SRB RECOVERY SHIPS ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

LARRY F. COLLINS
INTERVIEWED BY REBECCA WRIGHT
CAPE CANAVERAL AIR FORCE STATION, FLORIDA – 10 APRIL 2012

WRIGHT: Today is April 10th, 2012, and this oral history is being conducted with Larry Collins 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. Thanks again for taking time out of your afternoon to sit and visit with us. Would you start by sharing a brief overview of your career here and how you got started and what your roles have been?

COLLINS: I was born in Florida, in Gainesville. Grew up there, went to school there, went to college there. Not to bore you with any details about all that, but I did major in accounting. While I was in school I was teaching diving and got into a technical type of diving while I was there. Several years after I graduated, an opportunity came up to come down here and interview for a job because of contacts that I'd made in the diving world. I liked diving a lot better than I did accounting. I never intended to be here longer than a few years, and that was 31 years ago.

WRIGHT: Talk about your first jobs when you got here and some of the first missions that you worked on.

COLLINS: Well, I was hired as a lead diver. That was my primary job, but like everybody else over here we did multiple jobs. My responsibility was to lead teams of divers, particularly

during the Shuttle missions. That was what we did 90% of the time. Then when we came back from the Shuttle missions I would work disassembly shifts to take apart the boosters until they were done. After that was completed, then we would do preventive maintenance on the dive gear, what we call the GSE, the government-supplied equipment, the retrieval equipment that we use during the missions.

WRIGHT: What was the first Shuttle mission that you worked?

COLLINS: STS-3.

WRIGHT: Were a lot of the procedures already in place when you first got here? Or did you help develop some of the procedures and processes that you used on the very last mission?

COLLINS: Oh, I helped develop a lot of procedures over the years. We had procedures in place for recovering all of the equipment—the boosters, the parachutes, the frustums, everything. Some of those, like particularly the frustum, stayed. Except for buying new power blocks, that procedure stayed the same practically from the time I got here, from STS-3 to STS-135. The recovery of the parachutes changed dramatically over the years. Originally the parachutes were all blown off and floated free from the booster, and we would swim on them, attach a line to them, and bring them on board.

After STS-4 and the failure of the parachutes—during that mission the parachutes were attached, and we had to disconnect the parachutes by hand. This is very difficult diving because you had to hang on to the riser lines while you disconnected the links, what were called cargo

links. So you would be ten feet underwater and then five feet out of the water, hanging on, and then crash back down into the water while you're trying to untape these things and pull these cargo links apart and put floats on the parachutes.

The parachutes, they're huge. They're 100-foot diameter chutes. There's three on each booster, and they hang down in the water 220 feet. Normally you can't even see the bottoms of the parachutes, even in that clear water. That stayed the same until probably sometime around STS-25. I think they changed the chutes during the time that they were reconfiguring after *Challenger* [STS 51-L accident] to where the chutes would—I think they went to the salt water activated links then. Eventually that's what we wound up with.

WRIGHT: Before we came, we were trying to pull some research together so that we would have a better understanding of some of the operations here. In one of the articles, we found a quote by you that said that SRB retrieval is the second most hazardous job in the space program.

COLLINS: That wasn't me. I might have said it, but I wasn't the first one to say it. I don't really know who said it first, but it was someone in USA [United Space Alliance] or NASA.

WRIGHT: Would you like to explain why? Do you agree with that statement that the retrieval is a hazardous job?

COLLINS: It's definitely hazardous. It involves using life support equipment, scuba gear, to depths of 130 feet. Working on a booster that weighs about 80 tons, which is surging in the water as much as 20 or 30 feet at a time. And you're in 3,000 feet of water, so if you have an

issue, there's no bottom to work with. You have the possibility of divers getting too deep, divers getting injured. And you have all the normal diving problems, the bends [decompression sickness] and embolisms and drowning.

One of the most [hazardous aspects is] not specifically diving itself but getting ready to dive. You can't dive off the ship directly because you can't crawl back up on the ship, so you [are required] to dive out of small boats. Originally we used Zodiacs. Eventually we had some bigger Ambar boats, but just transitioning from the ship to the small boats was very hazardous. In fact, we didn't use the ability to dive [to determine if we could continue to operate]. Conditions-wise, you could dive sometimes in certain conditions, but you would not be able to transition safely from the ships to the small boats, and that was the key. If it was too rough to launch the small boats, then it was too rough to do the operation.

WRIGHT: I believe it was the mid '90s when you transitioned to a different type of boat. You had boats that could be hoisted down, or that you could hoist back up with a crane. You launched the boats differently, is that correct?

COLLINS: Well, the Ambar boats are a hard-bottomed boat, but they also have an inflatable RIB [rigid inflatable boat] on them. We [have] a davit that you [can] use to launch that boat with the equipment and with some people in it. You can't launch it with the whole crew in the boat, so the biggest help was being able to launch these boats with the gear in them.

Before, we would have to come back beside the ship, hand up these heavy double tanks from the small boat into the ship, and all the other gear, and then bring the boat aboard. At least

now we could leave all the gear in the boat. The tanks and the regulators and the cameras and the toolboxes and everything else, just bring it onto the boat. That helped a lot.

WRIGHT: What brought that change? Was it feedback from the crews to the management? Or was there a safety issue? Was there a diver that was endangered and therefore it brought that change about?

COLLINS: There was not a specific instance that caused that to happen. There was a general knowledge that it was always a problem transferring the gear and the equipment from the ship to the small boat. At the time that we started this operation, these Ambar boats were not available, to the best of my knowledge. We went from Zodiacs, which had no hard bottom at all, when I came here, to these Avon boats, British boats that had a fiberglass bottom but a bigger sponson, the inflatable part. You could launch these boats, but not really with the gear in them. There just wasn't the room, no places to put it.

The Ambars gave us the ability to put tanks and regulators and boxes and oxygen resuscitators and everything in the boat, and lash it all down. We could even launch people in these boats; you just couldn't launch everybody in them usually.

WRIGHT: You said you were here for STS-4.

COLLINS: We lost the boosters, yes.

WRIGHT: Can you share with us the end of that mission? What did you bring back after?

COLLINS: We brought the frustums back. It was my second mission, in [June 1982]. The ocean was like glass. Every launch we would seem to lose some parachutes. The boosters would hit the water, the parachutes had some type of pyrotechnic on top, and the feet would blow off when they'd hit the water, just before it hit the water, or at splashdown. All of the floats were up in the apex of the parachutes, and for some reason we kept losing one or two chutes on these launches. So they decided instead of blowing all the legs off, to blow every other leg off. That would leave one leg of the parachutes attached to the booster.

But what happened was the booster sensed splashdown thousands of feet up, so the chutes are maybe not even totally dereefed. Every other leg blows off, and then the chutes streamer. They hit, they broke apart, and they sank. The frustums were there. We got there, and there's no boosters. There was just nothing. We were there several hours. I remember I jumped in the water, I think I was probably the only one to dive. I jumped off the back of the Freedom [Star] with a scooter and went down to about 70 feet. There was this big black cloud, but there was nothing. We determined pretty quickly that they sank. Then I spent a great part of my summer out at sea that year, because we went out there with ROVs [remotely operated vehicles] and hunted for them till we found them and took a lot of pictures.

WRIGHT: Were the pictures given to people for assessment?

COLLINS: Oh yes.

WRIGHT: Other than *Challenger*, was there another time that you came back with a lighter load than you expected when you went out for retrieval?

COLLINS: We didn't lose any other boosters totally. STS-63 was memorable in that there was really bad weather, 40-knot winds, seas that were 15 to 20 feet. It was a nasty night when they launched. Apparently the boosters came down and slapped down on the water, hit on top of a wave, and basically it tore big gashes in the forward skirts, busted the nozzles. The nozzles were hanging on by the actuators, the only thing holding them on. It bananaed the boosters, ruined all the segments. At least one of the forward skirts fell off on the way back in. We were out there for days and days and days. We couldn't get a diver-operated plug [DOP] in.

If you were doing this year after year, you would notice something that would happen to you. The weather might look really really bad to you and all the divers. Way before the weather got really good enough, it looked good enough to go ahead, because you were just tired of staying there. After the first Shuttle launch when they tried to use the nozzle plugs and they didn't work, they developed this thing called a BARB, ballast aeration retrieval boom. It's just a pole with crossbar on it. Stick it up in the booster with the crossbar and hold it down with a line. You run air to it, and you can partially dewater a booster, what we call semilog mode. As long as you keep air going to it, you can pull it all the way back in. This is what we did on STS-63, because with the nozzles just hanging out by the actuators we couldn't put a DOP in there.

I remember putting a BARB in there, and at some point when we were towing it back, I think maybe this is when the forward skirt fell off. Of course we lost the tow then. Since we were having to drag a hose, the hose rips the BARB out, tears it apart. So we have to go put another BARB in it. Here it is again, it's up and down like this [demonstrates]. I swam up into

the booster to get the old pieces out. I'm getting all these old pieces together. The booster is going up and down. I remember Wulf Eckroth. He's still here; he's an engineer over in the ARF [Assembly and Refurbishment Facility]. He's swimming up, and there's nothing to hold on to there. He's totally out of control, and we just collide. Pieces are going everywhere. That's just the way that mission was. One of the engineers from California that was one of my divers—we got back in and he said, "They should give us a tickertape parade."

WRIGHT: Did you have a lot of night launches? You mentioned STS-63. I know it was a [Shuttle]-Mir mission.

COLLINS: We had a lot of night launches. They launched whenever they needed to, and in the early days they didn't launch anything at night. Shuttle launches had long windows, three and four hours. When it got to be [International] Space Station, everything was five minutes or less. So you had to go with whatever window you had.

WRIGHT: For the night launches did you attempt to retrieve them at night? Or did you just stand by?

COLLINS: We would retrieve [some of the gear, especially the frustum, if possible]. We didn't like to dive at night, but we have had to dive at night a few times in bad situations, like when we would get a parachute of some sort hung up in the screws. Or one night we had a DOP that didn't go in. Then it was damaged, and we were trying to get it out of the water. One night we lost a tow cable, the whole tow cable, and we had to dive on that. We had a practice booster

called the Ocean Test Fixture. It was the same size as the booster, approximately the same weight, had an aft skirt on it, everything. We actually did go out 90 miles one time and put a DOP in it at night, take parachutes off of it at night. Did the whole thing at night just to show we could do it during missions.

We never did start a mission at night. Sometimes we would run into nighttime and we'd be in a situation where you couldn't easily quit, or we would have extraneous circumstances. Diving at night is problematic in the middle of the ocean because if you lose a diver, it makes it many many more times harder to find them. We tended to be very very conservative in everything we did.

WRIGHT: Talk about how that impacted your safety procedures, and what type of rules you followed. How you set your teams up to make sure that the risk was less.

COLLINS: Well, first off, we followed all of [U.S.] Coast Guard regulations and we followed all of the Association of Dive Contractors rules. Then of course we made additional rules for ourselves. A standard rule in commercial diving and military diving is that you have a standby diver. You won't see this in sport diving, and in some commercial settings you won't see it. Certainly you don't see it in most scientific divers, but we always had a standby diver kitted out and ready to go in the water. We always dove in buddy pairs at least. Those are general rules that everybody uses. One of the unique rules that we set up was the use of a safety diver in the water.

Since we were diving in extremely deep water, 3,000 plus feet, the safety diver had one job and one job only. We never gave the safety diver any work to do. His job was to make sure

no one went past him. So he would go down and be slightly deeper than everyone else and make sure that nobody went deeper. He was just there in case somebody had a problem, ran out of air. In the early days, people ran out of air a lot because the NASA doctor in charge decided that the bends was a terrible thing and that if the divers only used singles we wouldn't stay down long enough to get bends. But of course drowning is forever, so single 80 cubic feet of air for a working diver at 100 to 130 feet just wasn't always enough. Many times we wound up buddy-breathing someone to the surface.

So we changed that, and I had a big hand in that because I had been schooled in the technical diving world. One of the first things I did was get everyone into doubles, with dual-valve manifolds and two complete regulators, so that you had redundancy everywhere. After that we had very few people run out of air. In fact nowadays we're using double 100s, big tanks, lots of air. Nobody runs out of air anymore.

WRIGHT: That's a good thing. Were there other types of gear configuration that you put in place or changes in suits?

COLLINS: Computers.

WRIGHT: Tell us how those work.

COLLINS: Wonderful. The whole dive industry, the sport diving industry, started going to computers, oh, 25, 30 years ago is when it started. The military and commercial dive organizations like the [U.S.] Navy, who in the beginning was the leader in everything, has now

become the lagging edge. It's now a situation where people in the tech [technical] diving world are generally the leaders—in some respects, not every respect. The Navy still leads in certain things like rebreather type operations and things like that.

We started using computers and nitrox at about the same time. Nitrox is just oxygen-enriched air, so it lessens your chances of getting the bends because you lessen the amount of nitrogen. Nitrogen is the primary gas that's responsible for the bends, so using oxygen-enriched air is a definite benefit. With the computer, we could set the computer on air. In other words, we would dive the mix like we're diving air, just give our divers the normal amount of time, because nitrox will give you more time and depth. So we would be, by doing this, taking what's called a physiologic advantage. We would lessen the chances of our divers getting the bends.

In addition to that, on any dive deeper than 100 feet, we require them to stop and do a safety stop for three minutes at ten feet. We've been doing that for a long time, and with the computers that we have nowadays, they also do that. So when they get back to ten feet—or actually it starts at 20 feet on these computers—it'll just start counting down. If you have something telling you to do something, you're more likely to do it. It's worked very very well. We've never had many cases of diver illnesses. I'm sure this helped.

WRIGHT: As the lead diver, did you assign the teams who would be working with who out on the missions?

COLLINS: It slowly became my job. Then when I became the manager, it certainly became my job, yes.

WRIGHT: Was there a rationale that you used? Did you mix seniority, or did you use personalities? What was the criteria for putting your teams together?

COLLINS: Probably a little bit of everything. In the early days we had few missions and many training missions. We used to go on a training mission once a month offshore, pulling that dreaded OTF [ocean test fixture] out. Didn't matter what the weather was, at least once a month you went to sea. If you had a mission you didn't have to do a training mission that month, but if you weren't doing a mission, you were going on a training mission. In the first year I was here, which was 1982, we had STS-3 and STS-4 and that was it for that year. Then I don't remember exactly when we started back up, but we had a few missions, and then we got busier to where we weren't doing many training missions anymore. Certainly in the later years we didn't even have the OTF anymore. The decision was made—and I don't know why—to get rid of it. I guess somebody decided we didn't need it. We were doing enough missions.

At this point you don't have those types of training opportunities, and the only opportunity you have to train anyone is on the real thing. So on any given job, you have to put experienced people, at least enough of them to get the job done safely, but you also have to work the new guys in so that they can learn. In the very beginning I would put people out there in the water and I'd say, "Just watch this time." Then, "Just do this simple job." And they would get it. They're smart guys; they'd pick it up pretty quick.

WRIGHT: You were here the morning of the *Challenger* accident. Talk about that morning and then the work that the ships helped with the salvage operations.

COLLINS: Well, it was a horrible night. Huge seas, biggest seas I've ever been in. 25 feet plus, huge. The seas were so big that we could not make headway into them. It tore up the dunnage on the back deck, the boat cradles, everything. The toolbox on the ship I was on came loose and ran around in the shop tearing everything up. It was an awful night.

The next morning—we had actually started heading back in. I think we didn't make it any more than 60 miles out and we needed to be like 140. I don't remember exactly where we were when they launched, but back in those days we didn't have any satellite TV or anything so we just heard everything over the single-sideband radio. We didn't know till we were told that there had been a catastrophe. It had gone in the water. We were directed to head back into that area. It was the strangest ocean. It was bitterly cold, I mean freezing cold. We put people for periods of time out on the wings in these bunny suits because it was so cold. You could only stay out there for a limited time.

All around us there were hundreds of water spouts forming and dissipating in the water. I've never seen anything like it on the ocean. I don't think I'll ever see anything like it again. Then all of a sudden, like a cloud bank, we just came out of it. It was just like you saw it that morning, crystal clear. So we stayed out, and we actually found some floating debris that day that we picked up. The [U.S.] Air Force was running around with helicopters dropping smoke on this and that. We didn't pick up anything useful.

After that there was a period of time where things were in somewhat disarray. Decisions being made and getting assets together, what have you. We had three ships at that time, the *Indie* [*Independence*], the Liberty [Star] and the Freedom. All three ships were sent out. Eventually what happened is the Indie had an ROV on board. On the Freedom we had just a big group of divers, and we were working grids. The Liberty was pulling side-scan sonar. Of course there

were a lot of other boats out there doing similar stuff. As we would find targets we would dive on them, or as we would find things in these grids. These grids we were laying out were like 600 by 600 feet. We laid out, I don't know, over 200,000 feet of line over nine or ten months.

WRIGHT: Not a good time.

COLLINS: No, it wasn't, because you're bringing up debris. Fortunately for us, we didn't work on the crew cabin at all. Whoever was in charge decided that the Navy boat out there would do that. They parked on top of it and they did it all, so we were left looking for satellites and other stuff, which was better.

WRIGHT: What are some of the other missions that you've gone on with the ships that were a little bit unique? Did you go out on the treasure hunt?

COLLINS: I wasn't on it. I guess at a period of time between launches, there was a group—I believe it was the ship the *America*, maybe—that had a considerable amount of treasure on board. A group had put together a plan and had an area staked out. You can get some type of a permit or claim, and they were working that when another group came along and decided well just in case they would hunt in the area near there. So the *Liberty* went out with them, and they pulled a towed array around but the first group found it. I think it was up off of North Carolina or someplace like that.

WRIGHT: A bit odd in the history of the ships. You did some work with NOAA [National Oceanic and Atmospheric Administration].

COLLINS: I did quite a bit of work with NOAA. Not all of it diving, but diving-wise we did one expedition to a place called the Flower Gardens, which being from Texas you should know about because it's not far off of Houston.

WRIGHT: Closer to Galveston [Island].

COLLINS: Galveston, yes. It's an absolutely fabulous place. We were out there for maybe a week to ten days doing scientific work for NOAA, diving every day. It's beautiful. The tops of these salt domes come up to about 100 feet of water and come out of about 400, 500 feet of water. They're very very similar-looking to the [Florida] Keys. Some fish that we have in the Keys like yellowtail snapper don't exist there at all, but a lot of the other stuff does. The most magnificent plate coral I've ever seen, and crystal clear water, just crystal clear, with oil wells around. Really interesting, something you don't see in Florida.

Then we've done quite a bit of work with NOAA at Aquarius, the undersea laboratory that's off of Key Largo [Florida]. One of the most interesting things I've ever done here was I had the opportunity to saturate at Aquarius for five days prior to one of the other missions, and that was very different.

WRIGHT: What does that mean?

COLLINS: In other words, I was able to go live in the habitat for five days underwater, and we were setting everything up for a 14-day mission. We were running cables and com [communication] lines and putting down little outposts and things for a week. That was very different. Since then we've supported quite a few scientific missions down there, one NEEMO [NASA Extreme Environment Mission Operations] mission. Hopefully we'll do another one this June.

WRIGHT: What is the value of working with those types of operations, for your group as well as the contracting group?

COLLINS: Well, they certainly learn things from us, and we always learn things from them. We have no opportunities to saturate, because that's the only undersea habitat in the world. It gives us an opportunity to work with them, and we get an opportunity to train our divers by going down to Aquarius. You can do a lot of diving, and it's working dives. Any time you're working your divers in the water, it's good training. You still have to load the boats out, you're still using the underwater communications, you're still lifting things and moving things. It's similar to the same type of retrieval work that we do. It's different, but it's good training opportunities. And it's in the Keys. There's a lot of neat stuff swimming around.

WRIGHT: Share with us how the communication techniques underwater have changed since you've been working with this group.

COLLINS: Well, when I first started working here, underwater communications were hand signals. That's how we communicated. And we still do a lot of that because sometimes that's just the easiest way to communicate.

Underwater communications are very very good when you're working with a hard-line diver. In other words he's connected with a hose to the surface, what's called surface-supplied diving. In the commercial diving world, that's really the preferred method of diving because you essentially have unlimited air. In the diving world, they don't worry so much about the bends. They worry a lot about gas supply, so with an unlimited gas supply that's really the safest way to go about it.

In our operation, surface-supplied diving was just not practical because you can't put a large compressor into the small boats, and you can't back the ship up close enough to the boosters in a surging sea working next to flight hardware to tend the divers. Plus you've got these parachutes hanging down, and it would be just a real mess. So very early on, before I even arrived, it was decided that scuba was the way to go.

Communications using scuba have traditionally been a problem, because through-water wireless communications just were not very good. The first ones that we bought—the first several different types that we bought—were really hit-or-miss. They simply were too weak, they weren't that good, they would break. You're operating in an environment that's not conducive to through-water communications, because all through-water communications use the surface and the bottom to bounce the waves off of. Well, when your bottom is 3,000 feet down and your surface is likely to be choppy and not regular, communications would suffer. Plus the ship where the communications are coming from, you have these screws churning around and creating all types of bubbles.

It just didn't work out very well, till finally someone built some com units designed for the SPECWAR guys [Naval Special Warfare Command], very very powerful units, and fairly expensive. We finally procured these, and since then we've had very good communications. I have actually talked to a diver half a mile away underwater on wireless coms. That's in perfect conditions when you're in 80 feet of water, but they work pretty well. We've been using them for a long time. We don't have all the divers on them all the time, but at least the safety diver will be on coms. That was our rule, at least the safety diver would be on coms.

WRIGHT: You mentioned earlier the [hyperbaric] chambers that are on the boats. Each boat has one.

COLLINS: Right. We didn't have any chambers initially either. The NASA doctors didn't think that we'd be able to operate them, and they didn't want us practicing medicine even though we're 140 miles away. I don't remember exactly when we got our first chamber, but we paid a dollar for it I think. It was a Navy chamber that we got from Seattle [Washington], one they were basically T&Ring [termination and redundancy]. It was an old aluminum chamber, and we brought it here and reworked it. We used it for a long time, and we only had that one chamber.

We would go to sea with that one chamber, and then we had it rigged so that we could move the chamber from ship to ship. That was fairly early in the program. I was only here like a year or two when we got that first one, and we eventually got another chamber for the other ship. Then both of those early chambers have now been replaced. Basically we bought bare chambers, and we built them up ourselves. Wired them and tubed them up and built the panels and everything ourselves so they would both be the same.

We try to keep the ships pretty much the same because the divers and the ship's crew would move back and forth, so it made it easier. It's impossible to keep them exactly the same, but as much as possible we would keep the ships the same so that if you moved from ship to ship you could operate one to the other without a problem.

But just having a chamber is not enough. If you have a chamber you have to have someone that can operate the chamber. Even as important as that, you have to have inside tenders. So myself included with some others, we went out and initially did four weeks of training with NOAA in Seattle to become diver medics. I think I'm the only one left of that original group, so we've trained diver medics since then.

Every diver that I hire into the dive locker for the last ten years has to either be or become an EMT [emergency medical technician], a diver medic, and a dive instructor. Because at the end of the day really one of the biggest jobs, the most important jobs we have is training divers. We had divers coming and going and coming and going, and things were always changing, so that was a big part of my job and the leads' jobs, to train guys.

WRIGHT: I can see that. Do you remember about when it was that you went to that Seattle training?

COLLINS: I think it was '86 or '87. It was right after *Challenger*.

WRIGHT: Jennifer, do you have any questions that you can think of?

ROSS-NAZZAL: I was trying to think of something personal. I'm wondering, do you have any amusing or funny stories about any retrievals that you can share with us?

WRIGHT: Anything memorable. You talked about the bad weather conditions, but were there other times? Or are there any traditions that you guys do when you're coming back in or going out for a mission?

COLLINS: Gosh, most of the guys are pretty sullen when they're going out and it's bad. Morale is low. When you head out through the port and the palm trees are turned inside out, morale plummets, but the morale improves when they're heading back on the way in. I guess there's been lots of funny things. Occasionally we would do crazy things like we'd be on a training mission and we'd take a whole carton of eggs, and then we'd fly by the other ship's small boat and just plaster them with eggs, just for the heck of it. Things like that.

ROSS-NAZZAL: A little rivalry between the two of you.

COLLINS: Yes, sometimes you just turn into kids.

WRIGHT: Is there a downside part of your job? So much of what you do is enjoyable, because you enjoy the diving part, but is there—

COLLINS: I think I have the best job in the world for 30 years. It's not as good now as it was. It's not as good for anybody. I've spent the last several months being a point of contact for

getting all of our people and stuff out of Hangar S, so all I do is go to meetings about what percentage are you done here, what percentage today and tomorrow. Victory will not be declared until you're totally moved out of there, and when we're done with that, we'll start moving you out of some other place. That's not the same.

Everything for all those years was really just—for most of the people it was a launch. For us, for me, it was getting everybody out there. And I had one aim, get everybody back home. That was it. There's always the mission. You have to get everything done that you're supposed to get done, retrieving everything, but then getting everybody back. So really at the end of the program I guess that was in some ways a relief. We are still diving, so you still have to worry a little bit, but we're not doing what we were doing then. There's no bigger rush than doing those types of dives, in really big seas on really big stuff like that. So if there's a downside I guess it's just that that part of it is over.

Before the end of Shuttle we had Ares I-X [rocket]. That was a very very interesting endeavor, because we didn't know how deep the aft skirt was going to be. We're constrained by Coast Guard rules and our rules and the rules of the commercial diving association to not go deeper than 130 feet with scuba. The reason the Navy initially set that was because of gas supply. They don't have those same rules for a hard-line diver [or] for a surface-supplied diver. You could dive to 190 feet on air. I knew that we were going to possibly have to go over 130 feet, and I knew that surface supply wasn't going to work.

So I called the people out at ADC [Association of Diving Contractors], and I talked to them. I had talked to them before. This was several years before Ares actually launched. The president of the ADC said, "Well, have you thought about using rebreathers?" I said, "No, but always wanted to." So we initially purchased two rebreathers, and it's like learning to dive all

over again. It is a type of scuba. Open-circuit scuba is what you normally see where you just take a breath, and you blow bubbles in the water. You do that until all your gas is gone and that's it, that's simply it. With a rebreather, you have these two little tanks on each side. You have a scrubber; you have all these electronics. It's very very busy using a rebreather. You have a heads-up display, and you have a controller and another computer. You're taking gas in on one side, in one hose. It looks like an old double-hose regulator. And you have a counterlung, and when you exhale, everything you exhale goes back through the scrubber and back through the loop again. As you use up the oxygen in the loop, there's three O2 [oxygen] sensors, and it automatically senses that you're getting low on oxygen. You tell it how much you want, so it just automatically injects. This is a CCR [closed circuit rebreather]. There are others that work differently.

So this was a whole different type of diving. We eventually trained four divers and developed a new thing we called a stinger that we could put into the booster. Basically our plan was to let the four guys with rebreathers go down and put the stinger under the booster. This would be essentially doing almost the same thing we used to do with the BARB. Just put enough air in the booster to raise it up past 130 feet, then we'd send down the open-circuit guys with a DOP and put it in. So we were ready.

We trained on the rebreathers for years and had 50 to 100 hours on them. The launch came, and we jumped in the water with rebreathers. I don't think it was over 130 feet deep, but we were ready. We did it all. If we had ever actually gotten to the true Ares, I don't know how deep it would have been, because the I-X had one empty segment in place of another one. So it might have wound up being deeper than 130. But that afforded the opportunity to do something new and different.

WRIGHT: You're ready for the future, wherever it takes you.

COLLINS: We're ready for it, yes.

WRIGHT: Is there anything else you can think of that you would like to share with us about what you've been involved in all these years?

COLLINS: I don't think so. I'm sure I'll think of something later.

[Next day, April 11, 2012]

WRIGHT: I'm glad you had a chance to think about some other areas that you'd like for us to know about. Where would you like to start?

COLLINS: There was actually only one thing that I missed out on yesterday. I'm probably most famous in most of the divers' minds—or maybe infamous—for the fitness program. We were quite unique in our fitness protocols. No organization that I know of, with the possible exceptions of military diving units, had anything close to what we did. Of course the first thing that we had everybody required to accomplish is a dive physical, which was basically a flight physical that they had to pass. In the commercial diving world they require you to pass a physical, and then they recommend one every year. Well, we made it mandatory that you had to pass a physical every year. NASA and the OHF [Occupational Health Facility] supported this

until we were probably five or ten years in the program. All of a sudden the Occupational Health decided that guys under 50 didn't need one every year.

I didn't like that, and so we took it to USA. At the time actually I think we were working for Thiokol [Inc.]. They supported us in doing it once a year, so in the off years we would send our divers outside. They would either go to Parrish in Titusville [Florida] or someplace in Orlando [Florida] and get a physical. Finally the OHF relented and started doing them every year, so we had the physicals every year. That was a good thing. It was really a benefit to the divers to get a physical once a year, and it made us feel better because not only were we diving and putting the guys into an extreme environment, but we were so far away, 20 to 24 hours off shore, that you really needed to know what was going on with people.

The other thing that we did was a physical fitness program, [the] other requirement. We didn't have any physical fitness program when I started. I wish I could say that it was all my idea, but it wasn't. Actually the manager that we had here at the time one day said, "I think your divers are soft, and we need to get them in some kind of a program."

We developed it over a number of years. We kicked around many different scenarios and requirements, and we finally settled on a protocol that was essentially the entrance physical exam for a U.S. Navy diver. This is what an 18-year-old U.S. Navy diver has to do in order to get into the Navy dive program. The Navy does something different, they age-rate theirs. In other words, as you get older you can do less. Well, we didn't age-rate ours. There were considerable attempts over the years by many of my divers to get us to age-rate it, because as people get older it gets harder. But to me it was you're out there doing the same job you were doing 15 years ago. If all of a sudden you can't do it now, I guess maybe you shouldn't be doing it. So it stayed the same.

We had quite a bit of pushback in the beginning with the program. Initially I was testing the divers once a year. Every year we'd take everybody. It was a timed run. It was push-ups and pull-ups and sit-ups. And it was horrible. Every year half the group would fall out, so I decided to do it every six months. Then that didn't work. So finally I said, "I'm going to do it every 90 days." And that worked better. Still, there were people who were already divers, and they just never did get it, and eventually they fell out of the program. It took a number of years, but what we eventually achieved was a group of divers who love to work out and love to stay in shape. It made for a safer, healthier dive team, and we're still doing it. It was really an integral part of what we do and what makes us different.

WRIGHT: Is this just for those whose diving was primary? Or those that crossed over?

COLLINS: Everybody who dives. If you're going to be on the active dive list, you have to pass this fitness test every 90 days. We still have some guys that are current and uncurrent, current and uncurrent. There's still a few that are having issues. They'll go for three or four months, you don't ever see them in the gym. Then they fail the test and then you see them over there every day. They still don't like to work out that much, but they want to dive enough to get it done. So that's funny, but it works.

WRIGHT: At the most, how many active divers did you have at your peak?

COLLINS: Between 30 and 35.

WRIGHT: And now how many?

COLLINS: Oh, 14.

WRIGHT: So a lot of the people who are still here are part of your active dive team, give or take?

COLLINS: Well, they're all active right now. Most of the divers are what you would call part-time divers. Most of them always were. I never had more than, say, four full-time divers that that was their primary job. And even those guys were all seconded off to other areas. They all worked disassembly. They all would go down and work on the ships if need be. There never was enough diving in this job to be able to hire someone just as divers and just have that the only thing they did.

All of the people that were involved in retrieval did various jobs. You had to be able to move from one area to another. I had engineers that would be heading up jobs here that would wind up on the deck of the ship taking orders from the lowest tech or the lowliest seaman that we have. That's the way it's been since I've been here. If you didn't fit in with that type of environment, it wasn't going to work for you. You had to be able to give orders and take orders.

WRIGHT: You spent many years with John [C.] Fischbeck. We had an opportunity to talk with him for a few minutes, and he told us about a time he was on watch. He noticed in the depths of the water while some of your crew members were out swimming that he saw sharks. Can you share with us some of the dangers of sharks in what you do for a living?

COLLINS: Well, sharks get a bad rep [reputation] actually. They're actually a beautiful creature in the water. That being said, you don't want them there when you don't want them. The other sad thing I guess about sharks is when I started this job back in '83, invariably, almost every mission we went on, if the boosters impacted one day and you're still working on them the next, or maybe even that same day, you will always see one or two sharks. These were the big fat oceanic whitetip sharks. You don't see them anymore. They've all been killed off. You hardly ever see one.

I haven't had an encounter with a shark at sea on any of the missions in many many years, but in the early years we saw them all the time. I don't know which particular time that you're referring to with John, but the one that comes most to mind was on a training mission where the ship had backed into the Ocean Test Fixture and put a big hole in it. It was sinking, so we had a number of divers who were in the water. We basically had a bucket of marine epoxy that we'd mixed up and wooden wedges. We're hammering these wedges into this big crack and stuffing that marine epoxy in there and putting a big patch around the OTF, which we had made up using some metal, some wire, and some chain binders.

It was nearly dark and into the dark, and these sharks started coming in on us. I don't remember who was actually pounding the wedges into the crack. I had my back to at least one or two guys, and I was punching sharks in the nose as they would come in on us. Nobody got bit; nobody got injured. Probably the sharks were more curious than anything else.

WRIGHT: John also spent some time sharing with us about the order of retrieval and the parachutes at the beginning, and how challenging they could be when they got all twisted up, and then how you changed I think from the cargo links to the SWARs [salt water activated

disconnects]. He said how it could be treacherous for them. Did you have actual events that caused injuries to divers working with those parachutes lines, or some potential issues that you felt?

COLLINS: We had some what you would call soft tissue injuries that happened to some divers. Nothing serious, but where some guys actually got hung up in some of the parachute lines and then pulled up out of the water. You're in the water, you have on heavy tanks and equipment, and then you get jerked up. That was actually rare. I can only remember one [injury] in particular. You would routinely get jerked completely out of the water.

Once the SWARs were employed, we didn't have to disconnect the parachutes by hand. All we had to do was attach these floats to the parachutes, and then we would swim around and cut the lines with seatbelt cutters. A diver in the water with a knife is more dangerous than a shark. A diver with any weapon is more dangerous than a shark. The seatbelt cutters—you literally can't cut yourself with them. But boy, they'll cut through anything.

The problems later with the parachutes—this was always a problem from the very beginning to the very end. Sometimes the chutes would come back over the top of the booster, and you would have one leg of the chute coming down this way and one leg coming down that way. Then it would wrap up with another chute, and the whole thing would look like a maypole. Then you have to try to decide. You can't really see where the chute ends up at. They're all tangled together, and you have to put floats on these lines. You're trying to get one big float or two smaller floats on each leg so that you can float the chutes. If you don't do it properly, when you cut them loose, one chute can go away and you can wind up with four floats on one chute and no floats on one chute.

That was a problem. You had to do a lot of looking around and up and down, trying to figure it out. Sometimes it was very difficult. I had tried way back in the ’80s to get the risers color-coded so we would know which riser lines went to which chute, but I never could. It was one of those requests that never made it up high enough to get done.

WRIGHT: Were there other inputs that you and the team sent back to the developers of the parachutes and the SRBs that you felt came to fruition and helped you?

COLLINS: Well, the SWARs. Getting the parachutes disconnected in any kind of manner other than us having to do it by hand, that was very important. Way more important than getting anything color-coded. That helped a lot and made the job a lot easier and safer.

WRIGHT: How big were the floats?

COLLINS: We changed over the years. Originally we were using these Oslo floats. I’m sure you’ve seen them. They’re big red balls. You probably see them with the smaller boats out here. They use them all the time. They’re about this big around [demonstrates]. The bigger ones, they’re called Oslo 80s. I don’t know exactly what the diameter is, but they’re the larger ones that they make. We were putting four of those on each parachute. It took at least two of them to float a chute. Later we started using ships’ fenders, the big white torpedo looking things. They’re that big around [demonstrates] and three or four feet long. They come in varying sizes. We would put two of those on each chute, one on each leg.

WRIGHT: On the trip out were these housed on the back of the boat, or were they inside the ship?

COLLINS: The floats stayed up on the bow. We used them as fenders and as floats for the parachutes, so they served a dual purpose. They're much bigger than the Oslo floats, so you didn't have to use as many.

WRIGHT: To get those in the water—

COLLINS: We'd drag them over. Too big to put in the boat, so we would throw them in the water and drag them over. You had the lines already made up to them, then you would just dive down and tie them in place. It worked out pretty good.

WRIGHT: You mentioned the seatbelt cutters. Were there other unique tools that you used for your job? You talked to us about the DOP.

COLLINS: We had to put lights on the booster. When you're towing something, you have to put a light on it. If you have a barge that's being towed from a tugboat at sea, it has to have a bow and a stern light. So we used magnetic lights for the front, and we'd basically stick it on during the retrieval process, just go up to it in the boat and throw it on there. Then we had another light that we would actually put on at depth. We would put it where the hold-down posts are on the booster, those leave four holes. We would put what we called a DIPP in there, which stands for diver-inserted post plug. It was basically a plug you could put in that hole. By turning it you expanded the plug, and it would hold anything. We used it to put an eye in there that we could

put a cable on, or we used it for the stinger that we made up later, and we had a light that we'd put in there.

Of course you had to train the divers to put it in the right hole, because on the towback at least one of those holes is completely underwater. So occasionally the divers would put it in the wrong DIPP hole and the light would be underwater. Did John talk to you at all about the dewatering process?

WRIGHT: A little bit, but you can share with us if you'd like.

COLLINS: Well, the booster would be in what we called a spar mode, which is sitting up and down in the water with about 40 feet showing and 100 feet or so underwater. When you got the plug in it and you started—you didn't really pump the water out, everybody wants to say pump—we would actually blow air into it and force the water out, so it would rise up in the water and then fall over into the log mode. Then with the plug in there, it would keep dewatering until it got up to a certain point, and then it would just quit.

There would always be a problem. Either the blue hose was wrapped over the top of the booster, or some of the riser lines were left on there and they were all over the forward light that we put on, or something. I'd say at least half the time we would have to put a diver—not in dive gear but just in his wet suit and booties—up on the booster, and they would have to walk the booster and do whatever work there was. Then they'd just jump in the water and we'd pick them up. That was common.

WRIGHT: Pretty interesting visual, walking along the booster out in the middle of the ocean.

COLLINS: We did have one case, maybe twice, where the canopy of the parachute fell over the top of the booster completely, so that you have a booster sitting in a spar mode in the water with a parachute hanging over the top. The first time, you stare at it a while, like well, what are we going to do with that. Finally we just put a couple guys out there and had them climb up the parachute to the top of the booster and pull the parachute off until finally it's gone. Well, now you're up there, there's nothing to do but jump the 40 feet to the water.

WRIGHT: Wow. Did you have that experience as well?

COLLINS: No, I was in the boat saying, "Climb."

WRIGHT: Was there anything else? Jennifer, can you think of anything else?

ROSS-NAZZAL: I had one other thought. You had mentioned that there had been changes to the parachute and the SRB. But there were other changes over the years to the booster. The program was constantly improving its hardware. Did that have an impact on your process and procedures as you went to retrieve the SRB, or was that pretty uneventful?

COLLINS: I'm thinking they were pretty innocuous because nothing changed the depth. The main change to the booster was going to the J-seals after *Challenger*, that was by far the biggest change. The ones that we noticed the most were certainly parachutes. They were little things, like initially they had directional finders on the boosters, and they had a light on the top I believe.

That went away when they started putting cameras up there to look up at the parachutes. We never really needed a direction finder. We were always there. Very very seldom did we not see the boosters impact the water. We were as close as three and a half or four miles away once, really spectacular.

The Ares was really spectacular. The ship I was on—I think it was the *Freedom*—we were supposed to be in the impact area of the booster. The other piece, the dummy first stage, was supposed to go like 30 miles away from us. We never saw the booster come down, but we did see the dummy first stage. It was 30 miles off, and it had no chutes or anything. We were a good ways away, and it was a pretty spectacular crash when it hit the water.

WRIGHT: Wow. Hopefully you'll have an opportunity sometime in the future to see more spacecraft come down.

COLLINS: We'd like that.

WRIGHT: We all would. Well, thank you. I appreciate it.

[End of interview]