NASA JOHNSON SPACE CENTER
FACILITIES ORAL HISTORY PROJECT

GREGORY C. BLACKBURN
INTERVIEWED BY JENNIFER ROSS-NAZZAL
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ROSS-NAZZAL: Today is May 4, 2009. This interview with Greg Blackburn is being conducted at JSC for the JSC Facilities Oral History Project. The interviewer is Jennifer Ross-Nazzal, assisted by Rebecca Wright. Thanks again for joining us this morning. We really appreciate it, and we look forward to hearing more about the Avionic Systems Lab. I'm wondering if we can start by learning a little bit more about the laboratory. If you could give us a short history: when the building was constructed, what its purpose was.

BLACKBURN: The building was in existence, when I hired back in 1980. I hired into this building for Irv [Irvin J.] Burtzlaff. He was my boss at that time. He would be a good person to interview, actually, for this facility, so I would suggest doing that, too, if you get the chance. He's retired now. I came right out of college. Went to Oklahoma State [University, Stillwater, Oklahoma] and got hired here, so I was 22 years old when I started here in Building 16. I've been here approaching almost 30 years. When I came here to the Shuttle Avionics Integration Laboratory, the SAIL was actually here already [in] existence.

At that time, we were doing an upgrade to the test control center for that facility. … As I understand it, the lab started in other buildings and then migrated over here to Building 16 to create a ground-based test facility to check out the Shuttle before it flew. Check out all the hardware systems, all the software systems, in a test rig that was as close to flight as possible. It

exhibits the philosophy that you need to test what you fly and fly what you test. All the hardware, the cables, everything is as flight-like as possible, to the point where they even gave this test facility a tail number. It's considered as close to flight as you can be, but in a test configuration. There's obviously no wings, there's no engines, there's no External Tank—that's all simulated—but as much of the avionics portion of the vehicle: the black boxes, the computers, and all that it takes to fly the Shuttle machine, is all out in the high bay.

ROSS-NAZZAL: Do you know, by chance, how Building 16 had been changed as a result of moving all these facilities here?

BLACKBURN: I really don't, because it was in existence when I got here. … I believe this building was used [for] similar testing [in] the Apollo Program. This building has been here a while, dates back into the Apollo Program, so it [has been] a multipurpose building. It does have the high bays that allow for the creation of these large test facilities. A good part of this building has been focused on Shuttle avionics testing since the late seventies. …

Some of [the original SAIL support engineers] migrated from KSC [Kennedy Space Center, Florida]. … A lot of this work gelled together trying to figure out what NASA needs to make sure a Shuttle was safe to fly and was going to do the job it was supposed to. This culminated in this Avionics Integration Lab. This philosophy is now being taken forward, actually, for the Orion Program, Constellation Program. We're now building what's called a CAIL, which is a CEV [Crew Exploration Vehicle] Avionics Integration Lab, but it's going to be over in [Building] 29. It's the same kind of thing, where you basically bring in essentially the

flight vehicle into a lab configuration, run it as if it was flying, and check out everything. You simulate what you obviously can't do, since it's not flying.

I did a lot of that [testing] in the early days, and that was kind of fun for me, right out of college. I was writing some software at that time for the control center, and it had the ability to launch the Shuttle and watch the data run. You'd have the countdown, and then you'd have the launch, and all the data would start to flow through all the machines, and that [was] exciting, even though it's just sitting right there. It's essentially the real vehicle, with all the real software, all the real hardware, integrated into one lab. That's the main part.

The other part of SAIL [was] the simulation. There [was] a large simulation branch of activity that [supported] the SAIL that [simulated] out-the-window scenes, for instance. It's not a trainer facility, even though it's been used for training, because it's very hi-fi [high fidelity]. You've got a real cockpit, you've got real cockpit displays, but this is also augmented by some out-the-window scenes through the windows, so you can get a feel of what's actually happening outside the vehicle. It's not motion-based, though; it's fixed-base. Over in Building 5, they have the motion-based. This is all fixed in one orientation.

Training has been a secondary benefit, even though some folks may not think that, but it's really an engineering facility for the engineers to ensure that their systems indeed are doing the function they're intended to do. They also simulate a lot of the off-nominal errors that could potentially happen and try to stress the system in all ways that you can think of. We're talking about a very, very complex machine; there's lots of different things that can go wrong on you. This facility allows you to do that in a laboratory environment to see how the machine reacts to that situation. That's where a lot of fun is, too, for the engineers. Trying to figure out problems or why the machine is reacting this way versus what you thought it was going to do; whether it

be a software issue or a hardware issue. It's how [it] all comes together. That's why it's called an integration lab, because it brings both the hardware side and the software that's running in the hardware, how it all plays together.

Anyway, that's a big part of this building, the majority of it, that was managed. We used to have, I want to say, around 50 civil servants that used to run this lab, and in that initial phase, that's what I joined back in 1980. Over the years, that has slowly migrated to the contractor, and now it's 100% USA [United Space Alliance] managed, straight out of the Shuttle Program Office. The subtle difference there is that SAIL used to be part of Engineering Directorate, mail code EA. The EA organization is really not involved directly in running the facility anymore. …

ROSS-NAZZAL: We talk a lot to the astronauts who've done a lot of runs in the SAIL, but not necessarily people who worked in the SAIL as engineers, so it's nice to hear this different perspective.

BLACKBURN: One of the big customers are all the subsystem and system managers of the hardware, like the data processing system, the communication people, the various systems that will come in and sponsor tests and that kind of thing. It really is an engineering lab. But one of the biggest things in the recent years has been just primarily focused on the software changes. Amazingly, they continue to have GPC [General-Purpose Computer] software changes that need to be checked out. This is where it's done, where again, you make the change, and they bring that in and test it in this facility. The civil servants [and contractors] that are responsible for the

development of those software changes use this facility [for certification] testing to make sure that it's ready to go before you fly it.

ROSS-NAZZAL: Tell us about running a test and certification. How long does that last? Who does it involve? What's the process behind all of that?

BLACKBURN: It would vary depending on the type of test. It could be probably a few days to a few weeks or even months, depending on the complexity of what you're talking about. There's a lot of test planning that goes on regarding the facility folks themselves on understanding what the test is to the person that's sponsoring the test, the engineering organization system provider. Say they're bringing in the software to be tested, well they [would] coordinate that test with the facility folks and generate the specific procedures that need to be done to execute the test. It's very methodical, so there's a lot of planning that has to be done: what the configuration of the lab is, what needs to be on or off, the configuration of what part of flight. Is it just during the launch phase; is it during the landing phase; is it on orbit phase? Just trying to figure out how to best test the piece of gear that you have that you want to make sure it works. [There]'s a lot of test planning that's done with the facility back and forth.

Then once they get it all set up, it's very analogous, actually, to a real flight, because you've got a control center, you've got a test director that sits on a console, and then they execute the test in a very methodical way based on the procedures that were worked out with the customer. You end up running the test, you generate usually a lot of data, and you record a lot of data for the customer. Then that data set essentially produces a report for the test that was being conducted. Then, if you have problems, there [could] be some iterations, depending on the

complexity of the test. You may have facility-related problems, or the new stuff that you brought in to test may have problems. There'll be a lot of iterations back and forth. Is it the facility, or is it the mod [modification] that was done? You do this back and forth during the test. Depending on the complexity, it could take a while.

I would definitely encourage, if you have the opportunity, to get a tour. They could walk you through and show you the test control center and then the facility itself just to get a rough feel. It's an amazing machine. Right now, we're trying to get all our young engineers to actually see the facility. What's real cool about it is that it's got the skin of the Orbiter pulled away, so you get to see the guts of the whole Shuttle. You get to see where the racks are, where the computers are; you get to see all the wireways. You're just in awe of the number of wires, for instance, that's inside the Shuttle to interconnect all these boxes that are making the thing fly. It gives you an appreciation of what it takes to build a spacecraft. That's been another side benefit, is just to help teach ourselves and our young folks, particularly, the complexities of that. Because wiring, a lot of times, is not an overly exciting thing, but if you don't have everything connected, obviously it's not going to work. There's a lot of weight associated with that, [too]. Sometimes you hear numbers about how much the wires weigh, and it's a large number. Well, if you go out into the SAIL [you will say], "Oh, wow, I can see why that's such a big deal."

That's about, in general, how a test would run. Again, Don Magnusson over here, who runs the facility, would be a good person to talk to also. He works for USA, and he could give you a very detailed discussion of how the [SAIL] operates. It's been a long time since I've actually been involved with SAIL.

ROSS-NAZZAL: Oh, really?

BLACKBURN: … I was very lucky to get that kind of job because it was some really interesting work and a special opportunity for me to get involved with that. I didn't even have a real good appreciation for it. I have a better appreciation for the facility now than I probably did back then. Just a great experience.

ROSS-NAZZAL: Tell us about your work in the eighties. For instance, did you support the STS-1 mission or any of those flights in the eighties?

BLACKBURN: Yes. I got here in '80. Obviously, that was just before STS-1. I was an intern. I remember, actually, everybody in the facility got a little plaque or thank-you for supporting STS-1. I didn't even feel like I deserved it, because I just happened to be associated with it. I didn't have the blood, sweat, and tears for STS-1 in this facility. That really occurred before I got here. What I was working on was really the support of the facility after STS-1 and keeping the facility running. That's a lot of work in itself. We were working on, at that time, an upgrade to the control center for it, but it had obviously been used and was being used previously before I even got here, back in the seventies. That's when the SAIL facility was actually getting actually fully created.

ROSS-NAZZAL: Were there any times when there was a mission up, and you had to do some real-time support for any of those flights?

BLACKBURN: Occasionally. It can actually serve as a backup to mission control if needed. Generally, most the work that goes on in the SAIL facility is pre-flight. So your real time support is more in the context of troubleshooting a problem. If they have a problem on orbit, say, with a Shuttle vehicle in some way, they may come over and have the SAIL guys run a test case to try to reproduce. One thing that comes to my mind when you said that was, one of the things that the SAIL was used for was, after [the Space Shuttle] *Challenger* [accident], trying to recover data associated with that mission and play back and help understand what happened during the launch of *Challenger*. But it's more in the context of troubleshooting a problem versus what you would normally see during flight where you're monitoring systems. A lot of times, this facility will be [executing] normal operations [and] be on standby support for the mission. They may be working some change associated with the next mission, and then switch back if needed. It's not, a direct flight support, in the sense that it's tied up during the whole mission.

ROSS-NAZZAL: During the early days of the Space Shuttle Program, we were flying some DoD [Department of Defense] flights. Did that impact the facility at all?

BLACKBURN: Actually, quite a bit, from a security perspective. When I first got here, I almost kind of laugh about it, because we were very open. You could go anywhere. I can remember going over to Mission Control—what is now the old Mission Control—and just sitting down at the consoles. Just walk in the building and sat down and pretend like I was there. There was absolutely no security that I can think of, besides your own badge. Your badge basically got you in anywhere, including this facility here in 16.

When the DoD came in with the DoD payloads, we had to do a lot of upgrades, security-related upgrades, to the facility: routing of certain wires and access doors, cipher locks on everything, and processes to control data so that it's not uncontrolled. [There] was a fair amount of work that went on in the eighties to support that. Clearances to work certain things. So there was a lot of restricted access. If you walk around this building, you'll see in the hallways what looks like a big sewer pipe. Well that was associated with routing out wires to meet the needs of the DoD with regards to the routing of data. The control center that I was working on, they created a secure conference room that had special shieldings, that they could have private conversations, and the people wouldn't be listening in, that kind of thing. It was a fair amount of work, and it was very disruptive, but you did what you had to do. A lot of that's still in place today.

ROSS-NAZZAL: Oh, it still remains?

BLACKBURN: Yes.

ROSS-NAZZAL: But you don't use most of that?

BLACKBURN: Like I said all the access doors and stuff. Obviously the data itself is not DoD data anymore, so you don't have to worry about the actual data itself. But a lot of the processes and the modification of the facility, modification of how the wiring is routed and stuff like that, it's still as it was, because it doesn't make sense to undo.

ROSS-NAZZAL: Right. Has the facility been modified in any other way since the Space Shuttle began flying?

BLACKBURN: That's interesting. That would be a good question for Don. There's been modifications of sorts. For instance, the control center that I talked about, the original one was downstairs on the first floor; and the one I worked on, we moved it to the second floor; and then there's been a third upgrade in this time period, which is just down the hall. So the function is the same, but they have upgraded the support hardware. Some of it was very old, so you have to upgrade these systems as needed. This is like the lab support hardware. I'm sure they've done a number of those types of upgrades over the years.

The Shuttle piece, the core piece of the lab, is pretty much the same. If there was an upgrade to an avionics box, black box, over the years; they would have got it here, too. Those kind of modifications to keep it current to the vehicle. A big one they did was the glass cockpit. When they converted to essentially the LCD [Liquid Crystal Display] screens that they currently have, they upgraded all the vehicles, obviously, and then they upgraded this facility. But it still, just in a broad sense, in my mind, when I walk through it, it's very similar to what we had 30 years ago.

ROSS-NAZZAL: Would you give us a sense of the building itself, the different wings and what's contained in Building 16?

BLACKBURN: The lab probably takes up almost half the square footage of this building, probably. Maybe a little less than that. What's nice about this lab is that then it's surrounded by

the offices, so the engineers that run the facility are here located next to the lab, so it's easy access. I always call it 16A; I think they labeled it 16N. This is before I got here, but it was two buildings that were connected together. There was a 16 and then a 16A. So I got 16 annex, and then the primary 16 that we're sitting in now, where all the employees' [offices are located]. There's a little narrow wall connecting the hallway between the two buildings.

The building itself has been, as far as I know, pretty much the same for at least 30 years. There hasn't been any major modifications to this building. What does come to mind, there was an upgrade to women's restrooms over in 16A to provide more access for ladies, because this building was originally designed when there was probably 90-plus percent men, so the facility was designed around men, and now it's much more equal. So there have been those kind of modifications to try to make it more useful, but the building itself is pretty much the same forever.

It's shared with a number of organizations, though, in this building, including my division, EV [mail code for the Avionics System Division]; EG [mail code for Aeroscience and Flight Mechanics Division] downstairs utilizes this building—they're the GNC [Guidance, Navigation, and Control] folks; the MS [mail code for Space Shuttle Systems Engineering and Integration Office]; USA, obviously, is here, that supports SAIL. ER [Software, Robotics, and Simulation Division] is in this building—they have all the simulators—Robotics Division, Simulation Division; and then EP [Energy Systems Division], the power guys have a Shuttle power lab that's kind of a specialized lab that's here in the first floor of 16, that does certification of power interfaces to the Shuttle. If you have an avionics box and you wanted to get it certified that can plug into Shuttle power and not disturb Shuttle power, and your box will work off Shuttle power, there's a specialized lab, the power lab downstairs, that EP still runs. It's a little

smaller facility, but it's down here in the first floor of 16. I'm sure Bill [William C.] Hoffman over there in EP could talk about that. That's been around a while. From a historical perspective, I think it's pretty much the same age as SAIL. I'm not sure.

ROSS-NAZZAL: Would you tell us about some of these facilities? The electrical power system test facility?

BLACKBURN: That's the one I was just talking about,

ROSS-NAZZAL: … Just wanted to make sure.

BLACKBURN: Yes, that is it. I don't have any good history of that facility. Scott Woodard probably would be a good one to talk to, also.

ROSS-NAZZAL: You've talked to us a lot about the big rig. That's where the wires are and things. Is there anything else that we should know about that?

BLACKBURN: I don't think so, actually. I should mention, analogous to the power lab, we have the JAEL. That's over here in 16. In my mind, it's kind of a mini version of the SAIL. What does that stand for? JSC Avionics [Engineering] Lab. That facility does some specialized testing on GPCs, MEDS [Multifunction Electronic Display System, glass] cockpit, kind of pre-work prior to the Shuttle SAIL lab, and augments that test capability. But it's analogous to the same kind of test function, just a smaller version. SAIL, to me, is the primary facility.

ROSS-NAZZAL: You mentioned the simulators before, but is there anything we should know about the High-Fidelity Engineering Simulator or the Asset Entry Shuttle Engineering Simulator?

BLACKBURN: Back in the early eighties, those were all in the same division of responsibility, and that's now ER, so I would probably visit with some folks over there to get some of that history. Andre [J.] Sylvester, actually, who works in this division came over from ER and is now supporting us for the Constellation test facility work, can probably give you some good background and good history. He's a little bit of a history buff of sorts. He'd probably be another good one to interview for what has happened here in 16, if you get that chance.

I really wasn't personally involved in on that side of the house as much as more watching from afar and seeing some of the products that they developed. You develop, obviously, some skills and capability out of this in the early eighties. When Space Station was starting to be talked about, one of the things that we started to create in this building was some of the early avionics displays and control cockpits ideas, just to formulate how a Space Station would be actually designed and built. A precursor to Space Station was also in this building, based on some of the skills and work that came out of the SAIL, which would include some of the simulations.

They started to simulate Space Station. We started to simulate a cockpit that I was involved with to interact with that simulation. You [started] to get a feel for what that vehicle's going to be, because it's very, very different than the Shuttle. Very complex, too. What's amazing to me, sitting here, particularly with this last flight, I think back during those days of the

eighties and some of that early prototyping and some of the ideas that were just being formulated, being talked about, about what a Space Station would look like and how it would be designed. As an example of that, even back then, they simulated the mobile transporter on the Station, this transporter that moves the arm around, on like a railroad track. I can remember us simulating that back in the early eighties or mid-eighties timeframe. I'm thinking, "Wow, really?" Here we are, 30 years later, and all that is pretty much there. It's just pretty amazing to see that it actually happened. So a lot of the early prototyping and ideas were also done in this building, that shaped some of the thinking and requirements, essentially, that drove what's now flying in the Space Station.

ROSS-NAZZAL: Does your building have to be reconfigured at all for each new mission, or depending on which Orbiter you're using?

BLACKBURN: The SAIL does reconfigure to match. Mainly, I believe that would be software. The loads would be matched to the vehicles. The hardware itself is pretty much the same. The vehicles are very close. But there's not any major reconfigurations that have to be done that I'm aware of.

ROSS-NAZZAL: Do you have any idea how long that might take if a change had to be made, or is that relatively quick?

BLACKBURN: That'd be a good question for Don over in the USA side. I think it's in the hours of time.

They could be testing, say, a new software load for one mission and then be asked to go to another one. So they have the ability to switch and reconfigure the lab so it supports, say, the next mission, for instance, [STS]-125. If they were testing [STS]-127 configuration, they have the ability to reconfigure rather quickly to something's that considered to be valid for [STS]-125.

That reminds [me], also, the configuration management of the facility is key, meaning this is not a facility just casually managed. You've got to have tight controls on everything, because otherwise the integrity of the hardware and software systems is compromised. It's extremely important that you manage very closely any changes that go in the facility. There's this day-to-day work, but you don't want to mess that up, because you're trying to certify that this hardware and software is indeed ready to fly. You got to take that very serious. There's a lot of CM, a lot of configuration management over the test facility, just like the real vehicle. Obviously you don't go into a Space Shuttle and start rewiring things, right?

ROSS-NAZZAL: Right.

BLACKBURN: Or if you need to go in there and change something, you do it in a very controlled way. You preplan, you figure out what you need to do, and you coordinate it very tightly so that you know exactly what's been done to the Orbiter. The same thing here. It's treated the same way. So that's a big part of what goes in to make a lab like that run and operate successfully, is the proper control of the facility itself. Otherwise, what you test is not what you're flying, and you could have very wrong results. You want to be able to stand behind the test itself, because a lot of the test runs are essentially driving final decisions that the Shuttle is certified to fly.

You're basing that judgment on a SAIL test. To give you that warm feeling that yes, you've done everything you can to make sure that the hardware is ready to go.

ROSS-NAZZAL: How have operations at the facility changed since STS-1 to now much more complicated missions?

BLACKBURN: The biggest thing, I touched on already, at least for us, has been the amount of Engineering Directorate oversight in the middle of operating the facility. When I first came in, we were heavily involved. NASA's civil servants were heavily involved in the development and operation of the facility. What's happened over the years is the number of civil servants involved in the actual facility is very minimal. Over the years, it went down to one person, Bill [William F.] Ritz, one EA person, and then that eventually was eliminated. So as far as I know, there's really no civil servants in the day-to-day operations. It's just the program office as a customer deals with it. The amount of civil servant oversight has just been drastically reduced. USA does a great job running the facility, but that's a big difference in what's happened in the last 30 years. Like I said, it was an entire division, a division of civil servants, that ran the facility.

ROSS-NAZZAL: Did they then become contractors and work for USA?

BLACKBURN: Well, at that time, we had Lockheed. They were the engineering support contractor at that time. When we did shift, a lot of them did shift over to USA from Lockheed, but the civil servants pretty much went off and did other things, just like myself. Just scattered

into different jobs, primarily with, say, Space Station. That's what really drew me away from the facility, was the emergence of Station. I worked that a number of years.

ROSS-NAZZAL: You mentioned that the big rig has a tail number. What is that tail number?

BLACKBURN: I think it's OV [Orbiter Vehicle-095]. Yes, I'm pretty sure that's right. You can confirm that with Don.

ROSS-NAZZAL: We'll have a chance to go through it, and you'll also get a chance to edit your transcript, so don't feel like this is your last opportunity.

BLACKBURN: Sure, not a bit. Cool.

ROSS-NAZZAL: I think you've answered most the questions that we have. You've given us a number of names of people that we should talk to. Is there anyone else, in your mind, that we should speak with?

BLACKBURN: Well, Don is good, and then Irv. Irv Burtzlaff, I think, would love to talk about the early days of the facility. I would have said Bill Ritz, but he passed away recently. Irv, he might even have some information, written information, that might be good. This document here does provide some background, a little bit of background, if you want to take away and read. It's kind of built in the days of typewriters.

ROSS-NAZZAL: That's okay.

BLACKBURN: It does give some history, some background description of the facility. So when you're trying to write what this facility does, this would be a good source of information, and feel free to borrow this.

ROSS-NAZZAL: Great. Absolutely. We will.

BLACKBURN: But like I said, Irv, I think he's still available, and Barbara [G.] Shock here has his contact info if you want.

ROSS-NAZZAL: Is he still in the area?

BLACKBURN: He is still in the area.

ROSS-NAZZAL: Great. Now, you mentioned that USA is the main contractor that supports the facility, and Lockheed supported that before them. Were there any other main contractors?

BLACKBURN: Well, that was before USA existed. We're talking Lockheed, and then it was Lockeed-Martin, supported back then. Then the USA contract, the operations contract. The Shuttle Program, during this time period, went from development [to] flight. You know, the first four flights were very much development. They had the ejection seats in there. It was just very, very new. I'll never forget that landing, really that first flight, when John [W.] Young and

[Robert L.] Crippen jumped out of [the Orbiter], and they were just like little boys, running around. It was cute. But that first probably couple years, actually, few years, it was still very new, but then it transformed into an operational phase. To the point where they were going to totally hand it off to the commercial sector at one point, and that never really happened. When the *Challenger* [accident] happened, that caused a rethink. This is a very complex, very dangerous mission, every single time.

But over that time period, though, that's what caused this SAIL facility to migrate over to the operations contracts that were being put in place. So that was a natural progression, including the contracts that supported it, so we just kind of evolved with that. Plus, with the emergence of the Space Station program, that was a drain on the Center. You got to do both programs. You start in the early eighties and seventies very focused on Shuttle. Then in the early seventies, you had the shutdown of Apollo, and then you transition the workforce to Shuttle. Well, Shuttle is long-term, and all a sudden, you drop in Station—a very complex program, very complex machine, again. Then, now what we're facing is, "Oh, by the way, we want you to work Constellation, too." You got three programs right now, which is a real stretch on the organization. Also, because of that overlap, that caused—almost forced—NASA to do business a little bit differently. You end up having to essentially contract out more and more of the Shuttle job. It was definitely influencing things.

ROSS-NAZZAL: The only other question I have is, in addition to this document, do you have any other documents or memos or letters or anything that might be helpful to us as we put together a history of the facility?

BLACKBURN: I'd have to think about that. There's that plaque. See that plaque?

ROSS-NAZZAL: Oh, yes.

BLACKBURN: That's the one I mentioned earlier. That's the one I got for STS-1, and I felt very embarrassed to get that, because I had just got here. Because I didn't feel like I had contributed all that much. But that one, I really like.

ROSS-NAZZAL: Oh, yes, that's nice.

BLACKBURN: I'm sure there are a few of those around. Nothing comes immediately to mind, actually. I keep this out for grins almost, and as a history thing for myself, to remind me of those days. But down here in this cabinet here, see those little consoles of cardboard up there?

Those are about 30 years old. When I talked about the upgrade of the control center for SAIL, I was involved in helping Lockheed, at the time, design those new test consoles for this new control center. I kept getting questions: "What are these things going to look like? What are these things going to look like?" I think the PDR, the Preliminary Design Review, I think—one of the design reviews that we had—I just said, "Crap, I'm just going to make it out of cardboard." That essentially is to scale, based on the drawings. I just [kept] those. I've kept them all these years. I don't know why. I just kind of laugh at them every time I see them. I built those when I was in my early twenties. It accomplished [the goal], because now everybody knew exactly what it was. Needed a 3-D model.

ROSS-NAZZAL: Yes, that's great.

BLACKBURN: It's kind of funny, though.

ROSS-NAZZAL: Tell us about why there was a decision made to build this new control center.

BLACKBURN: I think it was based on—that would be a good question for Irv, actually—an operational need and more capability, make it easier to operate. Again, this kind of evolved, to make it better and easier to run the facility. Also, probably [updating] hardware that might have been out of date, that kind of thing. That's why they did the other upgrade, more recent one, because all the stuff that I worked on was very hard to maintain. For any test facility, that's one of your big challenges, having to support Shuttle hardware—which is old in itself, and you can't really change that—but then the systems that connect up to it, those start going out. We had a lot of VAXes [32 bit computer systems] around, deck VAXes, and those computers have essentially disappeared. The company that produced the computers that I worked on back in the eighties, [has] disappeared.

When that starts to happen, it's very hard to maintain test laboratory hardware. Again, this is generic, to all labs. So then you have to upgrade, and then you have to get the programs convinced that they need to upgrade, because that's going to cost money. A lot of times, we have a lot of systems still around that we haven't been able to successfully convince that you need to pump some more dollars in there to upgrade this machine, because it can be kind of expensive. So then you're limping along on these old support systems.

That's the typical problem of any facility, and that's just part of what I was involved with, was just upgrading it to a little bit more capable, more flexible, more general purpose. I guess when I look back on it, it was really laying the foundation for the long haul, because this was going to be a long program, so you needed a facility that was a little bit more permanent in the sense of its capability and flexible to do the tests that you need to do it. There was probably also, I imagine, some lessons learned from the early buildup on what you really needed. So when they went through that phase, saying, "I'm sure it would be nice if—." We started to design all that into the new system.

ROSS-NAZZAL: Do you recall when that opened?

BLACKBURN: That went operational in '81, '82 timeframe. I think it was after STS-1. I'm forgetting.

ROSS-NAZZAL: Do you know when the most recent change occurred?

BLACKBURN: That's within the last five years. Don would be able to give you the exact date on that. This thing right here came from that original—

ROSS-NAZZAL: What is that?

BLACKBURN: That's a kind of a tidbit of strange things to show you how things were so tight money-wise when we were doing this new control center. It looks like a core sample. One of

the challenges that we had when we were building this new control center was that we didn't have enough money to put in a false floor for this new control center that was down the hall here. So one of the NASA guys in the office says, "Well, why don't we just drill holes in the concrete, and we'll just run our wires above the first-floor ceiling"—like right about here—"and then just route the wires up into those racks, those consoles?" So that's what we did. In this building, you'll see some people have these, and there's one that's about that big around, too. But we had a company called Holes Incorporated, come out—they still exist today; I've seen them around. You can see that it has the linoleum tile on top of it.

ROSS-NAZZAL: Yes, it does.

BLACKBURN: They punched a bunch of holes, and it was very loud. That was very loud, and I can remember that. So if you go into the old control room—they moved it—you'll see a bunch of holes in that floor. Well, it was because we couldn't afford the false floor, which we would typically do in a lab, and then run the wires under the false floor. So our false floor is actually [the] concrete [floor].

ROSS-NAZZAL: That's interesting.

BLACKBURN: That was creative thinking at the time. I thought it was a funny tidbit of sorts. But then they actually moved the control center around the corner to another location, and they put a false floor.

ROSS-NAZZAL: Got the money this time?

BLACKBURN: Yes, got the money this time. That was always the challenges at the time, was trying to do as much as you can with the budget you got.

ROSS-NAZZAL: I imagine it was a challenge.

WRIGHT: I'm sure it still is.

BLACKBURN: Still is. It's age-old, and it's always this wrestling match between the engineering organization and the program office, since they're the ones that control all the funds. We want to do one thing, and they don't have enough money to do that, so there's this see-saw back and forth, and hopefully you get to the right middle ground on any decision. But being good stewards of the program's money has always been what we try to do, not just do it to do it.

ROSS-NAZZAL: Do you have any questions, Rebecca?

WRIGHT: No, just was going to ask if you had any more thoughts, any more personal thoughts you'd like to share about the building and the fact that how vital it is to the program?

BLACKBURN: It's very easy to say that the Shuttle Program would not be the success that it has been if it wasn't for this building and what's in this building, and the people that are in it and the facility. Not everybody appreciates that, to be honest. It's the traditional challenge, is to

convince the powers that be that you need an avionics integration–type facility. If you were to see the facility and see how complex a machine it is, and you go, "Wow." You can't just build it and then go fly it; you just can't. It won't work. The risk is way, way too high. I have true, huge appreciation for the avionics integration and test side of the program and what it reveals and the problems that it can help solve, to make sure that you wring everything out before you fly, and then troubleshoot, too.

WRIGHT: Can you think of an episode or an event that you guys troubleshooted or even one that you tested before it flew that it's really good that you had that opportunity to do it before someone took it out?

BLACKBURN: It's been so long. That would be another good one for Don. He probably could give you a pretty good laundry list of things they've discovered over the last 30 years. That would be a good thing. I'm thinking more in general of assurances too, that it does indeed work. It's just mandatory. We're having that battle right now with the CEV Program. The new facility is getting cut, delayed, and it's just not right. We get [into] these arguments of what the true rationale is for the facility.

From an engineering perspective, the integration job, when you put all this stuff together and hook it all up, it's just a mammoth kind of undertaking, and very complex. I'm amazed at every Shuttle flight. That's why I like this poster—it's a little bit outdated—of all the Shuttle patches and all the Apollo patches, but it gives you a sense of how many times the Shuttle is flown. You tend to forget how many times the Shuttle has flown. I mean, over 100 times. Knowing what it takes to fly each Shuttle and the violent launch to the violent reentry, it's just

incredible, from an engineering perspective. This facility was very much instrumental in making all that happen and making all those patches happen. Testing out the software, testing out the systems, to make sure that they accomplish what it needs to accomplish. Just about any engineer that's involved in the development of the systems would say the same thing. But Don would be a real good one to give you that history of over the years of how that's evolved. He's been involved in that facility for a while.

ROSS-NAZZAL: All right.

BLACKBURN: Touch base with Barbara, and she'll have all that contact info.

WRIGHT: Maybe it'll help you with some information for the CAIL.

BLACKBURN: Yes, that's true. Actually, we are trying to get the SAIL guys involved in the CAIL facility.

ROSS-NAZZAL: That would make sense.

BLACKBURN: That's another one of these natural migrations that's already started. As the Shuttle retires and that job goes away, then the Constellation and the CEV, CAIL, job is emerging. I don't know if you've seen it over there. It's way under construction. But that's going to be exciting to see put in place. Looking forward to that.

ROSS-NAZZAL: Well, we thank you for sharing your time with us this morning—

BLACKBURN: Sure.

ROSS-NAZZAL: —and your information about the SAIL.

[End of interview]