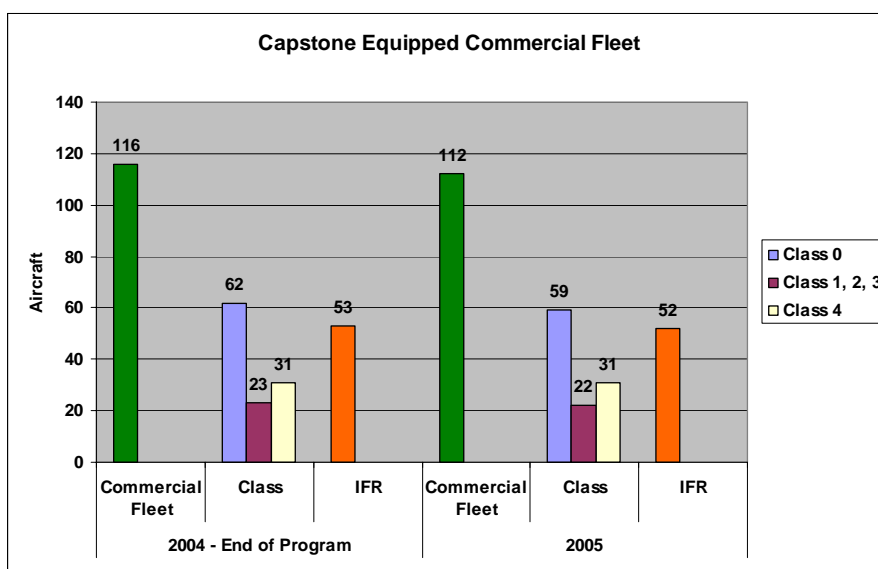
<sup>3</sup> ADS-B applications may use or require other on-board navigation sources instead of or in addition to GPS. Capstone Phase 1 avionics use GPS/WAAS and barometric altimetry.

## Capstone Phase 1's Implementation and End of Program Transition

### Avionics Transition

A total of 208 aircraft were Capstone equipped during the equipage phase of the Capstone program. Of these, 189 were, at some point in the program, operated commercially under FAA Part 135. During the 5 year program the commercial operating fleet in the Y-K Delta decreased due to operators moving into and out of the area based on the market and operating economics, bankruptcies, competitive pressures and other factors. At the end of the equipage phase in 2004 there were 116 aircraft in the Y-K Delta commercial operating fleet and Capstone-equipped aircraft accounted for nearly 100% of operations by Part-135 aircraft based in the Y-K Delta. Non-equipped, non-jet aircraft accounted for only 0.9% in 2005.

During the first year since the transition, 7 Capstone equipped aircraft have left the Y-K Delta commercial fleet and operators have self-equipped 3 additional aircraft. The number of Capstone-equipped aircraft in the commercial operating fleet declined to 112.



**Figure 4 Capstone Equipped Commercial Fleet Changes since Program Transition**

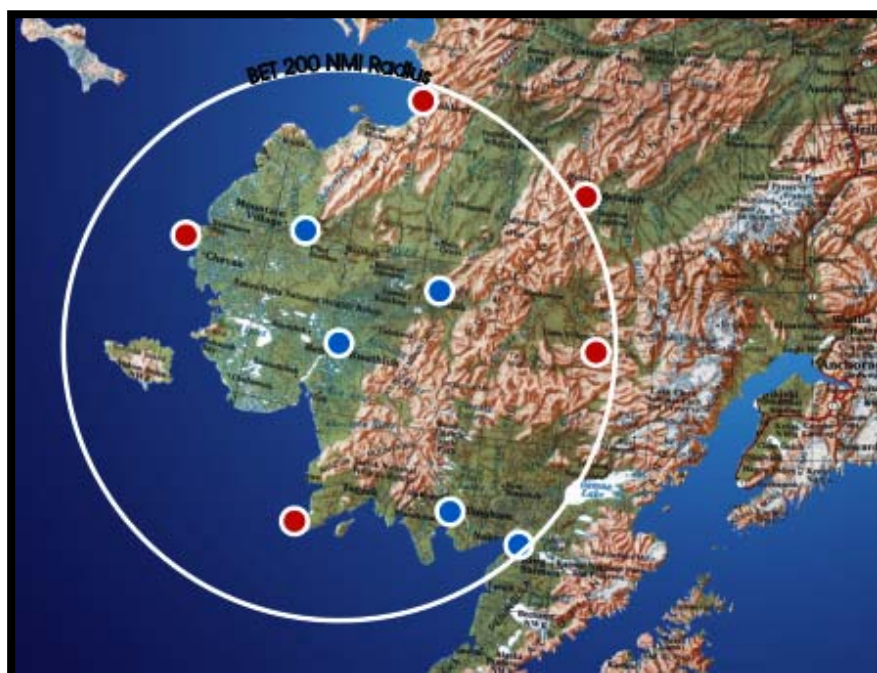
Figure 4 shows the current number of aircraft in the Capstone equipped Y-K Delta commercial fleet at the end of 2005. The fleet consists of 53% single engine piston aircraft (Class 0), 28% turbine powered (Class 4) and the rest are light twins (Classes 1, 2, 3). IFR qualified aircraft remain at 46% of the current Capstone operating fleet.

There are also 3 additional unequipped aircraft, not included in the above total, that have moved into the Y-K Delta fleet in 2005 and two aircraft that were previously not equipped with Capstone type avionics bringing the total non-equipped aircraft to 5. The 2 operators of the aircraft stated that cost of equipment was a major factor in not equipping now.



## Ground Infrastructure Transition

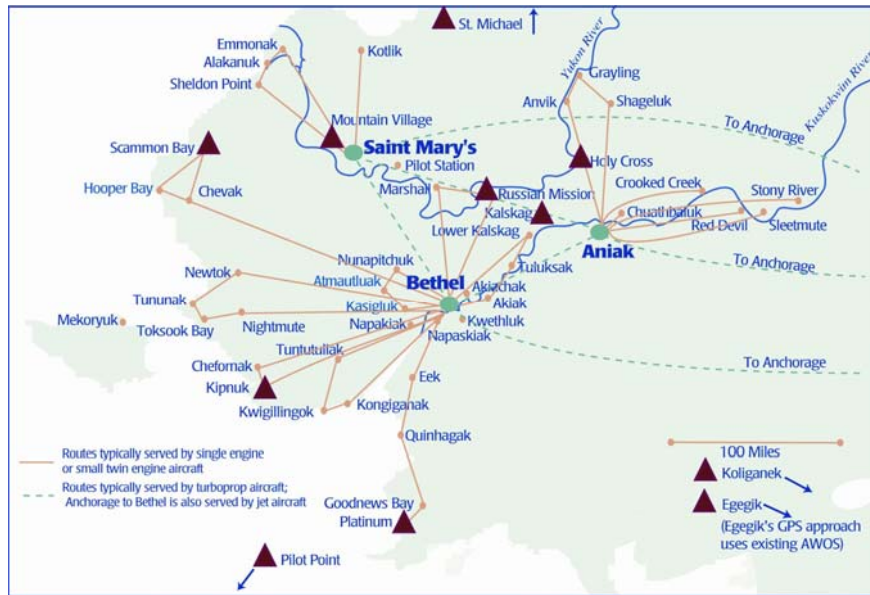
**Ground Based Transmitters:** During 2005, five GBTs transitioned onto the FAA's operational network. These GBTs are shown with blue circles on Figure 5 below. The remaining GBTs at (shown in red below) were scheduled to transition early in 2006. On December 15, 2005, these five GBTs were taken off the developmental network but were not returned to service in January 4, 2006 on the operational network as scheduled. (In 2006, after the period covered by this report, the transition did not occur as scheduled, reducing the number of GBTs and coverage area available to five GBTs providing Surveillance and Flight Monitoring by the operators. On March 24, 2006, the FAA Air Traffic Organization removed all GBTs from service. They were incrementally returned to service later in 2006 and this will be documented in next year's report.)



**Figure 5 GBT Transitions in the Y-K Delta**

TIS-B remains unavailable in the Y-K Delta. (It is only available in the Anchorage area via the Site Summit GBT.) Both CRABS and Flight Explorer flight monitoring data was available most of the year from either operational (Flight Explorer) or developmental (CRABS) GBTs. As each site transitions to the operational network, only Flight Explorer will be available for flight monitoring from the site. By the end of 2005, CRABS was available from the single developmental GBT at Bethel.

**AWOS and Non-Precision GPS Approaches:** There was no change in status of the ten airports in or near the Y-K Delta shown in Figure 6 that have received AWOS stations and associated GPS non-precision instrument approaches.



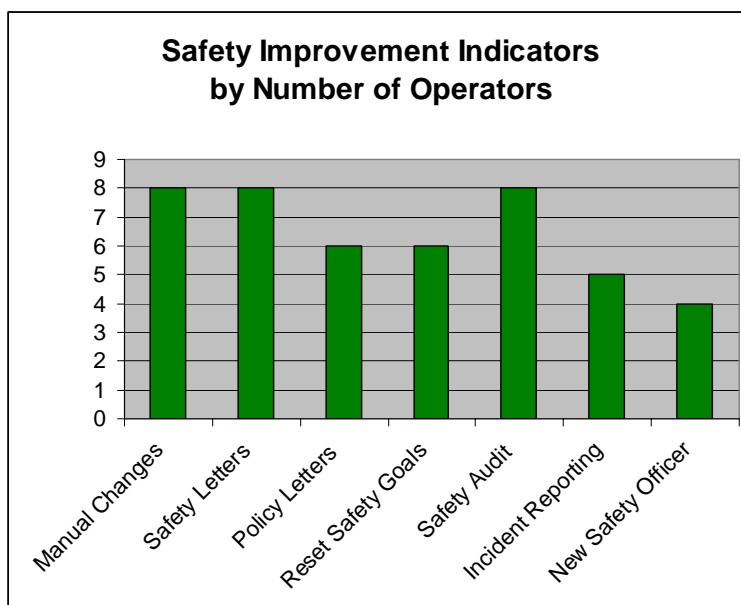
**Figure 6 Locations of AWOS and Non-Precision GPS Instrument Approaches**

**Radar-Like Services:** Beginning in January 2001, air traffic control scopes at Anchorage Center began displaying Capstone-equipped aircraft near Bethel despite the fact that there is no radar coverage in the Bethel area below 5,000 feet. Use of ADS-B to provide “radar-like services” was the first of its kind in the world. The FAA divided the air traffic control sector over Bethel into high and low sectors to allow increased controller attention to the aircraft targets covered by ADS-B surveillance. However, the horizontal extent of the low sector is too large to allow the controller to read the data-blocks for the large number of targets that often appear very close to Bethel, and for this reason, ATC does not provide surveillance-based separation services to ADS-B traffic on approach or departure at Bethel. If the low sector had been created with a smaller extent to allow Bethel to be shown at a larger scale, it would have allowed the en route controllers to provide these services. Instead, more complete services for approach and departure are planned with establishment of a Bethel Approach Control, to be located in Fairbanks, but the target date for this has slipped from 2004 into 2007.

**Flight Information:** In addition to the AWOS capabilities described above, the network of GBTs provides FIS-B to Capstone aircraft in most of the Y-K Delta. The primary products currently available to pilots are Meteorological Aviation Reports (METARs), Terminal Area Forecasts (TAFs), AIRMET (Airman's Meteorological Information), Winds and Temperatures Aloft and NEXRAD graphics from the weather radar at Bethel. Additional services are planned in the future.

## Changes in Operations Safety Structure

Most of the Y-K Delta operators are small companies certified under Part-135 and their required quality assurance programs and records keeping are more limited than Part-121 operators. Using surveys provides some indication of improvements in the general safety structure of the operators, as shown in Figure 7. A number of respondents stated that they had done safety audits and set safety goals as part of their association with the Medallion Foundation. Eighty-six percent of the respondents indicated they believed that the safety posture of the operators had improved since the beginning of the Capstone program.



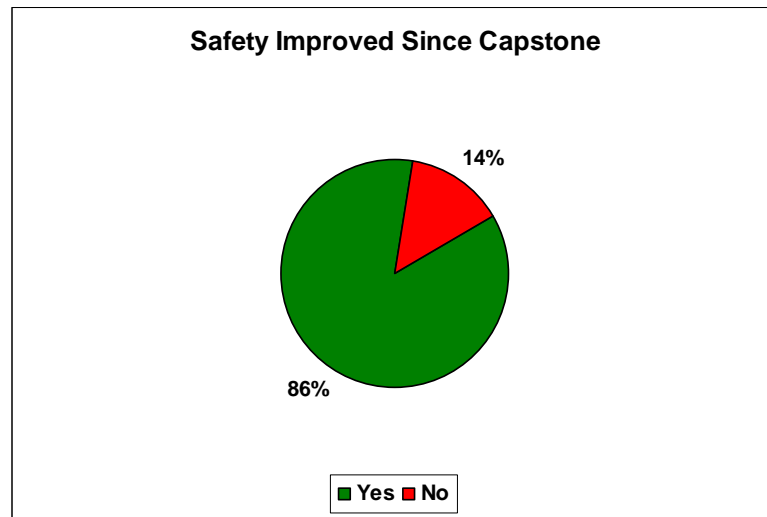
**Figure 7 Indications of Safety Posture Improvement**

**The Medallion Foundation**, created in 2001, is one of the more important voluntary flight safety programs in Alaska. To earn the Shield, air carriers must complete all program goals (Stars) designed to increase safety awareness and improve safety practices. At the end of 2005, all but one of the Capstone-equipped commercial carriers now operating in the Y-K Delta, representing 95% of the Capstone-equipped fleet, have joined the Medallion program. Six carriers have earned Medallion Stars for meeting at least one of the program goals. Those with a Shield or Stars operate 60% of the aircraft and 52% of the departures in the Y-K Delta. There was a significant improvement from 2004 in the percentage of flights operated by Medallion carriers with at least 1 Star, due primarily to one large operator achieving its first Star this year.

**Interviews with 15 airline managers** in Bethel indicate that Capstone has improved the safety of flying in the Y-K Delta. Below are some of the comments made during the interviews.

*“Aside from the capability the systems bring to the aviation community, its very existence helps to heighten safety awareness.”*

*“A combination of Capstone, Medallion and FAA policy emphasis combined to improve safety throughout the industry.”*



**Figure 8 Management Assessment of Improved Safety**

Although most operators are very positive concerning the overall Capstone improvements, there are a number of areas where they expressed concern. Only 3 operators felt that the transition of the program from the FAA management went well. As stated earlier in the report, the cost of installing the equipment in new aircraft is a key issue. Most operators expressed concern over the lack of adequate information and communications before and during the transition, and the costs and the future use of the equipment. Examples of the comments on the transition are below.

*“There were no transition coordination meetings.”*

*“We were stuck with limited or no knowledge of the warranties, or lack there of, that we were signing for.”*

*“We had to sign for and operate the system with a lot of unknowns, since the system has never been totally up and running.”*

Expenses were a big issue with the management. The 3 key issues were maintenance costs, software revisions and flight monitoring:

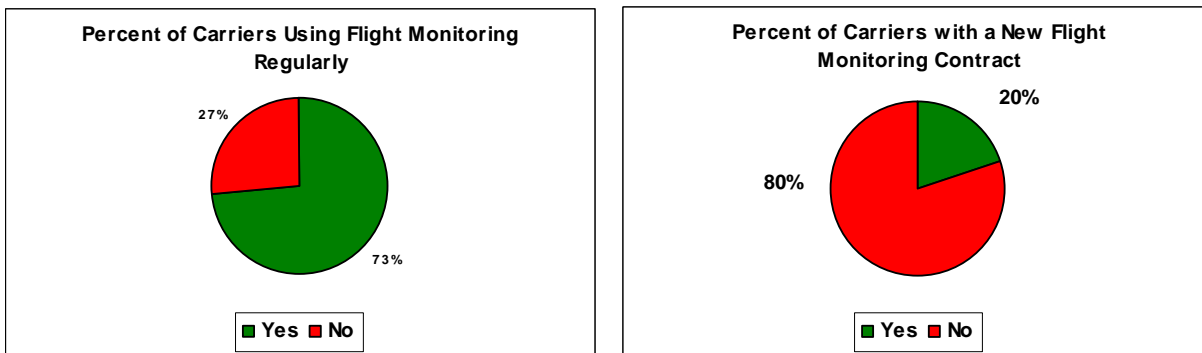
*“Cost of equipment, installation, and maintenance is prohibitive.”*

*“Revision updates are very expensive.”*

*“Using government contract through 31 Dec 05. CRAB’s provides the info needed - Flight Explorer does not, so we will not continue contract into 06.”*

The comments were also supported by the data from the survey questions. One indicator was the cost for maintaining and updating of the navigation databases. Sixty percent of those questioned do not have a contract for the maintenance of their databases.

In past reports, Flight Monitoring has shown to be an effective part of the safety benefits that were derived from Capstone. The operators continue to use the CRABs software which was still available during most of 2005 and is now available only from the Bethel GBT site. Capstone also provided the operators with a one year contract for use of commercial services from Flight Explorer during 2005. Figure 9 shows the disparity between operator use of Flight Monitoring and those that have signed a contract to continue use of those services. Although 73% of the operators stated the regularly use Flight Monitoring; only 20% have signed a contract to purchase Flight Monitoring services beginning in 2006.



**Figure 9 Comparison of Flight Monitoring Use and Contracts Signed**

*“Did not transition. CRABS is more useful for us. Flight Explorer does not provide useful information.”*

*“Not user friendly, so we leave it off (i.e. do not use it). Will not pay for at current level of use.”*

The operators also expressed concern regarding the services provided by Capstone in the Y-K Delta. One of the key concerns stems from the delayed implementation of surveillance-based separation services for approach – either by creating a TRACON or by defining a smaller-scale enroute sector for the immediate Bethel area. Without this, VFR and SVFR traffic must be excluded during IFR operations. Instead of improving the ability of Capstone equipped aircraft to return under SVFR conditions, the program attracted additional IFR operations into Bethel, forcing longer hold and delay times for Bethel based aircraft while the terminal area is restricted for IFR approaches. This was a common concern of nearly all operators.

Operators were concerned over the future of use of Capstone equipment:

*“Uneasy feeling that others are operating with inoperative or malfunctioning equipment, so the traffic picture is incomplete.”*

*“Within 5 years expect less than half of current Capstone equipped aircraft will be Capstone capable due to cost.”*

*“Until all commercial aircraft have the Capstone equipment and capability, many of the promises of improved operations in the Bethel area (including help from Fairbanks ATC) can not be met.”*

**Surveys of thirty-one pilots** that operate in the Y-K Delta were conducted. The average age was 37 years-old and the average flight time was 7436 hours total and 5959 in Alaska. The average hours operating Capstone equipment was 1507. It is important to note that 7 of the pilots surveyed are now operating aircraft that have Chelton EFIS avionics used primarily in Phase II. The Chelton avionics provide TAWS as required for Part 121 operations, but lack the cockpit displays of traffic (ADS-B/CDTI) and weather (FIS-B). This impacted the interview results, because of the lack of these Capstone Phase 1 capabilities.

The pilots were surveyed for their opinions on the benefits. Operations at remote airports were reported as safer, because of the presence of new instrument approaches and the orderly flow they enabled during marginal VFR weather. The same statement can be said for the benefit during marginal VFR conditions, with 78% of the pilots rating this area a significant or major benefit. Sixty percent of pilots surveyed found a significant or major benefit through improvement in Special VFR procedures as they, and the controllers, had better knowledge of aircraft positions.

Ranking at the top, along with safer minimum VFR condition benefits, is the reduction in navigation workload. Seventy percent rated this area as a significant or major benefit of the Capstone equipment. Terrain awareness benefits ranks high in the area of significant and major response (63%), and it is the only proposed benefit that did not receive a response of "None". This indicates Terrain Avoidance is the universally accepted benefit for the system.

Fifty-two percent rated the avoidance of near mid-air collisions as a significant or major benefit. Recalling that a portion of the pilots were in aircraft retrofitted with Chelton systems, one would assume that this rating would be higher if all aircraft had traffic displayed in the cockpit. Chelton equipped aircraft can not see other aircraft but can be seen by Garmin-equipped aircraft.

Based upon pilot ratings, the Capstone systems provide for easier enroute diversions and rerouting. Sixty-seven percent rated this capability a significant or major benefit. In a similar vein, 63% rated the Capstone benefit of more direct flights and time savings as significant or major.

The ability to identify aircraft near an intended destination and thereby solicit flight or weather information is rated by 55% of respondents as a significant or major benefit. One of the primary reasons this may not have been higher is the number of aircraft with Chelton equipment, which currently do not have the capability to display other aircraft.

## **Use, Usefulness and Usability**

Surveys in late 2005 and early 2006 asked pilots how often they used the capabilities of Capstone Phase 1 avionics and ground systems, its ease of use (relative to other avionics with which they have familiarity), and its usefulness. The array of pie charts in Figure 10 summarizes pilot responses.

The results clearly show the high acceptance rate of the Capstone individual elements. Traffic Avoidance, Terrain Avoidance, Flight Planning and Navigation have been consistently throughout the program as being used most often and rated highly in usefulness.

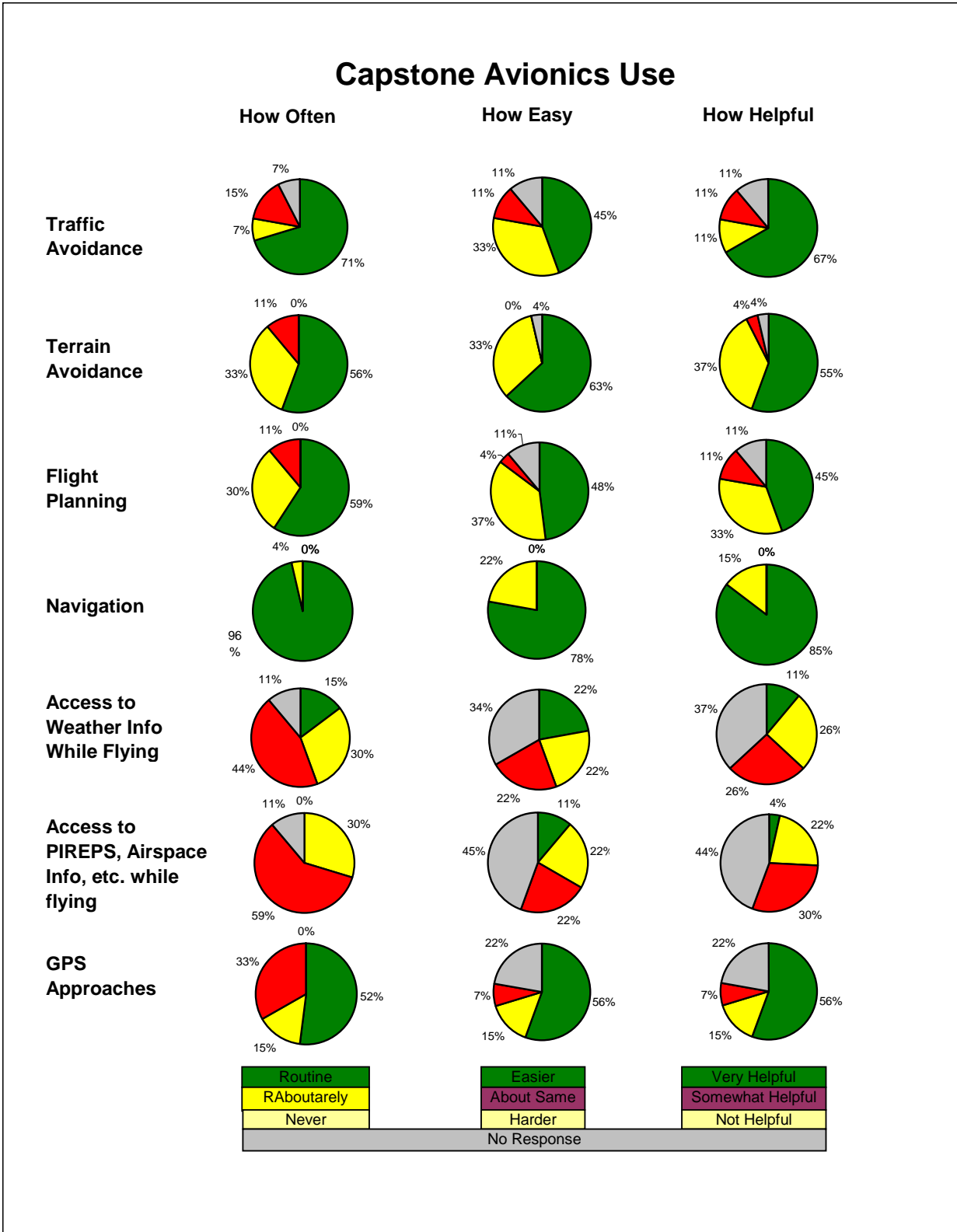
Navigation ranks the highest in all 3 categories with a 96% rating for how often it is used, an 86% rating on its usefulness and 78% on ease of use.

Traffic Avoidance use dropped from 91% in last year's survey to 71% in the survey this year. The results were certainly impacted by the 7 pilots operating Chelton equipment. If those responses are removed, since they do not have the capability available, the response shows that 90% routinely use Traffic Avoidance.

Flight Planning now is the third highest ranking in how often the element is used with 59% of the pilots stating that they routinely use the system. It also shows an increase of 14% over last year in use, usefulness and usability.

Terrain Avoidance showed little change from previous surveys. This year, GPS Approaches are being used more often than in past surveys. As noted in last year's report, weather in the Y-K Delta had been "better than normal" in 2003 and 2004, thus reducing the need for using GPS approaches. This year, the pilots stated that conditions had returned to a more normal state and therefore the use of GPS for approaches increased.

Access to both weather and other FIS-B products was not rated highly in this year's survey. This may have been impacted by two issues. As previously stated, 7 of the pilots interviewed are flying Chelton equipped aircraft without that capability and, secondly, the GBTs were in transition this year from the developmental network to the operational network. During this transition, FIS-B products were not always available.



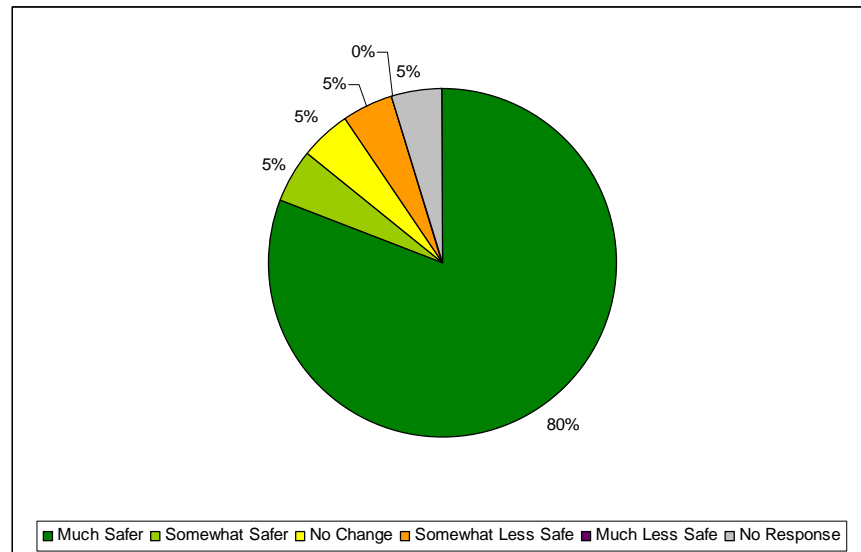
**Figure 10 Pilot reported Use, Ease of Use, and Usefulness of Capstone Services and Capabilities**

The Impact of Capstone Phase 1 Transition, Post-Transition Summary Report - 2005



The survey covered five areas or situations in which pilots think other pilots may choose not to use the Capstone equipment. Four of the five areas were rated “little or no concern” by the responding pilots. By far, the highest rated reason of non-use is not wanting to be under surveillance. At 56% this area is more than double that of any other “yes” response. Two areas tied in the number of “yes” ratings at 26%. First was trust of the equipment as related to inaccurate databases or missing data. The second was the concern that the equipment may break down when relying on the system. Only 7% thought that the equipment would be too distracting for pilots to use, and only 4% thought it may be considered too difficult to use.

Pilots rate the impact of Capstone on safety in the Yukon-Kuskokwim Delta area highly, with 85% rating it “safer” and none feeling that it was “much less safe.” Only 5 % see it as “less safe.”



**Figure 11 Pilot Rating of Capstone Safety Impact**

The fact that some rated the environment as “less safe” may seem surprising, but is backed by rational comments. The transition by the Chelton pilots from traffic in the cockpit to “no traffic” in the cockpit left some pilots feeling less safe than they had been. In addition, several noted reliance on cockpit presentations without reference to the “outside” environment.

*“Unequipped aircraft more of a hazard because the Capstone equipped aircraft doesn’t look out for traffic.”*

*“Can’t see non-Capstone aircraft is a liability to all.”*

The safety impact of Capstone in the Y-K Delta can be summarized in the comments of two pilots.

*“Capstone equipment is the best safety enhancement tool that I have ever used.”*

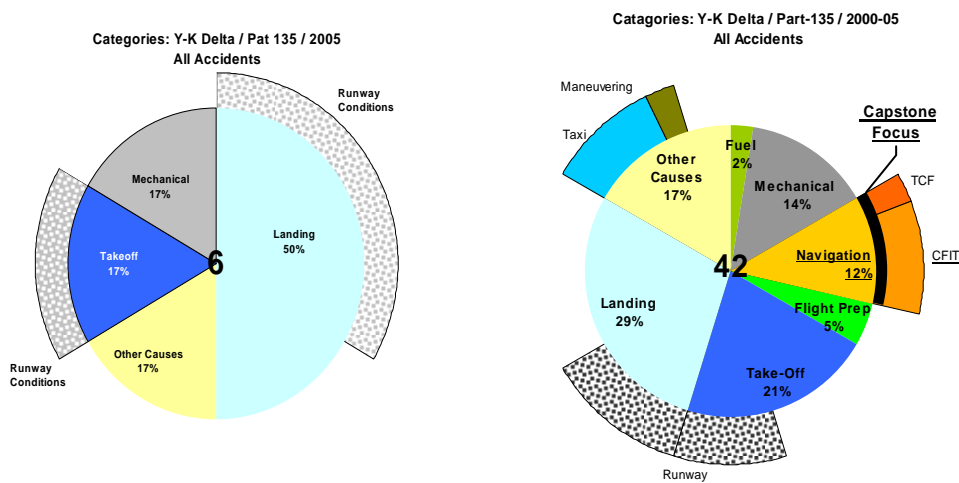
*“Not all the planes have it, so if the rest of them had Capstone it would be a lot better.”*

## Safety Expectations Based on the Capstone Program Progress

This section characterizes numbers and rates of accidents in the Y-K Delta. First, it classifies accidents in 2005 and in the 2000-2005 Capstone period and compares types of accidents between Capstone-equipped and non-equipped aircraft. Second, it compares rate changes of specific types of accidents targeted by Capstone to what we should expect if the capabilities work as hoped and progress on implementation is as we have described. The third analysis compares overall accident rates between commercial aircraft in the Y-K Delta and other parts of Alaska. It also compares overall accident rates between aircraft prior to equipage and after equipage. The final analysis compares accident counts between operator and operation types before and during the Capstone period.

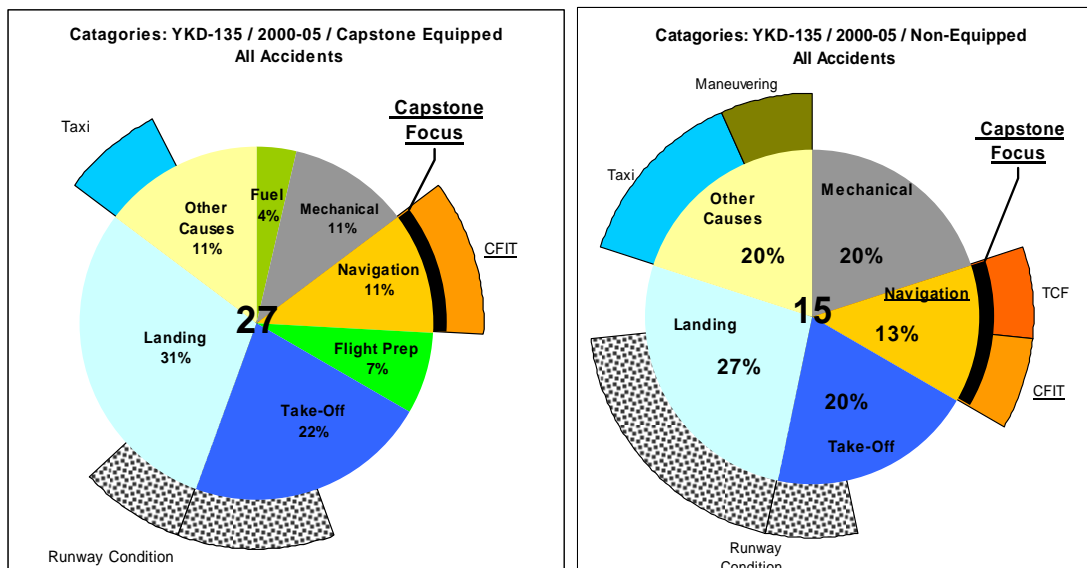
### Accidents in 2005

The left side of Figure 12 shows the accident categories of Y-K Delta Part-135 aircraft involved in accidents in 2005. The right side of the figure shows all Part-135 accidents in the Y-K Delta since Capstone implementation began.



**Figure 12 Categories of Accidents in 2005 and Since Capstone Implementation**

Figure 13 shows accident categories for Capstone non-equipped and equipped aircraft since 2000. The breakdowns of accidents by major category are essentially similar and within the levels of variation one should expect for this number of occurrences.



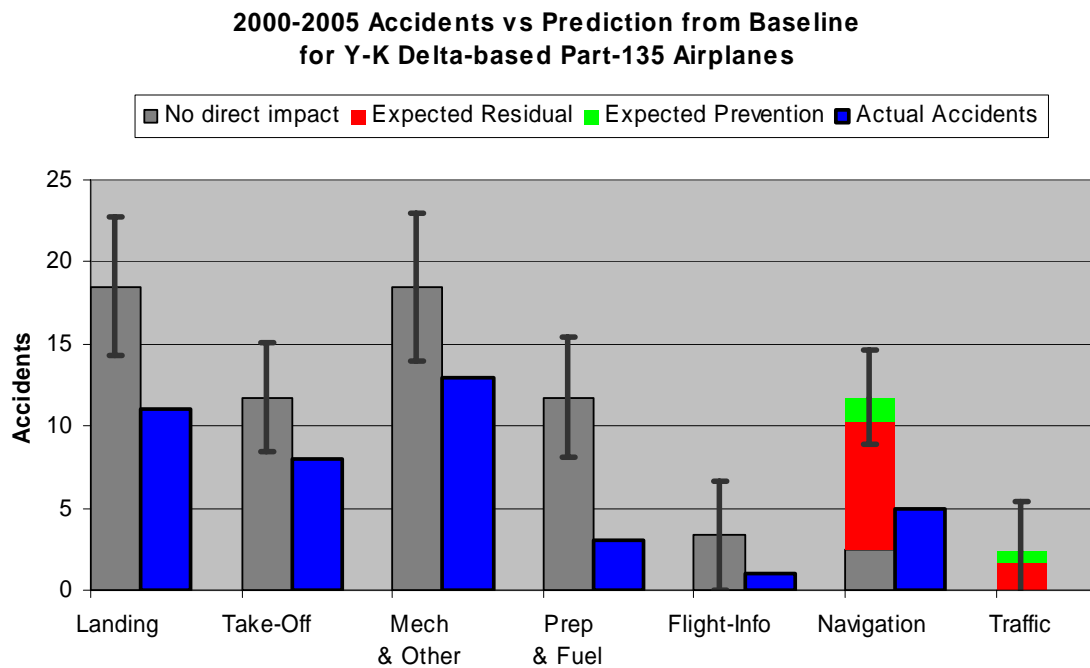
**Figure 13 Categories of Accidents by Non-Equipped and Capstone-Equipped Aircraft 2000—2005**

### Comparison of Accident Types to Projected Capstone Benefits

The safety benefit expected from Capstone depends on the types (and rates of occurrence) of accidents before Capstone, the projected effectiveness of a complete implementation, and the progress on implementation that Capstone has actually made. Since the safety impact of Capstone is best quantified over time, we expect to see changes from increased IFR capability, changes in safety posture from Capstone and other causes, and changes in operations from using Capstone capabilities in ways not predicted. As of this report, we can quantify expectations for only two of the accident types that are the direct focus of Capstone: accidents associated with navigation/CFIT and those associated with traffic.

The level of Capstone equipage and the effectiveness of Capstone training have had a positive impact on the prevention of navigation/CFIT accidents. From 2000 through 2005 an average of 78% of Y-K Delta-based Part-135 flight operations were equipped, and the average effectiveness of pilots using Capstone avionics was assessed to be 57%. For 2000-2005 we estimate 44% of preventable CFIT and 30% of the preventable navigation accidents should have been avoidable as a result of Capstone. Since warnings on Terrain Clearance Floor violations are not included in Phase 1 avionics (they are included in Phase 2), collisions with terrain during approach are not directly affected. For en route CFIT the full-implementation effectiveness was assumed to be 90%.

Progress on implementation affects traffic/mid-air accidents differently. While an average of 78% of Part-135 flight operations from 2000 through 2005 were equipped, only about 2/3 of all flights are Part-135 (the remainder are mostly Part-91 and public use). On average, if a Part-135 aircraft was at risk of a mid-air collision with a second aircraft, the chance they were both Capstone-equipped was only 52%. Even limited training levels can reduce this further. In 2000-2005 we estimate that 30% of mid-air accidents would be avoided as a result of Capstone (assuming a full-implementation effectiveness of 100%).



**Figure 14 2000-2005 Accidents vs Prediction from Baseline for Y-K Delta based Part-135 Aircraft**

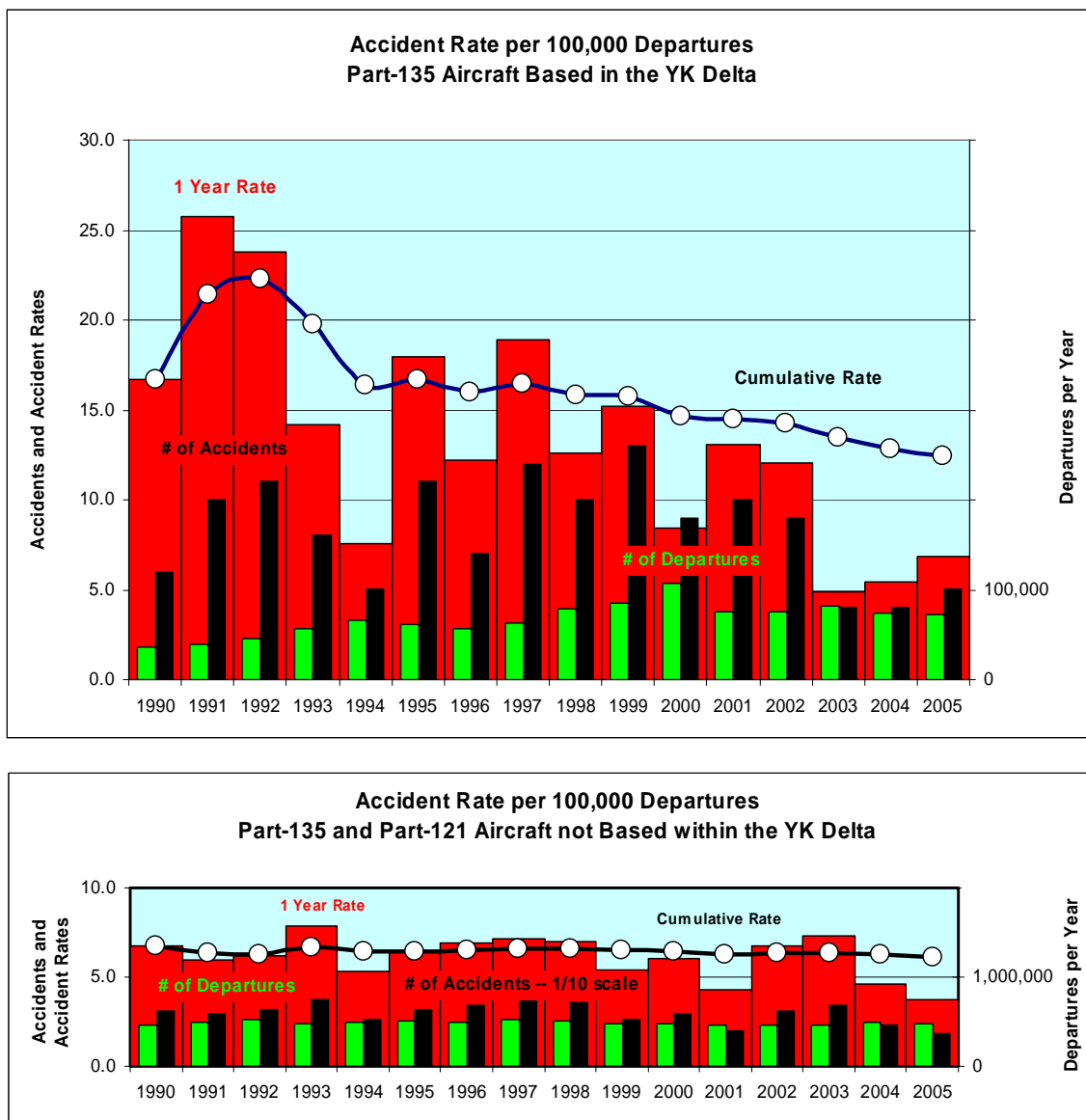
Figure 14 uses these estimated safety benefits for Navigation and Traffic accidents to project the number of accidents we should expect in 2000-2005 for Part-135 aircraft based in the Y-K Delta and compares this to the number that actually occurred. The projection uses the types and rates of accidents from 1990-99 scaled-up for observed growth in operations. The figure also shows error bars for the numbers of accidents that should be expected from history. This is the standard deviation for five-year periods scaled for growth. If there were no underlying changes in accident rates, the chance of observing a number in this range would be about 67%. For small numbers such as these, this variability is large compared to the average value (this is particularly true for fatal accidents, which are only about one tenth as numerous). In many cases, observing zero accidents is well within typical variations, and a gap in accidents will need to persist for several years before we can be certain it is significant. The estimated navigation and traffic accidents prevented by Capstone in 2000-2005 are comparable to these expected random variations. This means that further time will be needed at high levels of equipment and training before reductions of specific types of accidents can become statistically significant.

### Comparison of Y-K Delta Accident Rates to Other Parts of Alaska

Until recently, lack of data on aircraft flight hours and operations counts has constrained evaluation of accident rates in rural Alaska. Beginning in 2002, the Bureau of Transportation Statistics began archiving additional data on *scheduled* small carriers. In the Y-K Delta, some further information on hours flown by *unscheduled charter* operators (as a percentage relative to flight hours by scheduled operators) is also derivable from the flight-monitoring data archived by CRABS. Current and historical operations data and the methods by which we estimate historical operations counts are described in the appendices.

Figure 15 shows departure count, accident count, and accidents per 100,000 departures for Part-135 and Part-121 aircraft within the Y-K Delta and for all other flights in Alaska. The scale for accident rates (the

wide red bars) is the same in both the upper and lower sections of the figure, indicating that over time the accident rate within the Y-K Delta has been two to four times the rate for other parts of Alaska. From year to year, the accident rate in the Delta is also much more variable than in the remainder of Alaska.



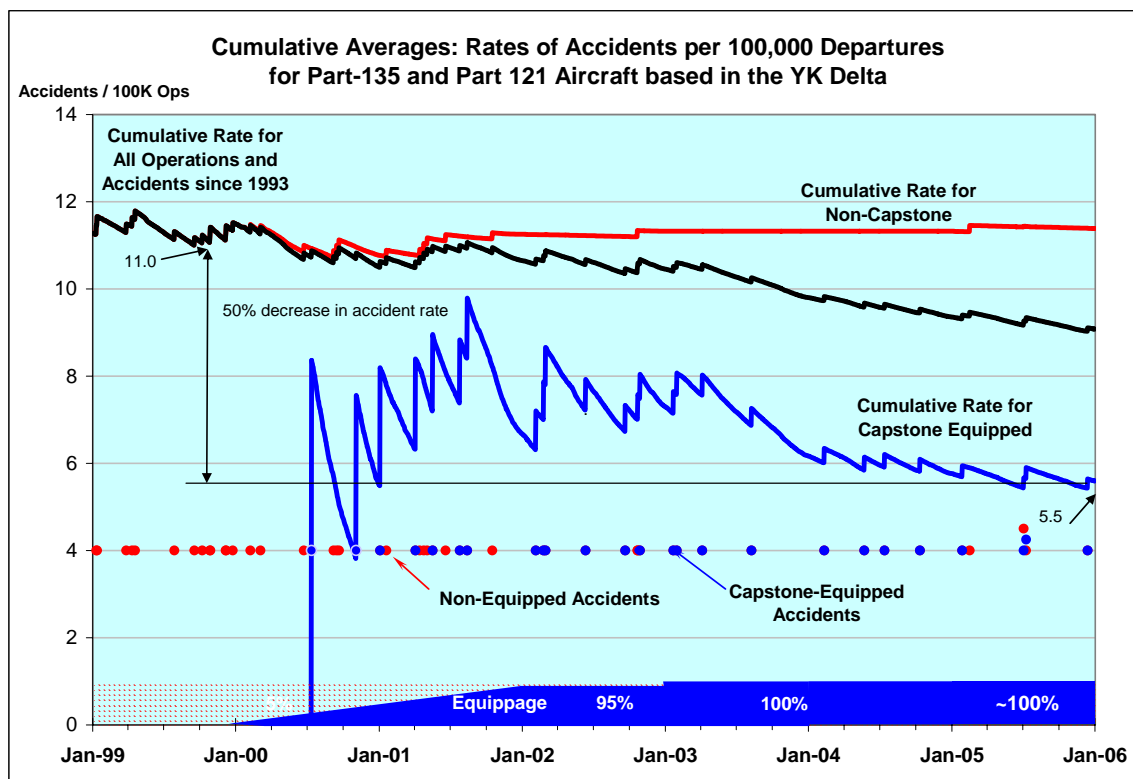
**Figure 15 Accident Rates for Y-K Delta Part-135 Aircraft and Those Based Elsewhere in Alaska**

The continuous curve (black line with white dots) on each chart represents the cumulative total rate of accidents per departure from 1990 through 2005. For other parts of Alaska, this cumulative rate has been quite stable. For operations in the Y-K Delta, there was a substantially higher rate of accidents in the early '90s from which the cumulative average has been slowly falling. The figure also shows that the accident rate for the years 2003 and 2004 for commercial flights in the Y-K Delta, all of which were Capstone-equipped, was the lowest it has been since the beginning of our accident baseline in 1990. The accident rate in the Delta fell below the rate for the rest of the state for the first time in 2003, and has remained

comparable to the rest of the state in 2004. In 2005 the accident rate increased in the Y-K Delta. It should be noted that two of those five accidents involved non-equipped Y-K Delta-based aircraft which account for only 0.9% of the operation.

### Comparison of Accident Rates Before, During, and After Equipage/Start of Services

The relative stability of Part-135 accident rates in the Y-K Delta since 1993 extends through the end of 2005 for aircraft not equipped with Capstone. A time-magnified view from 1999 through January, 2006 (using daily data), is shown in red on Figure 16.



**Figure 16 Relative Accident Rates for Y-K Delta Commercial Aircraft Without and With Capstone Avionics**

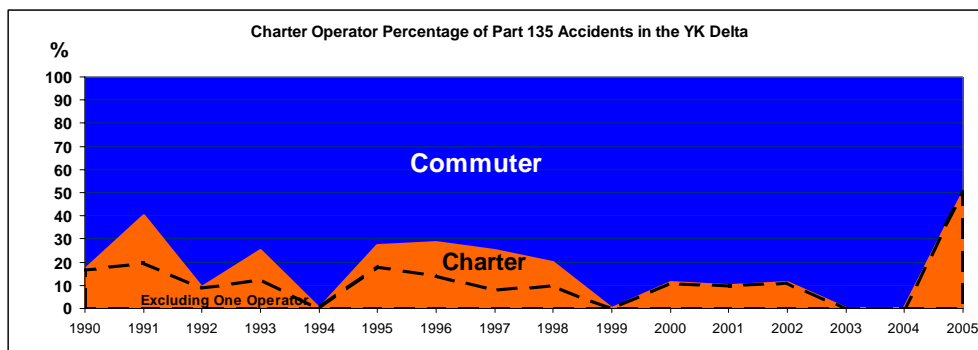
The blue line is the equivalent curve for Capstone-equipped aircraft. There were no accidents and few operations before July '00 for Capstone-equipped aircraft, so this curve is more erratic because it is averaged over fewer operations. Nevertheless, the Capstone-equipped accident rate has trended strongly towards stability at a rate significantly below that for non-equipped aircraft. The rate of accidents by Capstone-equipped aircraft is significantly lower than that for non-equipped aircraft. The percentage improvement in the accident rate from 2000 through 2005 is 50%. These results do not determine whether the improvement is due to safety benefits of the specific Capstone capabilities or to a heightened attention to safety on the part of pilots and companies flying Capstone-equipped aircraft.

### Comparison of Accident Rates Between Operator and Operations Types

Public aviation transport in the Y-K Delta relies on three major carrier types: Part-121 Air Transport operations, which fly larger, more capable aircraft with multiple crew members and have comparatively

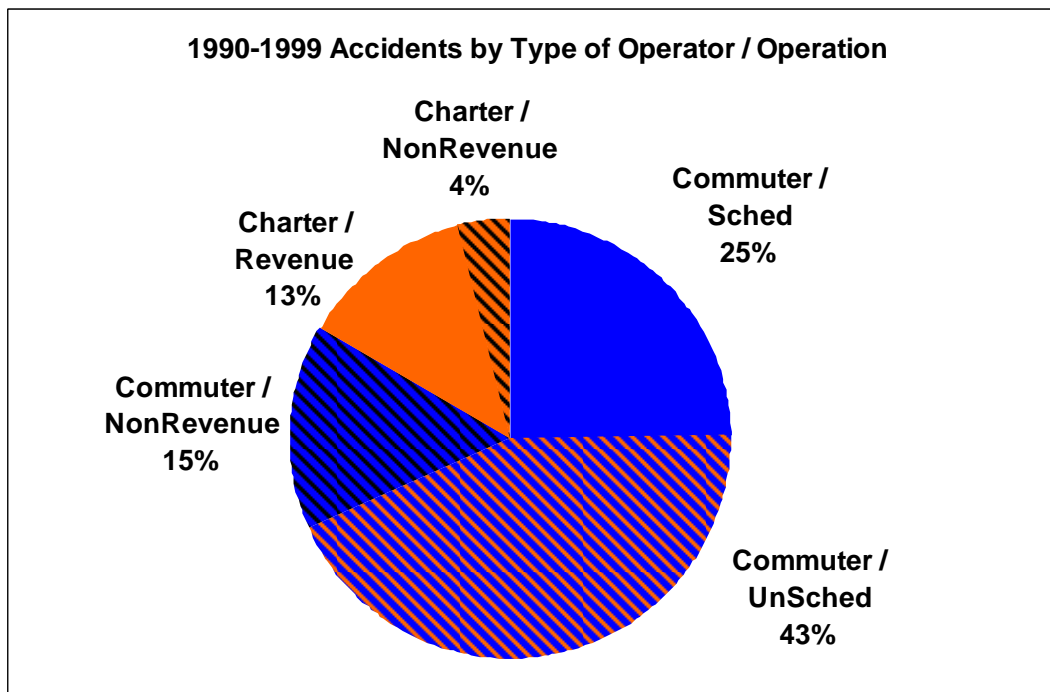
few accidents in the Delta (or any where else in the US); Part-135 Commuter operators whose operations include at least some scheduled service; and, Part-135 Charters who are not scheduled. Reporting requirements (and hence, available operations data) are very different between the two Part-135 types. Fortunately, CRABS' flight monitoring ability has provided data with which we could determine that charter flight time has averaged approximately 10% of carrier operations.

Accident rates for scheduled commuters and unscheduled charters are comparable. Figure 17 shows the variation of the percentage of accidents by charters over time. The orange area indicates that the charter accident rate has in fact been somewhat higher than that for commuters, but if accidents are omitted from one frequent-accident charter operator, the remaining rate is clearly at or less than charters' 10% share of flight time.

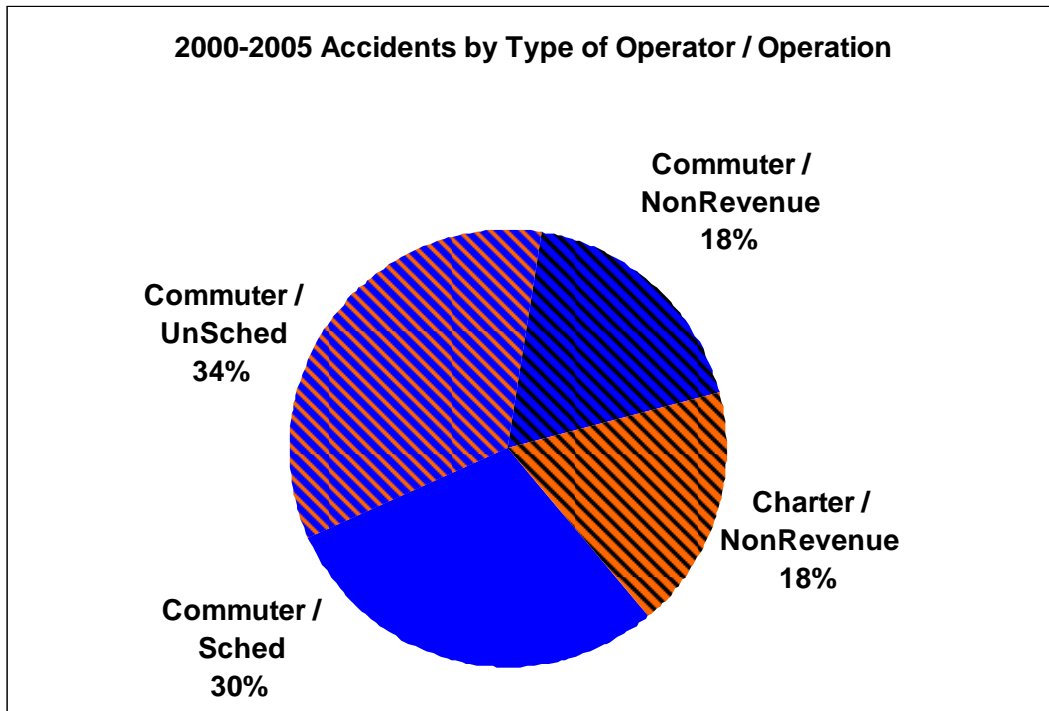


**Figure 17 Relative Accident Rates for Scheduled/Unscheduled Operators in the Y-K Delta**

Both types of Part-135 operators use non-revenue flights to ferry or position aircraft and for testing or training. In addition, commuter operators often fly unscheduled as well as scheduled flights. Figures 18 and 19 show the breakdown of historical and Capstone-era accidents for these operations types.



**Figure 18 Historical Proportions of Accidents by Operator/Operations Types in the Y-K Delta**



**Figure 19 Proportions of Accidents by Operator/Operations Type Since Capstone**