SRB RECOVERY SHIPS ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

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INTERVIEWED BY REBECCA WRIGHT
CAPE CANAVERAL AIR FORCE STATION, FLORIDA – 10 APRIL 2012

WRIGHT: Today is April 10th, 2012. This oral history is being conducted with David Fraine for the SRB [solid rocket booster] recovery ships oral history project. The interview is being conducted at the Cape Canaveral Air Force Station, in Hangar AF. Interviewer is Rebecca Wright, assisted by Jennifer Ross-Nazzal. Thank you for giving up part of your afternoon to talk with us, we know it's a really busy week for all of you. If you would, start by sharing with us how you became part of this operation and maybe some background of what brought you here.

FRAINE: Well, my first day was April 6, 1982. Last week, 30 years. I joined the [MV (motor vessel)] *Liberty Star* as second officer, second mate. My time on board *Liberty* was kind of short-lived. At the time we had a captain by the name of James Bond, who skippered the *Liberty*, and first officer was John [C.] Fischbeck. About six months into my time here, Captain Bond left us and I had an opportunity to move up to first officer on the [MV] *Freedom Star*. I went to the *Freedom*, and there I stayed for ten years under Captain Dan Riksen. Fine man. We're friends to this day, and I chat with him periodically either via email or on the phone. Dan retired in 1992, and I relieved him as master of the *Freedom Star*, where I remained until 2007 as captain.

Then I moved up here to the hangar and assumed a staff position, taking on a lot of different assignments. The list of things that I've been doing the past five years would include writing white papers on flight hardware recovery, advising NASA as far as procedures for flight

hardware recovery for the Constellation Program. This included the development of a "Concept of Operations." I wrote two papers for SpaceX [Space Exploration Technologies Corporation] on flight hardware recovery as well. Aside from that, a lot of public relations-type work—touring folks around here, special projects, special research. I also continued to fill in from time to time as a relief officer on the recovery ships. After 25 years on the ships I was ready for something different, so Joe [Joseph P. Chaput] gave me the opportunity and I came from the ships to the office. It was greatly appreciated.

WRIGHT: Let's talk about some of those first missions. You mentioned you were here in '82.

FRAINE: My first mission was STS-4.

WRIGHT: Four, what a way to start!

FRAINE: I thought I was jinxed, because STS-4—the solid rocket boosters performed flawlessly, and they separated flawlessly. Everything worked until it got time for the parachutes to deploy, and there was a fault there. My first mission, which I thought would be a few days, ended up lasting a few months. We deployed ROVs [remotely operated vehicles], remotely piloted submarines, to document the condition of the flight hardware and help NASA determine the cause of the parachute failure for their investigation. That launch happened in June, and we weren't done until September. That was a long one.

WRIGHT: Tell us about working on the *Liberty Star* and what that was like on that first mission and how you became familiar with your vessel. As its first officer what were your duties?

FRAINE: I was second officer on the *Liberty*, then I moved to the *Freedom Star* on October 6th of 1982. I was there for 25 years until I moved up here. The first officer is second in command to the captain, so if the captain for any reason has to get off or becomes ill then I would fill in as captain of the ship. In addition to that, my role on the ship was overseeing vessel maintenance—that's both the interior and exterior of the vessel—supervising the deck crew and the ship's cook, keeping track of the finances and costs and expenditures, and standing watch on the vessel when it was underway as a watch-standing officer.

In addition, I trained to be a deck supervisor and supervised SRB recovery operations on deck. This included recovering parachutes, recovering the frustums, and supporting the divers as far as the dive operations. I'm working for the captain, and I'm working for the retrieval supervisor in that capacity. I'm the guy who's down on deck directing the flow of the operations. Aside from that, just special projects and things like that along the way.

WRIGHT: The *Liberty Star* and the *Freedom Star* were very uniquely crafted vessels for this operation. What were your thoughts of those vessels when you first arrived here?

FRAINE: They're unique vessels. When I started out in my profession, I graduated from the Massachusetts Maritime Academy [Buzzards Bay] in 1978. I got a degree in marine transportation and a license from the Coast Guard. I wanted to pursue a seagoing career, so I worked in a variety of vessels. One type of vessel I worked on most frequently was oil field tug

supply vessels, working the offshore waters of New England supporting drilling operations, exploration. The captain and the chief engineer on one of the ships I was on had been following the progress of these vessels as they were being constructed, and they were very interested. They wanted to come to work here. They followed them in the professional magazines, and by hook or by crook, any piece of information they could find on them.

The captain ended up coming down here. He hired on as first officer on the Liberty, and he lasted all of 30 days. Things were pretty crazy here in the first years. It was trial and error. Nobody had ever done this before. It was a new organization. Everybody was kind of feeling their way around, getting to know the job, getting to know the vessels, and in the process trying to develop the procedures for the recovery of these boosters. Like I say, no one had ever done this before. When he came down, things were a little crazy, and he shook his head and said, "No, thank you, I'd rather be working the oil fields."

When he came back he told me about the job. I was newly married and had a young kid. I was interested in spending less time away from home, and this sounded like a good opportunity. I put in an application. I figured I could put up with just about anything for this opportunity. Six months later, out of the blue, I got a call from Captain Bond. They were looking for somebody who had family ties who wanted to stick around for a while down here, and I fit the bill. So I came down, interviewed, and ended up getting the job.

I was impressed with the vessels, very impressed, very maneuverable, very well-equipped. I mean, variable-pitch propellers—that's a big deal for that the time. The ships also had fore and aft thrusters. The controlling capabilities of these vessels was very impressive. Most of the equipment on board was state-of-the-art as far as the electronics and everything for 1982. I just love ships. I love these girls, they've had a special place in my heart ever since.

WRIGHT: Tell us how they've changed through those years, the modifications that have been done to them.

FRAINE: I give the folks around here credit for the way they've managed that. Rather than just automatically replacing a system as the technology got somewhat dated, they'd buy a new system and add to it. We kept the older systems as backups. The ships have duplicate, triplicate methods of communications and equipment. Multiple VHFs [very high frequency], multiple HF [high frequency] radios.

The way navigation equipment has evolved over the past 30 years has been impressive, starting with LORAN, long-range radio aid to navigation, going to NAVSAT (Navy Navigation Satellite System) satellite navigation, and then SAT NAVs [satellite navigation], which would give you continuous readout of your geographic position. Being a merchant officer, we're well trained for piloting and celestial navigation.

The company always managed to have the best electronics and the latest and greatest around here. I guess it's part of working for the space program. The ships have always been well cared for as far as the equipment and as far as the maintenance. We've always maintained those ships like they were yachts. Money wasn't spared as far as making sure the right things were done regarding the equipment and the maintenance. We also went the extra mile as far as the coatings and the corrosion control for the ships. We were blessed to have crews and personnel on board that had a lot of pride in those ships. They took very good care of them.

WRIGHT: We understand that you were kind of an all-in-one operation. People who worked on the boats—the crews took care of everything, you were all self-reliant.

FRAINE: That's one of the cool things about this place, we all wear multiple hats. That especially includes the retrieval divers who actually did the dive operations for recovering the SRBs. Their in port job titles included engineer, welder, draftsman, electronic technicians, mechanical technicians. They were a multi-skilled, talented team. In addition to that, the dive operations ran the small boats. They were the workforce on the aft deck for recovering the flight hardware, and they were also a majority of the workforce for the SRB disassembly operations once the boosters were brought back here to Hanger AF at Cape Canaveral Air Force Station. Granted, they weren't necessarily the team leads, but they were in the thick of it. That also applied to the seamen working on board the ship. The seamen were also cross-trained to do SRB disassembly operations, and some of our seamen and some of our officers also became retrieval divers.

WRIGHT: Is that normal in maritime operations, to have so many crew members cross-trained?

FRAINE: No no, not at all. It's not common, put it that way. It gives us an edge as far as efficiency goes. Rather than having 150 people working here performing an operation, and having a lot of those people be idle at any given time, we had a migratory workforce that could pretty much do it all, keep busy most of the time. So we'd have a workforce of 50 rather than 150, and that's pretty impressive. That's pretty unique. You might not find that too many other places.

WRIGHT: What was the most challenging aspect of maintaining the ships, especially here in the Florida coast?

FRAINE: We're in somewhat of a tropical climate here. Hot sun, tough conditions, especially from say, April through October as far as working outdoors, maintaining the exteriors of the vessels, corrosion control. Even though I'm sailing as first officer, it was a small crew so I got my hands into the painting and the chipping and the maintenance just like the crew. Probably the most challenging thing is keeping people from getting overwhelmed from the heat, and taking those extra precautions with both yourself and the people that work with you and for you to make sure they're not dehydrated. To make sure they're not passing out from the heat. I'd say that's probably one of the most challenging things about working here.

Some of the coatings that we used early on tended to chalk. You notice they're white vessels. Some of the epoxies we used tended to be a challenge as far as maintaining the appearance of the ship. Of course, when you do corrosion control and painting, what you're trying to do is preserve the metal, but we went the extra mile, as do most mariners, as far as making sure the ships also look good.

WRIGHT: Would you take us through a routine Shuttle mission? How you prepare your crew, how the ships were prepared, and then actually what happened the day of the launch? As a captain, when you became one.

FRAINE: Sure, I can do that. One of the first things that we want to be able to do is to make sure that the ship's ready to go for the mission. That falls on the chief engineer and the engineers as far as making sure that the ship's mechanically sound and ready to go. It falls on the chief mate and the seamen as far as making sure all of the deck systems and equipment are up to speed and all the safety equipment is up to snuff. Also all the retrieval gear, making sure we have it all aboard, that it's all in the right condition and ready. That was kind of a joint effort that you'd have between some of the retrieval technicians as well as the marine crew. Priority number one would be making sure we're ready to go on all aspects.

Ship's cook going out and doing the food shopping, making sure we had a good menu for the folks on board. We've got to anticipate that the mission might not go as per schedule. There might be delays, slips, that sort of thing, so you don't just buy enough food to last a couple days. You've got enough on board to last a couple weeks if need be. We've had a few operations where that was important, because the chow on board is kind of a morale thing as far as the crew. If you don't have a good cook, you don't have a good menu, you don't have happy people.

The ship's ready to go. We're underway 24 hours in advance of a launch. We pull away from the dock here at Hangar AF and go down the Banana River, through the Canaveral Locks and the bridge and through Port Canaveral and then head out to sea. We do this in company with our sister ship, *Liberty Star*. *Liberty Star* and *Freedom Star* would head out together. We'd pass through the port, and we'd pass offshore and around Cape Canaveral Shoals and then set a course for the mission support position for booster recovery.

That's usually projected well in advance. Some smart people figure that out. Sometimes they get it right, sometimes they don't. Early on most of our missions were to the east, so we just head out east of Cape Canaveral about 110, 120 miles, and stand by at a designated position

and wait for the Shuttle launch. In the late 1990s we began supporting International Space Station launches. The ships would go to the northeast off of Jacksonville [Florida].

We left a day in advance of the launch. We get to the vicinity of the splashdown point and our mission support position about three hours prior to the launch. We'll stand by there and maintain communications with the people back here at the Cape and monitor the status of the launch right down to the final countdown. As we're getting within minutes of the launch, the ship takes up position perpendicular to the flight path of the boosters and pointing away from where the boosters are projected to splash down.

The reason being is if somebody miscalculates the booster splashdown position and they end up coming down where we're at, we're ready to get out of the way. In reality it's kind of crazy because those boosters are coming through the air at 240 miles an hour, and they slow to 60 miles an hour after the chutes open. Well, these ships will do about 12 or 13 nautical miles an hour. But every little bit counts, so if we have to get out of the way, we can. In reality, the closest we've been to the boosters has been about four miles at splashdown, furthest about 24 miles—to my recollection anyway.

So we're waiting on the launch, liftoff goes. Everybody's out on the bridge wing. They're all watching as the Shuttle comes over the horizon, so you see booster separation on a clear day. At night it's really awesome. A little over two minutes after launch the boosters separate and arc through space up to an altitude of about 42 miles and then they start their fall. About six minutes or so after launch, those boosters splash down, and we'll get an S&A [safe and arm] safe confirmation over the radio from the folks back here. That means the safety and armed system of the SRBs has been safed so that we don't have the risk of explosives when we close on the booster to do recovery.

Say we're eight to ten miles away from the boosters. It takes us about 45 minutes to an hour to get to their position. Once we arrive we deploy a small boat. The small boat has retrieval divers on board who do an assessment on the surface of the boosters, the material condition, and that sort of thing. Meanwhile the ship will circle around the boosters, and we'll have somebody on a video camera as well as taking still pictures that will document the condition of the boosters. This is happening with both boosters simultaneously. Both ships are circling their respective boosters and documenting the condition.

One of the things we added to our procedures later on was that we would deploy divers who would document the condition of the boosters under the water. Keep in mind that as the boosters are sitting there, they're sitting in a vertical position. Thirty foot of the booster is above the water, 100 foot of the booster is below the water. The nozzle is at the bottom and open to the sea. The divers will dive down and do an assessment, take video, take stills underwater of the boosters. Next step is parachute separation. Divers disconnect the parachutes from the SRBs, attach floats to them, and float them to the surface. Next the ship will position itself to recover the parachutes over the stern. We reel them up on the parachute reels.

Next comes the frustum. We'll pick up the frustum via the end of its drogue chute and a line that's attached to it, and we'll reel that up onto a parachute reel. Next we use our crane with a specially designed power block to pick up that 5,000-pound frustum. The frustum resembles a large cone. It sat on the top end of the SRB and housed the main chutes. We'll pick that up out of the water and put it on the deck. It's a tricky operation. During recovery it was a real concern for whoever's running the deck to make sure everybody's out of the way before we swing it over and set it on the deck.

What you need to keep in mind is we're at sea. Ship's rolling and pitching, and that 5,000-pound cone that we're recovering is swinging back and forth. You want a good crane operator with a sense of timing for picking up that frustum at the right time, swinging it over, and setting it on the deck. Once it's down flat on the deck you want the crew to hustle to attach the belly band and the straps to secure it down on the deck so it doesn't slide back and forth.

We've recovered the parachutes; we've recovered the frustum. Now it's time to recover the SRB. Normally at this point in time we'll take a break. We have a pre-task briefing, and the retrieval supervisor and dive supervisor will go over what the procedures are going to be for the divers, who's going to do what at any given time. They make sure everybody's up to speed with the plan, answer any questions, address any conditions relevant to that day, identify poor sea conditions, weather, whatever.

Then we're ready to go. We'll deploy both boats with the dive teams in them. The ship will make a pass on the solid rocket booster, and we'll deploy what we call the diver-operated plug or DOP. It's about a 1,400–pound cylinder with a collar and flotation on it and legs that lock in place. We launch it into the water off of our DOP launcher. Once we've made the pass on the booster and launched the DOP, the divers will take possession of it via the small boat. They'll tow it towards the SRB, and then they'll prepare for their dive operations.

We're going to have two dives here. First team will take down the diver-operated plug and insert it into the open nozzle, lock the legs in place. They're going to inflate a seal around the collar, and then they're going to attach an air hose that we have dangling down from the side of the ship—about 1,200 foot of air hose. Now the divers come to the surface, and the second dive team begins an assessment dive. They go down and make sure that everything's hooked up right. It's a second chance also—say we ran out of time with the first team or something was

amiss. The second team could go down and correct it. They'll make the dive, they'll do their inspection, and once they've completed that dive, then we'll begin passing air to the booster.

Once we've connected the air hose, the ship is holding station with the booster. We have the booster floating vertically, and the ship in position probably 40, 50 feet away with an air hose dangling off the stern and down into the SRB. The ship and the booster are floating together, and the captain or the deck officer at the controls maintaining the ship's position with the booster as we drift along. Sometimes they have different rates, so it requires a lot of concentration and a fair amount of skill to do this.

The booster will rise out of the water as we pass air to it, and it'll fall over on its side. Some people ask, "Well how do you know which way it's going to fall?" It's going to fall downwind, so you position the ship in such a way that when that booster falls it falls beside you. We continue pumping until the rest of the water is out of the booster, and then we disconnect the air hose and hook up a tow line for the long tow back to port.

We're going to tow the booster in like a 130-foot log astern of us. We're going to use what's left of the parachute shrouds, after we've disconnected them from the parachutes, and we're going to tie that in to a special adapter which is in turn tied into a tow wire, which is paid out from the ship's tow winch. Once we've got the booster connected, we pay out the tow wire until it's about 1,200 foot astern of us, and we slowly pick up ship speed. Average tow speed is eight knots. We tow it in and usually arrive the next day or the day after early in the morning, depending on what time the launch was and what time we finished our recovery operations.

The booster's 1,200 foot astern of us. As we get into shallow water, we have to shorten the tow wire. The reason is that weight of the wire between the ship and the booster creates a catenary of 60 feet. We don't want to drag the wire across the bottom, so as we get closer to

shore we shorten the tow and slow the ship's speed so as not to jerk the booster around. The reason we empty catenary on the wire is that it acts as a shock absorber that reduces stress to the tow. Eventually, we slowly bring the booster in until it's near the stern—the shallower the water, the less wire that we have out—into Port Canaveral with the booster right on the stern.

Next we'll maneuver into one of the basins in Port Canaveral, and we'll do what's called "hipping the tow." We disconnect the tow wire. The ship then maneuvers alongside the booster, and we connect lines to it so as to tow it on the side of the ship. We have fenders that we've set alongside the ship so that we don't bang up that booster as we're towing it up the river. The reason we hip the tow is that we are operating in confined waters, and we have to have absolute control over that booster as the ship heads to Hanger AF. We do a final dewater of the booster, and then we tow it through the port, through the bridge at Port Canaveral, through the Canaveral Locks, and up the Banana River. Banana River, by the way, isn't a river at all. It's just a big saltwater estuary, very shallow. The channels are dredged ditches that we navigate through to get up to Hangar AF.

Once we get to Hangar AF, we position the ship with the bow into the dock using the thrusters. The bow will actually be sitting on some special fendering that we have at the end of the dock. We'll pass lines to the disassembly personnel on the dock, and we'll pull the booster into the slip. Disassembly personnel pick it out of the water with a straddle-lift crane (a modified boatyard crane) and put it onto specially designed rail dollies. The ship will then lay alongside the dock. We offload the parachute reels and the frustum, then the crew departs ship because of hazards involved in pulling the booster out of the water. It's a hazardous operation. This completes SRB recovery operations.

WRIGHT: It sounds so routine, but was it from one time to the next?

FRAINE: It was. Now, I wasn't there for every single mission. I did about 110 missions myself out of 135. STS-117 was my last launch, after which I moved to the hangar. That was in 2007.

WRIGHT: Did you work any of the barge tows for the external tank?

FRAINE: Yes, *Freedom Star* did the first tows for the external tank barges. Joe Chaput was captain of the *Liberty Star* at the time, and I was captain of the *Freedom*. Initially, we traveled to Louisiana where we rode aboard commercial tugs on barge trips between [NASA] Michoud [Assembly Facility, New Orleans, Louisiana] and the Gulf of Mexico so as to gain pilotage for the Mississippi River Gulf Outlet.

Freedom and *Liberty* were modified to tow the external tank barge. We did our first ET barge tow with *Freedom Star* in June of 1998. *Freedom* did the first four tows, and then we alternated between the *Liberty Star* and *Freedom Star* for tows of the barges. We delivered the external tanks from Louisiana to here at KSC [Kennedy Space Center]. A barge tow takes four to five days. We bring the barge inside Port Canaveral and then turn it over to commercial river tugs. They tow it up the Banana River to the VAB [Vehicle Assembly Building] basin, where it would be positioned at the dock and they would roll the external tank out of the barge. The ship would proceed back here to the hangar and tie up to the dock.

The ships are kind of cool in that they're almost like a giant Lego set. They can easily be reconfigured. We can change configuration in a matter of a few hours to do a specific mission. All the equipment on the aft deck is bolt-on. The crane is bolt-on, the parachute reels, even the

tow bits and the boats and the boat cradles. We can unbolt everything, lift it off with a crane, reconfigure the deck quickly and efficiently for towing operations. The ships are very adaptable to various missions.

WRIGHT: That sounds like some good planning and good strategy set in foundation.

FRAINE: We had a lot of smart people that figured out how to do things early on. As much as we might like to take credit for it all, the truth is that some good people mentored us and started things. We picked it up and carried it on from there.

WRIGHT: The ships have gone out on some other missions for customers other than just the Shuttle missions. You mentioned the ET [external tank] barges, but you also did some work with NOAA [National Oceanic and Atmospheric Administration] and some work for NEEMO [NASA Extreme Environment Mission Operations]. Did you work on those projects as well?

FRAINE: Yes, I did. Probably one of the coolest things we ever did—I got great satisfaction out of it—we used to do a lot of weather buoy deployment and recoveries. NASA has the support of NOAA weather buoys situated offshore here from the Cape. We'd set those up and deploy them and then recover them when they had to be changed out. We had one that broke loose in October of '04 after a hurricane passed. It drifted north, and we took the *Freedom* and chased it down off of Cape Hatteras, North Carolina, then got in tow. The weather was rough. We managed to tow it for a few days until we got into calmer weather and were able to get it aboard and return it.

We've done a lot of work with weather buoys. We've also done some work with NOAA and the University of North Carolina Wilmington. Everything from AUVs [autonomous underwater vehicles] to marine life studies. We've worked with the NEEMO missions on a number of occasions. They have this underwater habitat called Aquarius just south of Key Largo in the Florida Keys. It's an underwater research facility that NASA has utilized from time to time to do weightless training for divers. Astronauts remain in a confined space for an extended period of time and work in a weightless environment under the water. It simulates space missions.

We've also supported marine fishery studies and that sort of thing over the years, and that's been pretty interesting as well. Other customers have included SpaceX. On a couple of occasions we supported Falcon 9 [SpaceX launch vehicle] launches for recovery of the boosters. The boosters weren't recoverable, at least for these early missions. They're making further modifications. They think they'll be able to recover them down the road.

We also supported the radar tracking carrying an X-band radar. This was invaluable as far as bringing that data back and providing that data to NASA and SpaceX so that they can make good evaluations on the flight characteristics of their rockets. We're also going to do similar work, hopefully, for Orbital Sciences [Corporation] tracking the Antares rocket and the Cygnus spacecraft. The Cygnus COTS [Commercial Orbital Transportation Services] vehicle is to supply the Space Station just as Dragon is doing.

Aside from that, we've done a lot of salvage operations over the years. We supported *Challenger* [STS 51-L accident] of course, and that was tough. We've done Titan, we've done Delta, we've done Atlas rockets. We go out and support mapping of the ocean bottom with side scan sonar where the rocket has impacted, then go out and recover the pieces. That's really what

a salvage operation's all about. *Challenger* was tough because we started operations in January, and we weren't done till August. We supported mapping of the bottom, we deployed ROVs to document what was on the bottom and where, and then we deployed dive teams to recover the flight hardware.

WRIGHT: What's the longest trip that the ships have been out on? How far away have they gone?

FRAINE: We did Air Force drone recovery off of Bermuda and Puerto Rico in 1988. That was January and February of 1988 for Freedom, and then Liberty went out in March of '88 in Puerto Rico and did likewise. They were old Vietnam War–era jet drone aircraft that were being used to test a special radar defense system that the Air Force was setting up for North America, and they needed something that could mimic the flight characteristics of a cruise missile. Our job was to stand by as this drone flew through its paces. At the end of its flight it would parachute into the water, and we would pick up the drone and bring it on board. It was interesting. We were 1,000, 1,200 miles away from home. It was a long haul.

WRIGHT: We understand the boats are getting ready to go to Nova Scotia [Canada]?

FRAINE: Yes, this will be a long haul as well. This is for tracking COTS 2/3, the Falcon 9 and the Dragon capsule, which is delivering cargo to Space Station. Freedom and Liberty are going to depart on the 19th of April. We'll go up to Portsmouth, New Hampshire, we'll pick up a team of technicians who are going to operate the X-band radars, then we'll proceed out to our stations.

The *Liberty* will be 200 miles east of Cape Cod, and *Freedom* will be 200 miles east of Nova Scotia. The ships will be positioned to permit the radars and the special imaging equipment we have aboard to record the rocket as it flies over. It's very important for the NASA COTS office to get some information on the mission. We will track it as it flies over after launch. Then we'll stay out there for a day or so and track the fly-bys.

WRIGHT: Jennifer, do you have some questions you want to ask?

ROSS-NAZZAL: I do, thank you. Originally the ships belonged to UTC [United Technologies Corporation]. Why did NASA decide to buy them, and when did they put them on their property list?

WRIGHT: I can give you a little on that, sure. You have to go way back here. In 1979, when the plan was being developed for SRB recovery, it was being developed by "Navy Supervisor of Salvage." Some of the people who were involved early on felt that the Navy solution was going to be too expensive. United Space Boosters [Incorporated], who was the contractor for the boosters at the time, got some people involved. One of them was Anker [M.] Rasmussen, and there was another fellow, Bill Meinert. There were some other folks here who were kind of pioneers who came in. Utilizing some of the Navy's recommendations and based on their own insight, they developed some ideas and a plan for SRB recovery that wouldn't cost NASA as much money.

NASA did not have the money to go out and buy or build their own vessels. The parent company of United Space Boosters, United Technologies Corporation, had these vessels built. It

was financed by a bank in Connecticut. The bank owned the paper. In turn, NASA paid the lease cost of the vessels. UTC got a piece, and the bank of course made their money. NASA paid for the vessels about twice over before they finally figured out that, gee whiz, we ought to scrape some money together and buy these or we're going to continue paying over and over again.

So in the 1993 timeframe, NASA bought the vessels, and they went from being commercial vessels to being government-owned and -operated vessels. Prior to that we were working for USBI and then [Morton] Thiokol [Inc]. They were privately-operated and privately-owned vessels. They have been operated as NASA vessels ever since.

Our people have gone through a number of changes through the years with employers. I started with the United Space Boosters. Thiokol took over in 1984 with the SPC, Shuttle Processing Contract. Thiokol—Morton-Thiokol at the time, became Thiokol [Inc.]—ran the vessels until 1996. Then Lockheed [Corporation] stepped in for a short time, and then United Space Alliance took over operations. I've had four employers while I've been doing the same job during my time here.

ROSS-NAZZAL: Were there any differences between the two ships in any way, or are they pretty much identical?

FRAINE: No, there are differences, very subtle differences. They were built to be identical, but they are not exact. You see little differences as far as the fit of the vessels and the spaces and that sort of thing, but they're pretty close. Over the years there was a lot of competition between the two crews as to which was the better vessel. Depending on who you were talking to, you'd

invariably get a different answer. Truth is, they were both fine ships with fine crews. All the folks, top-notch people we've had working here over the years.

ROSS-NAZZAL: Any traditions when you were a captain and a first mate, when you went out to sea or came back?

FRAINE: Yes. Some I can talk about, some I can't. Just to give you an example, you go out to support a Shuttle launch. But the launches don't always go when they're supposed to. We're sitting out there 120 miles offshore, and some people like to fish, so during their off time we'd accommodate them. We'd cruise along at a slow speed, and the guys do their fishing. Sometimes they'd get lucky, and when they did, they'd often share it with the crew. It was pretty nice.

When you get a newbie out there, especially a newbie who was into fishing, he would receive some initiation. Everybody would be out there fishing, and the new guy would be out there with his gear. For some reason the others would find an excuse to get him to leave the deck for a minute. They'd get a big coffee can that had holes in it, and they'd attach it to his fishing line and put it back over the stern. Then they'd yell at him, "Hey, you got one! You got a bite!"

We'd get this on video and pictures, and the whole bit. He would be running out, all excited. He'd be fighting, and maybe you'd give the ship just a little extra speed to make it tougher for him to reel it in. Then he'd get it up to the transom and pull it up and realize and then everybody'd laugh at him. That was how we kind of broke in new people. They did it on both ships; both crews did it to the avid fishermen.

Sometimes we'd get observers on board, be it NASA or whoever, who would also come out, and maybe they'd be into fishing too. It didn't interfere with the operations. We're out there anyway, so what people did on their off time is fine. It was a way of passing the time. There were times we were out there for a week waiting on the launch. You'd have a delay and then have another delay. Normally if it was a 72-hour delay we'd come in, but anything under 72 hours—48, 24—you'd stay out there and wait for the next launch. There's no sense in rushing to get the ship in, burning the extra fuel, and then running back out there, so we'd sit and wait.

ROSS-NAZZAL: You mentioned that there had been modifications to tow the external tank. What sort of modifications were made to the ships?

FRAINE: There've been a lot of modifications over the years, but specifically for towing they installed a brand new tow winch. It was a double waterfall tow winch that had two different wires on it, much stronger, much more powerful than the original one we had. We also had reinforced plating put on the stern, and we had these things called Texas bars that were built. Texas bars actually provide a fairlead with a spool that the tow wire runs across back to the tow. We installed tow bits that were built in the center of the deck as a fairlead for that tow wire as well, and we made those removable later on so we could strip the deck entirely.

Other modifications we've had for the ships have included the dynamic positioning system that was installed in 2002. Aside from that, they're a shallow-draft vessel. The ride's always been a bit rough. They were built that way because of where we are based, the Indian River in Cape Canaveral Air Force Station. The channels are dredged to 12 feet, although there

are a lot of spots that are less than 12 feet. It's just a ditch. Early on, in heavy seas, the ride was horrible. You have what's called bilge keels, which are fins that are on the turn of the hull, right on the turn under the water where the bottom becomes flat. Those would dampen the roll a little bit, and those fins were later extended so as to further dampen the roll. Still a lousy ride.

Down the road some safety money became available, and we again modified the vessels and had something called flume tanks installed on the ships. What they really did was they took two of the ballast water tanks and they put a baffle system in between them. Rather than the tanks being pressed, they were only partially filled with water so that the water flowing between the tanks would in turn dampen the roll. Flume tanks are really a passive system for dampening the roll of the ship and making the ride more comfortable.

Of course electronics and that sort of thing, our Welin [Lambie Company] davit that was installed on the 01 deck of the ships for launching the boats that also came from safety money. The advantage being that we could launch a manned safety boat from the ship into the water if somebody were to go overboard and we had rough conditions, rather than launching the boat and putting somebody over the side to climb in the boat.

Probably the trickiest part as far as injuries for our folks, our divers and our retrieval team, was getting in and out of the boat, especially in rough conditions. If the conditions were too rough, you just couldn't do it. This davit system and the new boats that we had, the Ambar boats that they purchased, made it possible to work under rougher conditions, and in an emergency sometimes you needed to be able to do that.

There were a few times when we also rendered assistance to small boats that were in the area. Came up on them and launched a manned boat into the water and sent it over to help them out. Boats that were taking on water, people who had lost power and drifting out there and that

sort of thing. We've tried to help people along the way. We've also assisted divers along the way who were in distress. We had two occasions on the *Freedom Star* where we rendered assistance to sport divers that were in trouble.

ROSS-NAZZAL: You started working in '82 and you stopped working on the boats in 2007. Would you say that things changed in terms of retrieval ops [operations], or were they pretty much set?

FRAINE: No, they evolved continually. They were continually improved as far as the evolution of the recovery gear and the diver-operated plugs. They just kept on getting more and more efficient. Got better and better with the equipment, also with our procedures. We talked about competition between the ships and that included the retrieval teams. Early on, we'd fight to get a retrieval done in four hours or try to beat the other ship. As we added more safety steps, more things that we had to document, the operations actually got longer because we had to do a lot more. So we kind of went backwards as far as our efficiency. It got to the point where it was taking six, seven hours to do a recovery, but that's because we were getting so much more detail as far as documenting the condition of the hardware and doing extra things along the way.

It's been a nice run. Worked with a lot of fine people, a lot of them have retired. Most of them are retired that we worked with early on, but you've talked to some of the folks that have been here the longest: John Fischbeck, Larry [F.] Collins, Manny [Manual] DeLeon, Joe Chaput. Some fine people that have worked here. I still keep in touch with a lot of the people that worked here in the past, too. Anker Rasmussen is someone to talk to. I talk to him on from occasion. You've probably already heard stories about him. He was a character. He's the one

who was front and center as far as pulling this organization together back in the late ‘70s, early ‘80s.

Dan Riksen, my predecessor, was the original captain of *Freedom Star*. A fine man who I regularly keep in contact with. Carol Clement, port engineer. He’s retired, he works on the gambling ship as a chief engineer. That’s something I do on the side as well from time to time. There’s a lot of other folks. John Fike, another guy that was here early on, Bill Meinert. These are gentlemen that are in their late 70s or early 80s, they’re still kicking. We keep in touch with them, and they’re all kind of teammates. There’s camaraderie that goes with having worked here.

ROSS-NAZZAL: Thank you very much.

FRAINE: My pleasure.

WRIGHT: Speaking of crews, I think Joe mentioned to me that the average person spent about 18 years in the marine operations. You just had a really low turnover on your crews. Can you give us an idea of why they stayed so long?

FRAINE: It was a satisfying job. Also, a professional mariner, you’re at sea for quite a bit of time. For me, one of the big attractions for me coming down here was I actually got to spend time with my family. We might spend 60 days at sea, 100 days at sea in a busy year with these ships. That’s as opposed to working half the year working on a commercial vessel or something like that. So there’s an attraction.

Again, working with the space program. What we did is really cool. I could have made more money elsewhere—I still can—but I like it here. I like the people; I like what I do. When the time comes, when we're done here, if I still have to go out and make a living, I'll go find something somewhere. I'll do it, but it won't be with the same joy and the same satisfaction we had doing this.

Like I say, last week marked 30 years for me. Fischbeck was here about two years before me, Collins about six months before me, DeLeon a little after me, Joe Chaput just a couple years after. We've evolved through the years. We've raised families, and we've just enjoyed what we were doing. It's pretty cool. You get to meet astronauts, you get to go out there and see all of these launches.

The operations we've been involved in have been very diverse. We started out just doing SRB recovery, but we evolved to where we were doing salvage, we were doing commercial contracts and Navy contracts. We became jacks of all trades. That's kind of what I do now, as far as writing specifications for differing jobs and different customers. Wouldn't have known how to do it if I hadn't worked with all these fine people, and we learned by the trial-and-error method along the way.

WRIGHT: What about the ships, now that they're in age? Do you feel like they could be used for more? Are they still in shape to be used?

FRAINE: Sure. They've passed their design life. The design life was 25 years, and they've been in operation since January of 1981. It's 2012, so they've got some years on them—31 years—but they've got a life left in them. Those vessels were modeled on an intermediate-sized

research vessel design that was popular back in the 1970s and early 1980s. They were built at Atlantic Marine shipyard [Jacksonville, Florida], and they were the third and fourth of their class.

There were others that would follow, the [R/V (research vessel)] Seward Johnson and before them, the Columbus Island and the New Horizons. A number of those vessels, both the ones built before and the after, are still in operation. There's no reason why these girls, with a little bit of care, couldn't continue operations. If they don't end up staying with NASA, I would envision they'd be ideal as research vessels, working for the UNOLS, the University-National [Oceanographic] Labs [Laboratory System], that sort of thing. They'd be ideal there. Yes, they're quite capable, they've got some life ahead of them.

WRIGHT: That's good to hear. Is there anything else that you can think of that we might not have covered that you would like to share with us?

FRAINE: I mentioned a few of the people that were here before us, Dan Riksen and Anker Rasmussen. If you want to talk to somebody who's really bombastic and really—he's a character. I'll give you his number, you could call him up. Same with Dan Riksen, he'd probably be tickled. The old guys would be tickled to have somebody actually call and ask them about what they used to do, and you might get a kick out of talking to them.

WRIGHT: Well, thank you.

FRAINE: All right, a pleasure.

[End of interview]