NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
EDITED ORAL HISTORY 2 TRANSCRIPT

VICKIE L. KLOERIS
INTERVIEWED BY JENNIFER ROSS-NAZZAL
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ROSS-NAZZAL: Today is September 26th, 2012. This oral history with Vickie Kloeris is being conducted in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Jennifer Ross-Nazzal. Thanks again for taking some time out of your afternoon today to visit with me. Certainly appreciate it. Last time we had talked, we had talked off tape. You had mentioned you had done a chamber run where you had spent 91 days in one of the chambers on site. Can you talk about that test?

KLOERIS: Yes. From like '95 to '97 NASA did a series of chamber tests in the high bay in Building 7 in a chamber within that high bay where they were testing air and water recycling technologies. They did a 15-day, a 30-day, a 60-day and then they had planned a 90-day test. We got involved in that because we were providing some of our flight foods for those chamber tests.

Well, in preparation for the 90-day test, they originally set that up that it was going to be divided in half, and they were going to have two crews of four, 45 days each. Well, actually a little more because they were going to overlap them. They were actually going to try to simulate what it would be like on ISS [International Space Station] when you had an overlap between an arrival and departing crew. That was the original plan. They were looking for volunteers, so I volunteered to participate in the test. We went through an interview process. I remember going. I forget [exactly, but] there were multiple people, six or eight folks on the panel that asked me questions during the interview. Much to my surprise, I was selected to be one of those eight crew members. Then as it turned out, a decision was made to do it as one crew for 90 days—actually for 91 days. The reason they chose 91 was because they wanted to break the US record for the chamber test. There was a 90-day chamber test that had been done in conjunction with Skylab. I think Boeing did it somewhere. So anyway they wanted to break that US record.

They knew they couldn't break the world record because Russia had some big huge record, I think. But anyway they wanted to break the US record. So that's why we changed it to a 91-day test. I became a prime crew member; four of us became prime, and the other four became backup. This was in 1997. It was planned for September 19th through December 19th. Obviously we did a lot of training during the months leading up to that. We did team training for all the eight crew members. My position in the test was I was the science coordinator. So in the chamber test, Space Life Sciences had agreed that they were going to do a series of experiments during the chamber test.

My job was to coordinate between the investigators on the outside and the crew on the inside as far as making sure that the crew members knew when they needed to participate, what they needed to do to fulfill the requirements for participating in those experiments. Also to make sure we had all the equipment, supplies, whatever we needed. We did have an air lock where we could transfer trash out and equipment in as needed. It was mainly a coordination thing. That was the main purpose of the science coordinator.

We did I think a series of about 13 different experiments. So some of the things that we did, we did a weighed diet record where for a period of time we weighed and recorded everything we ate. The purpose of that was to compare to a food frequency questionnaire that had been developed by the Nutritional Biochemistry Lab. So we were comparing the food frequency questionnaire, they call it the FFQ for short. It was a quick and dirty way to collect dietary information. So the PI [principal investigator], Scott [M.] Smith, wanted to compare how the quick and dirty method was to the manual way and record everything you ate. This was part of the development of that FFQ. It's now used on orbit on Space Station. The USOS [US Operating System] crew members, they fill this FFQ out on a weekly basis. So part of what we did, our experiment, was to help develop and validate that FFQ.

We also did exercise protocols that were developed for us, so these were precursors to the protocols that they use on Station now. We also did things like [microbiological] surface sampling. Again they were trying to validate how often they would need to sample on Space Station. We did questionnaires that were developed by the psych support team. Again they were trying to develop questionnaires that they were going to use on ISS with the crew members on a weekly basis to try to keep track of their mood and how they were doing on orbit.

We also worked on telemedicine. Nigel Packham was also a crew member in that test with me, and Nigel and I were trained as medical officers for the crew. We went through some of the similar training that they were using at the time for Shuttle crew members, for nonmedical crew members, who were trained as medical folks for the flight. So we went through some of that training. We also did the simulation of remote [medicine]. We had a monitor inside the chamber and we telemedicined to the outside. This was when the flight surgeons were trying to work on telemedicine for both rural communities—because they had a project with UTMB [University of Texas Medical Branch, Galveston]—and then also with how they were going to telemedicine from orbit as well. So we did some work with that. There were a whole series of experiments that we did.

Basically we were there as biological loads on the chamber. That's the main reason we were there. We were testing air and water recycling equipment. That was really the main thing we were doing. Some of the earlier tests had done biological systems separately and then physical-chemical and/or mechanical systems separately. Our test was a combination of the two. So we were using part of a biological system to recycle our air and then a physical-chemical for some of it as well. So we had 10,000 wheat plants growing in an adjoining chamber, and we were providing CO2 to the wheat, and the plants were providing a fourth of the oxygen that we needed to our chamber. The rest of it was being provided by mechanical and/or physical-chemical means.

We were also testing water recycling. Again, it was precursors to some of the equipment that's on Station now. This was all part of the development of what they're using on Station now to recycle water. It was 91 days. We did a lot of educational outreach. With Space Center Houston—you know how they have their mission status room? Twice a week we would do a briefing for the mission status room of what was going on in the chamber. I remember we had one outreach event that we did for the Education Office. It was a school system. I want to say it was in Iowa, maybe. They had all these schools that were teleconferenced in. We answered questions that had been presubmitted, so there were several schools that were able to talk to us directly, and then there were a whole bunch of others that were just listening in. We had several events. So there was a lot of outreach stuff that went on as well.

So anyway like I said, we were mainly biological loads on the chamber, but we were in there through Thanksgiving, which was interesting. Yes, it was an interesting experiment. It was a lot of fun. I was a little bit apprehensive about what's it going to be like to live in close quarters with three other people for 91 days, because it had three levels. The first level of the chamber was the main living area, that's where we had bathroom, what served as a kitchen. We had a shower. We had a washing machine. We actually had to wash clothes in there because we had to push a certain amount of water through the system every day. There was a table. We spent most of our time on that level.

The second level was mostly all equipment, so it was very loud up there because it was running all the time. We didn't spend very much time up there at all. Although we had an exercise bike up there, because we had to exercise. Then also we would do tests of our aerobic capacity. Throughout the 91 days we were trying to see the efficacy of the exercise protocol. So we would run tests. Our exercise bike was on the second floor. You always either wore ear plugs or listened to music while you were exercising so you could cut all the noise that was around you, because it was really loud up there. That was where all the equipment was running that was processing the air and the water.

The third floor we had living quarters, which were very small. It's basically where you slept and dressed. The way it worked, you had two rooms. There was a bunk bed. Actually the top bunk bed was in one room and the bottom bunk bed was in another. So you were sharing a bunk bed with the person next door to you. You can visualize how small that meant the rooms were. We did have a desk and a chair in there. We did have a computer, a workstation, in our rooms so we could telecommunicate. We could do videoconferencing with our spouses, with our significant others, but the walls were really pretty paper-thin. If anybody needed to have a private discussion we would leave them on the fourth floor and we would vacate to the first floor, if it was something that they wanted to talk privately with somebody about.

We got along great. We really did. We had a great time, and it was a really good experience. It was interesting. I know during the test there was a power failure, JSC Centerwide power failure. So everything went dark. We had a control room outside just like they do for flights. They had a control room, so we were monitored all the time. It was funny because when the power went out, we were on backup. We pretty quickly kicked in on the inside of the chamber, but everybody outside was still in the dark. So it was pretty funny. We had various things that happened during the test like the power failure.

One of the things that was interesting about that is they were monitoring us. We were drinking iodinated water, just like they did on the Shuttle. That's the way they guaranteed the purity of the water was they put iodine in it rather than chlorine. Municipal systems of course use chlorine. They use iodine because the chlorine—my understanding is it tends to corrode the pipes. So that's why they used iodine on the Shuttle, and we used iodine in the test. So we were drinking iodinated water and lots of it during that test.

Oh, another thing that we did was we drew blood work. Nigel and I learned how to draw blood. So we would draw on each other and on our fellow crewmates. We were sending out blood samples for analysis periodically throughout the test. They observed that our TSH [thyroid-stimulating hormone] values, which is one of the things they monitor about thyroid, were going up, up, up, up, up, up, up, up. There's a broad range of what's normal, and we were still within that normal. This was not the first time they had seen this in these ground-based tests. It wasn't the first time that they had seen it on orbit either, which we didn't know about at the time. That was all private medical data. They didn't really discuss that.

As a result of data that came out of our tests the Shuttle crew members were no longer drinking iodinated water on orbit. They installed a point of use filter to remove the iodine. They did the same thing in the chamber for us. So they sent this filter in to remove the iodine prior to us actually drinking it because of the [TSH] values that we saw. After the test they continued to monitor us to see if we would return to normal.

Everybody did except for me. So we all came down. I went to zero. No detectable level at all. They freaked out because it was considered workers' comp [compensation]. So they sent me down to the Med [Medical] Center [Houston] to an endocrinologist. I had no symptoms. Typically a person with that level would have a certain amount of symptoms. I was asymptomatic. They sent me down to Med Center. I went to zero like in January or something after the test, so they started sending me down there. It took several months. The endocrinologist was threatening to put me on medication. First thing they did was a test to be sure I didn't have thyroid cancer, which I didn't, because that could be one of the causes of it. But went to this endocrinologist, and he said, "Well, there's data out there that shows that people who consume a lot of iodine, this has happened. It's not unusual." So he didn't put me on any medication. He just monitored me for several months.

Along about September he's like, "Well, your values still have not moved." He said, "Come back next month and if nothing has happened we're going to have to think about putting you on some medication." Came back the next month. Boom, they were perfectly normal. They monitored them quite a while in the Flight Medicine Clinic after that. I've never had abnormal values since.

It was just interesting because it's kind of because of the ground-based test, and in combination with some on-orbit data that they ended up deciding to remove the iodine from the water. So that was a result that came out of our test that wasn't even expected.

ROSS-NAZZAL: What a valuable experience for you though. Were you eating Shuttle food at that point and evaluating food?

KLOERIS: Some of the flight foods. We were eating a combination of flight foods and foods that were plant-based like we thought would be on a Moon or Mars mission. So it was a combination. It wasn't all flight foods. But yes there was quite a bit of the flight food in there. It wasn't the first time I'd consumed it. I've done ground-based studies before where like I spent a month consuming nothing but the Shuttle foods.

ROSS-NAZZAL: Did you really? Oh wow.

KLOERIS: I did that for a month.

ROSS-NAZZAL: What did you learn from those tests?

KLOERIS: Well, that was an experiment that Helen [W.] Lane was doing when she was head of the Nutritional Biochemistry Lab. So that's been quite a few years ago. The purpose was to look at—well, she was looking at several things. She was trying to compare ground-based data. She was really trying to validate a process on the ground before she used it on orbit. So we were really guinea pigs to try to work up the process for her experiment.

ROSS-NAZZAL: Did you implement any changes as a result? Because you thought, "Boy, I've been eating this for a month," or however long and "there need to be some changes?"

KLOERIS: Well, I think one of the biggest things that I learned from that was as we went into the Space Station era I knew very well that the foods that we had had on Shuttle were too limited to support a six-month stay. At the time we thought it was just going to be four months on Station, but it's evolved into six months on Station. From my experience I could tell you that it was like no. We're going to need more variety to support these longer stays on Space Station. So that was one thing that I guess you could say I learned from that experience was that our menu was somewhat limited, which was fine for a two-week Shuttle flight. You just don't need as much variety. But when you're somewhere four to six months, you're going to need a lot more variety. So as we started going to Space Station we started adding a lot of foods to the food list so that we would have a lot more variety.

ROSS-NAZZAL: And you noticed there was a psychological impact?

KLOERIS: Oh yes, absolutely. I remember part of the time I did that, I had to go down to Florida to support a launch. So I was traveling. I had to go into restaurants with my scale with me and sit there and weigh everything I ate. I either had to choose things off the menu that were very pure, so not with sauces, so that I knew what the ingredients were, so I could give that information to Dr. Lane. Or I would have to ask for recipes from the restaurants, or ingredients. Tell me what the ingredients are in there. So that they could formulate the nutritional content of what I was eating. I would weigh it, but then I would have to also know something about it so that they could figure out what nutrition I had gotten from that.

So yes I have to admit when I was at home it was easy but traveling and doing that was pretty tough. When you're eating out and trying to do that, that's pretty tough. We had a lot of crews during that same timeframe. We had Shuttle crews, like for SLS [Spacelab Life Sciences]-1 and things like that, and other flights where they did in-flight medical experiments that required nutritional monitoring. On orbit they would scan with a barcode reader the packages. We instituted barcodes on all our foods so that the crews could easily track what they were eating on orbit.

When they would come back after flight—maybe for a week after flight or two weeks after flight—they would have to be weighing and recording everything they ate. Usually that meant we were cooking for them so that we knew what was in it. We were delivering meals to them.

There have been times when I've gone to postflight parties with a scale in hand and followed crew members around weighing and recording what they were eating. I've done that in crew quarters, because we've had several flights preflight where we've had the four crew members who were science on that flight who would have to weigh and record everything they ate during the quarantine period. So again we were cooking for them for quarantine anyway, but then we would have to make sure that we weighed everything that went out on the plate to them. If they left any plate waste we would have to weigh what was left so that we knew exactly what they consumed. Done that many a time.

Then at some point the crew members get a little cranky about having to do it. So you're having to deal with that as well, because they do get tired of it. I understand why. After doing it for a month I certainly know why they get tired of it. The nice thing is for them in most of the cases we were doing it for them rather than them having to do it themselves.

ROSS-NAZZAL: They probably see you and want to go the other way.

KLOERIS: Yes that's right. Okay. I'm looking at your list of questions here. You said, "Talk about providing food and treats for crews during quarantine at JSC and KSC [Kennedy Space Center, Florida]." Yes it was part of the Shuttle food contract responsibility to feed during that—typically it was a seven-day preflight quarantine. They would divide that time up between JSC and KSC. So typically it was like three to four days here, and then the rest down at KSC prior to launch.

It varied from flight to flight. If they needed more training here in Houston, like they needed to be in the simulators, then they would extend the part that was at JSC and shorten the part that was at KSC. So it varied from flight to flight, but we were responsible during that whole time for feeding them. We would work with the crews ahead of time to try to plan the meals for that period, because it was just regular food.

ROSS-NAZZAL: You weren't giving them the pre-packaged?

KLOERIS: We weren't giving them flight food. It was just regular food. The only stipulation was that it couldn't be restaurant food. Had to be stuff that we bought the ingredients for and prepared there. The two ideas mainly behind quarantine was to keep them away from very young children at home who might make them sick and to keep them away from restaurants where they might get foodborne illness, because they didn't want them getting sick prior to flight. That's the whole reason we were cooking for them in quarantine.

Here in Houston the same people that did the food processing for the Shuttle and did the packaging and stowing of the food, those were the same people who did the food preparation and did the quarantine work here. At KSC we did it a little differently. They had part-time employees down there. So we would have maybe one or two people from Houston go down, food people to go down to supervise that operation. Then we would have part-time employees who worked preflight. So down at Kennedy they also did TCDT [terminal countdown demonstration test]. So when the crew went down there for TCDT, which was usually a two-day deal, those same part-timers would come in and prepare the food for them during that TCDT period.

That was just more for expediency than anything else, because during TCDT you would have the prime crew there but then you'd also have the astronaut support people. They called them the C-Squares [Cape Crusaders], the astronaut crew members who were down there supporting the launch. You'd have people like the flight surgeon in crew quarters too. So there was a fair amount of people who needed to be fed. So we would use those part-time people to do that.

Then [the part-time food folks] also obviously worked during the preflight period when the crew was in quarantine, and they would work post flight. So on landing day they would provide a meal not only for the crew coming back but for the families of the crew members who had come to view the landing. If the crew was staying overnight for any reason then they would come in and provide breakfast for them before they flew back to Houston.

So the part-time people were the main backbone of the food service activities down at Kennedy. Again we would send people during launch, one to two people from Houston. Mainly it was the part-time people who handled it down there. These were your grandmother types.

They knew all the rules; they'd been trained just like restaurant people would be trained, but these were your genuine cook from scratch real cooks. These ladies would love cooking for these folks. The crew members really appreciated it. Some of those ladies did it for years and years and years down there. So the crews got to where they knew what their specialty was. They would come in, "Oh I want some of your this or that while I'm down here." It was pretty neat. It was almost like it was mom or grandma cooking for them. It was a pretty neat deal.

ROSS-NAZZAL: Did you go down there ever for launch or landing?

KLOERIS: Oh yes. I used to go quite often early on. When I was working with USA [United Space Alliance] I went down for every launch. Well, I take that back. I never worked for USA. I worked for FEPC [Flight Equipment Processing Contract]. I worked for Boeing before it became USA. It was all the same facility. But yes when I was with FEPC I was required to go down there for every launch.

When I came over to the NASA side for quite a while I went down there for every launch. Then at some point they totally turned that over to the contractor. Nobody from the NASA side was going down. That was more budgetary restraints than anything else. But yes I spent many a quarantine down there. Working it here in Houston and then flying down there and working in Florida.

ROSS-NAZZAL: That must have been challenging because Shuttle launches don't go off on time.

KLOERIS: It is challenging. During that time period I basically didn't have a life. Well, I did have a life but you couldn't plan vacations, because all of those launches kept shifting. So we'd joke. Even my folks now, many of the folks that work on the Space Station food system also worked on Shuttle previously. So they were used to all the launch slips. They're like, "The nice thing about Station is we don't have to worry about that because we're not dealing with the preflight for the crew. We don't have to deal with that." Now that Shuttle is over that's all done in Russia so we don't have to deal with all those expediencies now. So that's nice. Makes your schedule a lot more predictable.

ROSS-NAZZAL: The crews have that cake that you always see.

KLOERIS: Yes. That was actually done by a bakery at Kennedy because you would see that when they did the traditional picture of them at the preflight meal at the table up there with the blue tablecloth on it, and they were sitting around the table. The cake would be in front of them. So that was done at KSC in crew quarters. They always had the photo op, the last meal that they ate in crew quarters before they went out to the pad, before they suited up. They couldn't consume it. So what happened was that was put in the freezer. It would come back to Houston and they would have it at the postflight party, because they weren't allowed to consume stuff from an outside source during crew quarters. That would get frozen and come back, and they would consume it later.

ROSS-NAZZAL: You never see the cake ever being cut into. I was just curious about that.

KLOERIS: No, that's why. After launch we would box it up and it would come on the NASA plane back to Houston and then it would get put in the freezer.

ROSS-NAZZAL: Interesting stories. I think last time you had told me about the SLS-1 recovery. You mentioned that you had to dress in bunny suits.

KLOERIS: That particular flight landed out in California [Edwards Air Force Base] and so that particular flight had a lot of dietary information that was gathered on orbit. We were feeding them post flight as well. Again we had to weigh and record everything they ate [post flight]. I want to say it was for a week or so after flight. I can't remember the exact duration. We had to go out there. They were staying at a dude ranch. If you've ever been out there where they land, it's in the middle of nowhere. There was a dude ranch about oh, 15, 20 minutes away, and that's where they stayed. So we went and stayed there. We were weighing and recording everything they ate. As part of [the on orbit data] process we had to evaluate the trash that came back from the flight.

So it had been on the orbiter for quite a while, and it was a few days after it landed before we could actually access it, because they were getting obviously other hardware and other more important things off the vehicle. But at some point they allowed us to go out there on the flight line. They had taken the trash off the vehicle and put it in barrels. It was sitting out in the Sun, out in the desert.

It stunk. We had to go through it and validate; we compared the serial numbers on the packages to what had been recorded by the barcode reader to make sure that nothing had been missed. Then we would look at the empty packages to see if there was residual food in there, and if so had the crew member recorded that they hadn't eaten 100 percent of it. We were going through item by item. This was gloves and face mask to cut the smell and bunny suits to keep from getting nasty stuff on our clothes. This was a hot and sweaty and stinky job that we did.

That was probably the worst case of that. We also did it in Houston a few times when I worked at FEPC. They would go through the trash just to be sure that the crew hadn't inadvertently thrown away something they shouldn't have into the trash.

We rotated that responsibility. So a few times when I was there I would go through the trash as part of my duties over at FEPC as well. We would do it on the loading dock out back, before we threw the trash away. So it would come back to Houston.

ROSS-NAZZAL: They would actually transport trash back to Houston?

KLOERIS: Oh yes, it would come back to Houston, and they would go through the trash to be sure. Because inadvertently the crews would sometimes get stuff in there that they shouldn't. Usually before we'd go through the trash over there we'd have a list of what we were looking for. "Here's what we're missing. See if you find it in the trash." That kind of thing. Usually it was because they had stowed it in the wrong place, and it would turn up later. But occasionally we did find stuff in the trash that was not intended to be trash, so we'd have to pull it out.

ROSS-NAZZAL: That is a horrible job.

KLOERIS: Yes, not a fun job.

ROSS-NAZZAL: I think last time we had talked about getting food ready for Station and the various places that you send the food, but we didn't talk much about Shuttle.

KLOERIS: Well, Shuttle was a lot simpler, because the food and the crew members never got separated. We would plan the menus. For Shuttle we were able to do a personal preference menu. Meaning each crew member could do a custom menu to their own liking. On Station we're not able to do that. On Shuttle we were because the food and the crew member went up on the same vehicle, so they never got separated. So it was easy to do, and it was a small amount of food. It was only for a week, two weeks, whatever. We went into the Space Station era trying to do the same thing, provide personal preference menus. It was an abysmal failure, because the food would get launched maybe on the Progress or go up on the Shuttle or go up—whatever. So it was a huge challenge to get all the food for a crew member there at the exact time that that crew member was there.

What ended up happening is that for a certain percentage of the time that they were on orbit they would end up eating somebody else's food. Believe it or not, even if it was like 10 percent or 20 percent of their increment, of their time on Station, it became a huge psychological issue. They would come back and complain. "You promised me this personal preference menu and 10 percent of the time or part of the time I had to eat Joe Blow's menu and Joe Blow has horrible taste in food." They really would complain about it. So that was one of the ways that it became very apparent of the psychological importance of food on long duration spaceflight.

We got ready for the first ATV [Automated Transfer Vehicle] to launch, and it kept slipping. So we didn't really know during what increment it would arrive. We didn't really know which crew would be on orbit. So within our lab we discussed it. We said, "Well, rather than trying to guess which crew is going to be there," we went to the Astronaut Office and we proposed a standard menu. Basically we created this standard menu. We used virtually everything we had, provided as much variety as we could without repetition. We said, "Okay, here's the standard menu. We would like to propose to use this on the first ATV, because we don't know when it's going to get there. So we don't know whose choices, whose preferences to use."

Well, much to our surprise they came back and said, "Not only do we want you to use it on ATV, we want you to use it from now on on all the increments. Use the standard menu." So that's what we do.

On Shuttle again we provided personal preference, so they could choose exactly what they wanted. If it was a nine-day mission they could choose nine separate menus: breakfast, lunch, dinner, and a snack every day. It was strictly up to the crew member. Some crew members for a nine-day flight, they'd choose three and repeat it three times. Three menus, repeat it three times. We had one crew member who every time he flew, he had a one-day menu that he repeated. You should have seen that menu. He loaded it down with stuff, so it gave him a lot of variety. Regardless of the length of the flight, his was that same menu over and over and over again.

ROSS-NAZZAL: Must have been easy to plan for him.

KLOERIS: Oh yes, very easy, made it very easy to plan for him. So yes, Shuttle was a little different in that regard. Shuttle, we prepared the food here in Houston. We used middeck locker trays, the blue trays that had Velcro nets on top. The middeck locker trays went inside the lockers. So they would get stowed in the lockers. We'd fill them with food, they would get stowed in the lockers, typically two trays to a locker, two trays would fill the locker. Then the lockers got boxed and shipped down to Florida. When they unboxed them in Florida they were ready to just be stowed in the middeck. So they were all labeled. They already had the decals on the front that would show where they went in the middeck. The folks that received [the lockers] on that end would just take them out at the appropriate time and put them in the orbiter. Usually that happened—oh, about a week before launch they would get installed. The orbiter was already on the pad in the upright position when they would install the food.

We did have typically one locker worth, two trays' worth, of what we called fresh food that was late stowed. It was typically one of the last things that got put on the orbiter before they started fueling the vehicle, because at that point they didn't want people out there. We would stow that in crew quarters down at Kennedy. So one of the responsibilities of the person who traveled from Houston to Florida was to stow those trays, because the part-time people down there did not have experience in stowing trays. They didn't want to deal with that. So whoever came from Houston was the person who stowed those trays. They were stowed per crew request. We would work out with the crews what they wanted in those fresh food trays.

Obviously volume was limited. The whole crew shared the volume of those trays. It was interesting because they would make their list, and 99.9 percent of the time the list was longer than what would fit in the trays. So we would get down there. We would make sure we had all the stuff that they had asked for. Obviously it had to be stuff that had a long enough shelf life to last through the Shuttle flight without refrigeration because it's all shelf-stable, no refrigeration.

The fresh food tray came into existence prior to my coming to work here. But my understanding from Rita [M.] Rapp and from Dr. [Charles T.] Bourland was that it came into existence because the crew demanded it basically. They wanted some way to put fresh items on there. Obviously when we were shipping the food six weeks in advance of the launch down to Florida, you can't put apples, oranges, anything fresh in there. So the fresh food tray came into existence because the Astronaut Office wanted it.

We would pack fresh items in there. Typically we would send things like oranges, apples, citrus fruit, things that would last a while without refrigeration. We'd also put in special request items. So if crew members had their favorite candy bar that they wanted or something like that, favorite commercial cookie. As long as it had sufficient shelf life and met our microbiological requirements we could put it in there.

We would put tortillas in there. Tortillas became the bread of choice in space. When I came to work here—I don't know if I mentioned this last week—the first few fresh food trays that I worked on, they were sending sliced bread. The crew members would actually request sliced bread. So they would pack it in a ziplock bag, put it in the fresh food tray, send it into orbit. Well, we had a payload specialist from Mexico fly, [Rodolfo Neri Vela]**.** Of course the payload specialists were one flight only typically. So he was flying. He wanted to take tortillas with him in fresh food. So he took a limited number of tortillas. When that crew saw how easy it was to take a tortilla and roll something up in it and it was like having a sandwich without having to deal with two pieces of bread, from that day forward we had tortillas on every Shuttle flight. Flour tortillas became the bread of choice. We would buy those. We had to go through the process of okay, whose tortillas are we going to use. So this was about the time that—if you remember the Fiesta that was down here --

ROSS-NAZZAL: No.

KLOERIS: There was a Fiesta market on 45 over there where Burlington Coat Factory is right now. Fiesta opened one of their big stores. One of the things they had was they manufactured fresh tortillas. So we went over there and looked at theirs. Not so clean from a microbiological point of view. So we started going around Houston trying to figure out who had the best tortillas. We ended up with La Espiga de Oro in the Heights because they had the best, the cleanest as far as yeast and mold. Yeast and mold, that's really what happens to bread. When bread spoils it's [usually] either yeast or mold. The fresh tortillas that we were sending, we were just putting them in ziplock bags and sending them to orbit. We wanted the cleanest tortillas we could get from a microbiological perspective so that they would last longer, because we didn't have refrigeration. So we would go to La Espiga de Oro and buy the tortillas before every flight. They would get on the NASA plane and go down to Florida.

Early on in the Shuttle program you couldn't get tortillas in Florida much, at least not in that part of Florida. Eventually there were some close-by sources of tortillas. So at one point we took samples of those to see if we could buy them down there. Uh-uh. Didn't come near being as clean as what we were getting here in Houston. So throughout the Shuttle program we continued to ship tortillas on the NASA plane from Houston down there.

So when we bought the commercial tortillas those would last through the shorter Shuttle flights without a problem. Even though there was no refrigeration they would last eight to ten days or so, and then they'd mold. That's about it. That's what would happen. They would mold. As the Shuttle flights got longer we had to come up with a way. On those 14-day flights, 12-day flights—and eventually it was longer than that—but when we started going beyond about the ten-day length, crew members wanted tortillas that would last all the way through without having to worry about them molding.

So we had to develop an extended shelf life tortilla. That was one of the projects we did in the lab. Basically you can vacuum-package bread products, and they'll last. You remove all the oxygen so you package them in an anaerobic environment, and they can't mold. They just can't because yeast and mold need oxygen to grow.

But the trick is when you anaerobically package and take away all the oxygen, you create an environment where there's a small probability for anaerobic pathogens to grow like Clostridium botulinum, which is very very nasty. It is only a very small possibility, but in order to eliminate that altogether what you do is you reformulate the tortilla to where you lower the water activity of the tortilla. Water activity is a measure of free water in a product. If you get the water activity below a certain level, and they have equipment for measuring this, if you get it below a certain level, no bacteria can grow, period. There's not enough free water for the bacteria to grow. We had to come up with a formulation of tortilla that we could vacuum-package. So we got into the tortilla manufacturing business in the food lab. We had the dough divider and the dough press and the whole bit so that we could make tortillas, and we did that for quite a while.

We wouldn't make many. Basically we were making enough to just pick up the end of the flight, the part that was too long for the fresh. We would send a combination of fresh and then the vacuum-packaged ones. So between the two, they had tortillas for their whole flight. We did that for quite a while. The tortillas that we made in the lab would last oh, about four months and then they would develop an off flavor. They would become somewhat bitter. So we were about to undertake a project to research how to get rid of that bitter flavor, because for

Space Station we wanted them to go longer. As we got to the Space Station era we wanted them to have an even longer shelf life [than four months].

About the time that we were going to start that, Taco Bell started marketing a kit in the store that had flour tortillas in it. That kit, every time we would look at it in the store, it had at least a nine-month shelf life on it. We're like that has got to be a low water activity tortilla. So we got samples of it and analyzed it, and sure enough it was.

We went to them and said, "Okay, who makes this for you?" Sure enough, they had a company that was making it. I can't remember the name of the company right now, but they had a company that they were buying it from. We started buying from that company, and we were able to get out of the tortilla manufacturing business. So then all we had to do was buy them and package them. That's what we're doing now. We buy those and package them to send to orbit. We were doing that at the end of the Shuttle program and of course for Station. Those tortillas we have tested out to a year. They were still good at a year. They would probably have gone longer. We just terminated the test at a year because that's really all we needed for Space Station. Now we're using this commercial tortilla, but it's the same principle. It's a lower water activity tortilla.

The military has quite a few bread products that they use in the MREs, the Meals Ready-to-Eat, it's the same thing. It's an extended shelf life bread product. So they package it anaerobically. There's a company in San Antonio [Texas] called Sterling Foods that makes all of those bread products for the military, but they don't do tortillas. The military doesn't ask for tortillas. So we have to get them from this other source, but it's worked out really well.

It was interesting when we started working with the Russians, because they didn't have a clue what a tortilla was. Not part of their culture. I didn't take long of either being on orbit on the Shuttle with crew members who used the tortillas or once they started living and training over here in Houston. They quickly figured out what tortillas were. The tortillas are pretty much as popular with the Russian crew members as they are with our US crew members.

ROSS-NAZZAL: How long did it take you guys to develop that tortilla or any food product that you guys develop?

KLOERIS: Well, it depends on the product. I'm trying to think. The tortilla project probably only took about a year from start to finish. That's the way I remember it anyway, about a year to develop that.

ROSS-NAZZAL: You mentioned the payload specialist from Mexico. Were there other payload specialists who introduced new foods to the system over the years?

KLOERIS: That's really the only one that I can think of where it really stuck, where it really stayed with the system afterwards. But every payload specialist always had certain items from their country, if they were from another country, that they typically wanted to take with them. That happened all the time when we had payload specialists; we would end up with some kind of [new food]. So we would have an Italian ESA astronaut flying on the Shuttle. There would be some special foods from Italy that went in the fresh food locker. So that was often the case. If there was a different nationality involved there would be items that went into Shuttle fresh food from that country.

ROSS-NAZZAL: You mentioned that Shuttle crews had their own personal menu. When crews would pick out a menu, is there a certain guideline that you have to follow? Like at some point let's say they wanted candy bars for all three meals.

KLOERIS: No.

ROSS-NAZZAL: At some point do you have to say, "You can't have that because you have to meet these requirements?"

KLOERIS: To be honest we never had to say that. Yes, we had dietary guidelines. When a crew member would choose a menu, we would analyze per those dietary guidelines. However, in order to keep their flight eligibility, these crew members had to be so healthy on the ground that normally when they picked a menu it would fall right within the guidelines, because that's the way they ate all the time. They ate healthy. They had to to maintain their body weight and maintain their health to keep their flight status. So they would always pick pretty much balanced menus.

We would give them feedback. After they planned the menu our dietitian would analyze the menu. We would give them feedback on the menu. Typically if anything they would choose too few calories. We would have to say, "Hey, you're below. You might want to consider beefing up a little bit." The thing about Shuttle flights that was difficult though is because the flights were so short, the crew members felt compelled to work all the time. It's like, "Oh we're only here for ten days or two weeks. We got to get all this done." So they tended to skip meals, especially lunch.

Breakfast, they'd eat something in the morning. At the end of the day they would eat, but often they would skip meals during the day. So we would get a lot of food back because they just never got around to eating it. A certain percentage of the food that was launched would come back on the vehicle. We took that food. We would utilize it in training. It didn't get tossed in the dumpster. We had a way to use it in training, because there were a lot of simulations that we would provide flight food to. If they were in the simulators for more than six hours they would get at least one meal of flight food. They had galley training classes where we would provide meals for them to practice using the galley. So we had other outlets for that food.

But it was hard to convince crew members that you haven't selected enough calories when they knew that a lot of the food came back because they didn't have time to eat it. So what we saw on Shuttle was a lot of weight loss because crew members were skipping meals. We saw a fair amount of weight loss. That trend has totally turned around on Station. Because once they started staying on orbit for an extended period of time—they're busy and they work, but they settle into a more normal routine of eating three meals a day, snacking, all that kind of stuff. We just don't see the weight loss on Station that we saw on Shuttle. That's not to say we don't see any, but now we have a lot more crew members that are maintaining their body weight or if they're losing they're losing much less. We even have a few outliers who've gained weight on orbit, but that's not typical. Typical, it's maintain or maybe lose a little. On Shuttle it was bad because they did skip a lot of meals.

ROSS-NAZZAL: I think last time you had mentioned when you first went in the lab you did some tastings for Barbara [R.] Morgan and [S.] Christa [C.] McAuliffe.

KLOERIS: I did. That was one of the first things that I did. Rita Rapp was the manager of the Shuttle food system at the time, so she conducted the food sessions. Part of my job responsibility was to prepare the food and have it ready for her to give to the crew members. So yes, one of the first things I worked on was the food session for them. I think I came to work in early August and I want to say they came in either late August or early September for a food session. So very soon after I came to work there, yes.

ROSS-NAZZAL: You want to talk about those different food sessions that you do with the crews and how they taste things and how they rate things?

KLOERIS: We do it a little bit differently for Station than we did for Shuttle. For Shuttle typically we would do one food session for a crew. Obviously with the amount of foods that we have, they couldn't try everything at one food session. We would make them come at lunch so that they would be hungry. We would work this out with their scheduler. It would get scheduled in just like any other training class that they had. We would do it over lunch, because typically they would come and they would have maybe 40 to 50 food items at a food session. That's food and beverage, so it wasn't all foods, but most of it was.

So we had a score sheet for them. They would score these foods. We had a rating scale that they used. They had room for comments. So they were writing down. Really this was comments for themselves so that when they went to choose their menus they would know what they liked, what they didn't like, why they liked it, why they didn't like it. We would have them score all that, and then we would keep copies of all that so that they would have it when they got ready to choose their menus.

For Shuttle we only typically did one session. That was because they would see the food again during the simulations so they would get further exposure to the food during the simulations. They had more opportunities to taste the food. For ISS that's not the case. They don't get any food during training. They have a galley training class. They might consume food. Typically they only rehydrate the food and learn how to use the rehydrator, but there are no simulations for Station where we're providing food. So our food sessions are their only opportunity to try the foods. For Station we do multiple sessions to where we usually do—it depends. If a crew member [has flown] on Shuttle, obviously they're familiar already with the food so we don't have to do as many sessions for that crew member. If this is someone who's never flown on Shuttle, like a cosmonaut or like one of the newer astronauts, then we'll do three to four food sessions for them for Station so that they get to try everything. They'll go to Russia, and they'll try all the Russian products as well as part of the training. Again they'll score it.

Now a lot of people ask, even the crew members will say, "Well, why am I doing a food session if you're using a standard menu?" Well, it's because you get to augment that standard menu with bonus containers. You get to choose what goes in those bonus containers. What you choose can be more of our flight foods. So if there's something you particularly like then you can include that in your bonus container. That's the purpose of having them try all the food. Plus it gives them familiarization ahead of time before they get to orbit with what's going to be in the standard menu.

We do try to get them to try pretty much everything before they ever leave the ground. So we do multiple sessions. Like I say they come at lunchtime. They sit at the counter in the kitchen [in the food lab]. Depending on how many people we'll have there we'll rehydrate one to two servings. They'll spoon out a serving on their plate. They'll try a bite of everything.

They don't eat a full serving of 40 items. Obviously they couldn't. So they're just tasting, basically they're just tasting the drinks and the foods.

ROSS-NAZZAL: I had read an article where you had helped Sandy [Sandra H.] Magnus on her expedition crew. I guess she wanted to incorporate some cooking while she was up there and trying new things.

KLOERIS: Sandy has come closer to doing real cooking on orbit than any other astronaut ever has. For Sandy it was a recreational thing somewhat because she's a big cook on the ground. So it's like a hobby for her. She wanted to be able to do some things on orbit. Basically she came up with some very ingenious ways. Because really on Station—and the same way on Shuttle—there's nothing that gets hot enough to cook anything. All you've got is a warmer. You're basically warming stuff up that's already cooked.

She got very creative. Like in the Service Module, where they dine, they had slots in the table where they could warm the Russian canned foods. On the Progress they would send a certain amount of fresh food. Every time a Progress docked there would be a certain amount of fresh food on board. Similar to every time a Shuttle docked [to ISS] some of the Shuttle fresh food would get transferred over to the ISS crew members.

The Russians have a very different idea of fresh food from our crew members. Typically what they'll want is raw onion and raw garlic and things like that. She described taking the raw garlic, and she would cook it if you will. The way she would do that is she would put it in a package, an empty food package basically. She'd empty out a food package, put it in there, put it in that warmer. She would cycle the warmer over and over again until it cooked it basically.

Then she would take and cut that garlic up and incorporate it into some of our foods. So she got very creative in combining foods and in combining stuff from her bonus containers, and cooking that garlic and using it.

I attended a briefing that she gave about how she cooked on orbit. Of course very different than cooking on the ground. She is definitely the closest we have come to actually having someone truly cook something on orbit. She described the challenges of trying to chop. She would put her hands inside a ziplock bag with the knife, and she would chop so that it would come up but it would be contained within the ziplock bag. She talked about how difficult it was because stuff would get away from her. She'd have to try to clean all that up. She was up there for the Super Bowl, and she put together some of these combination dishes and came up with some special stuff that they could consume for the Super Bowl. So she did some neat things, she really did.

ROSS-NAZZAL: I also understand she was the person who came up with the idea for that last Shuttle crew, the "all-American meal."

KLOERIS: Yes, I believe she was the initiator of that. That all started when that flight was going to fly over July 4th. As it turned out, it did not fly over July 4th. It got shifted. So the Fourth of July meal became the all-American meal. We had to change the title for it because the flight slipped.

Basically the original premise was that it was going to be like a backyard barbecue Fourth of July. So we came as close as we could with the stuff that we were able to provide to trying to meet that backyard barbecue concept. So yes, she was the originator of that.

ROSS-NAZZAL: Oftentimes the crews are up there over Christmas or Thanksgiving. They might have a birthday. How do you guys support those special events?

KLOERIS: Well, often if we know they're going to be up there during a certain holiday period, we will solicit from them, "Is there anything special that you want for your bonus containers for the holiday?" Very often we'll have crew members request the cans of the commercial icing that you buy for cakes, the shelf-stable icing. They'll take that and have it up there, and they'll put it on the regular cookies that we have available just to dress them up and make them more holidaylike. Different crew members have requested different things like that over the years for the holidays.

They might have a traditional commercial candy that they always have with their family at Christmastime, and so they want that in there. So we do that. We ask them if there's stuff that they want. Very often it's hard for them to think in terms of a year in advance or nine months in advance what am I going to want. So there is another alternative for the families, and that's the crew care packages that go to orbit. The psychological support team provides on most vehicles—not every vehicle that goes to Station—but on most of the cargo vehicles they get a crew care package [CCP]. The families can put a variety of things in there. It can be a video, a book.

Often they will put food in there, candies. If there's a CCP going up at the holiday time, then the families have the opportunity to put some special things in there. Again as long as the shelf life is adequate and it meets the microbiological standards.

We don't provide that food. Really the families provide it, and the psych support team packs it. So the families will go out, buy what they want, give it to the psych support team, and they pack it.

I do get involved to the extent that they send me the list of what's going to be in there. I have to verify that I think it's going to be safe to send. I have to examine the list of any food that goes in the crew care packages. I don't see the rest of [the non-food items]. Any food items that go in there, I have to sign off on basically a little memo that says, "Yes, this'll be safe to use." So I do that every time they're going to have a crew care package [containing food]. Just did that for SpaceX-1 not too long ago.

ROSS-NAZZAL: Is there anything people have tried to put in there that you said absolutely not?

KLOERIS: Oh, absolutely. There's just certain things that aren't going to last long enough or that aren't safe without refrigeration or are just too messy. Often people will try to send very large bulk bags of stuff. It's hard for the crew to deal with that on orbit. So if you're going to send a bulk bag, you've got to be sure that it's overwrapped in a ziplock. Obviously when they open it they're not going to consume all of it at one time. So I will give a lot of advice to the crew care package people, because they'll have on there what it is and what the volume or mass of it is. So I can look at that and say, "Wow, that's a lot of whatever. Can you get that in a smaller portion?" Or something like that. So there's a little bit of give-and-take. They've been doing it long enough now that they already know what to tell the families will work and what won't work.

So by the time it gets to me usually it's just, "Yes this all looks fine." Nowadays, early on there was a lot more give-and-take. Now they're used to what'll work and what won't work.

ROSS-NAZZAL: A lot of the packages that you use for the food, they look like they're plastic. BPA has been a major issue. You hear about it that all the time. Is that something that you guys have concerns with?

KLOERIS: No. What we have is food-grade. It's approved for food contact. So it's not an issue in the materials that we use. We use laminates, different plastic laminates, but they're GRAS, generally recognized as safe. They're approved for food contact. So no, that's not an issue for us.

If a food meets the shelf life requirements, we're going to let them take it. Even if we know it's probably not going to work out. You can't always tell an astronaut no. If they really want something they're going to do it. I can remember many a time when they first started putting Pringles in cans. The crew members were like, "Oh man, I want to take potato chips to orbit." It's like, "Do you know how messy this is going to be?' So we would send them.

Not so much when they were like this [demonstrates], but when they came out with the smaller cans. Then Frito-Lay followed and many of their products were in cans as well. Well, the can would protect it to a certain extent, and obviously better than a bag would for preventing breakage. But if you've used them at all, you know from experience it doesn't prevent crumbs. So a lot of them would come back and say, "All right, I know you tried to tell me not to do this. I should have listened to you, because it was so messy." But then some of them will come back and say, "It was worth it. It was a mess but it was worth it."

ROSS-NAZZAL: Just had to have those Pringles.

KLOERIS: Had to have them. Yes.

ROSS-NAZZAL: I'm sure there's a lot of food they miss. I noticed that you were working on PRO-SAN, which I think Dr. Bourland told us about.

KLOERIS: Yes.

ROSS-NAZZAL: Safe for food but it would get rid of microbes.

KLOERIS: Yes, it's a sanitizer. It was actually one of the things that came out of our Food Technology Commercial Space Center. It never caught on, for whatever reason. I've tried a few times to bring that back up with the micro people about why not pursue that. I don't get to make that decision on that particular product and for whatever reason they haven't been interested in pursuing that. But I thought it had potential.

ROSS-NAZZAL: For a short time we thought we were going back to the Moon and on to Mars. Were you doing studies for the Constellation program about what the food system might be or how you were going to feed crews on these very long duration spaceflights?

KLOERIS: Absolutely. We have a group in our lab called the AFT, advanced food technology. Our AFT team, it's headed up by one of the other civil servant food scientists. That AFT team evolved out of the R&D portion of the contract. We've always had even through the Shuttle program, even through Skylab, the whole bit, there's always been a certain component of the lab that was research and development. So that R&D component has evolved into what we call our advanced food technology program now. So yes, during Constellation they were looking at—and actually this dates back to when we did the chamber tests. Even at that point they were looking at growing plants in chambers hydroponically. The plants were going to help with air recycling and also with water recycling, because you can recycle wastewater through plants and it'll help purify the water. So they were looking during those chamber tests and then into Constellation. They were doing plant work and looking at what the food system of the future might be, and they still are.

There's a little bit less focus on plants right now; you might grow some what we call pick-and-eat plants in transit [to the Moon or Mars], maybe cherry tomatoes or lettuce or something that doesn't require a lot of processing in transit when you're in microgravity. In order to grow something like wheat, which is what we were using in the chamber tests, you're going to need a lot of infrastructure and you're going to need some gravity, because in order to utilize that wheat you're going to have to mill it into flour. Or you're going to have to do some heavy-duty processing. You're not going to be doing that in microgravity. That would just be too much mess, too much overhead.

So maybe pick-and-eat on the way to Mars and the way back. We've looked at that. Right now our AFT system is more focusing on how to extend shelf life on our packaged food system to make it adequate for that first trip to Mars, because right now with the current propulsion system I'm sure you're aware that you're looking at about six months there, you're looking at about 18 months that you have to stay there before you can come back, and then about six months coming back. You can't take all the food with you. You're going to have to preposition some of it. Probably most of it will be prepositioned for that first flight, most likely in some kind of unmanned cargo vehicle. It'll either be on the surface of Mars waiting for them or perhaps in orbit waiting for them and they'll dock with it and then land.

But what that means is if you preposition that food you can only launch to Mars every so many months. You can't go any old day and launch to Mars, so that means that the food that they're going to eat on the trip home is going to be prepositioned maybe a year or a year and a half before the flight. So in total you're probably looking at those foods needing about a five-year shelf life. You don't have a whole lot [of foods with the shelf life].

There are some things that have that kind of shelf life. The military has MREs. Their MREs have that kind of shelf life. But you don't have a whole lot of food that has that kind of shelf life. We have very few within our current food system. Obviously the powdered beverages would probably last that long. We have some thermostabilized entrees that would probably last that long, but we have very little in our current food system that can achieve that kind of shelf life and still provide the proper nutrition.

Because over time these shelf-stable foods, chemical reactions go on in food. So even when it's shelf-stable and it's packaged, it's going to continue to degrade in quality and in nutritional content. Currently we don't have a lot of foods that can give the kind of shelf life that we would need for a mission to Mars. That right now is the biggest focus of our advanced food technology group. How can we extend shelf life?

So they're hitting that a couple ways. They're looking at how to improve packaging material to increase the shelf life. Because the oxygen and moisture that get to the food are the two things that are really going to affect most dramatically the shelf life of the food. So anything you can do to prevent moisture and oxygen from coming into contact with the food will help extend the shelf life. So they're looking at improvements in packaging material.

Military is looking at some of the same requirements. The trick is there aren't commercial companies out there that are interested in a five-year shelf life. They don't want you to be able to buy food in the grocery store that lasts five years. They want you to go back and keep buying it again and again. So really us and the military about the only people who have a requirement for this kind of shelf life.

So we have partnered with Natick Labs; it's in Natick, Massachusetts. It's the R&D facility for the military. They do food research there. They do clothing, all kinds of military-related research. So we've partnered with those folks. They're looking at improved packaging materials just like we are. They're also looking at what in the food industry is called emerging processing technologies. [There are] two they're really focusing on now. There's high pressure processing, which is already done in the commercial market to a certain extent. If you buy the ready prepared guacamole in the dairy case, that's high pressure-processed. Canned products, when they're processed to make them shelf-stable where you don't need refrigeration, they are put in what's called a retort. A retort uses high temperature and a little bit of pressure to kill all the bacteria in the food. High pressure processing changes that equation in that it uses a lot less heat and a lot more pressure to kill the bacteria.

So because of that, like with the guacamole, you get the nice green color that if that guacamole was put in a retort it would come out black probably, because the heat would kill the color. High pressure processing allows you to apply a lot less heat and yet kill microbes.

Now currently for commercial use of high pressure processing, it can only be done at a pasteurization level, meaning it still needs refrigeration when it's done. You're not processing it all the way to shelf stability.

What the military is looking at is can we do this to shelf stability, because they want shelf stability. They want to be able to have it be like an MRE. So they're doing a lot of research in that area. The advantage is because you're applying less heat you get better color, you get better texture, you get higher beginning nutritional content.

So in theory that means it'll last longer because if you start at a higher point then even if it degrades over time it'll last longer than if you're starting down here and it's degrading. So high pressure processing is one of the things that we're looking at, they're looking at.

Also microwave sterilization. Again similar concept in that you're using less heat, so you'll get a higher quality product. Both of those are emerging processing technologies in the food industry that have promise to be able to help us extend the shelf life of the foods.

The other thing that we could do of course is to take these shelf-stable foods and refrigerate them. Because even though they're shelf-stable and they really don't need refrigeration, if you refrigerate them it helps slow this degradation process that occurs within the package. So refrigeration would be another possibility to help extend the shelf life, but that becomes a lot more prohibitive for the vehicle. We want to try to avoid that if possible, but that is another alternative potentially. So right now the AFT people are focused on how to extend the shelf life either through packaging materials or through different processing technologies.

ROSS-NAZZAL: A couple years ago there was a program on *Top Chef* that involved recipes for space travel. What was your involvement in that? Why was it at Goddard [Space Flight Center, Greenbelt, Maryland], not here at Johnson?

KLOERIS: The reason it was at Goddard and not here was because they were filming a whole series of *Top Chef* shows in Washington [D.C.] at the time. So we were just one of a series of shows. I was invited strictly to be a judge. That's all I was there for is to be one of the participants. Sandy [Magnus] went too. She was one of the ones that participated in that as I recall. Yes, pretty sure it was Sandy with me.

So we got to participate in the panel where we tried the different products and gave some inputs. We didn't get to choose the winner. Our vote didn't count. The chefs were the ones that the vote counted. It was done in DC just because they were already there filming a bunch of other shows. It was done at Goddard because they basically went into the communication room and so they sent down the recording from orbit. It was actually the crew on orbit that gave the challenge to the contestants. It was a [recorded] feed from orbit that gave them the challenge. So they [filmed the replay] at Goddard.

Then the actual food preparation was actually done in [the] Ronald Reagan [Building]. It was a building there in downtown DC that had kitchen facilities. That's where they did it and taped the show, where we actually tasted the products. So I flew up there. That was over a weekend. We went to Goddard on Friday and then we did the tasting on Saturday and filming, and that was it.

ROSS-NAZZAL: Have you flown the winner's food yet?

KLOERIS: We actually took the winner's food and freeze-dried it and flew it on STS-134. So the next to last flight I believe it flew on. All of that food was great, but the poor chef. I would hate to even offer to show him what it looked like when it got freeze-dried, because you can't do justice to that. They're not thinking in terms of what's going to freeze-dry, how it's going to [look]. It was okay when it was freeze-dried, but it certainly wasn't of the quality that it was when he prepared it.

ROSS-NAZZAL: A lot of people like going to the food lab. It seems to be one of the places that people like to stop at JSC. How do you deal with all that media interest? And who have been some of the interesting people that have come by that you enjoyed?

KLOERIS: Oh goodness. We do tons of PAO [Public Affairs Office] luncheons. As we've had different Center Directors over the years—George [W.S.] Abbey used to bring every visitor who came to JSC. He wanted them to come have lunch in the food lab. During George Abbey's era we did more VIP [Very Important Person] luncheons in the food lab, just an unbelievable quantity. That [quantity] went away. It has never gone away completely. At various times when they bring down groups from Headquarters or they would have some VIP group come in, they would want them to have lunch in the food lab.

Well, we're actually back in an era where that's on the upswing now because the whole focus on innovation and partnering with these outside companies. They're bringing so many more of them in. Dr. Jeff [Jeffrey R.] Davis, who's head of our directorate, he's in the middle of all that innovation and trying to partner with companies who do a lot of innovating. Whenever he brings people in he often wants them to come and lunch in the food lab.

Over the years, goodness, we've had all kinds of people in the lab. During *Apollo 13* movie, we did two different meals for the cast. The first time I was here. They made their first exploratory trip to JSC, and it was Tom Hanks and Ron Howard. Ron Howard had his wife with him, and he had a daughter with him. Yes, pretty sure it was a little girl, and the Imagineering, the Disney people who produced the movie, they had representatives with them.

They came and we did a breakfast for them one morning in the lab. I'll never forget, because Jim [James A.] Lovell was there, who wrote the book that the movie is based on. So Lovell is there. Two or three of the current astronauts at the time were there. They were in their blue flight suits. So everybody's sitting there having a Shuttle breakfast.

Lovell is eating this food. He's like, "Man, this stuff is good," because it's so much better. It's evolved so much from [his era]. The other crew members across the way, the current ones, are sitting there looking at him like, "If you say so." He was so impressed because it had changed so much since Apollo.

ROSS-NAZZAL: Yes, it wasn't those little cubes.

KLOERIS: Right, so a lot of improvement since he had flown. So he was very impressed with what we had. Subsequent to that, after they had chosen the rest of the cast, they made a second trip back. So Kevin Bacon and the rest of the cast were with them. I actually was on travel at the time, so I wasn't there for that. But they came back and had lunch a little later on. So those guys came. We did a PAO with Rachael Ray when she came. If you remember, she did a lot of stuff here, not just in the food lab. She did stuff with the suit people.

It was right at the time when she started filming for her talk show, when she went onto regular TV and started doing her daytime talk show. So she came and filmed, and we did some food preparation. We actually took a couple of her recipes, freeze-dried those, and sent them to orbit. So she came in the lab and filmed during the time we were processing, for her show.

Emeril Lagasse, we did a show with him as well. This originated with PAO at NASA Headquarters for Emeril Lagasse. So they contacted us and said, "We want to do something jointly with Emeril." So we started teleconing with Emeril's people. What we came up with was they submitted a series of recipes, and we picked basically a meal's worth of stuff. It was like four or five products that we thought we could reasonably freeze-dry. We did that, prepared those, and freeze-dried them. They went to orbit during I want to say Expedition 13. They went to orbit, and they were consumed on orbit. There was live feed back during his show into his studio where he was filming, and he had some current astronauts there in the studio with him as well. So they did that show.

Emeril never actually came to our lab. It was his folks that came. Rachael Ray did come herself. We also had the cable show. The guy that goes around and eats all the horrible foods all around the world, [Andrew Zimmern]. He came and did a show. He did a Texas show and tour through Texas. It was in the fall because part of his Texas show was he went to the state fair, sampled all those weird fried foods that they had at the state fair. Then he came down here and did a food session with us and tried space food.

ROSS-NAZZAL: I just had a couple more questions for you. How do you think women's leadership roles at JSC have changed since you started working there, or have they?

KLOERIS: Significantly. My best example of that would be ever since I became a civil servant I've obviously been within a branch and then within a division. We used to have sections and branches and divisions. Then we did away with the sections, and it was just branches and divisions. When I first came to work here, there were women in my branch on the civil servant side. When a manager would be gone, you would never ever see him delegate authority to a woman. Never. That is not the case now. You would just never see that happen. At some point there was this transition where all of a sudden if you were out it was okay to delegate your signature authority to a female civil servant. For years that never happened when I first came to work here. So to me that's just one of my little indicators of how things have changed over time.

ROSS-NAZZAL: It's interesting too because you mentioned Rita was the head of the program when you came in, and she'd been working for the program for many years.

KLOERIS: Oh yes. She came from Langley [Research Center, Hampton, Virginia]. So she was originally at Langley. She always said she was not a food scientist, she was a physiologist. At one point she told me that, "Oh, I was just standing in the wrong place at the wrong time, and somebody pointed at me and said you're going to do food." She was a physiologist. That was the closest thing they had to somebody that knew about food, I guess.

ROSS-NAZZAL: I wonder if it was also because she was a woman, and they presumed women cook.

KLOERIS: I don't know. That's hard to say. Because at one point during Apollo and early on they actually had a whole branch or section maybe at that time, I don't know what it was called, but they had a whole group that was combined nutrition and food. They had a large group on the civil servant side, maybe six to eight people that worked on food. We never had that since then. That went away, and it's always been two until this past October when we picked up our third food scientist. It went from being a large group to down to two on the food side. Actually food and nutrition are split out now. They used to be combined, but now the nutrition research, Scott's Nutritional Biochemistry Lab, is over on the medical side in SK [mail code for Biomedical Research and Environmental Sciences] and we're in SF [mail code for Human Systems and Engineering Development]. We're on the hardware side because we're the provisioners. We provide the hardware so to speak. So it's split out, it's not together anymore. At various times things have changed. It's a much smaller group on the NASA side than what it used to be.

But back in the day when Rita was [working] there were men involved. So I'm not sure that it was because she was a woman. I can't really prove that that's true.

ROSS-NAZZAL: Do you think being a woman has had any impact on your career at JSC in any way, positive or negative?

KLOERIS: I think as far as working with the crew that it has been a positive to be a female. I just think I possibly have been spared a little bit. You know treated maybe a little bit more politely than they might have treated a male engineer maybe or something like that. I don't know that for a fact. I'm just guessing that that might be the case, because I've worked with so many crew members over the years and I would say 99.9 percent of them have always been very nice and very agreeable to work with. We've had a few difficult ones along the way but not very many. So I don't know if my gender had anything to do with that or not.

Like I said, early on it was pretty obvious that if you were female you weren't in the inner circle so to speak, but that's changed over the years. At this point in time I don't really see gender as a big issue. I heard stories from the female astronauts about how it was to be the first female astronauts. They took some grief. I'm sure there's still some folks around here who've been here a long time who probably have some reservations about women still, some prejudices against women. I can't imagine that there's not, but they don't really get vocalized anymore.

I have to say the content of conversation over time has changed. You don't hear as many crude jokes as you used to hear and that kind of thing. So that has changed over time. In general I don't think my gender has been that big of an inhibitor. I don't know, I've just never been super sensitive about that. Figure there's not a lot I can do about it. Just keep plugging along. But it definitely has changed from what it was when I was here early on, definitely.

ROSS-NAZZAL: Looking back over your career is there anything that you consider to be your greatest accomplishment while working at JSC?

KLOERIS: I don't know. I feel like it's been an unbelievable privilege to be able to contribute to Shuttle and then to the Shuttle-Mir program and now to Space Station. So I can't help but think or feel like that is an accomplishment that I'm very proud of. But I'm also very proud of the 91-day chamber test and my contribution to that, knowing that that helped develop some of the stuff that's being used on Station now.

But long term, I have to feel like it's been a big deal to be able to contribute. I would have never thought that I could contribute to the space program. That just was not in my mind that I would end up doing that. I grew up right down the road in Texas City, so I grew up not that far from the Johnson Space Center. It just never occurred to me that I would end up in a situation where I could contribute to the space program, so I just think I've been incredibly lucky to be able to do that.

I have to say that I feel like I got the best food science job that anybody could have. It's a niche job but it's pretty cool.

ROSS-NAZZAL: I'm sure you get a lot of people telling you that's what they want to be when they grow up and you tell them there's only three of us.

KLOERIS: Yes, there's only so many of us. Yes, that's true.

ROSS-NAZZAL: Anything that you would pick out as your biggest challenge over the years?

KLOERIS: My biggest challenge I guess has been to try to educate folks about what the limitations are as to what we can do based on the fact that we don't have refrigeration, because a lot of people don't really think about that, about how food has to be different. How certain foods just aren't going to work because you don't have refrigeration and you don't have a way to do that.

It's been a challenge over the years and interesting to see how the whole philosophy about food has evolved. Because when I first came to work here, of course for most crew members, I would say for 95 percent of the crew members who went on Shuttle, food was way down the totem pole as far as importance. "Oh, it's a camping trip, I'll find something I want." No big deal. That's really the way it should have been, because short duration. There were very few crew members who flew on Shuttle who were that concerned with, "Oh I'm going to be without something for two weeks." It just wasn't that much of a psychological issue on a short duration flight.

Well, when the same Shuttle crew members went to Mir—and I think I mentioned this last time we talked. Originally the plan was that when our crew members went to Mir they were going to eat all Russian food. So Dr. Bourland and Dr. Lane at the time, who were on the management side on the civil servant side, they immediately started working to figure out how to get some US food on board.

So we started talking to those first crew members who were going to go to Mir about the food. "Oh, no big deal, don't worry about it, just look at when I flew on Shuttle. It'll be fine."

We had all that data, so that's what we did. We looked at the preferences based on what they had picked on their Shuttle flights. Well, then when they started coming back from Mir they were like, "I should have paid a little more attention." When you're there for a longer period of time all of a sudden it takes on more importance, because it's one of the few creature comforts that they have. When they're sitting down like on Mir, different from Shuttle. Shuttle was more like they were grazing. Maybe they would do one meal a day. But on Mir first and then on Station, when they settled into a more normal routine where they were maybe eating together more often, it became more of a social thing, food took on a higher importance.

Quickly the word got to the Astronaut Office, to the other astronauts who were going to fly long duration, "You need to really pay attention to what you're taking because when you're up there for a long time it takes on a lot more importance."

So there was a process whereby first the astronaut corps got educated about the psychology of food, and then management got educated about the psychology of food. Because all the managers over in the Station program, "How can food be important? I worked Shuttle. It was never important during Shuttle. How can it be important that we get certain food there at a certain time?" They just couldn't relate to that.

Over time when they got enough complaints from crew members on orbit because they didn't have the kind of coffee they wanted [or other issues], they began to realize how important the psychological aspect of food was for long duration spaceflight. Now that is tracked very closely by the ISS program management because they know how important it is to these crew members and to their whole frame of mind when they're on orbit. So it has changed dramatically as far as the relative importance over my career.

ROSS-NAZZAL: That is interesting. That must have been a challenge. I was just glancing at these [questions]. I think we've gone over [everything]. But is there anything else that you thought you would like to talk about? Or something else you would like to add about personal experiences? Trying to be thorough.

KLOERIS: Man, I don't know what else it would be at this point. I was trying to think of other folks I remember that have come to the lab. Remember when we had the Republican convention in Houston?

ROSS-NAZZAL: I think that was probably before my time.

KLOERIS: At one point the Republican convention was here in Houston, the nominating convention, the whole bit. So during that time they had a bunch of VIPs who came down and toured. We did several different meals during that process.

ROSS-NAZZAL: It must have been fun.

KLOERIS: Over the years like at one point the queen and her husband came. They didn't come to our lab. This was during Dr. Bourland's time here. They actually came to Building 9, and they set up all kinds of exhibits for them to walk around and see. Food was one. I remember Dr. Bourland had to go take a protocol class before he could go over there. You had to learn how to greet the queen and all that kind of stuff. We've done things like that. When John [H.] Glenn came back to fly on the Shuttle, during his training, the President came, again not to our lab but came to the training facility. We provided food for John Glenn to share with him when he came there.

So there's been things like that over the years that we've supported at various times. Three summers ago now, the Smithsonian has a summer festival on the [National] Mall [Washington, DC]. Each year it's literally in tents out on the Mall in front of the Smithsonian.

Each year they have an overall theme but then they have four or five subthemes. Three years ago one of their subthemes was NASA. So we had a space food exhibit there. It's a two-week deal. Basically we were doing food briefings all day every day for two solid weeks. Every hour or 45 minutes we were doing a briefing about the space food system. We'd have a tent with chairs set up and people would come in.

We're talking lots of people because it's a big outdoor festival that everybody goes to. So we've done stuff like that over the years. Smithsonian is actually, they're doing a documentary of some kind. I don't even know all the details about it yet. We just got contacted from PAO because they're going to come to our lab and film in October. So we've done a lot of that kind of stuff over the years.

We've had a lot of different visitors at different times come through the lab. We had Tracy McGrady from the Rockets. He came at one point. He wanted to tour JSC. So any time they bring VIPs down here, very often they'll end up if they have time bringing them to the food lab, because it's something everybody can relate to. Everybody eats so they can relate to all this "weird-looking food" that they have to eat on orbit.

ROSS-NAZZAL: Well, I thank you very much for coming by today. I really appreciate it.

[End of interview]