SRB RECOVERY SHIPS ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

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INTERVIEWED BY REBECCA WRIGHT
CAPE CANAVERAL AIR FORCE STATION, FLORIDA – 11 APRIL 2012

WRIGHT: Today is April 11th, 2012. This oral history is being conducted with John Fischbeck for the SRB [solid rocket booster] Recovery Ships Oral History Project at the Cape Canaveral Air Force Station, Hangar AF, in Florida. Interviewer is Rebecca Wright, assisted by Jennifer Ross-Nazzal. I'd like to start by asking you to give us a brief overview of your career, and then how you became part of this operation. I know it was a while back.

FISCHBECK: Like yesterday. Unbelievable, it's gone by so fast. I was sailing on a ship out of Port Canaveral in 1978, 1979. I was the chief mate on a small cargo ship, and we sailed from Port Canaveral downrange to the Caribbean Sea. We were actually at the time dismantling all of the downrange sites that supported the manned spaceflight before Shuttle.

Just by chance one day I walked into our dispatching office, which was in Port Canaveral at the Army terminal there. There was a lady there who I got the cargo manifest from for each two week trip. I asked her by any chance was she aware of any maritime jobs in this area. Melbourne [Florida] in 1978 wasn't a big maritime community. Port Canaveral wasn't as developed as it is today; the West Basin wasn't even in existence. She said that there was a fellow who was hiring people for the two SRB retrieval ships at [NASA] Kennedy Space Center to support the upcoming Shuttle program. I got the name of the individual to contact and made an appointment to come to Hangar AF.

I interviewed for a second mate's job on—it was then called UTC *Liberty*. UTC stood for United Technologies Corporation. They had charge of the vessels at that time. We were United Technologies employees for three years, until the main Shuttle processing contract changed about 1984. I came aboard here in August of 1980 as second mate on the UTC *Liberty*.

At that time the two ships were at Atlantic Marine in Jacksonville, Florida, and they were still under construction. The UTC *Liberty* was the first one finished, which was in about October/November of 1980. UTC *Freedom* was about January/February of 1981. There was some urgency because the first space launch was in April of '81. When the two ships finally got down here we had 10 people on each crew. Nobody else in the world had done what we were about to do. We couldn't call up some company and say, "How do you guys retrieve rockets?"

Nobody had the faintest clue what to do, so we had a model made of a solid rocket booster. We called it the Ocean Test Fixture, OTF. It was our training aid. It was the same length and width as a regular solid rocket. So we started practicing. Out of a month we'd spend two or three weeks at sea. We were on an accelerated course to get all of our personnel and divers up to speed on how to do something we had no idea how to do and couldn't ask anybody how to do. We had to learn the whole thing ourselves; it was pretty interesting, pretty hectic.

By the time the first Shuttle mission went off we had success in bringing the two frustums, the six main parachutes, the two drogue parachutes, and the solid rocket boosters back into Port Canaveral. Not to get ahead of the story, but that process never ended until the last Shuttle mission. We were constantly revamping, reviewing, renewing our procedure to A) make it safer, B) make it more efficient, and C) make it more professional.

Also during that 30-year period we had a number of personnel changes, so every time somebody left we lost tribal knowledge. We had somebody new who'd come on, and we were years ahead of where they might be. You had to start over with new people.

WRIGHT: Are there other details that you can tell us about how you were able to define those processes? You mentioned that this isn't anything that anybody had done before.

FISCHBECK: Well, first of all, we had to get the crew stabilized. We had 10 people from all different backgrounds. Some of the guys had military backgrounds, some had merchant marine backgrounds. Some of the nonlicensed people—officers are licensed by the [U.S.] Coast Guard, and the nonlicensed people just have ratings like ordinary seaman or able seaman—they were from all different backgrounds. Everybody had to somehow get on the same page, and that was one of our biggest challenges, getting everybody focused on what our job was going to be when these two solid rocket boosters hit the water.

We didn't even have a picture of this. You couldn't go back to the archive and look at some video or movie of something that happened in 1960. It's true that the capsules came back and landed in the ocean from the earlier programs, but no rockets came back. We did a lot of brainstorming, and we did a lot of butting our heads against dead ends because sometimes our plan didn't work. Of course the paramount objective was keeping it as safe as possible.

We worked with that Ocean Test Fixture. We made a frustum that was the same size as the flight model. The parachute facility gave us some practice parachutes. We'd go out and train with these things. Meanwhile a lot of the divers that we had weren't certified to do what we were doing. A lot of them had sport diving certifications; very few of them had professional

certifications. This was all scuba diving to a depth of 130 feet, but these guys had never done that either.

The Ocean Test Fixture—they would have to dive down to 110 feet or so to get to the bottom of this thing, then insert the diver-operated plug, which was the cork in the bottle so to speak. We had to develop that process. The early version was an aluminum pole that was positioned at the nozzle of the rocket, and an air hose was connected to it from the ship. It was called a BARB, which is ballast aerating retrieval boom. That was the first diver-operated plug, extremely simple. It worked, but it was extremely simple.

The problem was that when we finally pumped enough water out of the booster to have it come over from vertical to horizontal, which was what we call "semilog." That means it wasn't totally dewatered. It's down by the nozzle end like this [demonstrates], which was the most water we could get out of it. We had all sorts of problems with that in practice and during the towbacks. We used that BARB device for a few of the early launches.

In a rough sea sometimes the action of the SRBs with the BARB being towed by the ship going over six- or eight-foot swells caused the SRB to stand up, to go vertical again. When that happened a few things had to be done in a hurry. You had to stop the ship because you had a towline connected to it and the SRB, and you also had an air hose connected to it. If you broke either of those, then you had to start all over again.

We were always concerned about the towline breaking; we had to watch that the whole time we were coming back. The towline didn't break, but if the air hose broke you had to repair it. We'd be out there another two days doing that, then you had to start the air going to it again. We had a lot of trouble with that. Not that it didn't work—it was the sea state sometimes which

made it difficult to get the BARB positioned without the SRB going spar. Spar was vertical, and log was horizontal.

After roughly six or eight missions we developed a new diver-operated plug, which actually filled the nozzle. If you look in the east side of the hangar, there's four of them out there in the parking lot. That's the end result of the diver-operated plugs, which really were way superior to what we started out with. But that was part of the process. That was part of what we did, develop a better safer way to do things. Larry [F.] Collins was instrumental in all that, because he was our lead diver throughout this whole process. He was hands on. He'd be down at depth inserting the DOP [diver-operated plug].

The first DOP, compared to the BARB, was a big help. The DOP is basically the cork in the bottle. We would insert the diver-operated plug, and it would fit tightly in the nozzle. Then we would pump air into the booster through a quick disconnect on the DOP and water would be ejected through the center. When the booster went vertical, into log mode, we would pump all the water out of it.

We didn't need the air hose on tow-back anymore. That made the towing exponentially easier, because we didn't have to worry about the swells pushing the SRB vertical again. That configuration remained throughout the whole program, with some improvements along the way.

WRIGHT: Do you want to talk about those first few missions, especially the first one?

FISCHBECK: The first mission was April of '81. Actually it was a nice day, sea wasn't rough at all. We had great anticipation, as did the whole country. However, there was a little issue that went along with that. In the 1980s, we were still engaging in—I don't know if you want to call it

a Cold War, but it was the cat and mouse game with the Eastern Bloc countries. The Russians had a trawler out here the whole time we were practicing. I don't mean a fishing boat trawler, I mean a *trawler* that had enough antennas sticking up on it a bird couldn't have gotten through it.

WRIGHT: Wow.

FISCHBECK: They would shadow us all the time. They'd come in three miles—the U.S. waters go out to three miles—and they'd stop. Well, sure enough on the launch day, the Russian trawler is right where the boosters are supposed to land. In the first number of launches there was a Coast Guard cutter, a Navy ship, a couple of Air Force and Coast Guard planes that were on station with us. When the boosters actually landed in the water and the two ships, the Liberty and the Freedom got to them, the Russian trawler was practically right in front of us in our way. We stopped because we don't have jurisdiction on the high seas to tell anybody what to do, but the Coast Guard does.

We talked to the Coast Guard cutter on the radio. We'd worked with them before, so we knew each other. The Russian trawler put up International Code of Signals flags, which basically said I am broken down, unable to maneuver. There's the International Code of Signals book that every ship has. It's a common language among all mariners that certain flags mean certain things, and it's universal so everybody can understand it. Books might be printed in different languages, but the meaning is the same.

The Coast Guard sent up a flag signal that said, "What is the nature of your problem?" All this is taking about 45 minutes, so it was a good thing it was a nice day. They sent a signal back saying that their engines won't answer the controls. So the Coast Guard sent up another

signal that said, "We'll come and tow you." As soon as they sent that signal, a swirl of water appeared behind the Russian trawler as their propellers got engaged, and they moved off out of the way.

It was just a little show. They got out of the way, half a mile, and they sat there. I'm sure they were monitoring all our frequencies, because they were developing their shuttle, I believe, at the time. They watched that whole process. We got everything done and came in, and I don't think after that the Russians actually got in the way of any mission, but they were around. They would follow us around a bit. I don't know which mission it was or whether it was when the Berlin Wall came down, but somewhere they gave up on the *Shuttleski* and tracking us. It was quite a time, maybe six or eight missions after that where they didn't show up anymore.

After that, the only things that would possibly get in the way would be another merchant ship transiting our area, and we would keep track of that. That was one of our jobs, to track all vessels from about 48 miles in to the impact area. We would be in contact with the range and the launch director as well as our own office here, and we would plot with our radars all these ships to make sure that everybody's out of the way. That always worked out okay.

On STS-4, something happened to the parachutes on descent. I don't know the exact engineering reason, you're going to have to ask an engineer. I believe the parachutes were supposed to release on impact. As the parachutes were streaming down, the three main parachutes for the boosters—instead of slowly opening they opened prematurely, so the booster went like this [demonstrates] when they all opened. The booster thought it hit the water and released the parachutes a couple thousand feet up, so both boosters hit the surface and sank in 3,000 feet of water.

We went out later with a company that had some submersible tethered vehicles with side-scan sonar, and we located the boosters. They took pictures and got data and turned that over to NASA, but the problem was not the booster. The problem was the parachute release, so they changed that process. They open slowly, streaming they call it. Other than STS-4 where they actually lost the boosters, no other booster was lost until *Challenger* [STS 51-L accident].

WRIGHT: Would you tell us about your experiences that day and then salvage after?

FISCHBECK: *Challenger*—everybody that was here, on land, had a crystal clear cold day. We were out 120, 130 miles east of here. The reason it was such a cold day here is because a cold front had come through. This is January 28th, 1986. Really cold day, there was ice on the launch towers. Out there where we were, that front came through a day or two before. We had gone through 60-mile-an-hour winds out there for two days. It was one of the worst sea states we had been in, in fact that might have been the worst.

That was the worst nontropical storm I've ever been in. A wintertime cold front, but there was a heck of a pressure gradient behind it of wind. It was so bad that we couldn't even turn the ships. We had to keep our bow into the waves for two days. I remember I went on watch two days, and the wind never got below 60. The waves were 15 to 25 feet. It was so rough on the ship's bow, it cracked the paint on the deck. The ship was working so much the ocean washed away a lot of gear. We were about 30 miles from where we were supposed to be, but we couldn't even turn around. We couldn't do anything except keep our bow into it and hope you don't get turned sideways.

When the wind finally started easing back, we started heading toward our station, MSP. It's a mission support position, you'll hear that term. That mission support position was where we're assigned to be. We were about 30-odd miles from that. They went ahead and launched, and of course the accident happened, which we didn't see. The Gulf Stream starts 30 miles east of here, and it's 30 miles wide, so we were way on the other side of the Gulf Stream.

As we got back near the Gulf Stream that morning, the water temperature could have been in the 70s. Well, you had freezing air coming over it. That creates fog, so we were in pea soup fog out there. Everybody thought it was strange, because here on land it was crystal clear. We couldn't see anything; we didn't see a darn thing at all.

We were trying to get ourselves put back together after being in the storm for two days. We had gear all over the aft deck. Our small boats had gotten moved. Some of the cradles got bashed in. We had to check the cranes, the parachute reels, the DOPs. We had two DOPs per ship, and it's a wonder they were still there. Everything inside was turned upside down. Everything that could come loose was loose. We had a major cleanup going.

We heard the launch countdown. We had radio communications with Launch Control and our office here. They said there was an explosion, so we went to our station and started searching. All we could see in the water was some foam, which you see anyway. That's part of what's on the boosters. We didn't see anything big sink. We were still out 130 miles, and that's not where the capsule came down.

The boosters came down out near the MSP, so we spent a day or two out there then everybody came in. By that point it was going to become a multiagency search effort. They had to find out where things were in order to find out what happened, so it ended up we had about nine ships. The Navy was rotating submarine rescue vessels in with divers. There were some

private vessels that were chartered by the Navy Supervisor of Salvage and Diving, and everybody had sonar.

Our two ships had side-scan sonar, and we were directed to go back out to where the boosters were thought to have impacted. We operated side-scan sonar in 3,000 feet of water. Maybe a month and a half, going about three knots, dragging the sonar "fish" down 5,000 feet behind us. You had to go slow with this, so it took it a long time to get all the data together.

Eventually we located the boosters. They were split in half, and it was not feasible to try and raise them. It's pitch-black at 3,000 feet. They could see from the sonar resolution pretty much how they were lying, how many pieces. Then we stopped doing that and we came in-shore to where the reef line is here, along with the other ships, and everybody had an area to search.

During the month and a half or so that we were doing that, the ships in shallower water had located a good deal of data, pieces of equipment. It wasn't just Shuttle stuff out there, it was stuff that had been accumulating ever since someone threw the first beer can in the water. All objects were marked by latitude and longitude and description. The data print-out was double-sided—it's about half inch, inch thick, single-spaced. Latitude, longitude, apparent description of every single thing nine ships found out there in about six months.

Every one of those things had to be prosecuted. That is, had to have eyes-on identification or raised to the surface. I'm talking about things that were in less than 100 feet of water. We located—we meaning the whole group—everything from beer cans to airplanes to all the rockets that went in the water out here in the 20 or 30 years prior to that. Also, in the process, one of the submarine rescue vessels located the Shuttle's crew cabin.

It was interesting how I got involved with that, because we were locating stuff all the time, and we were bringing it up to the surface if it was small. All recovered objects were

brought into the port and turned over to NASA. The day that it happened—that the submarine rescue vessel located the crew cabin—nothing was said on the radio. By that time I felt that the press was listening to some of our frequencies, and our operations didn't want that broadcast.

That particular day, I'm on the Liberty. I had been out there maybe two or three weeks. We're rotating the crew one by one, and I was due to come in for two to three days. There were nine ships out there, different sizes. There was a little boat that SUPSALV, Supervisor of Salvage, had hired, a crew boat that would come to each ship, bring the newspaper, bring supplies, carry people back and forth. We were the farthest out, so I got on board the crew boat there first in the morning. By the time we went to all the other eight ships it was sunset, so I spent the first day of my day off riding to all the other ships on this little boat.

We're coming into the port through the jetties, and it's dark. The boat slows down. It's just a 60-foot diesel-powered crew boat. It's not a comfort thing. It's like riding in a school bus. We're following behind the submarine rescue boat, with no lights on. Since I'm a mariner, usually you don't run without navigation lights on, so I'm starting to put two and two together. I'm thinking, "Hmm, this is strange."

The submarine rescue boat tied up in the Middle Basin at the Navy Poseidon pier, which still exists there. My car was parked in the parking lot nearby, so I told the guy driving the boat, "Just put your bow against the dock there, and I'll hop off." He did that, and soon as I got off the bow he backs up. I took about three steps, and about four security guys see me and put their flashlights on me. They say, "Where are you going? Where's your ID [identification]?" I show them my badge, said, "My car is right over here. I've been out there on the ship." He said, "Go to your car and depart." That's when I figured something was up.

Sure enough, that was the time when they had found the crew capsule, and they were bringing it in and then turning it over. Of course I didn't stay for any of that, but that's what happened. It was interesting that I saw the actual arrival of it, and of course it came out in the news later that they had located it. Other than that though, we spent until the first part of December of 1986, basically a year on that accident.

WRIGHT: You have spent most of your adult life working on the sea. Tell us about these ships and how different they were from what you had worked on before, and their capabilities.

FISCHBECK: Good question. These ships are interesting. They're 180 feet long, so they're not big. A boat is defined as something you can pick up and put on a ship, so when we say these are ships, they are ships in that you put boats on these ships. I was on an aircraft carrier for three years. That's a ship. You could probably pick these ships up and put them on an aircraft carrier. 180-foot is not big, but it's amazing how well they do in some of the sea states that we got into over the years.

These ships were built specifically for this job. The model of these ships was similar to a model that existed. I think it was University of Miami [Coral Gables, Florida] that had a research vessel that had similar lines as the *Liberty* and the *Freedom*. A naval architect in Jacksonville, Rodney [E.] Lay and [Associates], took the design that we suggested and they modified it. That went through a process of looking at it, and then changing it, looking at it and changing it. That was actually before I got here, that was going on before I came. When I came the actual construction was almost completed.

For example, there is a stern thruster, which most ships don't have, except the newer passenger vehicles have thrusters instead of propellers now. Stern thrusters for small ships, usually you don't have them. The reason we had the stern thruster was because the EPA [Environmental Protection Agency] said that if you're going to transit the Canaveral locks, and you're going to come up into the Hangar AF basin, then you're now entering in the wildlife refuge area.

There's manatees in the river. You're not going to be turning propellers in the Banana River with the manatees. You're going to have to come up with something else. That was one of the big changes to the original plan, to put a stern thruster on each ship. The stern thruster is basically like a manhole that's louvered. It's a water jet that sucks in water and blows out water. It can propel the ship in the ocean maybe three or four knots. We can go up and down the river about three or four knots, but we're not turning the propellers.

As it turned out, over the years the stern thruster ended up being a big help to us. When we got to practicing with divers going over the side and launching inflatable boats that the divers go in and out of all the time, and when we're in the proximity of a parachute being held up by float balls so it doesn't sink when we detach it from the booster—if we had been turning propellers at that time, it would have made it a whole lot harder, and a lot more dangerous. We would just secure the main engines—or secure the shaft from turning—and then use the stern thruster. That was perfect for retrieval, it ended up being really a good thing.

We have a bow thruster, which most merchant ships have. Between the bow thruster and the stern thruster, we had total maneuverability at slow speed in proximity of divers and of flight hardware. That was a great by-product of the EPA saying put stern thrusters on. Early on,

before we started practicing, we were just saying okay, stern thruster is for going up and down the river, but it turned out to be really good.

The other construction that was different was the deck layout being a fairly open aft deck. That was to accommodate the four parachute reels and the crane and the tow winch and the DOP launchers and the air hose reel, which took up quite a bit of space back there. That equipment had to be lined up so each of those components could do their job at the same time. While we're bringing in parachutes on the reel we might be putting a DOP over the side or launching a boat. While we're bringing in the air hose we might be putting out the towline. All equipment had to be organized so it could do everything together.

That was the product of a lot of planning and scrutiny during the process of designing where the components would go. As I said earlier, nobody had done this. We had to take a good look at it, because once those components got put on—for example the parachute reels have all under-the-deck hydraulic lines going to them, the crane has hydraulic lines going to it, the DOP launcher has hydraulic lines going to it.

The small boats have to be picked up by the main deck crane. We had to make sure that the reach of the main deck crane would be such that it could get to the area where the small boat was. The small boat had to be out of the way of the air hose going past it, in front of the DOP launcher so it got a little protection from the sea in rough conditions. All these things had to go on at the same time and be designed.

If you were to put all that equipment on deck and then change it, you would have to go back to the shipyard and move all the hydraulic lines and cut holes in the deck. That's another two months. We really didn't want to have an opportunity to go back up there, especially since the first launch was coming up. Our main objective was to get trained.

Fortunately we had good prior planning and a good location and some practice. All that equipment was in the right place. It never did get moved, so that was a good testament to the fact that it was done right the first time. Of course our process refined itself because people who stayed got better at what they did, and we improved a lot of things. We improved the small boats, we improved the hydraulic lines, we improved the reels for the parachutes. We improved the main tow winch. We improved some of the equipment we used. We got safer equipment, newer equipment over the years. As I mentioned, it was an evolutionary process that went on to the last mission. We were still making things better.

WRIGHT: Were the ships out of commission at any length of time due to some type of problem or overall long-term maintenance?

FISCHBECK: The ships go out of commission once every three or once every five years for a required mandated Coast Guard and American Bureau of Ships (ABS) inspection that says you will take the boats out of water. ABS will check the through-hull fittings that go from the inside to the outside, where seawater comes in or goes out. The shafts, the propellers, the main engines, the generators—all that gets inspected. All the lifesaving equipment gets inspected; all the navigation equipment gets inspected.

Our licenses have to be renewed every five years. We carried medical supplies on board, and they had to be turned back in to OHF [Occupational Health Facility] at KSC and then reissued. A log is kept of all that. Other than the required yard period, which usually lasted maybe three weeks—and we always planned those in a downtime in between launches.

Another thing that started up—the external tank barge is a unique barge. It has a cover over it and looks like a floating covered wagon. We decided that we could tow that from Michoud [Assembly Facility, New Orleans,] Louisiana to the Kennedy Space Center cheaper than what NASA was paying a commercial tugboat to do. We approached NASA with our pitch and gave them some figures, showing we could do it a lot cheaper.

About 1996 we started with the two ships towing the external tank back and forth. To do that we had to augment our tow reel, because the tow winch and tow wire that we used for the rockets was not big enough to support towing the barge. We looked in the industry, and there was what they call a waterfall array of a tow winch. It was two together. The upper one had a lighter-gauge wire on it for the boosters, and the bottom one had a wire two or three inches in diameter. Much heavier gauge, much stronger winch, used to tow the barge. We had basically one structure, two different reels.

A few of our guys had had experience towing, so we had some knowledge base of how to do that job. That wasn't as new to us as starting out recovering solid rocket boosters. We got involved with the process of towing the external tank barge back and forth to Michoud. When it got into Port Canaveral, we had to use two tugboats because you can't tow an external tank barge on the Banana River. It's 280 feet long, 50 feet wide, with a hard cover over it. That's a lot of windage.

You can't just have a two boat in front towing, because the barge gets away from you. We would transit from the harbor to the drawbridge, and then would get in and out of the Canaveral locks. Next, we would transit through the NASA causeway bridge. Our ships made it up to the VAB [Vehicle Assembly Building] basin for the open house sometimes, but we had to go really slowly. For the barge we used a tug in front and a tug in back made up right to the aft

end of the barge, integrated with the barge. The aft tug acted as the rudders. The barge didn't have any propulsion of its own. It had no rudders, no propellers. It only had two generators on it for lights and running the stove and the air conditioning.

That was one of my jobs. I was pilot of that barge from the port to the VAB basin and back. That's about a four-, five-hour trip. That was way harder to me than anything we did at sea, because I had to be on a radio talking to both those tugboats. You couldn't do it if the wind was blowing more than 18 miles an hour, because the barge would start going sideways. You can't have that happen going through the bridge and the locks near the port and going through the NASA causeway bridge up here. When we went through these bridges, there'd be maybe eight feet clearance on either side of the barge. The river all the way up to the VAB basin is not a straight line, so we had a few times when it was really difficult with the wind.

The tug guys would do what I would say. The guy in front would be fairly close to the barge because the further he was away, the more the barge could swing behind, so you had to keep that line short. On either side of that channel, from here to the VAB basin, the water is about two feet deep, so you can't be falling asleep at the wheel. You can't have the line too long. The problem is if you have it short like we had it, and the guy in front doesn't pay attention and runs aground, the barge is going to go right into him.

That happened once. We were going around the last turn up there, and the guy took it too wide. He stopped, and I yelled, "Full astern to the tug behind!" But you're going four knots, you can't stop. It's like trying to stop a freight train engine or a ship. It doesn't stop but keeps going for a bit. So we kept going. We glanced off of the lead tug and went off to the side and broke his towline. Finally the stern tug stopped us. Lucky the bow tug didn't get run over.

I told the tug company you got to send people down here that have some experience. While I'm the pilot, that tugmaster is still responsible for his tug. If I say come a little bit more to the left or stay in the middle and he doesn't do it, then it's on him. We got to the point where the guys coming down were repeating the trip. They all knew what to do, so that didn't happen again.

The tugboat guy in back couldn't see anything, because he's looking at the back of the barge. He's my rudders, so I'm telling him a little bit to the left, back to midship, little to the right, midship, little to the left, little bit more left. That's going on for five hours. I had to have another guy that I trained, another one of the mates on our ships, because it was too much for one person. It was constant attention. Just because they would send the same guys back doesn't mean they'd all be paying attention. A couple times guys tried to cut corners, so you had to watch them.

Fortunately that whole river bottom is mostly mud, so you really didn't hurt anything, you just stopped. The hard part was keeping it in the middle of the channel if it was windy. And of course the operation is really visible. If that barge had hit the iceberg that sank the [RMS] Titanic, it wouldn't have hurt that barge. That thing had a double hull; it was thick. It had dents all over, because tugboats push barges. It's like that guy that said tires are ugly. Well, barges are ugly too. You just tow stuff with a barge. You push it around and bang it, never hurt it at all.

We did that operation to the last tank with success. We had a permanent crew on the barge. We had four guys on the barge that kept the maintenance up, and two or three of us were qualified to take it up and down the river. Then we finished the last tank and brought the barge to KSC and eventually the barge was moved to Stennis Space Center [Mississippi].

There was an issue during *Columbia* [STS-107 accident] where the foam was a problem. I think there were three tanks here that had to go back to Michoud. When that happened, an interesting thing happened. Up to that point they always had a couple tanks here ahead of where they needed them in the "flow" of integration in one of the load cells in the VAB. They'd have an extra tank here, so we'd always go get a tank after a launch.

Usually there'd be maybe three months, four months between launches, so there was plenty of time to schedule our barge trip, which took about 11 days to do the round trip. It was one ship, but we had time to do that. It was not a rush on this end. After they sent those three tanks back—and they sent them back pretty quick, probably within two or three months—we did some extra trips.

We had to get these tanks back to Michoud because they wanted to look at the foam process, the glue on it or something. When that happened they had no tanks here, so every tank that we brought from Michoud to here was what they called on critical path, which the tanks never were before. Tanks were on critical path once they got here, but suddenly the transportation became critical path. That means every time that tank is delayed it's a launch delay, so it's like day for day. That put a couple pressure points on us. Michoud would give us the date for a tank to be ready, and sometimes it wouldn't be the correct date. We would have to try to schedule a ship to go get the barge or take the barge from here back out there to get the tank, but you had to schedule a lot of support on each side. I had two tugs on this end.

After Hurricane Katrina went through New Orleans they closed the MRGO, which is an acronym for the Mississippi River Gulf Outlet. That was a straight line from Michoud out to the Gulf. It wasn't built for Michoud, it was built to ease the traffic load on the lower Mississippi

River. It was really a great thing. It was very wide, very deep, big major ocean liners could go up and down it.

It happened that it ended at the Gulf Intracoastal Waterway, practically at the Michoud basin, so it was a big help for us. That was a straight line 60 miles long, a straight line from the Gulf of Mexico through the Spoil Islands, ending right at the Michoud basin. After Katrina they decided a lot of the storm surge came up through this 60-mile piece of water, so they were going to close it off. [U.S. Army] Corps of Engineers started putting out all these notices. They had meetings for about a year. Eventually, two or three years after Katrina, they started closing the Mississippi River Gulf Outlet off.

We had to take the ship and barge to Gulfport, Mississippi, leave the ship there. Two tugs had to come from New Orleans, take the barge on about a 12-hour trip. They'd have to bring the barge with two tugs on the Intracoastal Waterway, the ICW, from Michoud to Gulfport. Then when the barge got to Gulfport the tugs to connect it to the ship take it to Port Canaveral, transfer it to the two tugs, and bring it to the VAB.

Meanwhile I had to get line handlers; I had to notify the bridge tenders. This Roy Bridges [Jr.] Bridge is not manned; we had to call people to get it manned. Then you had to let everybody in the ET [external tank] world know that the barge had arrived. It was a big deal getting it all scheduled. Dates were important, especially if it got to be a date where sometimes the ship would have to be towing a barge back here four days before launch. We couldn't do that. The launch got priority.

WRIGHT: That was really interesting, all the details you gave about that operation that looks so simple. Can you tell us about your responsibilities during the missions, and how they changed over the years?

FISCHBECK: Well, six months after I was here in 1980 I became chief mate on the *Liberty*. The second mate's job is basically in charge of the navigation and to stand watch while we're under way at sea. We all stood watch—captain, chief mate, second mate, as well as three ordinary seamen or able seamen. There's two people on the bridge all the time when the ship is moving. I spent about 10 years as the chief mate and then I was captain of the *Liberty* for about two years. That brings us up to about 1992 or '93. My boss at the time asked me if I wanted to come up to the hangar and take over the retrieval operation. I said okay, that would be interesting. I'd like to do that. So I came off the ship.

I was a little bit sad to do that, come off the ship. I'd spent 11 years on that ship, so it becomes like part of you. It's a very tight community, the ship's crew. At that point as the years went on, fewer people left, so the learning curve got better and better. When one or two new people would come, the other eight or ten people could assimilate the new people a lot easier than we could in the beginning when it was all new. As more time went on, the longevity of personnel increased

Because it is a unique job—it's a good job, interesting job, every mission was different. I did all but two missions. There were 135, and I did every mission but two. Every mission was different; there was something different. The weather different, wind direction, waves different, visibility different, sea state different, communication problems, ship problem out there maybe in the impact area. It was always interesting that way. Of any of the guys that stayed, I don't think

anybody ever got tired of it. Most people stayed. People that left left for a number of reasons, but in the end, say the last 20 missions, were basically the people that had been here for a long time. We had a tremendous amount of knowledge on what we were doing.

They used to call me MOM, which was mission operations manager. The captains were in charge of their individual ship, the dive supervisor was in charge of the 10 divers they had under them on each ship. We had 20 hands-on people on a mission, and then we would take 22 to 24 people—we had observers. We had a NASA observer, maybe we had a safety observer, and we had a retrieval supervisor on the other ship. I was the senior retrieval supervisor. My job was to, firstly, coordinate with the retrieval supervisor on the other ship all the radio frequencies we were going to use, the order that we were going to retrieve the hardware—and there was an order involved to it—then we'd talk to the dive supervisors and find out who was going to dive. The underwater communications, make sure that all worked.

The underwater communications is another thing that we had that's rather unique. We had these poles that go down through the deck of the ship into the water. We can talk to one of our divers underwater at a distance of maybe a quarter of a mile. That was a big help because we could keep track of the safety of the divers underwater real-time with a safety diver, who was the guy we talked to. His only job was to observe the other divers and communicate what was going on to the bridge of the ship.

When the time came to depart on a mission, we had a governing document. It was a retrieval manual, basically an operation that was signed off by NASA, by our company, by safety, by quality. The order that we'd do things—that's the way they do everything out here, by process. Our's got developed over the years too. When I became retrieval supervisor, I got involved with the development of that manual. As it changed, we had to have it made officially

changed. It used to be called a retrieval manual, then it became a RODS [Routing Operation Document System] document when we became USA [United Space Alliance], but it was still the same words.

When we would leave, we would have a certain speed that we'd need to go to get to our station on time. We would proceed with our radar observations for about three hours prior to launch, then we would do our radio communication checks and equipment checks. We had a recompression hyperbaric chamber on each ship, and that had to be brought up into operating configuration. We had four lead divers and a dive supervisor, and those lead divers and the dive supervisor all were diver medical technicians, DMTs. A couple of them were even paramedics. These were our only in-house "doctors." They, in addition to all the other divers, would go to 40 hours of school every year on how to operate these chambers. We saved three or four lives over the years by knowing how to operate the chambers. We had three or four rescues, local fishermen out there in trouble.

When T-minus zero came and they say "we have liftoff," all of our people and all of our equipment had to be right on time, totally focused, and everything working. I'm happy to say that was the case every time. We were always ready, except for the *Challenger*. The weather knocked us off, but after that we had all of our ducks in a row.

It took a bit of doing. It's interesting, our makeup of our crews. The 10 ship's crew are permanently assigned to the ship. That's what their job is, they maintain the ship. The 10 or 12 technicians, those guys all have other jobs up here in the hangars. We had welders, we had guys in the machine shop, we had guys from electric shop. We had four guys out of the dive locker downstairs. When the ships would come in on a mission, all these guys would go and work sometimes a month on disassembly.

The ship's guys stayed there and cleaned up ship, kept painting. The rest of the crew would come up here and do disassembly, and when that got over they'd go back to their shops. Put on their tech [technician] hat and weld or machine or fix dive gear or fix electrical stuff. I would come back up here and get started getting ready to do a barge tow, all that organization, then start planning for the next mission. Our guys were unique in that they all wore three or four hats.

I still kept my master mariner's license up so I could go in as captain a few times if they needed, but I had to do the whole barge business, the whole retrieval business. One of the biggest parts of my job, like any job when you get to the operations level, is the communication of different groups of people—that and the safety oversight. Communicating with all these different groups of people to try to get a barge with a tank in it back in here when NASA wanted it. Working with outside people, not all government. Michoud people would deliver it pretty much when they said they were going to.

I had to give the tug guy, the canal barge ops [operations] guy out there in Louisiana, two to three weeks' prior notice so he could get two tugboats. Commercial business doesn't stand around and wait for us. If they sit around and wait, they got to get paid for it. Fortunately, between the tug company in Orlando [Florida] and the tug company in Jacksonville we had a great working relationship. We always got the tugs here when we wanted them. If, for example, I would say get here on the 12th, and the ship was delayed because of bad weather or maybe the rocket was delayed a day, they would get paid, but you had to have them here. I had to draw a line in the sand at some point and say this is the best date I have. That happened at either end, and that happened fairly often.

I mentioned to you earlier if the launch came up right when we were supposed to do a barge tow, then we would have to go back and contract an outside source to do the ocean tow part. The river tow part was here, the Intracoastal Waterway tow was over there, and the ocean tow was the long distance leg. It was about a four-day trip one way from Gulfport around South Florida around the Florida Keys up the east coast of Florida. That was an expense that had to be borne because there was no other way around it, they had to get the tank here.

That was all post-*Columbia*, so those tanks were critical path. They couldn't wait for us to go do a mission, come in, and then go back out to get a tank. NASA had to get the tank here because they didn't have extras. That didn't happen too much, but we had the contingency to get an outside contractor. That always worked out okay. Sometimes we had to leave a couple people in here at Hangar AF to take the barge if it came in when we were still out at sea. That happened once or twice.

Another interesting experiment we had which had never been done before—I got to do a couple things here that had never been done before. The second, other than picking up the rockets, was there was a period of time, about 2004, when the Canaveral locks had to close down for a period of about two months in two different times. They had to close down one six-week or eight-week period to change the doors. The whole lock gates had to be replaced. They would open the locks for a period of maybe 10 days, and then they shut down again to do the west side gates for six weeks.

In that period, 2004, you recall we had Hurricane Charley, Hurricane Frances, and Hurricane Jean. There was three of them that we got dusted with. I got asked to submit what I thought would be a plan to take the barge—you see it on this map over here behind me [demonstrates]. This is the Middle Basin here, and this is the Trident pier where the Navy is

now. Right here the Boeing Company built a pier for when the Boeing ship came in. They wheel their rockets off, and they take them up to their facility. We used this dock to tie the barge up sometimes if it came in too late in the afternoon, and we couldn't get up the river. Or, if it was too windy, we would tie the barge up here and wait till it got calmer. Then we'd take the barge through the [SR] 401 drawbridge and into the locks. This is the West Basin where all the cruise ships are.

The question was, with the barge at the Delta Mariner dock, would it be feasible to offload it so that the tank on its transporter could travel on? Offload it from up the roadway on the Air Force side, all the way up to the north end, go across to where the launch pad is, and then into the VAB. I said yes, we could put the barge there.

Then the question became, could the support people get the "tank transporter" as they call it, which is motorized—actually it comes on the barge with the tank. That discussion literally snowballed into a cast of thousands. I remember at one point—in the LCC [Launch Control Center] building there's a conference room, number P4 or L4. Mike [Michael D.] Leinbach would chair the meeting, and that room would basically be full. Then there would be people on telecom from Michoud and from Huntsville [Alabama, NASA Marshall Space Flight Center] and [NASA] Johnson [Space Center, Houston, Texas] all listening in.

It evolved into not just physically putting the barge there. We had to get steel ramps to bridge the gap from the end of the dock—about 15 feet from where the barge had to stop it, to the bulkhead because it was too shallow up near the bulkhead. We got all the equipment things, and next it became a security issue. Facilities had to round some of the corners on the road off. They had to move some of the overhead power lines. Then the quality and safety community got

involved because the tank had never been delivered this way before, so they had to go through this whole process and understand it.

I think a couple hurricanes went through here before we actually got ready to do more. I remember the day we brought the barge back down the river. We had a transporter on it, but out of wire they made a mockup of a tank. It didn't look like anything the way a tank looks, but it was the same length and the same height and the same width. It looked like a weird erector set. We rolled this off, and they had the command vehicle going and all the security. They had everybody.

It's taken about two months to get to this point, and the thing worked. It went up the road, all the way to the VAB basin. In fact there's a certificate right on our hallway wall, on your left there [demonstrates], a group achievement award that we got for doing that process. I was asked to accept the award at the center director's presentation, which was very nice of Mike Leinbach to ask me to do, but I accepted it for a whole lot of people. It was a huge effort.

That was fun. That's one of the things that was new that I liked about this job. It was interesting, because the Achilles's heel of the delivery of an external tank is that drawbridge and those locks. If they go down, that tank doesn't get here. Can't go down Intracoastal Waterway (ICW) with the barge, it's too big. There's no other way to get it here. Everybody suddenly realized that, and that's when all the terrorism business started to get in the news as well. If somebody hit that bridge, the space program would stop for a while. That proved the tank could actually be delivered if we needed to. We did that one test, and that was the end of it. It worked.

Then another development—our marine people did this. In the VAB turn basin, on the south side, there's four white mooring balls floating. Those are mooring buoys for the external tank barge. Before those buoys were put in, every time there was a launch we had to take the

barge and call two more tugs down here from Jacksonville to take the barge all the way down to the port and leave it there until the launch. Then call two more tugs to get the barge back to the VAB Basin. It cost about $50,000 or so to get the two tugs down here and take the barge back.

Plus, other than the five hours, which isn't so bad, the early barges had pointed bows like this [demonstrates]. The Pegasus barge had a little bit of a flat bow. A pointed bow tends to do yaw back and forth because water gets on one side of the bow, and it'll push it over as it's going through the water. Really hard to control the early barges. Finally they got retired because they were World War II vintage. Pegasus was built in the '90s and could be handled much better. Still, it was very subject to windage because of the cover on it, but it towed better, towed straighter, made my job a lot easier.

We decided amongst ourselves, "Why can't we put mooring up there?" We got approval from the Corps of Engineers. We got approval from all the environmental people that we wouldn't impact anything. On one of these launch pads there were these huge cement doughnuts, I think they're three tons apiece, and we got permission to use four of them. We got them moved and we put one at a time on the ship, then we lowered them in the water. We had the locations all mapped out with our GPS [global positioning system] where we wanted to put them.

They had a hollow in the middle like a doughnut. We put chain around them, and our divers went down. The water is not deep, only 30 feet there, but you can't see anything while the divers shackled the chain together. Then we brought the chain nearer to the surface, shackled that to a wire, brought the wire further up, and put those buoys on it. So now when we had to move the barge, we only had to take it across the basin to the mooring buoys.

Then we got what we call push boats. If you go over there now you'll see two very non-marine-looking little gray square boats that the Navy gave us from the [Naval Submarine Base] Kings Bay [Georgia]. They didn't want them somehow, and one of our guys got wind that they were getting rid of them so we got them. Those boats now eliminated the need to spend $50,000 to get the tugboats down here. We could push the barge across the basin, which took about 20 minutes, between all four mooring buoys. One of our outboard motorboats would take the mooring lines from the barge, two in the front, two in the back, and the barge just sat there. With nobody on it, it was fine. That lasted from about 2005 until now. That was a big money saving and saved a lot of time.

Always interesting to me why we had to move the barge for a launch. The reason was the television people, the media people, at the launch site where all the trailers are. Earlier on, prior to 2000, we said we're not moving it. We made a unilateral decision, "We're not going to move the barge. This is a pain." This is when we had to go up and down the river with it. We got to about a week before we had to leave for a launch, and somebody at NASA called my boss and said, "You're going to move the barge." We said "Why?" "Because the head of one of the networks has a friend in Washington [D.C.], and if that barge isn't moved he's going to call his friend in Washington, and it's not going to be good for anybody." So we had to move the barge.

One day not long ago, probably in the last three or four years, I asked one of our PAO [public affairs office] people if she could provide me with really the reason why. The reason we had to move the barge was because the barge was considered "foreground clutter." We were "foreground clutter," official definition. If the launch was from Pad A, the barge was out of the way. If the launch was from Pad B, then they had to pan a little bit more this way, so now we would be "foreground clutter."

However, to our way of thinking, the barge is part and parcel of the Shuttle program. To me, it might have been interesting if somebody said that's how the tank gets here. But they never did that, we were just "foreground clutter." Over the 30 years of launching Shuttles, somebody spent a whole lot of money to move the "foreground clutter." Probably could have flown another two years without paying for the "foreground clutter" to be moved. And all the time it took us to do that, especially going up and down the river.

We caught a lot of fish over the years, fishing out there waiting for launches. We had a couple accidents, one interesting accident. Not for the guy that had it, but a unique kind of accident I guess you could say. We got out there, had a decent weather day, and the launch was delayed. Since we were in pretty close proximity to the eastern side of the Gulf Stream, we decided we'd just go fishing.

So we start trolling; guys are putting out lines and fishing. For some reason the dolphin were really biting that day. I don't mean the kind that breathe dolphin, the fish dolphin [mahi-mahi]. We caught 25 or 30 dolphin in the course of that day. Also there was a Navy frigate out there at the time that was on station. It happened to be pretty close to us. We could see it. One of our guys, in the process of cleaning a dolphin, puts the dolphin on the deck.

On one side of the back deck you'll see all this wood. That's called dunnage in maritime parlance, and dunnage is basically something you put on the deck to protect something that gets put on it. The wood has more give than steel when you're setting a frustum on it with a crane. Also it's not slippery, and you can take off and put it back. These guys are back there on the dunnage. It's not rough or anything. It's a nice sunny day. They put the fish down. They've got a decent dolphin, maybe ten-pounds.

He takes his knife, this fishing knife, and he's going to go put it to the head of the dolphin to A) kill it, B) stabilize it. His hands are all slimy from the fish, so his hand came off the top of the knife, and went right down the blade like this [demonstrates]. He cut these fingers to the tendons, and this one particularly was cut right to the bone. So we called our DMTs.

This is not a good deal. We're out in the middle of the boonies. Helicopters can't get out to us. So we made calls. First call is to the OHF here, then we call our boss. We call the Coast Guard, and they can't get out here. We're too far out. Jacksonville, at that point, is 24 hours travel time or a little bit more away. So Larry and the boys got him stabilized, got everything bandaged up and taped up, but it's not fixed. It's just stabilized. This frigate comes by, so we call the frigate and we say we got an accident over here, described the accident, spoke to their captain.

Captain says, "Because we have a helicopter and we're a frigate, not a destroyer, we have an MD [medical doctor], not a corpsman." We say, "Could we bring this guy over to you on one of our boats?" He said, "Yes, bring him alongside, and we'll get him up." Our boat goes over there with him, and we're about 100 yards apart. The ship waits there, and they hoist him up. They put him on a litter.

Our boat comes back, and we're standing by. The ship captain comes back on the radio. He says our doc [doctor] has looked at it, and he's got to go ashore. He's got to go to Patrick [Air Force Base, Florida]. They said we'll fly him in there, so they fire up their helicopter and they take off. An hour later he's in Patrick, and he had microsurgery on his tendons. They sewed them all back together again. He had to go through a few months of this rubber band thing, a tension resistance band. He got about 90% use of that finger again. He couldn't go all the way, but pretty much.

WRIGHT: Amazing.

FISCHBECK: That was an interesting story. You'd never think that would happen. Slimy hands just slip right off the handle. I think that was one of the worst accidents. We had a couple bangs and scrapes over the years but nothing too bad.

One time in the early years we got out there and it was flat calm, so everybody asked if we could go swimming. As much time as I have spent on the ocean, my whole life—I was born and lived 17 years in Hawaii, then I moved to Bermuda and lived a long time in Bermuda—I never liked to swim in the deep ocean so I didn't go swimming. Everybody's swimming around the side of the ship, and I just happened to go out on the bridge. I'm standing there watching these guys swim, I look right down there, and I see this dark color. It's 3,000 feet of water, so it looks like you're looking into infinity. It's like looking into space. You could see down maybe 100 feet.

I see this dark blob, and it's getting closer and closer. So I yell, "Shark, get out of the water!" These three guys are right there, and they start kicking. That shark came right up under one of them. He just happened to kick—none of them saw the shark, they just kicked to get back into the small boat—and the shark turned like that [demonstrates]. Thought we had another Jaws situation.

There were sharks out there all the time, but they were whitetip sharks. They were there almost every mission, and they were more inquisitive than hungry, which is probably good. Pretty soon we just got immune to them. It's unbelievable. They didn't bother anybody. There

was a lot of thrashing and jumping in and out of boats. We never threw any of our trash overboard or anything, we always kept it till we got back.

We had a few jellyfish stings over the years, nobody got bit by anything. Caught a lot of fish, but that shark thing, that was interesting. That's the first time I saw one actually looking like something might be good eating. That looked just like the *Jaws* scene, spooky. Those whitetip sharks, you can see them, they swim right under the surface. They were about four, six feet long, actually very pretty. They had white tips on the end of their dorsal fin and their side fins. This was not a whitetip shark. I never did see exactly what kind it was because he turned, but it was big, bigger than the swimmer was.

WRIGHT: After working all of those missions, it came time for the last one. Can you give us your thoughts about what it was like to take the crew out?

FISCHBECK: Nobody wanted to see the last one, nobody. It's amazing. I've seen a couple of telecasts—they had one the other night, last Sunday, on the Shuttle. I think everybody, including me, gets very attached to the Shuttle because you spend so much of your life with it. If it had been a two- or three-year thing you'd go on to something else, but you spend that much time, you're forming bonds. You form bonds with people, because you're with the same people for years going in and out on storms, in and out on bad weather, in and out on accidents. It's like a family. And you spend time with the equipment. The disassembly guys feel the same way about their stuff downstairs as we do about the ship.

The guys in the launch pad, guys in the VAB, the guys in the external tank world, parachute shop, all those people spent years with that equipment. You just get attached to it.

Their equipment has to work or the whole thing doesn't work. Our part has to work, or you can't get the boosters back. You can't get the boosters back, you can't launch down the road. It's all connected, which was unique about this program. Every little teeny piece had to work.

We used to kid the astronauts—sometimes the astronauts would come over here, and we were always out of the way. We're the cleanup guys after the launch. We're post-flight. Nobody paid any attention to post-flight, unless post-flight didn't work for some reason. If post-flight didn't work because we had bad weather, had some delay, then post-flight became important—I'm being facetious.

The astronauts would come over now and again and see us, so we would say, "You know, that thing you're riding in has 50,000 parts all put together by the lowest bidder." They chuckle at that, and we say, "We're glad we're not going in it." All those 50,000 parts had to work, or the thing didn't go. I think that was the thing that bonded us all together too. Bonded us individually as the marine group, but it also bonded us to everybody else out here, because the goal was the same.

Everybody's goal was the same, and that made it unique. It's a huge amount of people with the same goal. I know big companies do that, but I don't think big companies communicate as well as we all did. I never saw so many contractor people, 12,000 people out here all working 100% towards the same thing and all contributing some little thing to the main effort. That was incredible. It took me 10 years to see that. It's such a big program that you don't see that in the beginning, it's too big.

When new guys would come in, they're bowled over by the acronyms. Then you get bowled over by all the rules that are out here. Finally, if you can accept all that, then you get into the phase where you start seeing maybe beyond your horizon, out of your playground. You see

into the other things. Pretty soon, after 15 or 20 years, you start seeing the whole thing and appreciating—things like we did with that overland barge delivery of that tank.

That was amazing because there were so many people involved to make that work. I'm sure if it had been outside it could have been done with 50 people, but we had probably 5,000 people doing it. That's the culture. The end result is putting somebody safely in space and bringing them back again. Everything trickles down from that.

Every mission, particularly since *Challenger* and *Columbia*, everybody had their fingers crossed, saying your prayers. Every mission after that became special, because we knew then it doesn't always work. Two of them didn't work, so you hold your breath. The Shuttle would go right over our heads, we were right on the azimuth. The boosters would come down about 10 miles away from us.

Once those boosters release about 60,000 feet, that Shuttle would go right straight over the top of us. It was really pretty. Couldn't always see it, but a lot of times you could. Until that point, we'd all be really sweating it. We got to get those boosters off of there and get the parachutes. Get them off the Shuttle, and the Shuttle is on its way. We're good, looks like it's going to work.

President [George W.] Bush mentioned earlier on in his Vision for Space Exploration that the Shuttle program was going to end around 2010. At that point, "Oh, that's way out there. It'll change." Well it never did change, so finally the end of the road came. It's like having a disease. It was disbelief at first, then rejection, then anger, and finally acceptance.

When we came in, we came in with the two ships. The mission was the same, our job is exactly the same as it was 10 missions earlier. It was a good day. It was the last mission, but once the SRBs hit the water we go into automatic retrieval mode. We're not thinking about next

week, we're doing what we're doing. That all went well; everybody did great. We came in, pushed the boosters in the slip, tied the ship up, came back the next day.

"Now what? Now what the heck is going to happen?" We all knew not everybody's staying. There's no Shuttle program. It's like getting kicked out of your house almost, pitched out of the family. It's a strange feeling. Fortunately now I've been here a little longer since the program ended, and I'm getting over the shock of it all. That's your way of life for 30 years. And not just your way of life, I mean a dedicated way of life. I bet a police officer would feel the same way or a fireman. Somebody dedicated to what he does would feel, "What am I supposed to do? How can you take this away from me?"

There's still a lot of feelings about why did it stop, did it have to stop, could it have gone longer, why didn't we have something in place to take its place? So here we are. We call ourselves, the 20 people remaining, the cockroaches. We survive. We survived the whole thing, and we're still here. I'm amazed. We're the bottom of the food chain and we're still here because COTS [Commercial Orbital Transportation Services] wants to use us, SpaceX [Space Exploration Technologies Corporation] wants to use our ships for the Weibel [Scientific] radar telemetry. We're hanging on by a little thread.

I'm pretty close to retiring but my wife is still working. For me, this is a hobby. This has always been my hobby. I feel like Ratty in The Wind in the Willows, I'm messing about with boats for 30 years. It took me 'til I was 40 years old to find something I enjoy doing, just by asking that lady down at the port a long time ago. There was a job up here and by a chance meeting, I got here and finally found something. I did a whole bunch of different stuff before I got here, and finally found something that I enjoyed doing and could find a progression to work

up to being a master mariner, which I am. Having seen this thing from launch one to launch 135, the last one.

Seems like it's been about two weeks, the whole thing, can't believe it. Both my boys were born when it started. Now they've finished college and everything. It seems like a flash to me. And I'd do it all over again, if you want to ask me. Yes, probably all of us would. It was great.

WRIGHT: Before we end, I was going to ask Jennifer if she had a question or two for you.

ROSS-NAZZAL: I had a couple. Can you tell us about the names of the ships? Who came up with those names?

FISCHBECK: Yes. UTC of course was in reference to United Technologies Corporation. The names were already there before I got here. Liberty and Freedom are part of our national pride, national being, liberty and justice for all. They wanted some national name that was recognizable, rather than a personal name.

Then of course the third ship was Independence. That was built over in Pascagoula, Mississippi. It was delivered here, and I was the first captain of that ship. I was asked if I wanted to take the ship to California. They were going to Vandenberg [Air Force Base, California]. I talked to my wife, and we decided it would first be more expensive to live out there. She'd have to get relocated, find a new job. Just had kid number one, so probably better to stay here. I'm glad I did stay here, because the Vandenberg thing never happened. That ship

got chartered to the Navy, and they spent a lot of time out in the Gulf of Alaska. It's still going. The ship is still in operation.

When the Shuttle processing contract changed we became Thiokol. It was Thiokol, then Morton Thiokol [Inc.]. They wanted the UTC off of it at that point, and I guess Lockheed [Corporation] had a say in it because instead of UTC Liberty, UTC Freedom, it became [MV] Liberty Star and [MV] Freedom Star. The Star is for Lockheed's logo, which is a star. Then not too long ago NASA took over ownership of the ships. The NASA logo is mounted on both sides of the smokestack, but they left the names the same.

Those name boards that you see on the sides of those ships by the bridge, those big wooden boards—they're actually required by the Coast Guard to be there. They're called name boards, and every ship has one. That's a lovely piece of mahogany about eight feet long. I was given one from the UTC Liberty, which I still have on my patio, because they had to get new ones calling it Liberty Star. People still ask me, what is UTC? I met some people thought it was a university, like university of something. We'd go to different places in our charters and people would say what is that UTC thing? It became Liberty Star and Freedom Star. Still nice names, but the UTC and the Star part were the corporate image on them. The names I think were universally recognized.

They're called motor vessels, not ships—MV. Independence never had a Star after it, because it was actually owned by the Air Force. The Air Force built it. It was just called Motor Vessel Independence. Motor Vessel Independence did two or three launches here, and then finally one of the members of the crew of the Freedom was certified to be captain, so he got the ship and took it to California with a crew.

They went out there to prepare for the Vandenberg launches, and then when that didn't happen they did charter, mostly for the Navy. Sometimes NOAA [National Oceanic and Atmospheric Administration] chartered them, University of Hawaii [Honolulu] chartered them, Scripps Institution [of Oceanography] in La Jolla [California] chartered them a few times. So they had a long and illustrious career but in a different business.

ROSS-NAZZAL: Earlier you had mentioned that the order of retrieval was important and significant. Can you walk us through that process?

FISCHBECK: The retrieval order is a definite process, and that's because sometimes if you do something out of order, you can't get the rest of it done. The first thing that you have to do is get the parachutes off of the boosters. Let me illustrate that.

The parachutes on the boosters went through a couple of changes over the years. Initially when they hit the water they blew free. The parachutes all had floats that were packed and loaded on the forward skirt, actually inside the frustum. That was to support them when they did blow free. The booster would sit this way [demonstrates], so the parachutes would be floated, then the riser groups and the canopies. It'd be way down, 200, 300 feet down. We never dove that far down, but we could get them with the floats and bring the ship to the floats. The small boat would tie a line from the riser group to the ship, and we'd pull it on.

Well, somewhere midway through the process of all the launches they had what they called some damage to the forward skirts. You may have heard of all this in the '90s. It was called slapdown damage. It got to be critical because for some reason the slapdown damage happened mostly to the left-hand booster, the left-hand forward skirt. As the parachutes came

down and hit the water, the parachutes would blow free, but if there was a wind of about 30 miles an hour or more, the SRBs are not only coming down but it's going sideways too.

As the SRBs hit the water, the bottom, the skirt part with the nozzle, hits the water first. It hits the surface and trips, and it goes bam like this [demonstrates]. It happened so fast you couldn't see it, but in video we could see it. At the slapdown the SRB started cracking and getting holes in the forward skirt, mostly the left side. I don't know why it was the left side. The program didn't have a whole lot of extra forward skirts. There was some instrumentation in the forward skirts, and the program really didn't want water in there.

Once the SRBs got banged up with holes in them, we couldn't repair them. We had a lot of soul searching and head scratching with the Marshall engineers, and we decided that one thing we could do was leave the parachutes on like they used to be. Originally they stayed attached, and we had to disconnect them. First number of launches the riser groups were attached to the deck fittings, which were right on top of the booster. The nose cone comes off and the frustum comes off, and three riser groups were attached to the deck fittings. We had to detach them. 40 feet down from the riser group there was what was called a cargo link, and each riser group had a cargo link. It's just a mechanical click thing like this [demonstrates], clicked together.

The divers had to go down and hang on against the riser group, push buttons or somehow disconnect, or else cut the riser line and disconnect these cargo links. Trouble is at 40 feet below the surface—in diving parlance 33 feet is one atmosphere. You go from one atmosphere to the surface quickly, you have a really good chance of getting an air embolism, because you're going to the surface too fast. You're supposed to come up at a certain rate of ascent, and if you exceed that rate you're really putting yourself at risk. Our divers figured that out pretty early. In a

rough sea they're yanked up to the surface, sometimes back down, trying to get these cargo links disconnected.

It took a number of missions, and finally we had an Air Force general, who was a diver, come out and dove on one of the SRB retrievals with us. He said you guys are absolutely right; we got to get these cargo links out of here. Actually some guys had a shoulder dislocated, a couple of other injuries, and we had to retire them from diving. They stayed here and worked but they didn't go out there anymore, two or three of them. The general says, "Okay, come up with a new way."

That was how they originally came, the first launches, cargo links. Then it went from there to where they got blown free. That lasted a number of years until the slapdown damage started wrecking forward skirts. This was four, five, six years in between, didn't happen in a week. Slapdown damage is on-going, and now the program is saying we need the parachutes attached longer because if the parachutes are attached longer, when the SRB hits the water the parachutes remain inflated. There's still resistance because the parachute is supporting the SRB, so it slows this slapdown thing down.

Question is, how do we get the risers off? We can't go back to the cargo links, that's too dangerous. We need the parachutes to stay inflated to minimize the slap-down damage. So we looked corporately. Everybody discovered that the military uses what they call Salt Water Activated Release, SWAR devices. Every military pilot that flies over water has Salt Water Activated Releases on their parachutes. When they hit salt water, they pop open free. The pilot is now free of his parachute, and it happens instantly. And it's fail safe. It can go off in your hand. It won't even hurt you. They were too small for these parachutes. We're talking a huge scale, Dumbo-size scale.

We contact the company that makes them in Jacksonville, and NASA Marshall took over at this point. "We need a parachute Salt Water Activated Release that can support this much weight, this much inertia," all the figures. They engineered this whole thing, and they made them. They drop tested them over the desert somewhere, and they worked okay.

They're all man-rated, so they were safe for us to go out there and climb all over the SRBs and retrieve them, because we retrieve the SWARs with the parachutes. They put them on, and they worked fine. The parachutes stayed attached, and the booster goes over like this [demonstrates]. The SWARs are not way at the top, they're down nearer to the booster. As soon as this SRB hits the water, it slows the momentum down. Booster comes up, parachute risers, SWARs get wet, they release, parachutes float down on to the water.

We made two Kevlar lines to each parachute that were attached to the booster. They didn't pack the floats on the SRBs anymore because each float was about this big and this thick [demonstrates], and you had to have three of them for each parachute to hold all that weight. Every pound of weight that booster carries up equates to like 20 pounds of cargo, so they said, "We can put more cargo in if we take the floats off." If we take the floats off and the SWARs blow the parachutes free, if you don't put another line on there they're going to sink.

The parachutes were fairly expensive and reusable, so they said, "Okay, we'll attach two" what they call standoff lines. The standoff lines were attached to the top of the rocket, to the deck. The booster would go down, SWARs would release, parachute would hit the water, and because each parachute had two Kevlar lines going to the risers, the parachutes would float upside down. The canopy is down in the water, riser here [demonstrates]. Kevlar lines are holding it up.

That worked fine, no more slapdown damage. Made it a lot easier for our divers, didn't have to go deal with the cargo links. We took our own floats over to the SRB. In our conference room there's pictures of all this stuff. Our divers would take these big round float balls and took two of them for each parachute. We'd take all the float balls out there and attach them to the parachute. Before we cut the Kevlar lines, we'd attach these floats.

The divers have to go down about 40 feet and attach them to the risers that are being suspended by the Kevlar line. They get all these risers tied in, then they cut the Kevlar lines. Then the parachutes float slowly away from the booster to the point where we take our small boat and put a line around one of the legs of the parachute. The ship would go over to the small boat, the boat crew would transfer the line to the ship, and we'd reel the parachute aboard onto the reel. That's how we did probably the last 15 years with the Salt Water Activated Releases, and that worked really well. That took care of all the parachute problems, but it took 20 something years to get to that point. We had injuries in the first part with the cargo links, then we had problems with the slapdown damage. Finally it evolved to a system that was safe and practical.

Now the DOP—initially when the DOP got to the point, past the BARB, to what it looked like out here [demonstrates], it didn't look exactly like it looks like now. The first DOPs filled up the nozzle. You pump the water out of the booster and tow them back. However, the phenolic and loose material, the cork material inside the booster after burnout, is all floating around inside the SRB. It's not clean in that there's still all this floating carbon stuff.

When you look at these DOPs, there is a great big plastic hose that attaches to the DOP. That goes on the inside of the SRB. On the front end of the plastic hose—we called it a catcher's mask, it looked like a catcher's mask. It's a cage with grills about this big [demonstrates]. It fits

into that hose, because the hose is taking the water from inside the booster, and it's pushing it out the center of the DOP. There's a flapper valve in the DOP so the water can only go out, it can't come back in.

Air is coming from the ship. The divers put the air hose onto the DOP with a quick disconnect, and the air is now going into the booster. Very simple process, and it worked really well. Air goes in, it pumps water out, and gradually the booster falls over like this [demonstrates]. Incredible. Probably a six-year-old kid can do that with a straw and a Coke bottle in a bathtub. Occasionally though this catcher's mask on the end of the hose, the dewatering hose, would get filled up with all this cork.

We had about a three-foot-long line with a small float buoy, a float ball, inside attached to the catcher's mask. This dewatering hose was probably six or seven feet long. It had to be long enough because the water level in the booster changed. When you pumped water out, the SRB got higher. You know how that float in the toilet works when the cistern is filling up, it works just like that. As the water level changed, the float ball would keep the dewatering hose where the water was.

The catcher's mask would fill up—that happened, I think, three or four times over the course of maybe four, five years. Didn't happen all the time. The booster would come up, and it would get into semilog mode. It would take about 30 minutes to do that. I would tell the small boat to go around the SRB, out to the side, not behind it but out to the side, and tell me if they are observing water flow from the rocket. If the answer was yes then the dewatering hose is not plugged up, because water is coming out as we're pumping air in.

Sometimes they would not see water coming out and we'd be pumping air in. A couple times we're pumping air in, no water is coming out, and the DOP goes boom, right out the back.

I saw the guys in the small boat jump right over the side of the boat. There's a lot of air in there, a lot of volume, but not much pressure, so when the DOP comes out it's pretty much in the water anyway. It went out about three feet, then it just floats.

The Thiokol people, who were in charge of the aft skirt and nozzle, were concerned that the DOP might damage the nozzle. Turns out that it didn't damage the nozzle, but we can't have that DOP popping out all the time. The last name change was made to the DOP, which became known as the EDOP, enhanced diver-operated plug. The enhanced DOP had a really unique thing, couple of neat things. This change on the DOP was like the SWARs to the parachute.

We decided corporately, all of us, that if we drilled a hole in the mandrel of the DOP in the vicinity of where the air goes in, and we put a burst disk across that hole, when the DOP reached a certain pressure the burst disk would break before it got so much pressure it'd blow the DOP out. Also in the burst disk we put dye like aviators have when they hit the water. They have a dye pack, it's red or fluorescent green, and it spreads out in the water and you can see it better. That would be the telltale that said the hose is clogged up. You've reached a pressure, about 11 psi [pounds per square inch], to blow this burst disk, which was basically a membrane.

Under normal operations it would be fine because the pressure on a dewatered booster never went over 11 psi, so if it got over 11 psi then the dewatering hose clogged up. We're pumping air in but we're not pumping water out, so the burst disk would go. The dye would hit the water, and you'd see what happened. Another great thing was that we could put a new burst disk on out in the ocean and close the hole back up and pump air in it and then get the SRB higher in the water. Never had any more trouble with blowing DOPs out.

It was easy to fix. If the hole where the burst disk was happened to be underwater, because of the way the DOP went in to the nozzle, then we just tow the SRB back that way and

put the burst disk on the DOP where it wasn't rough. If it wasn't rough on the ocean we could fix it there, so it was really easy. It was foolproof. It did everything it was supposed to do. It never blew any more DOPs out, worked great. Larry can give you a diver's-eye view how that all worked. So by the end of days, the parachutes worked, the booster worked, the DOPs worked. We had it all going well. We could have gone another 10 years.

WRIGHT: Was that order of retrieval something that was posted in a checklist?

FISCHBECK: Yes, the order was in our retrieval manuals, in our RODs document. In our governing paperwork, which I still have copies of, that procedure was spelled out. In our particular case it said that the order could be changed if it didn't increase the safety hazard. I'll give you an example of why you couldn't change things, because it would interfere with the next process. The parachutes had to come on first because they had to go on the reels. We couldn't put the frustum on first because it was blocking where the parachutes came on, so the frustum always came on last.

We couldn't dewater the booster first because we couldn't have it floating off. When it landed it was full of water, it wasn't going very far. If it got horizontal, it was like the barge. It was very light in the water. It would just float off. Also when it's floating vertically it's a really good radar target. You can see it ten miles away with our radar, so we always knew where it was. When we were doing this process we were about 100, 200 yards away from it, it was all right together. Parachutes, frustum, booster all landed in a grouping. They might be a half mile or mile from the other booster, but all one booster's components were right together.

The parachutes came on first, then the drogue parachute, and that was the last parachute reel. The first three parachutes from the front of the ship back—the first three reels were the main parachutes. Sometimes the main parachutes would get tangled, and we'd have to put two or even three parachutes on one reel. You couldn't get them separated out there. That happened fairly often too.

Of course when the parachutes blew free we didn't have this problem, but when they were tethered by the Kevlar lines, they're down 300 or 400 feet. The booster is spinning around—and if there's a night launch, you had to wait till morning. It's plunging up and down, and by the next morning they're wrapped all around the aft skirt. They're wrapped inside each other. Unbelievable mess. We'd send an inspection dive down, and we'd video it. It was unbelievable. We had to cut risers sometimes just to get it free; we had no choice. We try to reuse this stuff, but we can't get the booster in if we can't get the parachutes off of it.

A couple times when the booster was straight up and down, actually a calm day, a day with no wind, this would happen: the rocket hits the water and comes back up, and the parachute came down right over the top of it just like a big jellyfish. So we just left that parachute and got everything else done. Left the frustum in the water, dewatered the rocket so it came up like this [demonstrates], and then our divers climbed on the nozzle end.

Where the rocket goes down, the nozzle comes like this [demonstrates]. That's the lowest point in the water. We could put the bow of the small boat there and someone could hop up. They'd walk up on the booster and just work the parachute off. Took about half an hour, three guys working the parachute, to finally push it off the front where we got it. That happened a couple times I remember.

You'd have to get the three parachutes, then you'd have to get the drogue parachute on, then lift the frustum from the water onto the dunnage. That side of the deck is now done. We'd secure the frustum with strapping so it wouldn't move, then we'd have to go put the DOP in the water. Divers take it down, insert it, dewater. All this is taking about an hour, and if it's rough it's even longer. Get the booster up like this [demonstrates] and then keep pumping it until it's level, all the water is out, then get the air hose off and bring it back on the ship. Then hook the towline up, then get the small boat back on the ship and the guys out. That was pretty much the sequence of what we do.

WRIGHT: Quite a process.

FISCHBECK: All that took from four to eight hours depending on how rough it was. I think four hours was the fastest we ever did it, but that was when the parachutes were blown free and you could just go pick them up. When the parachutes were attached, the detaching process with the float balls took longer. We had to do underwater video surveillance to check everything first to make sure there was no damage to the casings underwater, so that added an extra dive. That was an extra 45 minutes to an hour's effort.

There was one other incident. To this day there's no explanation except one, and nobody can prove it. This is like the UFO [unidentified flying object] of our Shuttle missions. In all 32 years nothing like this ever happened before or since. One day, in the '80s, we were out at 150 miles with two ships. We had the Ocean Test Fixture, that practice booster that we made, and a practice frustum. We had all our toys out there. We would go out in the actual op area to get experience.

One day the frustum is sitting in the water. It's upside down, and it has a real, but old drogue parachute on it. It's hanging down maybe a couple hundred feet. Not a rough day. I happened to be on watch on the bridge. I was still a ship's officer at that point, and I'm just at the aft station of the bridge. When you're out there, there's a forward station and an aft station. At the aft station, the windows are right here [demonstrates], you can see the deck. You get used to driving the ship backwards, because you can't see anything from the forward station. We all got used to working from the aft station.

The frustum is right astern of the ship 50 yards. We're practicing getting the drogue chute on, lifting it up. We put it back in the water. The next crane operator gets to practice. The divers get to hook it up. We used to do that constantly until they started launching about every month or two about 1985, '84. When the launch frequency went up we started getting really good at what we were doing. The launches were actually our practices because they were so frequent.

This was back when there was three or four months between launches. We're sitting here in the ship, boat's here in the water. We're just sitting. The bottom of the frustum, the open part, goes down like this [demonstrates], and the parachute is here. This thing is sitting in the water and it goes skhhh, just disappeared. It went away. We didn't see anything, we didn't hear anything. Nobody saw anything, and we never heard anything about it afterwards. 15 or 20 people saw it happen. I'm looking at this frustum and it just went shoo, gone, and that fast.

This practice frustum wasn't like the real one. It was totally full of Styrofoam, so to sink that thing you had to put a lot of effort into it. We surmise, but we don't know—at that point Kings Bay in Georgia, where the submarine base is, wasn't built. A lot of the Trident missile submarines—the ballistic missile submarines, as opposed to attack submarines—would come in

out of Port Canaveral. The Trident basin, the eastern of those three basins—that's still a submarine base. We don't go in there much, but the submarines used to come in and use the ranges off of here to calibrate some of their stuff. A lot more submarine activity in the '80s here than lately, because now they're all going up to Kings Bay, Georgia, which was built specifically for that.

On the nautical charts you will see submarine transit lanes. They're like highways under the ocean, like airplanes have airways they fly. Submarines, when they get out in the deep ocean, can go where they want to go. When they're approaching the coast, there's certain lanes that they travel in so they don't run into each other. We think that the parachute hanging down was down far enough, and a submarine was coming by and it snagged it.

It would have had to have been the conning tower, because if the whole submarine was 200 feet or less from the surface we'd have seen something happening in the water. Those things are huge. We went behind one in the port one day that was getting ready to get under way. The ship went behind it, and when the sub engaged its propellers it actually pushed our ship sideways. It's just leaving the dock—hardly moving—and it pushed us. So we think a submarine conning tower grabbed that frustum, and it just took off with it. We never saw it again.

Usually this is a pretty tight community around the port, there's not many secrets. A guy catches a big fish or loses a fish or gets drunk or whatever, pretty soon everybody knows. The guys in the crew live here, they grew up here. You hear stuff, but we never heard a single thing about that frustum. We knew guys in the Navy, we knew guys in the NOTU [Naval Ordnance Test Unit]. We know guys on the test range, we know merchant marine guys down there, we know fishermen. Not one word ever about that frustum. For all I know it could have been a

Russian submarine, or it could have disappeared out in the ocean. But for a little place like this was, never heard a thing. Maybe the submarine was going somewhere else.

A big submarine may not even have noticed that. If that frustum didn't hit the submarine, if it didn't bang off of it, I don't think they would have noticed the drag. They have so much power, it'd have been like a flea. If it hit the sub, if it banged under the water, then probably that would have caused some alarm. But if it didn't hit it right away they wouldn't even have noticed it. That was an interesting story, a true story. Nobody ever figured that out.

WRIGHT: Amazing, that's a great one.

ROSS-NAZZAL: I just had one other question. You mentioned you had all your "playthings" and you'd take them out and practice. When did you guys get to a point where you decided that you had all the procedures down?

FISCHBECK: It was right about '85. We'd go out a week or two of every month when the launches were six months apart. We needed to because we were getting new people, and all of our stuff kept evolving all the time. When the launch rate started going up, there was a launch almost every month or every other month. There was nine launches in '85. We had been in the business like seven years at that time, and we were pretty stable, the equipment was pretty stable. With the launch rate at that level we were doing enough real-time.

I hate to use the term "practicing" on a real launch, but they were so frequent that we were staying tuned up. We didn't have to wait three or four months to go out again. We needed to go out was because the divers had to keep diving. We had to do so many dives a year to keep

everybody in qualification. You get a new diver, and no matter what he did before, he had never done anything like we were doing, so these guys had to come out and see this stuff. To the last mission, if a guy was a new guy we wouldn't put him on any hands on. He'd just go down and watch for two or three missions before he could actually touch something, push a DOP down. Took four guys to help install a DOP. Go out there and hook up the tow, hook up the air. The new guys never did that. They watched for a few times.

It took longer to assimilate divers than it did crew members. You could take a crew member off a Navy ship or off a yacht or off a sailboat. Deck guys know how to anchor, they know how to throw lines, they know how to paint. They know how to do all that stuff. Standing watch is pretty routine everywhere, same requirements. But the diving was totally new, so it took longer to get the divers up to speed than it did anybody else. And once they got there they had to stay there.

Once we started going six or seven launches a year that was enough that everybody was current. After *Challenger* there was nothing for a year or two, so we went back to practicing again all the time. The launch rate never did pick up like it did in the early '80s, so we would go and practice. If there was a launch every three or four months we'd go out a couple times a month. When you start getting into the mid '90s up to the end, you didn't change people very much. Everybody was here, everybody had been sifted through, and everybody who was left in the mid '90s pretty much stayed to the end.

One nice thing, we had a huge amount of tribal knowledge. All these guys on this floor, they've all been here 20 or more years. That's one of the sad things—we used to have 90 people in this group and I think we're down to 22. All that knowledge is just gone out in the world somewhere. It's all good knowledge, too bad we couldn't have gone longer with this program.

My personal opinion is the Shuttle could have flown longer. Everybody said it was old technology but it worked. I talked to an astronaut named Dominic [A.] Antonelli who went out with us one time, he actually was pilot of one of the later missions. I asked him how he got started—interesting story. He said that the Russian rocket is like one of our old locomotives. It's not pretty, but it's very simple and it works well. Even the Shuttle, as old as people now say it was, it still worked well. It was a lot better-looking and probably more efficient.

They had problems over the years, but they fixed them all. They had problems with the foam for *Columbia*, they fixed that. They had problems with the seal for *Challenger*. In both of those cases those problems existed before the actual event happened. It's too bad it got to that point, but we got complacent. I remember the launch. The mission manager on *Columbia*—I was listening to the radio—he said the smoking gun looks like foam but it's not foam. But that's what the problem was.

I read the report they published a few years later, the *Columbia* Accident Investigation [Board], CAIB, book. It was just like on *Challenger*. A whole lot of people knew that was the problem. When those boosters would come in here before *Challenger* after missions, those guys down there on the hangar floor—who I know like brothers—could see that burnthrough was already happening. The "gun" was already smoking. Something was going on there with the seals.

There was one report before *Challenger* when they called up the head of Thiokol. Said, "Come on, play ball, let's go," so he caved in and said launch. One of the engineers there said, "If you launch when it's this cold, this rubber is going to be too hard and it's not going to seal." Pretty simple. And that's exactly what happened. They knew about that, and they knew about the foam. I don't get that part at all.

WRIGHT: I do have one question, and it goes back to you using the term "being on watch." When you'd go out to your station and be waiting for the Shuttle orbiter to fly over and the boosters to release, were there specific people assigned for the watch? Or did everyone help?

FISCHBECK: No, specific people. The ship's watch is always the ship's crew. Same thing for example like an aircraft carrier. There are 5,000 people in an aircraft carrier, but only the ship's deck officers are trained to be watch officers. On our ships we have a captain, a chief mate, a second mate, a lead seaman, two ABs [able seamen] and an ordinary seaman, and a cook and two engineers. The watch is only a captain, a chief mate, a second mate, an AB or the ordinary.

To get our license we have to go through an enormous amount of material: ship handling, ship stability, radar, celestial navigation, coastwise navigation, piloting, ship characteristics, ship maneuvering. You get tested in this every time you go back to upgrade your license. The seamen go through similar tests but on a simpler scale.

All of us have to know how to use all the radios on the bridge, all the communication equipment; all the radar—changing scale, plotting contacts; and radio protocol, what all the frequencies are: VHF [very high frequency], HF [high frequency], UHF [ultra high frequency]. How the machinery works—the engineers keep it running, but we have to know throttle controls, rudder controls, pitch controls on the propeller, the navigation, all the rules of the road. The COLREGS, the International Regulations for Preventing Collision at Sea, is basically your driver's handbook. That is extremely complicated. It covers everything that floats, and there's a rule on both situations, you and the other guy. That's a 90% subject. You have to get a 90% on

those tests or you fail the navigation and the safety and the rules of the road, so you've got to pay attention.

The 10 or 12 divers that go out there don't stand watch; they're not qualified to stand watch. There are set watch people. We're going on a trip next week up to Nova Scotia [Canada], and I'm on the 4:00 to 8:00 watch in the morning and the 4:00 to 8:00 watch at night. David Winston, who's the ordinary seaman, is on watch with me. The captain is on another watch with the other seamen. We're so short of people now—that's why we kept our licenses current, to fill in—so he's going to be standing another watch. The watch is only Coast Guard-licensed or certified personnel, usually the permanent crew.

WRIGHT: When you would see the boosters, when they would hit the water at splashdown—originally you didn't have the GPS systems that you had at the end, is that correct?

FISCHBECK: No. They had radar though, and the radar always picked them up. We had LORAN [LOng RAnge Navigation] back in those days. The early versions of GPS were very rudimentary in that they only gave you a position about once every six or seven hours, which was pretty good. We used LORAN and we used celestial navigation, which I enjoyed doing, because it was an art and a science. Now I can take this GPS and go anywhere in the world with it, and I'll be within six feet of where I think I am. I can have a course, I can have a speed, I can have a distance, I can put a waypoint. It'll tell me a lat [latitude] and lon [longitude] of anywhere in the world, using two AA batteries. Amazing.

WRIGHT: Come a long way.

FISCHBECK: All the new cars have these things now, and a pretty dashboard display. I have two sextants I bought when I used them in the Navy. I used to enjoy the sextant. It was written—I think [Nathaniel] Bowditch said celestial navigation is an art and a science. The art was being able to use the sextant with two mirrors to get the reflection of a star or a planet right on the horizon. At that particular instant you mark the time, and you work out a sight reduction, spherical trigonometry. You get one line, two lines, three lines, that's where you are. Now with GPS you just turn the thing on and, provided you read the instruction manual, you can see where you are. Took all the fun out of the whole thing.

I got pretty good at using a sextant. On that ship I was on before I started here, we used a magnetic compass and a sextant for position. I did a lot of ocean sailing too when we'd only have a sextant and magnetic compass. That was an art, and you refined that art. The more you refine it, the better position you got with it. I liked doing that.

WRIGHT: Was there anything else that you can think of that you'd like to share?

FISCHBECK: No, I think that's all the adventures. That was all the exciting things.

WRIGHT: Well, thank you so much. It's wonderful information, we appreciate it.

FISCHBECK: You're very welcome.

[End of interview]