

Kirk Barrow

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Erik M. Conway,
Interviewer

Q: I'm Erik Conway. I'm talking to Kirk Barrow today, and it's the 27th of February [2023].

So, Kirk, first off, tell me a little bit about yourself. Where were you born? How were you educated? How did you wind up at JPL?

Barrow: I was born in Belize City, Belize, formerly British Honduras. I immigrated to the United States in 1975, I believe it was. I was educated at UCLA with a bachelor's degree in physics, and I've been working at JPL straight out of college, so I'm currently here at the Lab about 38 years.

Q: My, you've been around for quite a while, then. That's pretty good.

Barrow: Yes, yes. My involvement has been with systems safety my entire career, whereby I helped with the design and implementation and integration of many shuttle experiments. The biggest one that I have worked on is the Shuttle Radar Topographical Mapper, whereby we mapped 80 percent of the Earth's landmass in ten days.

Q: That was Charles Elachi's big experiment, yeah.

Barrow: Right. So what it look Lewis and Clark years to complete, we did it in ten days.

Q: And the dataset I know is still in use for lots of things.

Did I just lose you?

Barrow: No, I'm still here.

Q: Okay, great. You've kind of already explained what systems safety is, but is it really—sorry.

You focused on the shuttle, which, of course, has now gone away, but sometime while the shuttle was still operating, you became involved with the sample return efforts from Stardust and Genesis.

Barrow: My involvement with Stardust and Genesis came as a result of, I was on division staff of Division 52 at the time. That was entitled Environmental Health and Safety, under the management of Frank Mortelliti. That division has since been dissolved, and there's no longer a division of EH&S.

So for Genesis, I was thrown into the lions' den, so to speak, and says, "Hey, the sample return capsule is returning, and we need to put together a safety data package for UTTR." [Utah Test and Training Range.] I was not involved with Genesis at all from the design or launch. I only got involved upon the return. So I believe it was only like six or seven months we had to get this thing done, and at the time, we were even working with NASA Headquarters with requirements documents that were still draft. They weren't even completed yet. [NASA NPR] 8715.5 [Range Flight Safety Operations] was still .XX at the time being, because it wasn't a released document.

Q: So was that document in review because it was related to the *Columbia* accident? Because I know what had some impact on what you were doing.

Barrow: Yes, when Genesis was returning, yes, you had the *Columbia* accident and there was a whole paradigm shift in communicating risks to upper management, including up to NASA Headquarters. And at that time, I don't know if specifically it was draft because of *Columbia*, but we were given the document and that had all the risk probability that you had to do for people, property, and the environment, but it was still a draft at the time. So we worked with it, because the numbers weren't changing as much, and there was only one slight difference between the NASA requirement and the UTTR requirement at that time, and we made sure—and it was only for one—I'm trying to remember now. I think it was the casualty analysis for the general public, if I remember correctly, and it was just an order-of-magnitude difference, so we made sure we complied with the UTTR requirements. Now for Mars sample return, for example, the UTTR and the NASA requirements are the same per the NASA document.

Q: Okay, but they weren't then.

Barrow: They weren't then, no. At that time, no. But we made sure we complied with the more conservative one.

Q: Right, right. So it sounds like, to go back to Genesis, it sounds like there hadn't been very much preparation, at least in the sense of risk.

Barrow: That's a true statement, Erik. That's a true statement, yes.

Q: Boy, that's a little odd, but this was the "faster, better, cheaper" era, I guess. [laughter]

Okay. So they had then planned this return to Earth, and they'd chosen Dugway, and you're not involved in any of that.

Barrow: No, I was not involved with the site selection. I believe that must have been done long before—no, to answer your specific question, I was not involved with that, no.

Q: So I don't have the proposals yet, but I'd be curious to know when the site was chosen, too, is one of my questions, is why Dugway. In one sense, it's obvious. It's out in the middle of nowhere. Go ahead.

Barrow: Erik, I was going to say I think the document you probably need to get is the FONSI, the environmental assessment document, because I think that would have the return site, I believe. I'm not sure.

Q: Okay. Thanks for that. So you get involved about—I guess you said eight or nine months before the actual return, when this set of requirements from NASA were still in draft.

Barrow: Right.

Q: So what did you have to do in order to comply with that draft document?

Barrow: I created a document called “The Earth Targeting and Entry Safety Plan,” the ETESP, Volume 1. There were two volumes that were created that had to be submitted to upper management at JPL and also NASA Headquarters, Volume 1 and Volume 2. Volume 1 had to do with the safety analysis of the spacecraft and the sample return capsule to show that there are three main hazards one has to address for sample return missions. One is the breakup/burnup analysis, one is the far-field overblast hazard analysis, and another one is the Toxicology hazard analysis. So they want to make sure that in the event of any anomaly, if the spacecraft and sample return should break up, what debris would actually come to Earth.

The second one has to do with the propellant tank of—no, I won’t just say propellant tank. Any pressure vessel that would be either on the spacecraft and/or the sample return capsule, and then any toxic materials that could be released, either biological or radiological. But because Genesis was determined to be a Category 5 unrestricted Earth return, there was no need for biological assessment.

So ETESP Volume 1 addresses all those three hazards, in addition to the probability analysis to show the likelihood of any people, property, or the environment being harmed by Genesis sample return.

Q: Okay. And so that’s the documentary requirement. Then how did you go about gathering the information for it; in other words, doing those assessments?

Barrow: Okay. I need to be very clear. I was only responsible for ETESP Volume 1. A guy by the name of Curt Henry, he's Division 38, I'm not sure if he's not a division manager. Is he the—

Q: I think he's division manager of the 38. I've had lunch with him a couple of times. I had no idea he had anything to do with Genesis.

Barrow: Oh, yes. Henry authored Volume 2, ETESP Volume 2. It's termed "The Decision Criteria." So that volume determines when they were going to release the sample return capsule, such that then the spacecraft could do a divert maneuver and then go back into outer space. Curt authored that second volume.

To answer your specific question how did I go about getting—I started going about ETESP Volume 1 as talking to the project, getting different documents that were created, and I remember specifically looking at the environmental assessment. In addition to that, my manager at the time, Frank Mortelliti—I'm sorry. Because Genesis was the first sample return mission since Apollo, there were a lot of concerns about making sure that everything is valid that we are doing, and therefore I was tasked—no, I'm sorry, Erik. Let me make sure I'm getting this right. Was this Genesis or Stardust was the IRT—no, that's Stardust. That's Stardust.

So the main thing was working with the project, the PI, and the different cognizant engineers to get as much information as I can, looking at different design documents, Powerpoint slides, charts, to get information to put the document together. So I put the document together. It was requested—and I don't remember if it was Frank Mortelliti at the time or Matt Landano who was the OSMS director-for at that time, said, "You know what? We should have someone from

NASA Headquarters concur on this document since this is the first sample return mission since Apollo.” And as such, I had gotten Patrick Martin, Pat Martin, who at that time was the OSMA senior person to concur on the document. In addition to that, I think the payload program exec—on Genesis it was Brody. Steve Brody? I think it was Steve Brody, to also concur on the document.

So we had project approval on the document, OSMS, and then at the time it was Chris Jones, he was then the—not the ALD [phonetic]. Was he ALD at the time? Not ALD. Maybe he was. He was the OSMS—jeez, the thing that Tom Gavin was ALD for, used to be the Office of Flight Projects and Mission Success.

Q: It was Chris Jones when Genesis impacted. It was Chris Jones, yeah.

Barrow: Yeah, he was the ALD for Office of Flight Projects and Mission Success —yeah, yeah.

Q: And I think Landano worked for him, I think.

Barrow: Yes, Landano was the director-for for 5X, the OSMS director-for.

Q: Yes.

Barrow: And Frank Mortelliti worked for Matt Landano.

Q: Okay. So you started out by going to the project and gathering information, and then what's next? What kinds of analyses get done?

Barrow: Okay. So the breakup/burnup analysis was done. We then got the people responsible for shuttle. The JSC Flight Dynamics Group did some of the casualty analysis for us. Then their Toxicology Group did some of the analysis for any toxic hazard assessment, and there was one other group. It was the Toxicology Group, the Flight Dynamics Group, and I think it was the Orbital Debris. So we had three organizations from Johnson Space Center that helped us with the analysis. We had Lockheed Martin did some of the breakup/burnup analysis. We had—who was helping JPL at the time with the entry? Was Langley. I think it was Langley also. So that we had some outside organizations also helping, providing their expertise in the appropriate analyses. I got help with the Genesis systems engineer, was Tom Wahl. Tom Wahl helped also with the final completion of the ETESP Volume 1.

Q: Did those analyses affect the recovery effort?

Barrow: No, the analyses *supported* the recovery operations. They were all done prior to the recovery.

[laughs] Now, you brought up an interesting—no, no, that's for Stardust. That's Stardust. I have to remember that when you come to Stardust.

The other analyses was done in support of the recovery, because remember for Genesis, the recovery was supposed to have been a midair capture, whereby the helicopters were—there was kind of a boom, catch pole. There was a catch pole below the helicopter that would have

caught the parachute in midair and then gently lower down the sample return capsule to the ground, but then that never happened.

So, Genesis. Let me make sure Genesis. Yes. Okay, yes. So on Genesis, the Toxic Hazard Assessment showed that there were three species that we were very concerned about: cyanide that would have come from the ablative material for the SRC. Sulphur dioxide. Because the sample return capsule had batteries as part of its configuration, we were concerned that in the event that batteries should explode, release, that there were two gases, carbon monoxide and sulfuric acid. There were three toxic materials, one from the SRC material itself and two from the batteries, and I'm trying to remember exactly what those were.

But in any case, as part of the recovery, we had sensors as part of the PPE, Personal Protective Equipment, that we would sniff the air around the SRC to make sure none of those three potential hazardous gases were there, and so we trained—the person that was going to be the one going was a Lockheed Martin guy, and then the guy from the helicopter—jeez. The helicopter was Vertigo. I think one of the pilots from Vertigo, or one of the pilot, co-pilot on Vertigo was going to help support the Lockheed Martin to do the sniff check prior to actual recovery.

Now, I was told—I was out in the field at the time, so I did not see it personally, but I was told that the person that went to sniff the thing did not follow the rules that we had established. I'm trying to remember did he have on his haz mask or he did not? I don't remember now. I remember it was a big concern, whereby calls were being made from the higher-up management and even NASA Headquarters, the chief doctor of NASA Headquarters had called, said, "Hey, you're not following your protocol." So that's the big concern I remember on Genesis.

Q: Interesting. Since the capsule was heavily damaged from the parachute failure, you would think you'd be more careful with a damaged spacecraft than an undamaged one. That's just me, though. [laughs]

Barrow: No, no, to be honest with you, I was told, no, that luckily for the sample return capsule, it rained at UTTR the night before, so at least the ground was a little wet, that we didn't have a real hard landing, you know. So, yeah, it was fortuitous that it rained the night before.

Q: It was a muddy landing, rather than—

Barrow: Yes. [laughs]

Q: —hitting the hard desert floor. You might as well be hitting concrete sandpaper.

Barrow: Right, right. [laughter] No, interestingly enough, I heard that's the actual return for Mars sample return. It's going to be just one ballistic entry and it's going to go directly into the Earth.

Q: Yeah.

Barrow: There's no parachute, there's no nothing on MSR.

Q: Oh, really? I assumed there would be a drogue shoot, at least, for stabilization.

Barrow: No, no.

Q: They're not even doing that?

Barrow: That's what I was told.

Q: Oh, wow! [laughter] Okay, that's a surprise to me. I guess they want it to be simple, and that's the way to do it, I guess.

So were you at Dugway when the Genesis accident happened?

Barrow: Yes, I was. Yes, I was.

Q: So talk me through your day then at Dugway.

Barrow: On the day after the return, I spent most of my time in the hangar watching them assemble the hook on the aircraft, making sure, watching that activity. I stayed. I watched the three aircraft ascended and vectored out to the landing site. I was not part of the recovery. I was not part of the recovery team at all, so I remained at the hangar and also at—UTTR had a clean room and I'm trying to remember the facility. Avery Complex? Was that what it's called, Avery Complex? Erik, to the best—I remained either at the hangar or at the Avery Complex. I did not go into the field.

Q: Okay. So then when did you find out about the parachute failure?

Barrow: Oh, I found out about the parachute failure when the—was it the UTTR range safety guy? There were two UTTR range safety personnel, and one of them says, “Hey, I just heard the sonic boom. This thing is tumbling.” I don’t remember if he was in the room or he came into the room afterwards. He must have come in and mentioned it, because they probably saw it on their—. They must have seen it on one of their monitors or something, and he just came in and said, “Hey, this thing is tumbling.” I can’t remember the guy’s name. Bryce Billings? It was either Bryce Billings or the UTTR range safety officer was Flint Lachenmeier. It was either Flynt or Bryce Billings. It’s one of those UTTR guys I think mentioned it.

Q: Okay. And what then? As you said, you weren’t part of the recovery team. So what were your actions during the day?

Barrow: I don’t even recall going over to see the damage of the SRC. I’m trying to remember even if Frank Mortelliti was—I think Frank was there with me. Yeah, Frank was there with me, so I think we left. We did not go to—or at least I did not go to even see the damage of the SRC in the building. I don’t remember even being at UTTR after that. I don’t recall if I left UTTR the night after the thing landed and they took it to the building for—I’m not sure if I left that same day or not. I don’t remember now, Erik, to be honest.

Q: Sounds like it’s kind of a blur.

Barrow: Yeah, because I'm trying to remember. I think Frank was there with me. I'm trying to remember between Genesis and Stardust, but I think Frank was there with me and we left that same day, I think, that evening or that night.

Q: Couldn't have done anything about or for it anyway.

Barrow: Right, right.

Q: So there wouldn't have been any point. But then you have about a year before Stardust returns, so then do you do the same thing again, the same set of studies, or does that change?

Barrow: No. Yes and no. No, it did not change now on Stardust. My activity with Stardust is now completely separate. On Stardust, I was tasked as the lead for what's called the IRT, Independent Review Team, whereby because of the Genesis mishap, they wanted to make sure that all the procedures for ground recovery have been vetted and each of the hazards have been addressed. I led a team from JPL, Aerospace, NASA Headquarters, there was one other person from Ames, I think it was, Ames, from Ames, yes, whereby we reviewed the whole ground operation plan and procedures from witnessing the training, literally went out to UTTR again to observe the training that was done in real time, reviewing the various documents.

Stardust was very fortunate in that Genesis had done most of the work that they needed to do, so they just piggybacked from Genesis. Oh, and the big thing there was that on Genesis, Stardust was able to get the NASA Mishap Investigation Board preliminary findings before they became official. The MIB chair was able to get NASA's approval to let Stardust see some of the

findings before they actually became official, and so Stardust was able to implement some of the findings. For example, on Genesis, as part of the ETESP, we had a lot of the hazards from the ground recovery into several documents. The MIB found that, you know what, that should not be. They want the ground recovery operations, the planning, execution, procedures, all in one separate file folder that's separate from the ETESP. So that was done. So we reviewed those documents as part of the Independent Review Team.

Now [chuckles], I chuckle a little bit because I remember I said when Stardust comes up, I have to remember to say this to you. JPL has a paradigm that says "Test as you fly, and fly as you test."

Q: Yeah.

Barrow: UTTR has a similar paradigm that says "Test as you train and train as you test." Well, on Stardust, there were three helicopters that were supposed to go out to the landing site for recovery. One of the helicopters at the time was to be a Black Hawk helicopter. Two were commercial. One was military. During the training, the Black Hawk had to—I don't remember if it was the Iraq or the Iran—anyways, the military needed—the Black Hawk, since it's a military asset, had to support the military mission, so that did not participate in the actual recovery. They had to go and get a separate commercial helicopter. However, the helicopter wasn't as big as the Black Hawk, so some of the recovery people were complaining about the spacing in the commercial helicopter versus the Black Hawk. Well, I, as the IRT, said at the time, because JPL had this paradigm thing, that because the Black Hawk didn't participate in the training, it

couldn't be part of the actual recovery, because the thing was, test as you train and train as you test.

Well, the project at the time didn't agree with me, and they wanted a waiver, so they appealed to the UTTR, and the range safety UTTR says, "No. No training, no flight." So then they had to get the commercial helicopter that was a little bit less roomy to participate in the actual recovery, and many of the project people were upset with me at the time.

Q: Because they hadn't wanted to bring in that third helicopter?

Barrow: They wanted to get maybe another Black Hawk helicopter. They wanted another Black Hawk helicopter to participate in the actual recovery, but because it didn't participate in the training, you know, they couldn't use it.

Q: Right. So ultimately, they only had two helicopters, or did they take the third commercial one too?

Barrow: They took the third one, but I'm trying to remember—I don't even think they put the—they had to get a third one, but I'm trying to remember if they actually put the SRC in that one, because if I remember correctly, they took all the back seats of the helicopter except the seat belt, and they strapped the SRC in, and the one person that flew in the helicopter rode in a—I think it was a cardboard box.

E No!

D Yea, I think, if I remember correctly.

Q: Can't have been very happy about that.

Barrow: No, no. [laughs] But then again, it wasn't a long flight over to UTTR landing site.

But, no, I was not involved with the creation of the ETESP Volume 1 or Volume 2 for Stardust. I believe the ETESP Stardust was actually written by Tom Wahl. I think Tom Wahl actually did it for Stardust. Tom was the systems engineer, the project systems engineer? I think he was the project systems engineer on Stardust, I believe. I'm not sure. But Tom Wahl did it for Stardust.

Q: Yeah, I see his name on the Sample Return Handbook you guys did.

Barrow: Yes.

Q: But it doesn't tell me what his role was. Okay. That's good to know.

Barrow: I think he was assistant—I'd have to look up the org chart, but I think he was a systems engineer.

Q: Yeah, he's listed as Project Systems Engineering, but that's it. But that's easy to find out, I think.

Okay. So you're not involved in the same roles on Stardust as you were for Genesis.

Barrow: That's true. Yes, that's true.

Q: Other people did the breakup analysis and that sort of thing.

Barrow: Yes, that was done, but still within the breakup/burnup, JPL did it, Lockheed Martin did it, and—oh, yeah, that's what it was. Okay. So JPL did it, Lockheed Martin did it. Who else did it? I think Johnson Space Center did it, but Aerospace, as the independent organization, they reviewed all three. Aerospace had two roles. One was, because we had to write a contract with Aerospace for Genesis, they reviewed all of the analyses, the breakup/burnup analysis, the toxicology analysis, and the far-field overblast, and then in addition to that for Stardust, they had a member also on the Independent Review Team, the IRT. So, yeah, they reviewed all three breakup/burnup analyses that JPL did, Lockheed Martin did, and I believe also Johnson Space Center did.

Q: Right, in order to ensure that they were properly in agreement.

Barrow: In some agreement, yeah.

Q: Yeah, in some sort of agreement. There must have been some differences, though, because you'd think they would have had different analysis tools.

Barrow: They did, they did. JPL's analysis tool is different from Lockheed Martin and is different from Johnson Space Center, and each did their own independently. Then once the results were all finalized, released, then Aerospace reviewed those with, I believe, all the three organizations, and then there was some big discussions going back and forth until some agreement was reached. But, yes, there were different tools. Each organization used their own tool. Each organization used their own tool to do the different analyses, yes.

Q: Right, and makes sense. Then they would have had to come to some sort of an—"agreement's" not the right word, but consensus about where the centroid of risk was.

Barrow: Yes, yes, yes.

Q: [unclear] [00:37:40].

Barrow: Yes. As a matter of fact, Erik, yes, because if I remember correctly on Stardust, Lockheed Martin modeled—okay. The big issue at the time was tungsten. There were how many, three, four, five? I don't remember how many pieces. Anyway, they used tungsten material in the nose of the sample return capsule to stabilize, to balance, to balance it when it's coming through the Earth's atmosphere. Lockheed Martin modeled the tungsten as spheres. JPL modeled it as cubes. I forgot what Johnson used. Anyways, Lockheed Martin says that the whole thing would burn up. JPL tool says, no, some of the tungsten's going to reach Earth. And I believe also Johnson. So then they had discussions with experts in the field, and even Aerospace agreed with JPL that, yes, some of those tungsten material will, in fact, survive and reach Earth.

Q: Okay. And all from a difference of whether there's spheres or cubes. [laughs]

Barrow: Yeah, how you model it. Yes. [laughter]

Q: Sometimes engineering doesn't give you quite as solid an answer as you might like.

Barrow: Yes, yes, that's correct.

Q: Okay. So let's see. You were at the range when Stardust was recovered, so talk about that.

Barrow: Wait a second. I've got to remember now. Was I there when Stardust was recovered? Oh, gosh, no. Let me see. I was there for—oh, jeez, what they call it? On a flight project when you're going to go to another planet. ORT, Operational Readiness Test. I was there for the actual dress rehearsal of the ORT, so I witnessed the takeoff of the helicopters with the—yeah, I was there. But, no, no, no, no, no, no, no. I'm sorry. I was not there, because Stardust returned at night.

Q: Yeah.

Barrow: Genesis was in the daytime. Stardust was at night. Was I at UTTR on the night of the recovery? No, I don't remember now. Erik, I don't remember that at all. I remember we did the practice tests again for the three helicopters taking off, vector to their assigned spots at the same

time they expected the sample to return, because I remember clearly it was cold when we were doing the tests. But Stardust returned at night. No, I was not there. I was not there during the actual landing. I don't believe so.

So what else to let you know on Stardust that was different than on Genesis? Oh, on Stardust, Stardust implemented what they called ICS, Incident Command System, whereby one person was going to oversee the whole recovery, and that person was the project manager, Tom Duxbury. Tom Duxbury was the Incident Command—this, again, was the result of the Genesis Mishap Investigation Board recommendation, and so we did all the practice until everybody was comfortable that, yes, the recovery activity was safe to do, and on the final day of recovery, I believe Tom Duxbury gave the okay that everybody else could go now and implement their portion of what was practiced and dress-rehearsed during the previous days and weeks prior to.

Yeah, Stardust was at night. Stardust was a night recovery, because I remember the people even had to have the PPE, again the cold-weather gear for Stardust. That was different than for Genesis.

Q: Okay. You said your job had been as a team leader for the ground recovery training exercises and so forth, and you were coordinating, I guess, a multiorganizational team. You had JPL people and Headquarters people and so forth. So how was that group chosen for you, or how did you choose that group?

Barrow: Oh, by word of mouth from different people. I believe the NASA Headquarters person—oh, how did that chosen for me? Some of it was word of mouth and some of it was from my boss, Frank Mortelliti at the time. The NASA Headquarters, the main guy on the team, on my

team, was a very senior safety person named—oh, my gosh. I remember his name. Anyway, he was a senior safety OSMA guy. He was actually Occupational Safety, Jon Mullin.

And then I believe Pat Martin, I believe Pat told me, “Hey, Kirk, there’s some Aerospace people that you might want to—.” I believe it was Pat that told me that. So then I had to contact Aerospace and get a name, and I believe we had to set up a contract with that organization. We did. We set up a contract with Aerospace.

Then how did the person from Ames—that person was—was that a Human Factors person? I think it was a Human Factors person. I think Frank also gave me that name, because what happened is I think most of these people worked or were involved with the NASA IFOSA Audit. IFOSA is the Institutional Facility Operational Safety Audit, IFOSA. So Frank, my boss at the time, also knew some people, and he either contacted them or told me to contact these people and see if they would be willing to be a member on the team. I think that’s how some of it happened. I think it was Matt. Did Matt give me a name? I don’t remember now if Matt gave me a name to go talk to. To be honest, I don’t remember. I don’t remember, Erik.

Q: Okay.

Barrow: So, no, let me give you one other input that I got. [laughs] How to say this politely now? Another input that the Stardust project was a little upset with me at the time. That’s right. Okay. So as part of the *Columbia* mishap and the change in paradigm, NASA Headquarters came out with what they called the technical authority, but at the time it wasn’t called technical authority, it was called warrant holder. A warrant holder, that’s what it was. Because at that time it was

Brian Muirhead who was JPL's chief engineer at the time, and so on Stardust, I wrote an email to Brian and says, "Hey, as the warrant holder, shouldn't you be signing off on the ETESP?"

And he said, "Yes, I should be."

So Brian signed off on the Stardust ETESP Volume 1, but he didn't on Genesis, because at that time there was no warrant holder. I think at the time, too, Brian wanted—Brian actually went to UTTR, but I know he was also planning to go, but I'm not sure if he went there or not, to be honest. But, yeah, Brian Muirhead at the time was the chief warrant holder, so he signed off on the ETESP Volume 1.

Q: When you say signed off on it, did he have anyone re-review it prior to signing it?

Barrow: I don't know. I don't know that, Erik. Don't know.

Q: Okay. Not a fair question, then. What I'm interested in is precisely the changing level of procedure and rigor that goes into this over that period of a few years.

Barrow: To be honest with you, I need to look at the Stardust ETESP signature sheet to see exactly who all signed off, but I know for a fact that Brian wanted to sign off, and I believe he did. So I need to look at it and verify, and then I could let you know for sure.

Q: Okay. That'd be great. Now, after Stardust and Genesis, you and some others prepare this Handbook for Sample Return and future sample returns. Talk about doing that.

Barrow: Oh, okay. That was spurred—I got a call from—oh, jeez, the Juno mission manager now is Ed Hirst. Ed Hirst was the guy that called me and says, “Hey, I’d like for you to write one section on the—.” I think it was the recovery part. So I wrote something up, and then Ed critiqued it, modified it, and finalized it.

Q: Okay. So you wrote a section of it.

Barrow: Yes.

Q: Hirst was the one who managed it?

Barrow: To be honest with you, Erik, I believe Hirst is the guy that did the entire document. No, no, he didn’t do it by himself. He finalized the entire document before it became official. Ed Hirst was heavily involved with the writing and creation of that document.

Q: Okay. I’ve tried to reach him, but I haven’t succeeded yet.

Barrow: He’s an excellent guy, excellent.

Q: Okay, great. Well, that’s good to know. I’ll keep looking forward to getting a hold of him, because I need more bits of the story in order to finish my own work.

Barrow: I don’t know, is Tom Wahl still at the Lab? Because he would be another good input.

Q: I don't know. I'll look.

Barrow: I don't know if he's still at the Lab or not. I can check once we are done and let you know.

Q: Okay. I just have to VPN in and check the phone book, phone directory.

Barrow: No problem.

Q: Okay.

Barrow: But for sure Ed Hirst. Yes, Ed Hirst is excellent guy, yes.

Q: Okay, great. So what haven't we talked about regarding Stardust and Genesis that we should have?

Barrow: Stardust and Genesis. What can I say now? Now if this might add anything to it, NASA has now revised the NPR that Genesis and Stardust used, to now there are two documents that now pertains to sample return missions. The two documents now is NPR—now, let me get check, get this right. I have to go look. The NPR, it is 8715.5B, and NASA Standard, it is 8719.25. So now—no, which is which now? Got to remember now. It is 8719.25 has all the requirements for breakup/burnup analysis, far-field overblast protection, toxicology, and even

now they come up with a new one called containment, and all the probability analysis that needs to be done is in one document.

And the other document now even tells you who has to sign off on the--it's called the RSRMP, Range Safety Risk Management Plan, yeah. So now there's a new document that has to be signed for projects now that the preliminary baseline—they use the words interchangeably, so I think it's either a draft or they call it a baseline that's now due at the program PDR. So now programs know exactly what they've got to produce, they should not have to be scrambling a year or two years before return. They know what they have to do now at least to a couple of years prior to Earth return from wherever they're bringing the samples from now. So now at PDR, you have to produce this Range Safety Risk Management Plan, and that document tells you what you're going to have to put together your ETESP Volume 1 and Volume 2 and your recovery planning and the whole activities. So, yeah, that's new.

Q: So that's all been—what's the word I want? It's routinized, I guess. We know what we have to do upfront, instead of having to figure it out on the fly or at the end of the process.

Barrow: Yes, yes, yes. [laughs]

Q: Okay, great, great. Where did you go after Stardust?

Barrow: Well, right now I work now with—which I love now, is the R&TD [Research and Technology Development] and the technology folks, because I am seeing an entire part of the Laboratory that I was not familiar with in all my 38—well, I shouldn't say that now. My prior

maybe 34 years, because now I'm doing this for about at least four or five years. And what this is now, Erik, is seeing how the technology readiness level is advancing, the TRL, before it can be actually put into a flight project, because Dr. Elachi edicted at the time when he was Lab director, that no TRL is going to go on a flight project less than six. Got to be six or above.

So now I work with PIs that develop stuff, put it on planes, balloons, submersibles, Navy ships, you name it, various different platforms, sounding rockets. So I get to see a different side of the Lab, like I said before, that I was never exposed to before, and so now, even though a new APO, Airborne Program Office, within 8X that's looking at all these different technologies that are going on airborne platforms, which I find very interesting. So that's what I'm spending my time on now, hopefully for the next two or three years when I retire.

Q: Sounds like more fun.

Barrow: Yes, yes.

Q: All right. Well, thank you for your time.

Barrow: Thank you very much, Erik. Thank you so much.

Q: You'll see a transcript here in a couple of weeks, mostly likely. Okay?

Barrow: Okay. Thank you very much. Thanks again.

Q: Thank you. Have a great day.

Barrow: Bye-bye.

[End of interview]