DCA11MA076

Interviews with Former Gulfstream Personnel

(22 pages)

Interview Summary

Interview: Lee Johnson
Date/Time: September 30, 2011, 0930 EDT
Location: Via telephone
Present: NTSB: Mitchell Gallo, William Bramble
FAA: Alan J. “Jeff” Borton

During the interview, Mr. Johnson stated the following information.

He had graduated from the Naval Academy, completed Navy Flight Training, and served as a carrier-based pilot. He had completed Naval Test Pilot School at Patuxent River where he worked on “all the airplanes,” the S3 program, the Lockheed carrier based antisubmarine warfare (ASW) airplane. He then worked in an ASW airplane training squadron. He wanted to pursue engineering flight test on a full-time basis, but the Navy wanted him to be deployed to sea. He then left active duty and joined the Reserves.

Mr. Johnson was hired by Grumman American in 1977. Because of crowding, Grumman moved from Long Island, New York, to Savannah, Georgia, where they began building the GII in 1968. Grumman then took over a small airplane manufacturing company called American Aviation. Mr. Johnson had experience with jets and small airplanes, and when he was hired by Grumman American, he began testing small airplanes as well as the GII.

Allan Paulson bought Grumman American, which then became Gulfstream, and then Gulfstream Aerospace. Mr. Johnson had worked for Grumman American as a test pilot, mostly on light aircraft for Part 23 certification. He had worked with several people who checked him out on how to test Part 23 aircraft. At that time, they were just beginning to certify a light twin airplane, and he helped fly the GII. At that time, Corky Meyers was president of the company. Mr. Meyers decided that the installation of tip tanks on the GII would provide the range needed to fly from the Middle East to London. Mr. Johnson flew on that project for a while.

When Allan Paulson purchased the company in late 1979, one pilot was sent along with a pilot from Grumman to work on the GIII program in Calverton. The pilot that was originally going to go had a health issue, so Mr. Johnson went in his place because he might have had the most jet time of all the test pilots at Gulfstream. He spent his time there as the project pilot on the GIII and then returned to Savannah.

Mr. Johnson became the chief pilot on the GIII and worked production flight test on the GIII. They looked at field performance and they used Mojave a couple of times. Roswell was developed as a base during the GIV program because of its altitude, since there was no penalty for extrapolation up to 10,000 feet.

In the early 1980s, Mr. Johnson became the deputy director of flight test in flight operations during the GIV program and he was the GIV project pilot and chief pilot. He held that position until he moved into the GV program, at which time he entered a non-flying position. He maintained his flying, however. In 1992 or 1993, he became the director of flight test for the GV program.

Mr. Johnson said that, until the GV program, the flight test engineers (FTEs) and pilots were their own separate little groups. They did work together, but they were not as integrated as they were in the GV program. As director of flight test, he oversaw the FTEs, instrumentation engineers and, for a while, ground structural testing. He had two pilots who were temporarily assigned to him. He handled their reviews and they returned to flight operations.

Mr. Johnson held the director of flight test position until he left Gulfstream in January 1998. After that, he was a test pilot for Boeing in Long Beach on the Boeing 717 for about three years. The MD-11 and MD-90 production lines were closed, Boeing closed down the Boeing 717 production line, and Mr. Johnson was offered, but did not accept, a position training new customers in the Boeing 717. After that, he was employed by NetJets as a pilot for nine years, flying Gulfstream airplanes. He was able to live anywhere in the United States and he chose to move back to Savanna. He retired from NetJets in the summer of 2009, after a downturn in business jet flying, and he was offered a retirement package by NetJets. At the time of this interview, he was retired and still flew small airplanes for fun. He had not decided whether to "seriously" go into consulting.

The Flight Test Standard Practice Manual was developed when Mr. Johnson became the director of flight test for the GV program, because Gulfstream had nothing in writing. They had grown from a department that had been cut "dramatically" by the previous president (who felt that they were in "production mode" and did not want to have engineering personnel around thinking of things to test). At the beginning of the GV program, therefore, they had only 5 or 6 people, a group that did not include pilots. As they grew, it became obvious to Mr. Johnson that he needed to provide a structure. After researching flight test practices with Douglas and Boeing, he developed a manual for new personnel, and to help everyone "talk the same language." They had a mix of contractors, permanent hires, and some people who were brought in from engineering, who were all "professional in their own way" but were not that familiar with how Gulfstream did business. The manual was intended to be a beginning, but also to be changed as they gained experience. The manual was based a "little" on the Navy Flight Test Center and on his experience working the GIII program, during which he spent 9 months on Long Island and found that Douglas was "quite well organized" in flight test. During his research, he visited and talked with the Douglas and Boeing flight test groups, from whom he received "real good" cooperation. They gave him organizational ideas and references. He took those ideas and created the Flight Test Standard Practice Manual. He initiated the creation of the manual by himself and everyone within Gulfstream "kind of agreed" that they needed some guidelines.

In the past, they had held flight readiness reviews (FRRs), which were similar to the safety reviews that he set up. The FRRs were intended for a major step in a program such as the airplane's first flight, but they did not have a formal process for looking at things such as when going to Roswell to perform field performance testing, was the current airplane different from the previous airplane, or was there anything they should have considered. The people in the GIV program worked together for years and one "kind of assumed" that everybody was looking at their areas and would speak up, but there was no formal process. The GV program was different because they had multiple airplanes, and Mr. Johnson thought that the methods large aircraft companies used would allow Gulfstream to effectively manage several airplanes with a lot of people and keep the program flowing. Gulfstream leadership had changed and there was an incredible amount of interest in certifying the airplane "yesterday." Mr. Johnson needed to ensure that there was a structure to do that safely. The GV had no accidents during testing. They certified it on a schedule that was a "little hectic," but it worked out pretty well, and he retired from Gulfstream after the GV program was over.

Mr. Johnson said that he had felt he needed to put into place a structure to perform flight test safely. The Flight Test Standard Practice Manual met with a positive reception overall. It was liked by much of management, pilots, flight sciences, avionics, and FTEs. It was not at the top of everyone's list to work on, but he did not sense a real reluctance toward the manual either. Some people did not like it because it took them out of their "comfort zone," but changing the organization to reflect more closely what some of the other companies, particularly Douglas and Boeing, did was a good way to manage the program.

When asked why the Flight Test Standard Practice Manual contained different flight test titles and a division of responsibilities amongst these titles, Mr. Johnson said that some of the jobs were obvious, such as the instrumentation engineer or the configuration control person. The list of positions was, however, a "nice to have" high level structure they would employ if they had enough people. In some cases, one person would perform several of those roles. The test conductor (TC) was suppose to watch the airplane, keep the schedule, come to program management meetings, and brief the progress of the airplane to them or to Mr. Johnson. Their job function was to manage the airplane and not specifically to fly. Sometimes, however, the TC would also be the FTE aboard the airplane, or the test specialist might be the TC or someone from engineering. Some of the positions were "nice to have" and some of the jobs did not get filled, depending on the program and its status. It was "between the old way and the new way." He was trying to make a cultural change, and in some cases it was well received, and in others there was reluctance, which was not "bad."

Mr. Johnson said that the FTE was to perform the initial data analysis, and it was one of the areas where he was trying to get more cooperation. He said that if there was a landing gear test involving hydraulics, the FTE needed to work with the engineering personnel who designed the system. The FTEs did the initial data analysis that came off the airplane and then they were supposed work with engineering to determine if everything looked good and was all right. The responsibilities were not dictated by schedule. When asked if the FTE should review and analyze the data with the respective department, such as flight sciences during field performance testing, at an equal or more in-depth level, Mr. Johnson responded that that was the goal but he could not say that it occurred every time. Part of the problem in dealing with engineering and some of the "turf wars" was the difficulty in sitting down with engineering to look at the data. Some of the FTEs felt that they were as good as the engineers at analyzing data. Mr. Johnson, the TC, and others would look to ensure that the data were being analyzed with the engineering department. Mr. Johnson said that pilots are accused all the time of having egos, but engineers also have egos, and they had to watch for that "continuously." When asked it would be a benefit or a drawback to have engineering solely perform the data analysis function and not have the FTE perform data analysis, Mr. Johnson said it was a good idea to have engineering perform the in-depth analysis and to have the FTE perform an initial data quality control check from the airplane. The FTE could then move onto the next phase of the test flight. That was a process that was supposed to happen but may not have happened all the time because management was not watching them all the time and they may have been overcome by scheduling or by egos.

Mr. Johnson said that the Flight Test Standard Practice Manual cited the establishment of a safety review board (SRB) that was originally intended to meet when people felt there was a new test area, a hazardous area, or a major configuration change. They tried to do it for all major changes, like the beginning of the stall and ice shape programs. He could not say that it had occurred every time, however. The intent was to have these reviews more frequently than they had occurred in the past, such as during the GIV program. They had not had as many as they should have on the GIV program, and that was something he had tried to change.

Mr. Johnson was asked whether the SRB would reconvene if the margin between the stick shaker activation threshold and the stall angle-of-attack (AOA) was reduced, or whether such a change could be made solely by engineering without SRB review. Mr. Johnson said that those were the types of things they had to "pull out" due to culture. Engineering was to brief flight test and the project pilot, and they were to collectively agree if changes warranted a review by the entire SRB or a discussion with the applicable people. When the GIV experienced its first IGE stall, they changed the AOA for stick pusher activation to prevent another stall from occurring. This was a decision made by him, engineering, and the program manager during an informal board meeting convened to discuss what they were doing. The decision was made during a meeting involving the applicable personnel.

When Mr. Johnson was asked if he experienced any pressure with the inclusion of management in the SRB and whether they were more biased toward meeting schedule than ensuring safety, he said management was biased toward meeting the schedule, there was no denying it, but he never felt it was a bias above safety. There was discussion on the number of data points needed to certify a system. According to senior management, engineers always wanted more data than they really needed. His feeling was that engineers felt they never had enough data, and there was a point where they had to agree on the amount of data they needed to certify a safe system.

Mr. Johnson said that the Gulfstream process was a carryover from Grumman's GIII program. Gulfstream was a Grumman company based in Savannah, and the senior engineers, senior production personnel, and senior flight test personnel began their careers at Grumman and had worked there so long that "they understood what needed to be done." When new people were introduced in large numbers, however, it became difficult to keep that discipline intact without some guidance, and that is what he attempted to provide, to ensure that legacy information was carried over to new people in the organization. Mr. Johnson was asked by many of the former Grumman personnel to take on the job to ensure carryover. "Unfortunately," halfway through the program, many of them were removed, or the personnel were changed. They had some pilots assigned full-time who were part-time pilots, and he worked with them to provide lessons learned. He said that the idea was to pass down lessons learned by people placed in the flight test organization so that they could attend the SRB, meetings and flight briefings to point out what had happened in the past. He said the initial flight at Roswell was done in this manner. The idea was to provide lessons learned in the GV program. That had not been there in the GIV program.

Mr. Johnson was asked to describe an IGE wing stall that had occurred during the GIV flight test program. He said that, during the GIV program, he was performing abused takeoffs with a Federal Aviation Administration (FAA) certification test pilot in the right seat, a Gulfstream FTE in the jump seat, and, he thought, an FAA FTE aboard. They first discussed how to perform the maneuver, and then during the liftoff, the airplane pitched "very rapidly" and stalled. He had seen videos of that flight. The main landing gear wheels might have been a couple of feet off the ground, and the landing gear struts were extended. The airplane rolled right and hit the right wing tip. He applied flight controls to initiate a stall recovery, and the airplane rolled left, in part due to the impact with the ground. He then "jammed in" full rudder and was able to maintain the direction of flight over the runway. They then said "wow" and "we stalled."

The on-board crew called the telemetry personnel who told them that the airplane wing tip had struck the ground, and Mr. Johnson responded by telling them that they were going to come back and land. The wingtip had scrapes on it but was otherwise undamaged. Gulfstream personnel from Savannah, including personnel from engineering, flight sciences, and structures, came out to look at the airplane. They did not fly for "a while" and it was concluded that the airplane had pitched up, similar to an accelerated stall, and had reached a stall AOA before the activation of the pusher. It later became known that engineering had not really looked at IGE when designing the GIV wing because they had assumed that the wing was the same as the GIII wing.

After the incident, they reviewed the data and determined that the AOA for stick pusher activation should be lowered so that it would activate before IGE stall occurred, in case an abused takeoff, such as applying full aft stick or by pulling too hard, was performed while the airplane was being flown operationally. They began testing with the new stick pusher activation setting after having "sort of" a review in Roswell, with a portion of it being done via conference call with personnel in Savannah. Everyone felt comfortable with the change to the stick pusher system and then they flew again.

The change seemed to work, but about a week later Mr. Johnson encountered another stall at a "little higher" altitude, with a wing drop but with no wing tip ground contact. The airplane floated down while it was still in ground effect and they were able to climb by adding power. Mr. Johnson concluded that the change in the pusher setting was not going to work. They then spent a month testing different leading edge stall configurations and became very familiar with the aerodynamics of the stall. They installed vortilons, which worked "real well," and then performed natural stalls off the coast of Georgia, some as low as 2,500 feet above mean sea level to verify that they had enough margin beyond the stick pusher for anything that could happen IGE. They finished the program, and they did not have another IGE stall, and it worked well for 25 years. His impression was that nobody anticipated that the airplane's stall characteristics would be that different in ground effect. Mr. Johnson said that, shortly before this interview, he had attended a Society of Experiential Test Pilots symposium where test pilots and engineers said they had not anticipated IGE stall to be a problem in test programs, and that is what happened in the GIV program.

Mr. Johnson was asked why he thought nobody anticipated that the airplane's IGE stall characteristics would be different from those observed in free air, and how he recognized that the GIV had stalled during the incident. He said that he had performed a lot of stalls in Gulfstream airplanes. The GII had a gap band and if some of the sealant protruded, the airplane would stall before the stick pusher activated. He had flown all of the Gulfstream airplanes, except the GVI. The stall was instantaneous with a 20 degree bank, and a pilot could roll wings level and count two seconds and recover, because the airflow would reattach itself. He was used to stalls in the airplane, so he knew that the airplane stalled. The chief aerodynamicist had asked him how he knew to apply opposite rudder and Mr. Johnson had told him that he just did it. He did not know why he applied opposite rudder. He was just used to stalls in the airplane and knew how to respond. The chief aerodynamicist had been directly involved in the data review after the initial stall and they had worked "very closely" together on the fixes to the leading edge of the wing, the vortilons. A lot of people did not hear about the second GIV IGE stall because Gulfstream did not disclose that information in order to not "discourage potential customers." Mr. Johnson was unaware that an IGE stall had occurred during the GV program because he had left Gulfstream.

Mr. Johnson was asked who currently at Gulfstream would have knowledge of the GIV program, and he said it would be one or two pilots and an FTE. The pilots were not Jake Howard or Gray Freeman. John O'Meara worked on the GIV program and would be "very familiar" with it, along with an FTE, Ken Obenshain. Mr. Obenshain was involved in the GIII program, but was never in New York. Mr. Johnson thought that an engineer who might currently be working in Gulfstream's marketing department, Bill Shira, was in flight sciences during the GIV program and might have been involved. Mr. Johnson thought there were "not too many people" still at Gulfstream who had been there during the GIV program. After Mr. Johnson retired, and after the GV wing drop, he was not asked about the GIV program. Shortly after the G650 accident, however, Mr. Johnson was contacted by Pres Henne. Mr. Henne asked him what had occurred on the GIV program with respect to IGE stall and what they had done about it.

When asked how he had disseminated hardware or software changes throughout the organization, Mr. Johnson said that, between engineering programs, management did not like to perform a lot of engineering flight test. The majority of their work was production flight testing. They had to keep the production test specifications up to date for the configuration of the airplane. The test specification was developed with the FAA to ensure that the airplane met the type design for which it was certified. When changes were made, such as to the display software or the mechanical flight controls, they had to test it, and they might have had to change the specification they were using because of the configuration change. He found that he had a hard time keeping up on the changes when he was not in management. When he became a manager, he found that the pilots did not keep track of the changes, so he created a numbering system to ensure that each pilot was aware of the changes and he held at least weekly pilot meetings where he announced the latest production specification version. That had worked “pretty well.” The FAA knew of the system and the FAA expected the pilots to have the latest revision. The system was in place for production but not developmental flight test. Production flight test was always changing, but it would have been a “good idea” to have a similar system. They did not have a numbering system in place and each airplane could differ slightly from the other airplanes, depending on their role in the program. There were personnel in his organization as well as quality control personnel that kept track of the changes to an airplane before it was delivered to a customer. There was a tracking system and during down times they would work with quality control to incorporate changes with the test coordinator of each airplane.

During the GV program, engineering decided to increase the size of the tail design and the president at the time was not told. Mr. Johnson said that that change was going to have a large impact to the schedule. Mr. Johnson said that the president was “very detailed” and he was “personally upset” that the information was not shared. Mr. Johnson said it was not a safety issue. They had to change the tail design in order to pass some of the in-flight certification requirements. Engineering felt that this was a GV program problem and they were working it. Mr. Johnson said that in the past, management had not been that involved, but in this case management wanted involvement. Almost every week they had a program review with every team and the president attended each one as if he was the senior program manager for the GV.

Mr. Johnson stated that when he was employed at Gulfstream he reported directly to Mr. Henne. Mr. Henne was hired after the GV program manager was fired as a result of the change in the airplane’s tail design. Mr. Henne set up teams and had “life and death control” over them. Anybody on that team, particularly the team leader, reported to Mr. Henne. Mr. Henne did not control engineering, however. Mr. Johnson had saved one of Mr. Henne’s reviews of all of them because it was “interesting.” All of flight test engineering, flight test instrumentation, two or three pilots, maintenance personnel that supported the airplane, and a lot of group support personnel reported to Mr. Johnson. Charles Coppi was Vice President of Engineering and

George Viteritti was his deputy, and both of them had worked together at Grumman. Bill Murphy was the aerodynamic head. Mr. Coppi had probably designed every Gulfstream wing except the GVI wing.

At the inception of the GV flight test organization, there were about 6 people who had been working on miscellaneous things that came up on the GIV. The GV program then increased over a couple of years to about 135 people during the "heart" of the program. The increase in number of personnel was another reason that precipitated the creation of the Flight Test Standard Practice Manual. The idea for the creation of the manual was to explain to people who came into the program how Gulfstream "did business." If they had an idea from their background, they were encouraged to provide it.

In the early 1990s, Mr. Johnson met with Boeing and Douglas to develop the Flight Test Standard Practice Manual. He was a member of SAE S7 committee, which dealt with handling qualities and the cockpit design of transport category airplanes. The committee had met for over 50 years and developed the basic T-design of the cockpit instruments. He had been able to talk with members of the committee, and a number of airline technical pilots, about how they did flight test and why.

Mr. Johnson was asked who had provided resistance to the implementation of the Flight Test Standard Practice Manual. He cited an example involving GIV avionics testing. He said that the airplane that was used to perform the majority of the avionics testing in the GIV program was the first integrated airplane certified under Part 25 with a glass cockpit. The FTE on the airplane was also the test coordinator and the TC who looked at the data and planned the next flight. The FTEs liked to fly and perform data analysis, and Mr. Johnson respected this. When they were flying, they could not do anything on the ground that could help plan for the next day, but the FTEs worked long hours and tried to do both jobs. After talking to Boeing and Douglas and having watched what had been done, Mr. Johnson said that they could not keep up the required pace, so he decided somebody would have to be on the ground to handle the "care and feeding" of the airplane, and the FTE could not be both the airplane scheduler and the lead FTE on the airplane. He preferred that an FTE be the airplane scheduler because of their experience.

Mr. Johnson said that after he worked on the Boeing 717 program, he thought Gulfstream should have used more engineering personnel on the test airplanes, but he added that it "would not have done that much." Most of the FTEs who worked on the GV program had agreed to do one job while others did not want to do only one job because they wanted to keep flying on the airplane. There was one person who was "very good technically" and wanted to do both jobs. Mr. Johnson asked him how he was going to do both jobs and also provide briefings at GV meetings with Mr. Henne. This person replied that Mr. Johnson could provide him with personnel to do that for him while he was flying. Mr. Johnson said that the FTE then chose to do only one job. Mr. Johnson said that they were not happy, but most of them understood. Mr. Johnson said that the more senior personnel who were brought in from other organizations and larger companies said that this was the way to do it, referring to the division of job functions that Mr. Johnson wanted to put in place. Sometimes, however, when contract personnel ran the airplane, the full-time employees would get upset. The FTEs had to make a choice, however, and they did “very well in their area.” Mr. Johnson said he had made a decision, and he could not say that it was most popular one with everyone.

When asked how the division of labor was structured between flying the airplane, collecting data, and data analysis and whether this division was an area of contention, Mr. Johnson said that the personnel who flew the airplane had the test cards and knew what to do and would work with the FTEs. They would look at the data and sometimes the other FTEs working on the airplane would look at the data while the lead FTE would prepare for the next flight. Sometimes data were provided to another FTE who would analyze it with engineering. It was not as formal a process as it should have been. As an example, the engineer responsible for the landing gear would determine what was going on and deal with the FTE on the airplane who was doing the test. He could not say that he knew every step in terms of what each person would do, but the idea was that between the two, they would look at the data to see if it was correct and agree if they should continue testing. For the most part, coordination was “pretty flexible” and “adequate.” Occasionally, there were some engineers who would not come out of their “comfort zone” and go over to the main building. Some FTEs occasionally felt that they knew everything, so they had to deal with those issues as they arose. It seemed to work “reasonably well” when they were doing in-depth data analysis and looking at the data.

Mr. Johnson said that the FTE who was assigned to a certain test area would usually write the test report and invariably would have a signoff or would coauthor it with the engineering department. He said that this was during a transitory phase moving toward what might be a better way. He was not sure if a different direction was undertaken or if the process continued after he left. He said Boeing at Long Beach had a very involved process with engineering. Boeing had a Yuma base that Boeing had daily flights to. The people responsible for a system would fly out to Yuma or would be on a conference call during each debrief. Boeing seemed to have a “very active” and “better” relationship with engineering than he had seen while on the GV program. Mr. Johnson said that during the GV program he had a conference call system put in place and had daily calls, which resulted in a “little bit” more participation because people could just call in and not have to come to the flight test trailers to participate.

He said that during the GV program, it was typical for engineers from the engineering department to be present during tests. Some engineers would be more interested in attending than others, and a lot of them would come down for debriefs. During the tests, he did not remember how they tracked time slices during GIV testing, but during the GV program the tracking was more digital. Engineering was involved to a greater degree after the test but they would occasionally fly on test flights. For example, Mr. Murphy would go on test flights “quite often” during the GIV stall program, trying to determine how to prevent IGE stall. He wanted to see what the wing tufts looked like with the latest configuration, even though videos were taken. The flights were hazardous and Mr. Murphy had been on airplanes “off and on” throughout his career, but he took a “real hands-on” approach.

Mr. Johnson said that if they began looking at a particular problem, they would get more engineering support. If things were going along as they thought they should, then engineering was not as involved, but he added that “maybe they should have been.” Engineering got “really involved” if they ran into something that flight test thought was wrong, like the IGE stall that had occurred on the GIV program. Occasionally, they would call engineering to tell them that they would be debriefing a flight, and engineering’s response was, “Yeah, ok!” When they would have a problem, engineering would “mobilize and become very effective,” but in some cases, it was “after the fact” as in the case of the GIV IGE stall. He thought they got “real good” support after the GIV IGE stall. Mr. Johnson said he did not think anybody anticipated the IGE stall during the GIV program and “unfortunately” it was probably at the top of the list of lessons learned from every test project that one should not assume a test was “going to go swimmingly because it always has.”

When Mr. Johnson had contact with Mr. Henne after the accident, Mr. Henne did not mention any coordination issues between flight test and engineering in the GVI program. When he worked with Mr. Henne, Mr. Johnson learned that Mr. Henne answered emails with the least amount of words of anyone he had known. Mr. Henne was “high speed” and “very intelligent.” After the accident, Mr. Johnson had sent an email to Mr. Henne and one to the person in charge of Flight Operations offering his help. Sometime later, Mr. Henne sent an email to Mr. Johnson saying he was “going to the source” to ask what he was doing when he had the incident during the GIV program. Mr. Johnson responded with a summary and Mr. Henne replied by saying “Thank you that was very helpful.”

Mr. Johnson did not know the pilots and FTEs who were killed on the accident airplane, but he had met Kent Crenshaw once while they were training at Flight Safety. One of the FTEs on the accident flight had worked for Mr. Johnson, but Mr. Johnson did not remember him.

Mr. Johnson said that what was interesting, following the GIV IGE stall, was that, at the time, the personnel in the telemetry trailer were tracking the airplane with a high-speed camera. The video from that camera was converted so that it could be viewed on a television. Copies of the video were immediately made for all of the personnel involved. Mr. Johnson then received a phone call from a senior manager telling him not to make any copies of the video and to confiscate any video he saw because he did not want customers to hear about it until they knew what was going on. Mr. Johnson said he did not think he could get all the copies, so the senior manager told Mr. Johnson to tell everyone that they would be terminated if they showed the video to a customer. They did not want to “panic the customer” until they knew what was going on.

Mr. Johnson told Mr. Henne in a post-accident email he wrote to him about the GIV IGE stall that senior engineering people who worked on the GIV program had been more concerned with the new wing's performance at high altitude stall at cruise Mach, because that was where the airplane "makes its money." They had not done IGE wind tunnel testing. They thought that the GIV wing was going to act the same as the GIII in ground effect. Mr. Henne asked Mr. Johnson during their post-accident phone call whether the GIV IGE stall was a V_{MU} test or a one engine inoperative (OEI) continued takeoff (CTO) test. Mr. Johnson looked at his notes and told Mr. Henne that it had been an abused takeoff test with full aft stick. He told Mr. Henne that people had decided not to perform IGE testing because they had not felt that the change from the GIII to the GIV wing warranted it. After Mr. Johnson provided that information, Mr. Henne's only response had been to thank him and say that the information was "very helpful."

When asked what aspects of the GV wing design made the wing stall at a lower AOA in IGE, Mr. Johnson said he did not know, but there was a possibility that it was analogous to an accelerated stall because the airplane pitched "pretty rapidly." The GII, GIII, GIV, and, he suspected the GV, would lose lift inboard on the right wing as did some of the Grumman military airplanes he had flown. The GIV wing would lose lift on the first 2 or 3 feet of the wing and form what Mr. Murphy called a "bubble." It was basically a loss of lift in that area, and what would happen is that, at a certain AOA, that phenomena would appear on the wing, and the wing would instantaneously lose lift and drop. The vortilons were designed to provide an aerodynamic fence to delay the loss of lift to the ailerons so that they were beyond the degrees AOA for the stick pusher. The vortilons were not used on the GV wing because the wing and engines were different and engineering looked at it and felt it was not a problem. The aero engineers all thought the vortilons were "ugly" and "did not like them," but they worked. Mr. Johnson suspected there was a conscious effort to avoid the use of vortilons on the next airplanes.

Mr. Johnson said that a cognizant engineer would come from engineering, rather than being a flight test person. The Flight Test Standard Practice Manual was based on an ideal organization and on what he could find. They never had the personnel to fill each position. The test analyst might be the engineer who might be the helping the TC who might be the test specialist. The analyst might be the backup engineer. The role of the cognizant engineer was based on previous experience, and that person would be similar to the test specialist and TC. The test specialist was a person who was "quite familiar" with the system being tested. They did not have a dedicated instrumentation engineer on an airplane but they had an instrumentation group.

One of the problems, depending on the background of subsequent personnel who came into the program, was that the titles of the roles might have changed overtime. The roles were defined in the Flight Test Standard Practice Manual, but their definitions would basically change from test to test depending upon resources. The particular positions were "pretty defined," but sometimes the backup positions had to be slid back and forth. Once the company was actively flight testing, it was hard to actively recruit more people and get them trained, or at least get them to understand the airplane. The roles were fluid since they were moving from a one- or two- to a multiple-airplane program while maintaining intact discipline.

The previous owner of the company, Mr. Paulson, did not want to maintain a flight test organization. He said they had to “hide everybody” in the company between programs, and it was “very difficult” to maintain “continuity of experience.” They managed to get a lot of the personnel back when they started planning the GV program. Mr. Johnson said that Mr. Paulson’s thought process was that “we are in production, we want to put them out, we want to make money.” Mr. Johnson wanted to keep a flight test airplane, but Mr. Paulson told him that if they had a flight test airplane then engineering would have something to test and it would cost him money. Mr. Johnson said that was how he had ended up with six people in the flight test department.

Mr. Johnson was asked whether data analysis of V_{MU} testing preceded CTO testing. He responded, yes, because that was a starting point to determine how slowly the airplane could take off. The analysis was done by flight test engineering, in conjunction with flight sciences. He was not sure, on an hourly basis, who did more. They worked together.

Mr. Johnson was asked how V_1, V_R, and V_2 were determined after V_{MU} testing. He said he did not know the actual process. Engineering provided the values. They performed different tests using different trust to weight ratios, and after V_{MU} testing was completed, they began to look at the “takeoff numbers.” He did not remember the actual formulas. The extraction of lift coefficients and the construction of IGE lift curves from test data were usually performed by flight sciences personnel who provided that information to the FTEs. The FTEs would develop the test cards. He could not remember the details.

Mr. Johnson said that the stall warning systems he had worked on were on the GII, GIII, and GIV. The GII, GIII, and GIV had a stick shaker and a stick pusher. On a steady state deceleration, the stick shaker would trigger and at the critical AOA, the stick pusher would trigger and would lower the AOA by 2 degrees, as he remembers. The airplane had an alpha dot term to compensate for acceleration into the stall. On certain airplanes one could pull fast enough to get a stall but not a stick pusher because the alpha dot term was not be enough, but it would handle most cases. The airplane had to be airborne before the stick pusher could trigger. Occasionally, there were customers who pulled fast enough that the stick shaker would trigger, but not the stick pusher. Every airplane had that basic system and he did not know what was installed on the G650. He did not remember what the margin was between shaker, pusher, and aerodynamic stall. He did not remember what the difference was between the stick shaker and stick pusher margins.

Mr. Johnson said that after the GIV IGE stall incident, he had performed so many stalls in the GIV that he thought he could do them in his sleep. They would typically take it 2 degrees past the stick pusher to ensure that they had built in a little bit of margin. He did not know what the margins were in the GV and GVI. The margins were there to compensate for the IGE stall decrement. The lowest altitude at which he had performed an aerodynamic stall in the GIV was 2,500 feet mean sea level and he had found that there was a “pretty good margin.”

In the final GIV configuration with vortilons installed, they had performed aerodynamic stalls beyond the point where the stick pusher would have triggered, with the stick pusher disabled. They then tried changing the pusher AOA trigger point using a “curve” that would affect stick pusher activation so that it would fire at a lower AOA IGE up to a certain altitude and, above that, return to the schedule that was already in place. When that did not work, they installed vortilons and went back to the original stick pusher schedule. One of the concerns was that if they got “too exotic” with the IGE stall protection, V-speeds and takeoff performance would be affected. They wanted to allow the operator to operate from small airfields and thus sell more airplanes. He thought that would also be a concern with the GVI. Mr. Johnson said that he did not think much had been done with IGE analysis on the GIV, prior to the incident, and thought perhaps he had been “naive enough to assume that it was done,” but it was not. Nobody had expressed any concerns that the stall characteristics would be different from the GIII. There was not a particular program to determine the stall AOA IGE because, in the past, it had not been a problem. As a result, not enough build-ups had been used in flight testing. Looking back, that was a lesson learned.

When Mr. Johnson was asked whether test card procedures were limitations or flight test crews could deviate from them, he said that they almost always were on the radio with the ground station. The ground station would give them power settings based on weight. There was a lot of communication and, especially when the crew was working closely with somebody on the ground, they would not modify the card on their own without talking with them about it because they had briefed the card. One of the things Mr. Johnson had tried to stress was that they should brief the card, fly the card, and then you report what they had done. If they got to a point on the card where they realized that they could not go from one point to the next then there would be a discussion with the ground station to make a decision “on the fly.” The card development was usually done with the help of engineering, depending on test requirements. The cards sometimes had engineering involvement and sometimes did not, depending on the type of test.

Mr. Johnson was asked if pitch limits were specified in the test card procedures for takeoff performance testing. He said they were not at the time, but there was discussion of it later. They had talked about it somewhat in the GV program. Initially, it was not talked about, and it was a “hindsight” thing. What made it a hindsight thing was that there were a couple of ways to do the test and handle the mechanics of it. When they had the IGE stall incident, there had been some discussion with on-site FAA personnel and company engineering regarding whether they could obtain the same data with the same technique, whether it was appropriate, and whether they needed to fix the airplane. The discussion was basically about what went wrong. They did not feel it was necessary to have a pitch target because of previous programs. The onsite FAA were working closely with them and they felt that they were all in sync. He did not recall the test card specifying an initial target pitch attitude when he had done CTO testing, because when the Gulfstream airplanes were rotated, especially at higher power settings, the airplane typically "jumped off the ground." As soon as they got past a negative AOA, which was not a very high pitch, the airplane would "leap of the ground," and then they would transition to maintaining the speed to fly it out until the test point was completed.

He did not recall having any problems capturing V_2 or climb speed, in terms of overshooting or undershooting it. They had encountered problems trying to decide the trim settings for takeoff. They had come up with a trim that would allow the airplane to be in trim at V_2 if an engine was lost after V_1. The airplane could take off with full nose down or up trim. The green band on the trim wheel was the whole wheel. After doing "a whole bunch" of those takeoffs, a pilot got a feel for the airplane's pitch. They were not looking for a number and they were not asked to match a number. The idea of the trim setting was to be in trim at V_2 with OEI.

When asked how pilots would know they were safely away from stall, Mr. Johnson said he did not remember that being discussed in that manner, but it might have been part of the briefing. During the GIV program, they would see the AOA indication in the cockpit. Although it was not calibrated, it was close. When flying, a pilot could see how close they were to the stall AOA. They were not really briefed on that. Nobody worried about it while doing those tests, because they had the stick shaker as a warning and they were not doing any accelerated maneuvers, so it was "not felt to be a real concern."

Asked how the other departments became involved after the GIV IGE stall incident at Roswell, Mr. Johnson said that a couple of people from flight sciences were present during the incident and afterward information "propagated very fast" back to the company. A team came out to look at the airplane, examine the data, and to talk to them. There were a lot of conference calls that followed after they had looked at the incident. Mr. Johnson did not remember if he had called the flight test director or whether the FTEs had called the director before he got back to the hangar.

Mr. Johnson was asked whether, if the wing tip had not touched the ground, the company response would have been similar or different. He said that three weeks later, after the change to the stick pusher setting, he had the same thing happen and the wing did not touch the ground. He recovered the airplane while he flew IGE down the runway. They had gotten on the phone with the same people and, as project pilot, he told them that since it had happened before, it was "unacceptable." He said they felt that the customer might have the same thing happen to them.

Mr. Johnson said GI through GIV airplanes had a negative AOA as they rolled down the runway, and their stick forces were "momentarily be heavy" until the airplane got past the negative AOA. After AOA increased into the positive range, stick forces would drop off "dramatically" and be "very comfortable." A point he had made was that if somebody did not feel they were getting a response, they might pull harder and encounter a similar incident. Had that been the first incident, he felt they would have had a large response, but with a different makeup of people, because that was something that nobody had anticipated. The response would have included aero personnel and flight sciences would have been involved right away. If they had not, he would have gotten them involved. If it had been the first incident, they might have stayed at Roswell for a while rather than returning to Savannah.

Asked what he would think if somebody reviewed the GIV IGE stall incident and told him it had resulted from pilot technique, Mr. Johnson said he would have probably said that he and the FAA pilot agreed that it was the technique that was supposed to be used. If there was a different technique to be used or could be used, then it should have been discussed. There had been no hesitation about what they were doing. There would be a lot of discussion about whether they could do it differently and get the same results and meet the FAA requirements. If they had said it was due to his technique, he would have asked what was wrong about the technique. The whole team had agreed with what they were doing. If they were all wrong, then they had to change it. There had been discussion with the program people to see if it could be done differently and not change anything on the airplane, because they did not want to change anything if they do not have to. His concern was that somebody was taking off from Teterboro at night at maximum gross weight might pull early because they were worried about lifting off. Most people felt that they could not have an airplane that had experienced an IGE stall and do nothing about it, especially with the FAA on board. The company would not have accepted it. The FAA was present during the IGE stall incident, which made it obvious. The FAA was okay with the initial fix, but they were "real concerned" after the second IGE stall incident.

During GIV and GV takeoff performance testing, the rotation technique they used was a "hard" pull, but not a "jerk." They would pull "pretty strongly" to an attitude to attain a speed, because the key was to rotate as soon as possible and not use up the runway. When asked what a jerk control input was like, he said that it was a momentarily pull of X pounds of force up to what the FAA thought might be too much force. If you thought the airplane was not rotating as fast as it should, if you were worried about runway length, or if you were used to flying a different airplane, you might pull harder with a lot more force and more abruptly. He added that he could not quantify too well what a jerk input was like. He said that they always taught customers to "pull steady" and they tried to warn them that it would be "a little heavy at first" but it would "immediately drop off and be nice and light" and they should not pull "super hard" or "abruptly" because the airplane would "jump up into the air" after it was past the negative AOA. Most people who had flown the airplane understood that.

Mr. Johnson said that customers would return to him to tell him that they thought the takeoff speeds in the airplane flight manual were wrong because when they rotated at V_R and the airplane was airborne, they looked down at the runway and felt that there was no way to stop the airplane on the remaining runway. Mr. Johnson would ask them how fast the airplane was as it passed the end of the runway. They would say that the airplane was well past V_2. He explained to them what the takeoff speed values required and what they would have to do to achieve those values. He said they rotated "so gently" that the airplane was airborne, passing the end of the runway, and was probably past 200 knots. They tried to explain to people that if they were worried about performance, they would have to pull, but not jerk, the controls. If they were right at balanced field length and saw the end of the runway approaching, they got a little nervous and might pull harder that they would during a takeoff on a nice day at Dulles Airport.

Mr. Johnson said they never used a rotation technique involving 50-60 pounds of column pull force or a step input during rotation. They would use "one continuous pull on takeoffs." If you pulled at 50-60 pounds of force during rotation in the GIV, the pilot might reach the stall AOA before the airplane was out of IGE. In terms of a normal rotation technique, they would not use a step input as a normal technique, because it was not required and it was not necessary, based on the Gulfstream airplanes that he had flown, and because it would not be comfortable for the passengers. He did not think that kind of rotation technique was necessary. Mr. Johnson was asked if when demonstrating airplane certification requirements for takeoff field performance would pulling up to 50-60 pounds of force with a step input at rotation be considered a normal technique. He thought that rotation technique "might be a little excessive," and he did not think that it would be "a good idea" on a OEI takeoff because the pilot is trying to maintain directional control, trying to rotate, and "there would be so many things going on" for somebody that was "surprised," which differs from a test point where the pilot anticipates the maneuver, especially at 50-60 pounds. He did not think that the FAA would accept such a rotation technique. Mr. Johnson said that, Gulfstream airplanes, prior to the GVI at least, were not geometry-limited at normal takeoff speeds. At the higher thrust to weight ratio, the airplane could be rotated and might not lift off right away. He could not remember if Gulfstream airplanes prior to GVI were control-limited in pitch.

Ed Wilson was the name of the FAA pilot in the right seat during the first GIV IGE stall incident, which had occurred during certification flight testing. They had done a lot of tests with the FAA aboard so that Gulfstream would not have to repeat test points with the FAA after those test points were completed. The FAA would typically fly along and observe, and they would sometimes perform test points but they would usually not perform endpoints. Mr. Wilson would perform the test points where an engine was shut down during takeoff because that was considered an FAA test. Mr. Wilson would perform a couple of test points to ensure that he was in agreement with the data and check his test points with Gulfstream's test points.

Gulfstream had not experienced an IGE stall with the GIV during developmental testing. The first incident occurred during V_{MU} testing, but back then it was called an abused takeoff. During those tests, the stick pusher was active, and it was not a "crutch." The pilots avoided thinking that the stick pusher was always going to protect them because it would not.

Mr. Johnson did not remember changing takeoff technique as he learned more about IGE stall. When the FAA flew along, they would add time delays to the technique. He thought that the company was probably more aggressive in achieving the V_2 test point than an operator would be if they had just lost an engine. He said the "beauty" of concurrence with the FAA was that they were there watching and they would work out those details. Mr. Wilson was an “easy going guy” but if he did not like something, he would say so. Mr. Wilson would tell them during certification testing that they, the Gulfstream test pilots, were not test pilots now. They were corporate pilots and they had to “back off.” During both of the GIV IGE stall incidents, Mr. Johnson was at the controls.

Mr. Johnson said that if an airplane chronically overshot V_2, he would, as a test pilot, try to figure out if he could pull a “little harder,” but he would not necessarily use a step input to try to attain V_2. There would be crew coordination to ensure that he was starting the rotation at V_R. If the monitoring pilot waited to see V_R and then called out “rotate,” the airplane would be 2-3 knots or more past V_R, so they might look at calling “rotate” 2 knots before V_R. The first thing he would look at is that he might not be pulling hard enough. Occasionally, they might get the stick shaker and say, “Okay, that’s not working.” Based on the V_{MU} work, they would be “a little reluctant” to get “too aggressive” in continuing the testing if they were still unable to achieve V_2. They would sit down with the aero personnel and everybody and look at the numbers and see what they were getting and why and decide whether this particular point was worth pursuing. He said the test pilots tried their best to get the test point for the engineers and if they could not get it, then they would talk about it to see if they had to “pull harder,” and they would discuss whether the test point was attainable.

He said the FTEs were required to complete flight test reports and they were never completed soon enough for management. That was a “management pressure area.” There was no specific time frame within which a report had to be completed and he could not cite a typical time required to complete a report. The report completion time depended on the subject. The FTE reports would have to go from the FTE to engineering and back, so there was constant pressure to keep track of the reports and to get them done. About halfway through the program, it was felt that reports were not being completed fast enough. The test pilots would write their own reports to document anything that they noticed or what they thought should be considered, such as the color of lights or the airplane’s characteristics. Some pilots wrote detailed reports, while others did not. Mr. Johnson’s goal for the pilots was to make the pilot reports “quick” and “brief” so that they would be completed quickly. Pilot reports were written during both the GIV and GV programs. The pilot reports were separate from FTE reports and did not become part of the FTE’s developmental flight test reports.

Mr. Johnson asked to consider a scenario in which an FTE had written a V_{MU} report that was still in draft form about two months after the V_{MU} testing was completed and a person from flight sciences said they did not realize that a certain takeoff speed had to be changed until they had read the FTE’s draft V_{MU} report. Mr. Johnson was asked if such a scenario would signify a “disconnect” between flight sciences and flight test engineering. Mr. Johnson said that the example sounded like a rhetorical question. He would call it a “disconnect.” He regarded the two month timeframe as “kind of gross.” They tried to have flight sciences look at test data simultaneously with flight test, especially in the area of field performance, because so much was dependent on the numbers that were obtained after the airplane was delivered to flight test.

Mr. Johnson said that during the GIV program, he was told that they had not concentrated on the IGE characteristics of the GIV wing. At the time, he did not have the time to pursue what could have been done differently if IGE testing had been performed prior to the IGE stall incident. He did not have the time to look into why IGE had not been examined in greater depth because the focus had turned to developing a solution to the IGE stall problem. They did not draw “that kind of connection.” Mr. Johnson said there had been a lot of work done to design the wing to get the most efficient performance at cruise altitude, because most customers wanted to fly non-stop around the world if they could. Once they got the wing design to where they wanted it at cruise, they shifted their focus to takeoff performance. Mr. Coppi wanted a “nice smooth wing” without any bumps, such as from flap tracks, to distinguish the airplane from competitors.

Mr. Johnson said that a preliminary marketing analysis of the airplane would say that the airplane could fly 4,000 miles with eight people aboard at 0.80 or 0.85 Mach, and it would be able to take off at maximum gross weight from a 5,000 foot long runway on a hot day. Those values were provided to flight test and engineering to determine if the criteria could be achieved. During the GIV and GV programs, he never felt they had made any “sacrifices to meet the marketing goals” for the airplane. There were subtle changes if they could not meet the marketing criteria. They looked at V_2 and marketing criteria in an effort to achieve those values that would then make marketing “happy.” It was always done with the caveat, “Can we achieve those numbers safely?” They did not feel any “undue pressure,” but marketing might have been “pinging” on engineering, telling them flight test was saying that the airplane could not take off with full passengers, and what could engineering do about it. It was a team effort. There was not “undue pressure” on flight test. If there was such pressure, it would have been directed at engineering to make it happen.

Regarding pilot assignment for test flights, Mr. Johnson said that during the GIV program, they had three or four pilots and he would work with the director of flight operations to discuss which pilots, based on their backgrounds, would perform particular tests. Two or three of the pilots performed the critical flight tests, and they brought other pilots along on those flights to introduce them to the tests, depending on their backgrounds. If a pilot was a military-trained test pilot school graduate it was sometimes easier to get that pilot up to speed than a pilot who had not done flight testing before.

During the GV program, they had more pilots with a fair amount of experience and Mr. Johnson would work with the senior person from flight operations to determine which pilot had the experience to work on a certain program. Training was performed by having a pilot fly as copilot on certain test flights and if they did not think that pilot was ready, they would not have that pilot perform critical tests. They tried to expose as many pilots as they could to the testing they were doing at the time. During the GIV program, the pilots who provided instruction to the other pilots were Mr. Johnson and his manager, and sometimes Mr. Johnson's manager's manager, who had many years of experience at Grumman. There was not a person designated as an instructor because they never had the time or an airplane to train on. A pilot who provided instruction was a pilot with a lot of experience, or the project pilot.

Mr. Johnson said that the briefing for fire firefighting and crash rescue teams that was specified in the Flight Test Standard Practice Manual would be done on every program. Rescue personnel were invited to see the airplane. They were shown the emergency exits and the areas where they could cut into the fuselage. During the GIV program, the head of the ground crew in Roswell had invited the rescue personnel to see the airplane.

During GIV and GV field performance testing, not every certification flight was flown by the FAA. The FAA would accept company data by validating a test point, such as taking off at maximum gross weight and shutting down an engine, to ensure that the test point correlated with company-provided data. The percentage of field performance flights performed by the FAA was maybe 25 percent, with the remainder performed by company DERs. It was not 50 percent, and it the proportion depended on the test points. Most of the FAA personnel felt that the company "lives with the airplane and we [FAA] don't," and unless the FAA had worked with the company from the first day of testing, the FAA did not want to "break the airplane." They did not feel they qualified to do every critical test point alongside the company. Mr. Wilson's philosophy was that he would watch and test enough to be "comfortable" with the data.

Mr. Johnson said that during GIII field performance testing, there was one pilot who performed most of the field performance testing, because he was experienced and Mr. Johnson was not. Grumman was anxious to meet the schedule and did not want to spend time training another pilot. Mr. Johnson and the FAA pilot did the field performance testing on the GIV. During that program they never did field performance without the FAA aboard. During the GV program, they had a Gulfstream pilot and an FAA pilot perform field performance testing. They almost never had two Gulfstream pilots performing field performance testing unless there was some problem or some company investigation, such as exploring some way to improve field performance after the airplane had been certified. During field performance testing, they would try to keep the same two pilots in place for those tests. They would not have four or five different pilots doing them. It became counterproductive to have too many pilots involved during developmental testing because a smaller number could develop a better feel for the airplane.

Mr. Johnson said that Barry McCarthy took over flight test after Mr. Johnson retired from the company. Mr. McCarthy was an FTE. He was not a pilot. Mr. McCarthy had previously been helping to write flight test reports. He was brought in from somewhere out west and he had prior experience in flight test. Mr. McCarthy did not work directly with Mr. Johnson to ensure that lessons learned were passed on. He was going to take over and they were going to make it more of an "engineering organization."

Mr. Johnson said that the GIV initial flight was September 1985 and it was certified in early 1987. The GV initial flight was about 1995, and its certification was about 1997. The GIII initial flight was January 1980, and its certification was about the end of that summer. The GIII was a “basic” airplane without integrated avionics. Customers had to get the avionics installed and certified, which was a separate certification. Mr. Johnson estimated that field performance testing was done somewhere around the midpoint of testing during these programs, because systems such as braking and antiskid had to be mature enough.

Mr. Johnson said the predominant flight test safety issues were maintaining continuity from program to program and ensuring “very good interaction” between engineering and flight test. Continuity and good interaction between the two departments could solve a lot of problems.

The GIV IGE stall incident was a “combination” of developmental and certification testing because the FAA was aboard and they were participating in the test so that they would not have to go back and repeat a successful test point. There were some points that Mr. Wilson would do specifically for certification. From what Mr. Johnson remembered, the incident occurred during the first attempt of a test point. When the wing dropped, Mr. Johnson applied controls in the following order: rudder, full-left aileron, and nose-down column. He said that this response was “instinctive.” He remembered the airplane rolling back to the left. He thought it was going to roll too far because he did not know how high the airplane was, and he was “pleasantly surprised” when the airplane landed on the runway “nicely” but “firmly” and they were okay. If the incident had occurred with one engine inoperative, it would have made the recovery a lot harder unless he had been able to get the power off “real quick” and applied rudder and nose down control inputs (which he considered “critical” with high power settings). The aileron was helpful, but he would have had to have kept the airplane going straight down the runway and with one engine inoperative, it would have been harder to do that.

Mr. Johnson said he thought that once the airplane touched down on the runway during the first GIV IGE stall incident, he reduced engine power, but not prior to touchdown. During stall recovery, one had to get control of the airplane first. During that incident, the flat part of the wingtip, rather than the leading edge, had hit the ground, and the wing flexed, which might have helped to the airplane to roll back to the left. He did not know if his aileron input or the wing tip ground contact did more to roll the airplane to the left. Mr. Johnson felt that his experience from past stall recoveries that helped him to react effectively to the IGE stall incident.

Mr. Johnson said that Mr. Murphy was “very involved” in looking at the GIV IGE stall data after the incident. Mr. Johnson was also “sure” that Mr. Murphy was talking with Mr. Coppi, because of Mr. Coppi’s fondness was aerodynamics. Some people from flight sciences were also involved, but Mr. Murphy took the lead. Mr. Coppi’s position was vice president of engineering. Mr. Coppi had designed the GI, GIII, and GIV.

This concluded the interview.

Interview Summary

Interview: Ted Mendenhall
Date/Time: November 3, 2011, Time not recorded
Location: Via telephone
Present: William Bramble

During the interview, Mr. Mendenhall stated the following information.

He had worked for Gulfstream from 1981 to 2002, first as a test pilot, and then as deputy director of the flight operations department. He was appointed director of the flight operations department and served in that role for about 10 years. As Gulfstream, through General Dynamics, acquired other companies that performed completion and service work in the 1990s, president Bill Boisture wanted to develop a unified safety system across the company, and he appointed Mr. Mendenhall as a product safety officer around 1997 or 1998. In 2000, he appointed Mr. Mendenhall as chief of safety for the whole company and Mr. Mendenhall had remained in that position until he retired from GAC at the beginning of 2002.

Mr. Mendenhall recalled that there was “always” an industrial safety department looking at manufacturing floor incidents and that sort of thing, and that department had historically served as a safety focal point. Prior to his appointment, however, no one had held the title chief of safety. As chief of safety, Mr. Mendenhall dealt with production, completion, and service safety issues throughout the company. He had high-level oversight of various safety programs in place at the time. The industrial safety department and safety groups located at various facilities were technically under him, but they did not necessarily report to him. SMS was not a safety paradigm in widespread use back then. An approach Mr. Mendenhall used for managing safety was to have groups within the organization audit their own areas for potential hazards and perform risk assessments.

There were no major type certification programs ongoing when Mr. Mendenhall was appointed chief of safety. The GV had already been certified, but there were various smaller-scale flight test certification efforts under way. Mr. Mendenhall was not directly involved in managing the safety of flight test. He thought there was a “pretty rigorous safety culture” in flight test, with thorough risk management, preparation and briefings. He thought their risk assessment process, in particular, was “pretty robust.” He was not aware of Lee Johnson’s efforts to learn from other manufacturers’ flight test practices and develop standard practices at Gulfstream.

Mr. Mendenhall did not know what happened to the position of chief safety officer after he retired from the company in 2002. For a number of years after he retired from Gulfstream, he had worked part-time as a corporate aviation safety auditor for Flight Safety Foundation and for the International Standard for Business Aircraft Operators (ISBAO). The Flight Safety Foundation corporate aviation safety audit program had ended in 2010. Since then, he had just done an occasional ISBAO audit. He had not been invited by Gulfstream to participate in any post-accident reviews of the G650 accident, and he was not aware of any details of the accident, other than a preliminary report published on the NTSB web site.

Mr. Mendenhall said he thought investigators might want to look at the flight test team’s work schedules because there was often pressure to get test points accomplished in flight test programs, and it had been a concern of his that the company should make sure that test crews did not work beyond “what was reasonable.” He could not recall what specific duty limits the company had imposed during his tenure. He thought crews should work no more than 6 out of 7 days. He was not sure whether there was an official policy pertaining to flight test personnel. Daily duty time might have been limited to 12 hours per day.

Mr. Mendenhall said that his views on fatigue had evolved after he became part of a Flight Safety Foundation effort to establish recommended flight and duty time policies for Part 91 operators. That effort was going on around the time of the GIV and GV development programs. Mark Rosekind had been brought in as an expert and he had helped Mr. Mendenhall realize that no one was immune to the effects of fatigue. Mr. Mendenhall thought that it was important for someone to be monitoring the hours that people were putting in, beyond just the time that they were flying. This was particularly important in flight test where the people were very sharp and might have a tendency to take on more than they should. He did not know how well Gulfstream was monitoring that when he worked for the company. He had personally advocated a minimum of one day off per week.