CHILEAN MINER RESCUE ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

CLINTON H. CRAGG
INTERVIEWED BY REBECCA WRIGHT
HAMPTON, VIRGINIA – JUNE 23, 2011

WRIGHT: Today is June 23, 2011. This oral history is being conducted with Clint Cragg in Hampton, Virginia, for the NASA Headquarters History Office. This interview is part of a series to capture knowledge about NASA's participation in the recent historic rescue of 33 Chilean miners. Interviewer is Rebecca Wright. Mr. Cragg works as a principal engineer for the NASA Engineering and Safety Center located at the NASA Langley Research Center. We are in his office today for this interview.

Thanks again for taking time out of your schedule for us.

CRAGG: You're welcome.

WRIGHT: You were one of four members of the NASA team who traveled August 30, 2010 to assist the country of Chile in the safe return of the miners who were trapped underground when a section of their copper and gold mine collapsed. Explain how you first became involved with this rescue effort.

CRAGG: I don't know exactly precisely how the request came to the United States, but I did hear that the deputy minister of foreign affairs in Chile came to our embassy shortly after the miners were found alive, asking for help from the United States. This help was apparently nonspecific, so the embassy passed that back to [the Department of] State, and somehow it got to NASA.

Since the NESC [NASA Engineering and Safety Center] works directly for the chief engineer, we got asked to do some what-ifs—how could we as engineers perhaps support these individuals and allow them to survive for what at the time was going to be several months below ground. I was asked by my boss, Ralph [R.] Roe [Jr.], to put together a team and just do these what-ifs. We spent a couple of days just thinking about what we could do to help these people and wrote a little paper and passed it up to [NASA] Headquarters [Washington, D.C.], and that was that.

About that same time, so I understand now, the Chilean minister of health was opining in Chile that he'd like NASA's help specifically because we have experience in helping people survive in hazardous environments. What he wanted was medical and psychological support. When that happened Mike [James Michael] Duncan, then at JSC, got the call and ended up talking to the minister of health (who was at the mine) a couple of times. That was kind of choppy, as I understand, so it was mutually agreed that we'd send some people down for a site survey. Headquarters picked two doctors, Mike Duncan and J.D. [James D.] Polk, and Al [Albert W.] Holland, the psychologist, to go down. Because I had led this earlier team I was asked to go, specifically to support the doctors. If there was any type of technology or thing that they needed, I could be down there to assess that and reach back to the United States, to members of the NESC, that perhaps we could get what the doctors were looking for. That's how I got involved.

WRIGHT: This initial paper that you and your team wrote, what information was given to you so that you could develop this paper?

CRAGG: We had no information, nothing. One of our guys—we knew it was hot down in the mine so he did some experiments about freezing water bottles and checking to see how long it would take to get down and whether or not they'd still be frozen. I mean, just kind of crazy stuff. We really didn't have any information, so we were kind of shooting in the dark. I don't know whatever came of that particular list of recommendations, but the longer list of things for the rescue capsule came later.

WRIGHT: Within two weeks after the miners were trapped, you were there. Talk about the trip and how that came together.

CRAGG: That's the interesting part. I kid Mike Duncan about Al [Albert] Condes, because Al wanted us to all arrive in Chile at the same time. Of course everybody else was in Houston, so I wanted to go directly from here to Atlanta [Georgia], to Santiago [Chile]. Al goes, "No, we want you to arrive there." And I said, "Okay Al, you owe me one for this." So I had to fly Charlotte [North Carolina] to Houston, Houston to Lima [Peru], and Lima to Santiago. It was a long flight.

We got into Santiago and were met by some embassy employees and ushered into a VIP [very important person] section at the airport. I remember the embassy person looking at me and she said, "Welcome to the whirlwind."

I said, "What are you talking about?"

She goes, "You guys are rock stars down here." I was still somewhat clueless. I'd heard about this back in the United States, but I didn't realize how big a story it was in Chile. There was a bunch of press hanging outside this VIP area at the airport when we left. We didn't talk to

them, but our Chilean escort for the Chilean Space Agency [Agencia Chilena del Espacio] did. We had to wait for him, but that was okay.

We went down to the hotel and checked in, and we had a couple hours to shower and then we went off to a number of meetings that first day, and gosh, we met a lot of people. We met Laurence [N.] Golborne [Riveros], the minister of mining, and Jaime [J.] Mañalich [Muxi], who was the minister of health, and the head of the Chilean Space Agency. But the real important meetings were with the two ministers because we got the background on what was going on at the mine site, and the doctors got the medical history of all the trapped miners. We got a synopsis of what was going on.

The next morning we flew up to the town of Copiapó, which is the capital of the Atacama region. We arrived there and threw our stuff in the hotel. This town is set up like a normal Spanish colonial town with a big plaza in the center, and our hotel was on the plaza. It turns out right across the plaza was the local government, so we went over there and met the local governor [Ximena Matas Quilodrán] and talked to her for a while. Then we went out to the mine site, and we spent the next three days at the mine site.

WRIGHT: What were your impressions when you first arrived at the site?

CRAGG: How austere it was. It was quite a drive, about an hour from Copiapó. There was really little or no vegetation, except apparently it had just rained there a week before. It only rains once a decade, and when it does these desert flowers bloom. They're spaced pretty far away, but if you look at the hills and the desert at an angle, you can see these colors, and we saw a little bit of that.

I remember thinking as we got to this place—and this mine had been around since the 1880s—who would have gone this far out to find this mine? Back then it was pretty far away from everywhere. That was my first impression. Then as we got further into the actual mine itself, it was very interesting to see how many people were there. There were a number of security barricades that we had to go through, a lot of soldiers, and we finally got escorted past the news people, past the family members, into the inner sanctum there, and were allowed to put our stuff in the trailer, and then we were introduced to the key people at the mine site.

They split us up with our counterparts, so Mike and J.D. went with Dr. [Jorge] Díaz, and Al Holland went with the Chilean psychologist, whose name was Alberto [Iturra]. The two Als, the one that speaks English and the one that doesn't. I went with one of Codelco's [Corporación Nacional del Cobre de Chile], the state [copper] mining company, engineers, and got to go see the drill rigs and how they were resupplying the miners. Right from the get-go my main job of watching out for the doctors was circumvented by the Chileans, but that was okay. As it turns out, the doctors didn't really need any technology. They were really looking from their own background on how they deal with issues in space and looking for similarities, so my time was spent, all three days, with these engineers.

I got to meet André Sougarret [Larroquette], who was the head engineer. He was personally selected by the president of Chile, and he also worked for Codelco, to head up this relief effort. Unfortunately, he didn't speak any English, but his deputy spoke pretty good English so I hung around with him a lot, just seeing how they were conducting resupply operations and what kind of things they were sending down and what the plans for the future were. Around the same time I got to speak to the geologist there on the site about what his thoughts on the mine were.

One of the other impressions I had pretty early on—there was a significant Chilean navy presence there, a lot of enlisted guys. One of the key doctors, who was also working with our doctors, was a submarine-qualified officer who spoke good English. Apparently he'd gone to high school in California.

I also got to meet another individual, Renato Navarro, who was an ex-submarine captain. He had been asked to come up there early on because they wanted his opinion based on being at sea, under the water for a long time, how they could support these miners. I suppose after his suggestions were taken, they felt that he was a pretty squared-away guy. They kept him on, at least initially, as the unofficial head of the support operations. He and I hit it off pretty well, me being an ex-captain myself.

It was through him that I got to meet some more navy guys who were the Chilean navy engineers. We were talking about how they were going to get these guys out, and I came to understand that there were probably four or five different companies or entities that had been asked to submit designs for whatever capsule was going to be used to extract these guys. I didn't talk to any of the other companies, but this Chilean naval engineer group from one of their shipyards was one of these groups. I started asking them questions about the design and how they were going to do this and what kind of requirements they had been told this thing ought to be able to perform, and there wasn't much information that they were supplied with. They were told that the max [maximum] diameter of this device can only be this big, it can only be this tall, and there was no limit on weight. There was no other guidance from anybody at the mine site.

It was pretty interesting to be there because there was a lot of people there and everybody seemed to be busy and doing something. There was a real team effort, and it was neat to be a part of that. But the problem with that was, as I also found out, that the organization there, I

thought, needed some tweaking. Getting back to these naval engineers, there was nobody that told them what ought to be in this thing. They seemed like a nice group, and they showed me what one of their original designs was. It looked nothing like what ended up happening, but that's okay.

At the end of the three days, the four of us gave an out-brief to the minister of health who was there. The other leadership at the mine, which included the psychologist, the doctors, the Codelco engineers, and the governor of the region—we spent two or three hours, I suppose, giving them an out-brief on what we had found. That was broken up and we had to go to a news conference in the middle of that, that was kind of interesting.

One of the things I suggested to the minister of health was about this issue of the rescue capsule. I said, "You know, there's other things that you probably ought to consider." We had talked to people at the mine site and we sort of did a survey, how long do you think this extraction is going to take once they get down to these miners? We heard anywhere between one and four hours, so taking the outside guess of four hours, to be trapped in some kind of tube for four hours, there ought to be a little something else in this design. I told the minister of health that NASA does this all the time, we write requirements for all sorts of stuff, and that we could help them flesh out some of these requirements and provide them some suggested design requirements. That was really one of my main suggestions. I also talked about some streamlining that could be done in the organization there, and just some other sort of odds and ends.

WRIGHT: How was that received, being an outsider making these suggestions to the government?

CRAGG: You know, that's a good question. I've been to South America before and I really like it there, but many of the countries are very proud, and rightly so, but sometimes when you're too proud you don't want any outside help. I think to the credit of the Chileans that when they found themselves in this situation they were not too proud to ask for help, and it wasn't just NASA they asked. They had an American drilling team down there for Plan B, they had a Canadian team for Plan C. I know they had help from the Australians and the South Africans and Germans, so they were spreading a wide net. When we ended our briefing there most of the people in the room were writing very feverishly, so I think they wanted the advice. Particularly from what the doctors and Al Holland told them, I understand that they followed that advice almost to the letter.

WRIGHT: Before we talk about the advice that you gave them, tell me about the news conference that you said was a little bit interesting.

CRAGG: The first day we were there in Santiago we were in this conference room with the ministers, and they said, "The press is here." This conference room was—gosh, it might have been 60 feet long, 20 feet wide, and all of sudden the doors open and it was like the paparazzi. It must have been a hundred people come in with cameras and set up, and they wanted to talk to us and why we're here. The only guy who spoke was Mike Duncan, who, by the way, is very good with the press. He's very eloquent.

One of the questions the press asked was, "Dr. Duncan, we understand that the miners have asked for beer. What do you say about that?" Mike's response was, "Well, I don't think

I'd recommend it at this point." The next day we saw the headlines that said "NASA says no to booze and cigarettes." That was our first real press conference.

Daily at the mine site, Andre Sougarret, the head engineer, and the governor of the region stood at the edge of the enclosure at the mine speaking over these barricades to throngs of press. Mike Duncan usually talked at that time, too, but the one that you just asked about on the last night was a press conference just for us. There were a lot of people there, it was crowded and a lot of questions, but other than that it was just like the one before it.

WRIGHT: You returned home with a whole lot more information about the situation than what you had before you left. E xplain how you took that information and helped the Chilean government come up with some guidelines.

CRAGG: I understood the topography, I understood the people, I understood what the problems were, I understood how they were going to move this capsule in and out, and I understood from our doctors some of the things that they considered important that this thing ought to have. Just having a lay of the land helped a lot. In the submarine force, one of the things I was taught early as a young officer is if there's a problem in the ship, once you physically go look at the machine or whatever it is that's causing the problem, you have a much better feel for what the issues are. I did that as a captain all the time, so in this case, just having been there and seeing the people that were going to work this, I think I had a pretty good appreciation for what exactly they needed.

WRIGHT: You came back and you assembled a team. Tell me how you put that word out to the people that you needed to have help.

CRAGG: When I was down there they had cell [mobile cellular] phone signals, so I had my [Apple] iPhone [internet-enabled phone] and was pecking away at that back to my boss here. After I'd talked to these Chilean navy engineers I sent him a note saying, "This looks like someplace that we can really help for these suggested design requirements." He sent me back a note saying, "That's a good idea. Why don't you, when you get back, get with all the Tech [Technical] Fellows"—we have a number of Tech Fellows at the NESC—"and see what you can come up with." That gave me top cover from my boss. The minister of mining, when I told him this that last night, didn't say yes or no. He came and talked to me later about my ideas and the organization there, but he didn't say yes or no about whether he wanted these requirements or not.

But after I got back to the States—we got back on a Sunday, and it was Labor Day the next day. On Sunday or Monday I got a note via my submarine friend down there that the minister had sent to him saying that he wanted this list. On Labor Day I was working at home, and I sent a note out with all the issues to all the Tech Fellows saying that we need to meet on Tuesday and for the next several days in succession to come up with this. That went pretty well.

The first day we came back in we had a telecom [telecommunications conference], probably nine or ten in the morning. I had my boss, Ralph Roe, come, and all the Tech Fellows online were here. There's a bunch of them who were actually here for some other reason, and so a bunch of them were in the room. I asked Ralph to tell them that this was important, that they needed to give their attention to this.

WRIGHT: Can you share quickly about what their purpose is, why you have Tech Fellows that are involved with the NESC?

CRAGG: The Tech Fellows, to me, they're the bedrock of the organization. There is a Tech Fellow for a number of different disciplines like materials and nondestructive evaluation, human factors, passive thermal power, stuff like that. These people have gone out and established their technical discipline teams, and many of them know other like-minded engineers across the agency and people in academia and industry. All of them have put together this team of somewhere between 20 and 60 people that they meet with occasionally, but, more importantly, they know what each one of these people's specific expertise is within their area.

One of us principal engineers gets a job and we need something specific, then we can go to that guy. I was given a job several years ago where I needed some material expert who was knowledgeable in fast fracture. I'd never even heard of fast fracture, but he found one, some guy out in California that was a great guy. That's what our Tech Fellows do. They're usually older, well-established individuals that have been working with NASA for a long time, that know NASA. They're really a great group, so by my boss offering me all the Tech Fellows to help with this, I got the cream of the crop right from the start.

WRIGHT: Did you have a deadline you were working under too?

CRAGG: Yes, we did. That last meeting with the minister of health, we were told that he was going to make a decision on the final design a week hence, so what I wanted to do was get him

something by the time he was going to have to evaluate these designs. We came back to work on Tuesday, we had three full days, and I wanted to get that to him Friday morning. So that's what we did.

WRIGHT: So you had a bunch of them here for a reason, and you had Ralph come in and talk to them.

CRAGG: Right. We initially had a lot of help from Neil [Cornelius J.] Dennehy and Tim [Timothy S.] Barth, both from the NESC. We decided, at least initially, to divide the issues up by Tech Fellow areas, like materials and things like that. We had an initial meeting and we said, "Okay, come back at two o'clock this afternoon and we'll see where we're at." We did that for the first day, and we were not making a whole heck of a lot of progress because people weren't working together.

The next morning one of the Tech Fellows suggested that instead of doing it that way, we ought to divide the tasks up into issues specifically for the capsule itself and issues specifically for the support equipment that would be in the capsule. Everybody agreed to that and thought that was a better idea, and that's when we started making a lot more progress.

We then had two meetings each day, and finally on Thursday in the afternoon we had our final meeting. We had a pretty good rough draft. We were using WebEx [Communications Inc. internet conferencing software], and I told them at the time that this was going to be their final review up on the WebEx. I wasn't going to send it out anymore, because it needed to get done. That meeting took a long time, but at the end of it I thought we had a pretty good product. That night after Tim Barth and Neil Dennehy and I put the final touches on it, wrote an executive

summary, we sent it up to Al Condes who passed it through export control. So by noon the next day I'd sent it down. We were pretty happy about that.

Then I didn't hear much about it for a couple weeks, and I sent a note to my Chilean submarine friend and also to the Chilean navy doctor that we had met down there. The Chilean navy doctor told me that he was intimately involved in the design process, and they utilized or accepted most of our recommendations into the final design. But when I think about that, all we did was provide suggestions. The Chileans actually did the design and the building, and that's the real hard part, and I think they did a great job at that. We were just providing advice.

WRIGHT: Let me ask you a couple more questions about the team that you assembled. You mentioned the Tech Fellows because they have such a wealth of information. I think you had a team of about 20, and you mentioned about 10 were here at Langley. Were the other 10 from different Centers and/or outside the agency, or were they all within NASA?

CRAGG: I'm trying to remember if we had anybody from outside the agency. I think we did, maybe some retired people, one retired guy from JPL [Jet Propulsion Laboratory, Pasadena, California]. We had people from KSC [Kennedy Space Center, Florida], Tim Barth was at KSC. We had a number of people from JSC—some were here, some were still at JSC. We had Ames [Research Center, Moffett Field, California]. I don't think we had anybody from Dryden [Flight Research Center, California], but we definitely had people from Goddard [Space Flight Center, Greenbelt, Maryland]. Neil Dennehy, my deputy, was at Goddard. I think we had one person from Glenn [Research Center, Cleveland, Ohio]. It was mostly NASA employees, mostly NESC employees, but we come from all Centers. We're pretty well represented across the country.

WRIGHT: Did you receive unsolicited help? Sometimes when word gets out that you're working on something, people from outside the agency want to send you suggestions. Or was this pretty much a closed discussion within the people that you selected to be on that team?

CRAGG: I know that some of the Tech Fellows went out to their people, their technical discipline teams, and asked for advice, but those people never got into our meetings. I don't know how extensive that was. I think it was so short-fused that there wasn't a lot of time for people to give us unsolicited advice.

WRIGHT: Did you select these people, or did people give you names? How did you actually come up with the working group?

CRAGG: The Tech Fellows, there's maybe 15 or 16 of them. I just got all the ones that were available. I think all of them were.

WRIGHT: I would assume they were working on another project someplace, so they were able to stop what they were doing to work on this?

CRAGG: Yes, pretty much. Some of them came in for a while and had to step out for a little bit, but the majority of them spent most of their time with us.

WRIGHT: Part of what you did is your recommendations for the guidelines. As you mentioned, you included aspects from the behavioral health and the medical doctors. Were they involved in these discussions or were you using inputs they had given to you previously?

CRAGG: One or two of them was involved initially. I knew they wanted specific things. We had talked about it at the mine site, and we had talked about it at the airport before we came home. Some of the things that they wanted for medical reasons were the same kind of things that we wanted for engineering reasons. For example, we wanted lighting in the thing so that the individual had situational awareness. In case the thing got stuck we'd be able, or the Chileans would be able, to talk to the guy and, him being right there, to figure out what was wrong. On the other hand, the doctors wanted lighting for morale purposes. The doctors, psychologists wanted to keep the guys' spirits up. We wanted two-way communications, again, to help out if there's any issues on the capsule coming up. They wanted it so that they could talk to the individual in case he was experiencing some kind of medical issue.

I think we got everything the doctors wanted. After I got done with it, J.D. Polk and I talked for quite some time about the paper, and I think he was good with everything that we had put in there. Somehow I got all their inputs and some of the other inputs they had. You'll see in this paper that we've listed if the requirement had anything to do with medical. They wanted to have some oxygen onboard in case the air coming up was bad in the borehole. I think we got everything.

WRIGHT: There's so many unknowns. Were you still working on the premise that it could be anywhere from an hour to four hours to get them out?

CRAGG: Yes.

WRIGHT: Of course, that changed drastically as they moved along.

CRAGG: Yes. It did, it did. I didn't watch all of it on TV [television], but the first ones were very slow and determined, the first extractions. But the latter ones, the last three, I think all came out within an hour.

I remember when we were down at the mine site, they had these five-inch boreholes that they'd originally found the guys alive with, and they were resupplying them through these holes with a Paloma [Spanish for dove] device. They call it a Paloma, which was a two-meter-long pipe, capped at either end. I remember standing there watching as they were lowering something down to the miners and timing it. They had a winch hooked up to this two-meter-long pipe, and they just lowered it down. It was really going pretty fast, I thought. It took eight minutes and twenty-two seconds to get down, and I was thinking to myself, "That's pretty damned fast. I don't think they're going to be able to get these guys out at that speed. That would be kind of reckless."

So when they said one to four hours, I thought that probably makes sense if they want to make sure. But I think by the time they started doing it and they realized that the design that they had was pretty robust, they were able, as they learned more and more, to speed up the operation.

WRIGHT: During the discussion process, were there certain aspects from your group that yielded more discussion, pros and cons? For instance, did you put the list in priority, or were they all of significant value?

CRAGG: We didn't really prioritize them, other than we listed the medical things in the front of the rescue capsule section and in front of the other section. We did have some heated discussions. You can't have a normal conversation with a bunch of NASA engineers. Everybody has an opinion, and so that's why you have a group leader. "Okay, everybody said their piece. This is the way we're going to go."

They were all good people, and I thought they came up with a lot of really good stuff. I was more amazed that some of the best stuff came from people who had absolutely no connection whatsoever with mining. Some of the specialties, like materials, there's a direct translation there, but other people dealing with aeronautics and things like that had some really good ideas.

What I learned really from all of this was that the people in NASA, there's some really amazing people and that there's not many challenges that these people can't overcome given what the parameters of the problem are, what the issues are. They can design something that will help or provide, in this case, suggested design recommendations. I don't know, maybe I ought to start a company where we just hire old NASA engineers and go tackle hard problems.

WRIGHT: You might have a pretty big selection in the next few years to choose from as well. You were a charter member of the NESC.

CRAGG: That's correct, yes.

WRIGHT: Since 2003, you've had an opportunity to see, as you just mentioned, how these people come together. Did you find anything different with this group of challenges? It was so different in the sense that you weren't dealing with "normal" NASA, that the NESC steps out and helps industry when it needs to. So did you approach it differently, or is it the same as you have done in the past?

CRAGG: I suppose I approached it somewhat similar to the way I've tackled problems here at the NESC before. I'd never been involved in mining in my life, but in my talks with the Chilean navy people, they hadn't been there either. Once we understood what the mining guys were going to provide us, which was like a 26-inch borehole that went down a half mile, it became just really an engineering problem to figure out how we were going to extract them. So with all that background it was sort of out of the ordinary, but then again it wasn't because it was an engineering problem.

WRIGHT: Which I find interesting because you went down as a possible assistant to the medical folks, yet engineering took such a step forward in helping solve this problem.

CRAGG: Right, it was fortuitous. We were looking to help out in any way we could, and this is one way that I thought NASA could help.

WRIGHT: Talk a little bit about the team dynamics of you working closely with the other three members of the team. We just talked about how you came back and worked with engineers, but had you worked with J.D. or Al or Mike before?

CRAGG: No, didn't know them. It was the first time I met them, and I thought we got along very well from the start. We were all fish out of water, so to speak; none of us had ever done something like this before. I think all of us were trying our hardest to be able to help the Chileans and give them something that they could use based on our experiences. So we were really supporting each other, I think, and really put our nose to the grindstone when we were down there. I got along with them real well, and now we're best friends.

WRIGHT: I hear you have a team name.

CRAGG: Right, right.

WRIGHT: You said about two weeks after you submitted the paper you heard back. What became of your involvement after that time period?

CRAGG: Not much at all. I'd heard maybe once again from the doctor, and I've had a number of correspondences with the navy submarine captain, but really outside this issue just kind of friendly banter. We weren't asked anything else, and I don't know how much the others were asked either. I don't fault the Chileans, I think they did exactly as I would have done it. They asked for help, we gave them our advice, they took the advice and ran with it. Then, as the time

came for the rescue, it was a Chilean show. And it really needed to be, I think, a Chilean show. They did the majority of the work, they really kept those guys alive, so I don't fault them for that. After we had given them our suggestions, they didn't come back, at least too much. I know that J.D. had talked to the naval doctor maybe a couple times about some other issues, but I don't think it was very extensive.

WRIGHT: This engineering contribution had an urgency because you had human lives at stake. How did that impact the discussions when you were trying to work within that one-week deadline?

CRAGG: We obviously knew we wanted to make this thing strong, and we also wanted, again, to get them something, because it would really be bad if they finished the borehole first and this capsule wasn't ready. Some of the brighter—well, they're all bright—Tech Fellows relied heavily on t his document called "Personnel Lifting Standards." It's the documentation that provides for how to build elevators and things like that. I'm conjecturing here, but there's specific factors of safety that are involved, so we treated this capsule like that and drew upon these already accepted guidelines in the United States for building a structure that was going to lift people. We were well aware that we were dealing with the safety of these people and we wanted to make sure that this thing did not fail.

WRIGHT: You were here in the States living your normal day-to-day duties whenever you were watching the rescue?

CRAGG: Yes, it's pretty cool.

WRIGHT: Did you have a chance to share with your team that the Chilean government had accepted many of your guidelines, you were able to get that feedback back to them?

CRAGG: Yes.

WRIGHT: I know that there is a possibility that the four of you will be returning to Chile. What are your expectations or what would you like to accomplish going back to the site?

CRAGG: I think I'd like to garner some lessons learned. Maybe NASA could help out in a situation like this in the future. This particular case was, in my understanding, an unprecedented event. The Chileans were really writing the book on this, how to save some people from a half mile down in this type of conditions. For NASA to come down and help, I think really shows the strength of our agency, but if we could somehow figure out how to codify this a little better, maybe in the future if we get asked to help out with some other issue we would be better prepared. This one was pretty much ad hoc, as I understand it. I'd like to get that out of it. I'd like to see how things went with the suggestions that we made and if there were any other issues where we could have helped more, or didn't help enough. I think lessons learned, we could get quite a bit of good info. The doctors also would hopefully get some information that would help their studies in long-term survival in austere environments.

WRIGHT: Do you feel like, just from this process of going down on the site survey and then coming back and putting this tiger team together, you have lessons learned from that that you'll be able to apply for another situation?

CRAGG: Yes, I think so. I think the lessons learned that I'll take back is that you can get NASA engineers to do pretty much anything. Having that team here and ready to go as soon as we came back into work after Labor Day was really key to the success, and the fact that they were all charged up and ready to work helped too.

WRIGHT: As a leadership lesson, do you have something you can share on how you were able to work through some of those heated discussions? Can you give us an example? For instance, maybe one of the discussions that you had to settle, how did you come to the conclusion of what to put in that list of guidelines?

CRAGG: You know, when I first came here—I won't say that NASA was a culture shock for me, but I guess it sort of was. One of the first quotes I ever heard from an ex-general, he said that the difference between the military and NASA is in the military when you give an order it gets done, and in NASA it's the beginning of an argument. So what I've learned in dealing with all these really bright people over the past several years is that when you have spirited arguments, you let everybody have their say. If you exclude somebody or let them know that their opinion is not worth it, then I think that's where you get on the slippery slope. In this particular instance, in putting these recommendations together, that's what I did. We ended up going through every item line by line, and if there were any issues—and there were some issues.

I'm trying to remember if any knifes came out. One in particular, they were trying to figure out whether we should tell them these designs "shall" be used or just leave them as a "suggested requirement." One guy was really adamant that these were design recommendations, it should be "shall." Finally, after everybody had their say, I said, "Okay, that's fine. We'll just leave it at 'shall.'" To tell you the truth, I didn't really particularly care. The intent was to provide them guidance. That's my theory of leadership in NASA, let everybody have their say and then make a decision.

WRIGHT: How do you feel your involvement, or even NASA's involvement, with the situation is part of the overall agency mission? Why should NASA have said, "Yes, we'll be glad to be a part of this"?

CRAGG: It's always good to help people when they're in need. We didn't offer our help, they asked. I think for us not to help would have been bad, because we had the expertise that they needed. I think NASA is an organization that needs to engage with the public. Sometimes the public has that half-hour TV-show attention span, and some of the great things we do don't really get appreciated, so one of the other reasons I think that was helpful in this, is it got NASA back in the public eye at least for a little bit.

I think if NASA can help in things like this in the future, that we ought to. We have some exceptionally bright and dedicated people here. Just because we're doing engineering for stuff in space doesn't mean that we can't do other things to help other people, and I think we ought to do that if we can. For a little effort in this case, I think we were able to help out quite a bit.

WRIGHT: Do you have some other recollections or some other issues that you would like to share about your trip and/or about this whole process in general?

CRAGG: I think one of the first things I learned in the navy was don't volunteer for anything. In this case, I didn't follow my own advice. I really thought the Chileans—I was very impressed with them. They're a very industrious and hardworking group down there, and I thought that they asked for apparently the right advice, not just from us but other people, and they used that advice to good effect. I really thought, watching it on TV, that that was probably the most flawless operation I'd seen in a long time. They had, it looked like, no problems at all. So I'd take away that I have a lot of respect for the Chileans.

I met a lady by the name of [María] Isabel Allende [Bussi]. There's two of them, one's a writer and one is the senator. The senator was from that region of the Atacama. Her father was the president of Chile in the 70's when he was overthrown by [Augusto] Pinochet. A very remarkable lady. She spent 20 years or so in exile and is now back after the military is no longer in power. I got a chance to speak with her for a while, a very gracious lady, just adding to my positive impression of the Chilean people.

It's very cold down there in September, very cold. I remember reading that one of the reasons the Incas [indigenous Native American culture] worshipped the sun was because when the sun wasn't out or they were in the shade, the temperature would drop 15 or 20 degrees [Fahrenheit]. Up there once the sun goes away, it's very, very cold.

WRIGHT: So much of your time was discussion and sharing information. Did you have a chance to enjoy the surroundings and/or getting to talk to some of the Chilean people? It's such a short trip, I know it was full.

CRAGG: This is one of those trips where you work all day and then we got invited out to dinner, and being a Latin country or like a European country, they all eat late. A lady who worked for the minister of economics in the region had us all over for dinner at her house. It was very nice, she was very gracious. We got back to the hotel late, got up early and went back to work. Then the third night we got invited over to the doctor's house. We didn't get there until 11 p.m., and the next morning was an early flight. So we did get to socialize a little bit. Then the last day we flew back from Copiapó and we had five or six hours in Santiago. I was told the minister of health got us a tour guide to give us a windshield tour of Santiago. I thought that was very interesting.

WRIGHT: What a nice gesture.

CRAGG: Ask the doctors. All the doctors fell asleep, but I was very interested, so I stayed awake.

WRIGHT: I'd like to end with your thoughts of what you felt personally of your involvement as you watched the miners being able to reach the surface, knowing that some of the work that you had done had helped ensure their rescue.

CRAGG: Well, you may expect I was concerned about that, but I was very, very relieved when things started going as well as they did. It just seemed that the capsule—and again, I didn't design it, I didn't build it, we just provided suggestions—but I thought that the way they had built it, it was performing pretty flawlessly. So I was pretty happy about that. Very relieved, actually.

WRIGHT: I'm glad it worked out well for everyone. Thank you for this morning. You gave us some great information, and I appreciate it.

CRAGG: You're welcome.

[End of interview]

NASA Suggested Requirements to Chilean Government for Miner Rescue System Design, 9/10/10