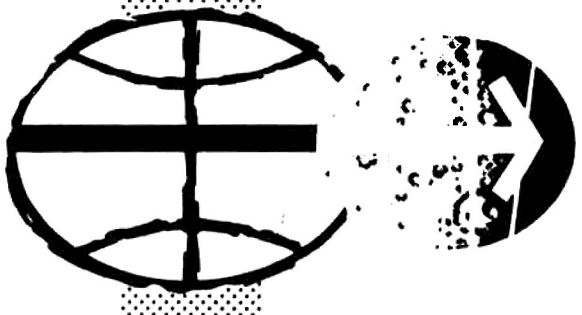
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 13 MISSION

PRESS BRIEFINGS



MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

APOLLO NEWS CENTER
HOUSTON, TEXAS

Haise Press Conference
Kennedy Space Center
February 25, 1970
8:02 CST

PARTICIPANTS:
Fred Haise, Lunar Module Pilot
John Mc Leaish, PAO

MeLEAISH Ladies and gentlemen we're ready to start now it you'll kindly take your seats, and then we'll turn over the program at this point to the lunar module pilot lor Apollo 1), Mr. Fred Haise. Fred will open with a formal presentation and then we'll throw it open to questions.

HAISE Thank you, John. Does everybody read me out there? Am I coming through the system here? Okay, the rules for engagement I guess this morning are that I'm going to give a little spiel about something I'd like to talk about, and then you get your chance later on to ask questions about any subject that you may be interested in. I'd sort of like to keep my part of it to discussion of the LM site and then a little more time on the hardware you see before you on the table, which is some of the lunar surface equipment we're going to be using that is different from the previous flights, 11 and 12. Could I have the first slide please. I'm afraid we're going to have to kill some of the lights for a moment here. Now if we can get our light at that station here. Okay, here we have a picture of the moon, and the approximate location of our landing site is here at Fra Mauro. Just in the way of orientation, Apollo 11 was to the east of us here in Tranquility, and Apollo 12 was about 75 miles west of that site in the Sea of Storms. Now, I'd like to bring to your attention to kind of give you a little bit of a feel for why we're going to Fra Mauro, to the large circular features to the north here, a little over 500 miles away from Fra Mauro, The Imbrium Basin. This, then, as you might imagine from the size, is a very significant event that occurred subsequently quite early in lunar history, and if I can you into it, if you look down in this region, you can see what appears to be lineation, lines raised that have been thrown out from the Imbrium explosion. Now, to people, who have not on USGS in Flagstaff likewise contend that the Fra Mauro formation is also a portion of the throwout or ejection from Imbrium. And I might point out that you'll see in the next slide that we're not actually aiming for Fra Mauro crater but rather the linear hill region to the north of the Fra Mauro crater. And so basically, we're going to sample some of the ejector that was thrown out of the Imbrium basin, which offered the chance to extrapolate some of the history of a very early significant event in lunar history, and also to collect, hopefully, some rocks and dust on the moon. Next slide. Now to bring it a little further down. This was a shot from Apollo 12 of the area, and the landing area is approximately where I have the arrow now. The flight path in for landing is from this direction, across this ridge, which is approximately 600 feet high, and hopefully to land in this flat field just past the valley which is beyond the ridge in this area. And I might just spell some of the words that are written that

HAISE call Fra Mauro a mountainous area. I guess you can accurately call it a highland, and in terms of the local, strategically, I might stretch it and call it hills, but I wouldn't call it mountainous. Next slide please. Now we're going down to the high resolution pictures that were also taken from 12, and I sort of shifted the scene a little bit from you directionally. Before on the previous slide, I showed you the path entering is this way

END OF TAPE

HAISE ... and I sort of shifted the scene a little bit from you directionally. Before in the previous slide I showed you the path end is this way, well, now the approach path is from this direction. The ridge that you saw running northwest-southeast is along this line. THis feature right here and I don't know if you had the trouble making craters pop in or out but here's a crater that lies in the top of a cone. The height of which is, I'd have to guess somewhere like 250 to 400 feet - to the top here. The lateral site - is approximately in this area, where I have the arrow. Now any further details on exactly where the trajectory is - it's just recently been changed and exactly piloting wise how we hope to get in there, I believe Jim Lovell will discuss this in about a month hence. It will pretty much rest on him where we end up. The - geologically though, if we hope to get this ejecta sample from Fra Mauro, it indicates that we either have to get back in the vicinity of Cone Crater, which this feature is about a thousand feet across and about 150 foot deep. And there is quite a rock pile around the basin of this cone and it would be very desirable to collect samples from this area. Anyway, because this landing site is further down in the valley around the plateau, if we end up a little long and felt that the surface layer in here is going to be some form of a regolith possibly a later - later in time of volcanic flow that has covered the lowlands. And the problem there is that there could possibly be a lot of loose ejecta around there but it becomes a problem sorting out what is Frac Mauro versus what may be Copernican soil - so if you're familiar with the moon it's a very large feature also that's hidden - hidden really as far as Imbrium to the north of our landing site. The second objective if we end up a little long, would he to get to this feature which we have dubbed as Sunrise Crater. And it's the next most prominent crater in our landing zone that offers a chance to maybe get through the regolith or the surface layer and get down there to bedrock. You can turn the lights back on now. We expect the EVA's just like 12 we're going to run two EVA's about three hours to the first one, we'll spend deploying ALSEP 3 and the remainder of the first EVA whatever time in realtime we end up running and the whole of the second EVA is going to be dedicated to the field geology experiment. Now, I have some hardware here that I'd like to show you that each of which represents some problems that have occurred in previous flights. As you recall from 12 they had encountered quite a bit of problem with dust getting on their suits and getting in the vehicle and this may not be the ultimate solution but at least within the time frame of getting things ready. I have before me here what looks very much like a paintbrush that we really hope to use on our extension tool before getting back into the LM, to do a little brushing of each other with this utensil and

HAISE hopefully at least get rid of the large clumps of dirt that may be in our suits. The - we also carry two small brushes which I'm really - don't have with me that will be in our suits that we can use to take care of dust primarily on camera lenses. And I'm sure this won't take care of the total problem because of the fineness of that material I think some of it is quite likely to be smudged into the material of the suit and I'm sure just a plain ordinary looking brush like this will not take care of that problem. Now, Pete also had a bit of a problem with using the old utensil we had for digging a trench --

END OF TAPE

HAISE Now Pete also had a hit of a problem with using the old utensil we had for digging a trench and actually on this mission we have a requirement to dig a 2-foot trench, and hopefully, if the place is interesting enough, and even beyond that 2-foot trench, I hope we will make use of this utensil to do quite a bit of digging in the sides of small craters or anywhere that you have a chance of maybe getting vision below the surface where you think there may be some laren or stratigraphy. This may be familiar to some of you who have ever spent time in the service. It's sort of a copy of an intrenching tool I think that's been used by the Marine Corp for years. Now the apparatus we have on the head, the swivel is different, as I recall from using one of these before in the old days. We have a little screw that we undid and repositioned and then tightened. Just because we can't turn screws real well they deviated and made it a little fancier, but it does the same sort of job, and the long handle is - I'm not sure, maybe Pete's digging problem partly may be due to height, but Jim's going to primarily use this, but at least a longer handle in the lack of bend in the suit will allow him to get down quite readily to 2 feet. Now you notice the shape of 90 degrees it also can be positioned straight out like a shovel, but we've found for use in the hard suit that it worked a lot better using it as a hoe. And this utensil we'll be using on the second EVA. Well, the next item I have here is not really different, it's only different in that it's being carried again. This is a TV camera. We;re carrying the same color TV camera that was - not the same camera, but a similar camera- that was flown on 12, and I guess we have redundancy in pretty much every system in the spacecraft so now we've come to redundancy in our TV camera system as well. This is stowed inside the LM rather than externally like the color TV, but on the first EVA we'll unpackage it upstairs and carry it down with us on one of the early transfers and it will be sitting downstairs in case we have to backup and replace the color TV. This is the same camera that was flown on Apollo 11. Another point that was brought up really on both 11 and 12 and we also noted in our SESL programs which is a gadget over in Houston that both puts your vacuum and provides the same thermal environment and really here we showed up with the glare effect of the sun, and the point being that if you look directly into the sun with this visor on you end up with a glare, a glare in the windshield, to put it simply, and we had sort of covered the cases where the sun was from the side by these side covers that could be dropped, but to take care of going straight into the sun problem we in essence built the central visor with the little flap here that you can lower and raise and it acts very much like sort of wearing a basevall cap. I'm not sure we've had this.

HAISE I don't think we've had this prototype when we ran our EVA exercise a couple of weeks ago. I have used this subsequently on other training excercises outside and behind the MSOB and we've run pretty late in the afternoon when we've had direct sunlight and it does work quite well. Another innovation is just a battery operated replica of our onboard 16-mm camera, and this will be going with us on both EVA's and the primary purpose is to record dynamic events like my drilling operation or our loping cross-country operation. Hopefully in the second EVA we can record for posterity a rock rolling down a slope and in general to get pictures of dynamic situations where we're, in the second EVA at least, going to be well out of view of the TV.

END OF TAPE

HAISE and in general to get pictures of dynamic situations where we're in the second EVA at least is going to be well out of view of the TV picture, that the Hasseleblad, the still camera, just can't record. We also have the capability of using it as a backup to document the samples if one of the Hasseiblads should fail. We can run it at 1 frame a second and use it also as a backup camera for documentation. Now here's another idea we got from 12, Pete lugged a pack on his back really with the thought in mind of carrying the pieces they were going to extract off the Surveyor and they felt it was a pretty good deal to lug rocks in. The other mechanism ahead for lugging rocks is a little sack that they had hooked on to the restraint hook on the side of their suits and these things were Teflon and I guess later on because of the collapsing venting they did collapse and we've been using earlier in our field training exercise and we've run on a mission basis about 16 of these now. We've been using just plain old ordinary backpacks and we feel that they work pretty well. In this mission we'll use two of these gadgets, each of us will have one. And, this is where the rocks will be collected on our EVA and you see we have quite a bit of volume here and it shouldn't be any problem getting just about everything. At least we hope we can make use of most of this volume. There is one extra pouch here which is really just a way of keeping separate camera magazines. In mine we have a hundred foot tether which began as a sort of a safety thing if we end up going down in a crater for the guy going down to be attached to the one who stays up on the rim. Now I see one item that's missing here that I was supposed to have over and it's been a great innovation for our exercises that were run here at 1-g where I guess that's been one of the biggest and most plesant surprises the real versus our practices the ease at which these things are at 1/6 G versus the 1 G and Pete and Al commented about getting thirsty while they were running around out there and I'm not sure if it was because of the amount of talking they did or the workload which wasn't really that high. At any rate, to combat that we have a — it's a little pouch about so big that's clear plastic and has a tube that comes out of the top. This gadget sits on the inside rim, just under the helmet lip here and the tube protrudes up so you can grab hold of it and by biting the bit on this thing you can get a swallow of water. The quantity is 8 ounces which on the basis of our 1 G three-to-four hour exercises for that workload hasn't really seemed enough but hopefully that lower workload up there will suffice. It's

HAISE just a matter of wetting your whistle anyway. Could I have the next slide now, the viewgraph slide Say this gives you a picture of the ALSEPS at least. The ALSEP number 1 was flown on Apollo 12. We're flying ALSEP 3 and 4 I guess is on 14, and we have one experiment that's in common and will remain in common as many more ALSEPS as there are. It's mainly the test of seismics. We have the last two first, we have a charged particle experiment and a cold cathode, this one has to do with measurement of flux on the surface, primarily solar wind, low cosmic energy stuff and this one is, in rough terms, a measurement of the lunar atmosphere and I'll dispense with the discussion of this in the first place because Jim's part of the ALSEP and I'm not really that familiar with them and I'll make a few remarks about the passive seismic and the heat flow. The heat flow, of course, is my primary part of the ALSEP and the passive seismic is of interest, because of it's association with the geology -

END OF TAPE

HAISE Both of these are pretty much for determination of structure of the moon beneath the surface and origin. Now, because of seismic, In case you are not aware of why it is a common element. This device, which you are probably familiar with in earth use has gotten a lot of publicity for primarily for measurement and finding out where earthquakes occur on the earth. Now, beyond that of the moon, they would also like to see earthquakes on the moon, primarily, they utilize this device to see into the structure of the moon below the surface. To get the proper measurement to find out if such an event occurs, where it occurs, you need a network of these things to triangulate and pin down where the event occurred. Right now we have one station operating up there on Apollo 12, and unless you predesignate the object that it's going to hit, like the LM ascent stage, which they did, where you know exactly the energy and where it's going to hit. Any other event they've recorded, it's a sort of an energy measurement, and they can - they're sort of stymied in really picking out exactly how far away this event occurred. It could be a large event that occurred far away or small energy impact not so far away so we're putting another package up which will help close up the net a little more in spite of our close proximity to the 12 site. Later missions will complete this net to give a little better triangulation to pin down where these events occurred. Now there is one advantage to our site being so close. If the order of magnitude of events are low energy, at least over this time period of this experiment, and the energy is not imported to the moon over a great great distance, then the 2 stations we have on 12 and 13 will pick up a lot of events that possibly the larger wider spread nets would not see. One other point which you may have missed in what I've just said, unfortunately the moon to date at least with the looking I've done, it's been a fairly quiet body compared to the earth. And in that regard, the significance of our artificial impacts with the LM ascent stage, and in the case of our mission, the S4B takes on a little greater importance. If you want numbers, I guess the byline on the S413 is its chances are something like 50-50. I'm not sure of that. It depends on maybe whether you are from KSC or MSC, I don't know. But the place they're aiming for is about 200 kilometers further west of the 12 site with our S4B, and the timing of that is, it would hit about

HAISE the time we're on the backside so unfortunately, they will still have only the one net going when the S4B bangs in. The significance though, is that that energy impact should give them some insight into the surface structure of the moon down to about 50 kilometers below the surface. Now, there is another calibration data point that is the same as 12 at the end after jettison of the LM, our LM ascent stage will be impacted also in the moon at a point approximately half way between the 2 stations which will hopefully be running after 12 and 13. And again with that known energy and location of impact, it serves to better calibrate the 2 stations, and again refine the methods and means of figuring out where something hit. And the kind of numbers in terms of distance of something like 3 to 5 kilometers, 6 on this point. Early in the game, with the more data points you have, the more refinement you can narrow down. I guess on earth, a slight 1/10 of a kilometer. Okay. You can turn the lights back on now. Now the heatflow brings in a rather interesting piece of hardware. The gadget I have here is a drill, which some of you witnessed in an EVA exercise a couple of weeks ago. And the heatflow experiment has an objective of measuring the heatflow

END OF TAPE

HAISE The gadget I have here is a drill, which some of you witnessed in the EVA exercise a couple of weeks ago, and the heat-flow experiment has an objective of measuring the heat flow to the amount of the heat flow that's coming from the center of the body and also to measure the change in temperature with depth, and to do both of those jobs we have to get probes down into the ground and hence the drill, and if it works it's good, as it has for me in training here on earth with equivalent lunar soil matter back in Houston I'll be able to drill 2 holes 10 feet deep and place these probes down into the hole for Dr. Langsford so he can find out these 2 things. Now with that sort of data and the correlation with the seismic and a little bit of smarts about the structure of the moon below he can play games then with trying to extrapolate this data that we get from 10 feet and bootstrap it down hill and get some idea of the internal temperature of the moon, which in turn gives you some smarts about the origin and the type of energy that is developing this high temperature. Now back to the hardware again. The drill itself is used actually to drill 3 holes, and the weight of this thing is about 30 pounds and you may have noted at the exercise that it is quite heavy to operate with the suit in 1-G but we are quite fortunate in that the moon - on the moon it won't quite be that heavy. For the first 2 holes we'll apply the stems you see here in the rack, which are fiberglass, mainly so as not to hurt the conductivity measurement of the probes and there are 2 sets and the third set of core stems I don't have - oh, yes I do. The third hole is made up of a hollow core stem that is metal and this is the one that I would strike and unscrew section by section and recap and bring this tube back home. The first tubes stay in the ground and the probes stay, hopefully, stay in in the core stem. Now, the advantage of the third hole is that Dr. Langsford gets a first-hand look if the hole is hidden in some different type of material of at least what the material is in the surface in which the probe was sitting and that, of course, is a very important thing for again collaborating the data he's going to be reading back in real-time. The heaters that he will be employing in the probe to get conductivity measurements is a matter of interest yet is the first active experiment that has been done on the moon since the Surveyor scraper. Of course, geologically another point of interest thawt is tracked in the core is the first time we get a vision just a little bit deeper, not very much, I realize 10 feet compared to the center of the moon may not be very deep, but it does give a look-see through the surface structure at least in place what in time represents several million years. I guess that concludes my discussion of the first 3 hour portion of the first EVA, namely the ALSEP. I'm open to any questions anyone may have now.

PAO Okay, we're ready now for questions from the Cape if you'll raise your hand, please, and we have mike handlers here, and wait for the mike.

QUERY Fred, I understand there is some kind of a vacuum cleaner gadget that you are also going to use along with the brush. If this just part of an identical portion of hosing or something, or could you describe what it is?

HAISE Yes. There was talk of building an independent sort of vacuum cleaner which isn't going to make it on our flight. The vacuum source we're utilizing is our own LM ECS system and we have a hose which we transfer from the command module and we can hook it up to the LM, the same hoses that are feeding our suits, and utilize that scheme to vacuum and clean both the LM and the articles that we're bringing back.

QUERY Fred, could you describe how you use that drill? You take one of your stems and put it in and another one on top of that and another on top of that?

HAISE The way it works is - I start with 2 stems. I can handle, starting out, 2 and thereafter I found, at least at 1 g, I may try it once on the moon again with the less weight I may be able to handle putting 2 on top, so I drive 2 down and end up with about that much of the stem protruding from the ground and just with the weight of that drill here on earth anyway I found it very difficult to put 2 core stems on top of that and lift the drill up on top of that stack, so I've been going one at a time after starting with 2, and I guess the drilling time has been averaging somewhere about 4 to 6 minutes to drill - I'm talking drill running time to drill "a" hole, and the model that I'm using back in Houston has some rather large blocks, basalt blocks sprinkled in with the very fine stuff, so it -

QUERY (garbled) can you go through, have you been able to find out?

HAISE Well, the limit is the time which you want to spend and the battery's power. The rate is about, I guess, 2 inches a minute through someting like basalt, and the ground rules we're going to go on this - actually it's more of a problem than just, for this part of the experiment anyway, than just going through rocks. First of all, the conductivity measurement is somewhat degraded if we end up - even if I went through a rock, the measurement at least over that portion that he's measured from the heater to the ring gage, that measurement sure would have to be sorted out, although he has 8 different measurements he can take so he can work around a rock, but in that portion at least it's undesirable from the heat-flow conducdtivity measure-ment. The ground rules we're going on are if I go down

RAISE with the first 2 sections and I hit a rock I just pull it back out and start again. Beyond that we like 3 sections down in real time we'll have to play games with - if I go 1 or 2 minutes worth, and then if I hadn't gone through trying an extraction with 3 sections and start over. Beyond 3 sections I'm sort of in trouble. It's going to be a little hard with that height to pull it out at that point and start again.

QUERY A couple of questions. Back in December I think it was you had some open items left that weren't solved. One was the EVA radius of 1 kilometer, another was that 20 degree yaw on the LM during PDI. Those are 2 that I recall. Have those been settled?

HAISE Well, let's take the second one first. The only yawing that we're concerned about for our landing site, which is pretty close to 12, is the one during ascent and in that case we're actually yawing a little more than 12 yawed 20 right, we're yawing 30 right, and that's just for S-band coverage. We don't lose the S-band antenna tracking of earth. We're essentially going down to zero yaw PDI for descent. The first part of your question on the 1 kilometer distance, yes, we're hopefully going to land such that we're right at about 1 kilometer from our objective at the base of cone crater and again that's a real-time thing, how do you measure 1 kilometer when you're out walking around on the moon? I think distance - it's hard to put a number purely distant because it also - it's a greater effect there of what you've been stumbling over. Have you been going down hill or have you been going up hill, what's the way back, it is going to be easy to make it back or is it going to be hard to make it back? And I think those kinds of factors are just as important as a pure distance measure and we really don't have an extremely accurate way of striding out and then stopping and saying I'm exactly at 1 kilometer right now.

QUERY A couple of questions. On ALSEP 3 versus ALSEP 1 you've eliminated 3 experiments and you've added 3 the way I read your chart. Is the physical dimension of the (garbled) in the stowed condition are they still the same? In other words, the LM hasn't been reworked, they fit on the same base (garbled)?

HAISE The physical dimensions, let me say that they may not be exactly the same but they still fit on the LM. They are still fitting on the same FEQ base and to my knowledge our FEQ bases are not different than on LM7 than on LM6.

QUERY The second part is the HFE, the heat flow, the drill package there. That fits on one of the pallets in the stowed condition. The film I saw is a little confusing. I think I saw you carry that out separately. Is that correct?

RAISE That's right. Actually it's sitting on package 2, we pull that out first. I get the tool carrier, hand the drill off of that package and I sort of going about my business around the corner and unpack rock box number 1 and get all the stuff ready to head out to the ALSEP while Jim is working and getting the bar bell and the 2 packages tied together and doing some panorama picture taking.

QUERY Fred, has Jim or have you picked out something near your landing site, some easily discerned feature remeniscent of the snowman, and question 2, will the powered descent be done entirely face up as it was done on 12?

HAISE Okay, the second part I'll tackle that, it's easier. Yes, we'll go faceup the whole way. See, the way our timeline goes is -

END OF TAPE

HAISE PRESS CONFERENCE, 2-25-70, 1G/1

QUERY (garbled)
HAISE You see we the way our timeline goes as you know the command module gets us down low, we go down low on rev 3 and we don't have to land until the 14th revolution and actually end out the rev earlier than 12 did and so in that sense we get two free passes over the landing site to look before we ever set down so even if we had some inclination to get a look down the trade off versus the landing radar early, there's just no need to. The first part, just the other night we did sit down and name all the, what we felt were the most prominent features in our landing zone. Again, we needed them for traverse planning and for talking purposes when we're running this EVA simulation and unfortunately we don't have a feature pattern that is quite as distinctive as a SNOWMAN. However, from the topography of that ridge which is like 600 feet and cone crater 250, 400 feet sticking up. Those features to the lead in certainly ought to be pretty prominent in themselves without needing much of a pattern, beyond that without going to the trouble of turning out all the lights and showing the slide again we do have a set of triplet craters and a doublet beyond that that should show up fairly well. There are fairly new sharp rim crater sets. Down range we have another large crater that I pointed out as the second objective, sunrise, it's way down range, in case for some reason the trajectory may be in that direction and there's another one I didn't point out, we'll call them star craters, another fairly bright kind of crater.

QUERY Fred, how far will you be from the LM when you start drilling, will you be within sight of the TV?

RAISE Yes, the other day we ran that fact out to the MSOB pad with Houston on TV and I guess their feelings were looking at the monitor were that they could see two figures and they could see our relative displacement to each other but it was really very difficult to tell exactly what I might be doing and just by virtue of the timeline I guess they helped talk themselves into saying that they could tell I was at the drill or something and - unless it raises - and I hope not - an awful lot of dust or something like that. I doubt very seriously if you'll be able to see. Hopefully, though, you'll be able to hear it. The drill is a rubbery percussion type device, that is, it not only acts like a jack hammer in pounds, it also revolves and it - for those of you who did hear it a couple of weeks ago - makes an awful clatter and hopefully that'll rattle up by the arms and be resonant enough to come down over the VOX and the ground will hear the drilling. I say hopefully because we'd like to mark

HAISE and stop each cord that goes down, particular third hole where we hope to be looking at it with the seismic if it's active at the time and that way It'll save me from having a - to forget as I usually do to say mark and stop it because people can hear the drill running.

QUERY Could you tell us what changes in procedures and rules that there have been in two instances in regard to the lightning in the last launch and also for the depth pad in landing?

HAISE The first one is in the form of a memo, that I thought is out but I'm afraid I haven't really reviewed it yet and that's fortunately not in my bivovac of decision making and I suppose this information would be available through Kapryan here but I've really not reviewed the memo and it is sort of complicated with perspectives or the cloud cover that exists and I'm not going to be in a position up there when that day comes to really begin to make that sort of decision. Let's hope we don't have to cross that crater. Let's see, the second item was the perspective of depth. The system, I think, in the LM was proved fairly well by Pete that that system we had does the job quite well because I don't think you've looked at his landing pictures. It was a fairly high far landing, that is, he didn't have much reference out the window and the last moments of that approach. We have added, if you read the todays paper, a module in the landing program and a computer that extrapolates a little further with the autopilot feature to damp the horizontal velocity so Jim can leave it in auto and let the computer null out the left - right 4 F velocities and you can still use the clicker for rate of defense control. If there was not much maneuvering and a lot of phase and you had time to set up high like we normally try to do, up on our feet and come down from there, it's a - in that case it's kind of a luxury item really because we have a set of cross pointers on the instrument 2 element packs on the instrument panel that are displaying to you the same information that the computer's using to do that job and you can null these needles maybe not with the same finesse and savings in fuel as the computer but certainly do an adequate job manually all the way which is what we would predict - not roughly - but exactly.

QUERY I seem to recall Pete Conrad making that suggestion before such a program very early maybe it was on the return flight.

HAISE Yeah, now the point I didn't get to was the situation where that is very nice to have if you do some very late low down, low to the ground manouvering, you have it come down in a straight path and had time to null everything out and you get pressed for time in that area. The

HAISE computer very nicely gets these rates all to zero much faster than you can do it without over controlling.

QUERY You're saying that if you have a maybe a fuel con - propellant consideration you could land quickly with the computer program whereas you have to null everything manually you might not have propellant is that it?

HAISE Now I think it has to do with the characteristic of the latter phase of the approach, do you have to change where the things headed for? If you've been smart enough to interpret through the window that it's gone where you want it to and make the proper LPD inputs while you're still fairly high up and zero in on a place that you want to land then in essence you don't have to do any changing when you get down low but as you know, for instance, in Pete's case he ended up veering a little bit to the left and long and Neil went quite long on his, changing that from like 500 to 600 feet on down in that area. And it would when you get to where you want to be, if you wanted to stop everything all of a sudden and then come straight down, that transition in the computer program can do very nicely.

QUERY Fred you mentioned that you described the landing area as hilly, if you land where you want to is there any chance you can walk through some of these hills or ridges in the area and perhaps take some samples from various heights.

HAISE Well, again, that's kind of going to be a real time thing. We hope to get back to at least the base of Cone Crater. Now, the slopes on one flank, the flank facing us as we walk back are really a little too steep to negotiate but around one side and I guess they're in the order of about 20 degrees and that's the same kind of slope Pete and Al were working with in Surveyor Crater and so at least it's feasible to go up that side of Cone Crater. From a sampling standpoint there really is a very definite ejecta blanket of rock fragments that's thrown down around the base of this thing so from that sampling standpoint we can get what came out of the hole at the base of the cone and it would certainly be of interest to get up to the rim and with that size feature hopefully there would be some outcrop some place from the size and shape of this crater and even if you just got pictures of that it would be of extreme interest. Another benefit, of course, high ground would give you a magnificient panorama. You could see a good deal more of the countryside than you can see from, of course, walking around, you're a little less than a mile to the horizon and

HAISE PRESS CONFERENCE, 2-25-70, 1G/4

HAISE in the LM I guess it gets you out to about 4 miles but whether we end up going there depends on where we land, this would be sort of at the extreme of the traverse and what's the consumable picture at that point in time - those questions I think can only be answered the day we get up there.

QUERY Fred, what are the dimensions again of the Cone Crater. How high is the rim?

END OF TAPE

QUERY Fred, what are the dimensions again on that Cone Crater? How high is the rim off the lower level?

HAISE Al, again they're kind of spattered numbers up there. They're like from 250 to 400 feet. The crater itself on the top of the cone is about 900 or a little over feet in diameter and I think about 150 foot deep.

QUERY If you had a like a 20 degree slope on the side of this thing and some ejecta material, is there a danger of a rockslide, could there by walking on it? And is this something that you're looking for?

HAISE We're just stuck - I'm not sure what the angle of repose on the moon. It's something like forty something degrees on earth and at the angle that you'd see that things aren't in equilibrium and we wouldn't really expect that at a 20 degree slope to generate very much of a rockslide, at least not with my small mass traipsing around up there.

McLeaish Howard Benedict.

QUERY On the heat flow experiment. Could this give you information about whether the moon is heating up or cooling off and could it provide information on whether you've got a molten core in there, in the center of the moon?

HAISE The answer to both of those is yes. I guess the problem sorting out the energy sources and I guess bodies can be hot for various reasons, for reasons of origin and in the case of the earth and probably the moon for radioactive materials that are continually generating a heat source.

McLeAISH Mary Budd.

QUERY Do you think any of the seismometers will pick up this drilling that you're going to do?

HAISE We hope to. That's why we're hoping to get this seismometer running by the top - there's no question that it'll record the drill. The seismometer has recorded footsteps throughout the traverse on both missions. It recorded people running up and down the ladder and - it's a very sensitive gadget. In fact, the main concern about drilling with the third hole is that I'll be too close to it to follow the tracks very successfully.

SPEAKER Howard Benedict.

QUERY Fred, you - do I understand right, you said you were - the command module and the LM will go down on the third rev down to the 50 thousand foot perigeeor parallel and

QUERY then you won't have to go down until the fourteenth?

HAISE That's correct.

QUERY You will stay in that for eleven - for eleven revolutions then. During that time you will get two looks at the landing site?

HAISE We'll get more looks than that. It's just the early part for a few revs the landing site is in darkness and it really won't be till the LM part of the activities that the lighting is getting sort of close to what we want to land at. Each rev it shifts one degree so two revs before it will be approximately 8 degrees at the landing site. And then the last rev before landing we'll take a look at it at 9 degrees sun angle.

McLEAISH Howard.

QUERY Once you separate how long will it take you go get down there?

HAISE Let's see, it'll take approximately just under three revs which is 7 and a half hours time.

SPEAKER When you've dropped off that low in altitude won't it take 3 - 3 and a half revs.

HAISE Well, see what all we're discussing is the time to do one maneuver which isn't that much. We still have the same sort of LM activation and checkout to go through and beyond that they desired one extra rev for tracking to better pin down our position. And in terms of the time that elapsed from the time that they called in the LM till landing in 12 there isn't that much difference in us. We're undocking one rev earlier than 12 did. Some of the LM checkouts we're doing after undocking.

McLEAISH Okay, I understand we've got no questions from Houston. Why don't we take two more questions here from the Cape and then close it. Mary Budd.

QUERY Fred, you personally, what do you think will be the most interesting aspect of the whole moon exploration from your personal viewpoint?

HAISE Could you clarify what you mean by the whole moon exploration?

QUERY Well, on your mission, I mean, are you personally more interested say in geology experiments or whatever it may be.

HAISE I don't think that at least for the two experiments I discussed in some detail here and on the ALSEP they're really very closely related. My personal interest I have to say is in the geology. I think the area we're going into is very interesting. I think it will be - I hope at least the contrast in the rock types that were seen on 11 and 12 hope we'll get to see some rock from a depth.that have crystals that even I can recognize and the ALSEP drill operation is pretty challenging part of the operation too. Like I said, I think it's a good gadget and I think it'll work if the moon'll cooperate and not put bedrock in the wrong place I'll be all right.

McLEAISH One final question. In the absence of a final question, we'll close it.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

MEDICAL STATUS BRIEFING
Kennedy Space Center
April 6, 1970
6:50 P.M. CST

PARTICIPANTS:

Dr. Charles Berry, MSC
Jack King, PAO

APOLLO 13 MEDICAL STATUS BRIEFING, 4-6-70, CST 6:50 PM, 8A/1

KING We're ready to procede with our conference at this time. Your colleagues also are listening in in Houston. This will be a two-way conference, and after we accept questions here, we will switch to Houston to take questions from Houston also. Now, I'd like to introduce Dr. Charles Berry, who is Director of Medical Research and Operations at the Manned Spacecraft Center. Dr. Berry.

BERRY I guess you all wonder why we called this meeting. I think it would probably be best to try and run down for you where we are now in regard to this situation, and in line with some of the statements in the release awhile ago, and try and re - tell you what we're doing at the moment, what our plans are, and that will, I'm sure, lead to some questions. We have at the present time, got word to the crew that they're to have no contact with other individuals as of now. We separated the prime crew from the backup crew in separate areas of the quarters. There will be - as we would do normally anyway - there will be checkups of both prime and backups on a daily basis, so that we can have some idea about our status day to day during this period because as you know, the last big exam was - would normally be today. We have a situation where we have a backup crew man who has what we all feel to be clinically a fairly classical case of Rubella or German Measles. We have every evidence that he has been, of course, in very close contact with all the other members of both the backup and the prime crew, and certainly during the period that was infectous here you are - you can communicate this disease for a 7-day period - normally a 7-day period prior to the appearance of the rash or - and then it goes for at least 4 days after the rash that you're still communicable, and they have taken throat washings for a lot longer than that and found that you can still cause infection with that material. It's passed by mouth, by contact from respiratory passages, and the situation that we have is making - one making very sure that this is the diagnosis that we have. We feel clinically that's certainly the case. In this instance, we'd like to be further sure to that, and one other thing that you'll ask right away, I'm sure - "Well, what else could it be?" There's only one other thing that would possibly fit this sort of a situation. It's a very long shot, but it could be one of the echo viruses, and there is one of the echo virus strains that produces some symptomatology which is similar to this, and some of the findings that we have here, and it doesn't help our situation much if it would happen to be that. At any rate, there would be a difference as far - it could be a difference as far as the diagnosis is concerned. The incubation period is 14 to 21 days and this is not uncommon for most of the viral diseases and the average

BERRY for this particular one, the Rubella, runs about 18 days. We have a plan whereby we have taken blood, as you know, each of the blood samples that we take, we always store some of the serum, and we always have - we have a serum bank, and we can go back for any of the people for any exam that we've done. We can go back and check that serum for some particular thing, if we so desire, if there's any need to. In this instance, of course, we have serum stored from the F minus 30 days exam, and we plan to check that serum plus this serum that we're drawing this morning, and these will be run in our laboratory. In fact, they're on their way to Houston now and will be there tonight, and we'll start running them tonight. We plan to check very carefully both the prime and backup's serum and of course, Charlie Duke's blood was drawn in Houston, and we plan to do it the same way, and we will check it for Rubella antibodies. We'll check it for Rubeola antibodies and we'll check it for the level of echo virus antibodies. With this information then, what we would hope to do is be in a position to determine what the possibilities are of the prime crew developing this particular illness. That's the kind of position that we're in at the moment. We're trying to get to a point where we can determine what that possibility is, and have some sort of confidence that we can hang on that particular number. So that's the role that we're playing at the moment. We're trying to gather that data and we hope we will - we may have some of that lab data late tomorrow afternoon. Certainly, we will have it by Wednesday morning with a check on it, and we are developing tonight some plans as to what we plan to continue to do in specifically the actions that we have done with the crew members and also where our decision points are and the information that we need to make a rational decision at each of those decision points. So, that's the status of the game at the moment.

KING Thanks, Chuck. We're now ready for questions. John, ask your question.

QUERY Dr. Berry, we understand that it's very rare for an adult male to get the German Measles. For this reason, more than likely, whether they know it or not, they have built up an immunity to the disease. So, what do you think are the chances of any one of the prime crew getting the German Measles?

BERRY I'll be far better able to answer that question when I know what their antibody levels are because I can answer it with some assurance. Now all I can do is guess with you. And if I told you that I was going to look at a number of adults I'd say that the chances of any large number - you know, any number of adults getting the German Measles are pretty slim normally. It's not an adult kind of disease, but the difficulties

BERRY are that when you get an adult disease - when you get a childhood disease as an adult it's always a worse disease, and secondly we have very - a very definite known exposure, and one thing you can say is that when you do get exposure like this with the measles virus, that you almost get a sure case. If there is one thing your doctor will tell you when you go to see him , and you've got the measles, and you have somebody with exposure, he'll tell you "Well, okay start - you can start looking for the symptoms to develop in so many days." Now, there are a lot of things that alter immunity. You know, it's not a simple process. We are capable now with some of the laboratory techniques of looking at these antibody levels and that is a very helpful thing because it gives you some idea whether the individual has built up immunity or not to this particular condition. The timing of that is, of course, helpful to you also. So, I think that the position that we're in here now - I don't know what the chances of these individuals getting this disease and that's what we really need to find out.

QUERY Is there any reason to suspect that because of weightlessness of pure oxygen environment or something like that would speed up the incubation period or alter the disease in any way if they got it?

BERRY Again, I'll have to tell you - we really - I can't give you an honest scientific answer to that and tell you "yes" it will or "no" it won't, and so that tells you the answer is that I don't really know. We are concerned about the effects of the spacecraft environment upon both viruses and bacteria. As you know, we have seen some changes and some effects in this area, and so it's something that we are concerned about, and something that is weighing on our minds right now. It would certainly enter into the decision when we finally make it.

KING Come around the front row and we'll take your question.

QUERY Dr. when did Duke get sick? Who did he pick it up from if he - when was the - how, let's start it this way. How sick is he now? Who do you think he picked it up from? When do you think he got it, even though he showed the rash on Sunday, and when was the last time he was in contact with the crew?

BERRY Oh, boy that's a long series of questions. Okay, one how sick is he now? He is not - he is better today than he was over the weekend. He initially had symptoms starting on - apparently started on Friday afternoon from the best we can determine on our very good history now and going back over the things several times. He just didn't quite feel right on Friday afternoon. Saturday he had some generalized aching, and fever. He had this again on Sunday, and then finally Sunday afternoon he had a rash late Sunday afternoon and so he was seen late Sunday evening.

END OF TAPE

BERRY - and so he was seen late Sunday evening and so, and at that time it was thought that this was what he might have. Now, he was seen in Houston, in the meantime while he was seen I was in route down here, and the first we heard of this was this morning just before the exam and there was a question about what we had for an actual diagnosis, and so he was being seen again while we were examining a crew here this morning we had him being examined again and a lot of laboratory samples being taken. There are some histories asking the very kinds of things you're asking me here about contacts and so forth was being taken there too. He has had very intimate contact with the backup crew up through last Friday. He also had the same kind of contact with the prime crew and his last contact with them was on Friday. There was a crew meeting that occurred in the crew quarters very late on Thursday that involved prime and backup crews for a fair amount of time. So, there has been a fair amount of contact here without any doubt and certainly during the infectous period. Now, as to where he got it, we do know he has gone back to recall, and there is some question of - and we're trying to chase this down right now but there is some question about a possible contact about 2 weeks ago from, 2 weeks ago Friday. And, so, we don't know this definitely at the moment and we're trying to chase this down. It is a possibility and if that turns out to be the case well that certainly fits in with the incubation period. It would fit in with it, some 2 weeks ago Friday.

KING Does that cover your questions now? Go ahead Mr. Schumacher.

QUERY I have 2 questions Dr. Berry. First, to reverse the earlier questions, how can you say statistically that there is, or will you be able to say statistically that there's no chance that these men will develop measles?

BERRY Well, I think that if we had, however, you can never say there is no chance, I don't think I'd ever say that even if they had a titer now because, a titer that we felt would give them some immunity. If they have a very high titer when we get these results, that would leave us in a position that we would feel fairly comfortable with that, that they had a high immunity level and they were probably not going to get this disease. They have everything else going for them as far as their immunity is concerned. They have nothing else that tend to knock their immunity status down. So, we would feel fairly comfortable with that. On the other hand, if we get no titer or we're placed in a position they're, okay, probably are going to get it, if we get a very low titer, we're in that Never-Never Land that is going to be a hard one to figure out. Now, you were going to ask another question I'm

BERRY sure, which is can you do anything to change that immunity, and that's certainly going to come up and so we ought to wipe that one out. It's very controversial at the moment about the effect of gamma globulin and you know that you, there is Gamma globulin available and we can produce some temporary immunity in this regard to a lot of diseases and it is used very effectively for the real measles, for Rubiola, it has been used very effectively. Now, in this instance, it's quite questionable as to the effect. There are studies that show that it is of no value whatsoever and there are other studies that show that it is of some value and we're talking to everybody who has run a study and I, we're going to have to, I suspect, take that information in tons before we're through as to decide that, you know, who we're going to believe, and you say well, you know, is there any problem in giving it once you go ahead and give it. Well the trouble is the dosage you have to give is a fairly walloping dose of this material, and so, you can certainly, you're going to have to give it in at least two times and maybe more if you do and I just don't want to do that if there's not a real reason to do it.

QUERY Well given the situation of low titer, would you spell that please.

BERRY Yes. Ti - you can spell it Tit - it's usually spelled titre but it's titer.

QUERY Given the situation such as that with no symptoms would you recommend they go ahead with the mission anyway?

BERRY A situation such as what?

QUERY In which they would appear not to have much immunity, but nevertheless have not developed any symptoms. Would you then nevertheless recommend that they go ahead with the mission?

BERRY As I told you what we're in the process of trying to do right now is to try and determine what we think their immunity status is and what's the odds of them developing the condition, and what I've got to develop over the next 24, 48 hours here, probably 24, is some plan to exactly what we feel we ought to do in that regard. I really would prefer not to answer that question right now until we gather some of these data and can have a pretty firm idea about what that status is because there are a lot of unknowns and we've got a lot of things going right now to try and chase down some of these angles and get some data that we can go on and I think once we have that I think that's going to have to be done probably within the next 24 hours.

QUERY (Garbled) now is exposed -

BERRY Because there's no point the possibility of the backup crewmen who have been probably better exposed

BERRY because of their closer association in training with Charlie Duke. We would like to not continue to add dosage to the crew, knowing, there's no point in continuing to talk virus at them at this point in time because any, any development of disease is a result of the amount of exposure versus the amount of immunity that that you have and you can get such an overwhelming exposure but your immunity, that it's possible that you could develop, that there's no point in taking that kind of risk right now.

QUERY Go ahead.

QUERY Chuck, given a low immunity finding in your lab tests, the incubation period, the Rubiola or Rubella places you smack in the middle of the flight, in fact for the Rubella it places you smack in the middle of the second EVA by the numbers here. Would you give a long commit decision if there were that risk of their developing it during the flight?

BERRY Well, I guess this is the, you asked me the same question really that was asked over here and, Jules, and this is the thing obviously I'm agonizing over at the present time about what I am going to with that particular decision. and I think that we all would be concerned about launching a crew with a real potential of any illness and what we've got to determine here I think is the risk, you've got to determine what your risk really is in order to be able to come up with a firm answer here, and I, again, I really would prefer to hold that off for 24 hours.

QUERY Holding off on it then, If the crew should develop the Rubella, which seems to be the more likely of the two things, if they develop either, would that make them that uncomfortable? Would that disable them during the mission?

BERRY It certainly could, yes. It could, right.

QUERY Chuck, may I follow Jules point there, given a situation like this, where you might make a decision, does the contamination committee sit in on this and have the power to veto your decision, stop you from toing for example.

BERRY No. They're advisory. My decision would be advisory too. I guess we could have, I don't make the decisions whether we launch, as you know, I can only make a recommendation, and whether they, whether somebody uses that recommendation, that can go all the way to Dr. Payne.

QUERY (Garbled) Would they be called into a situation like this where -

BERRY No. We have talked, as a matter of fact it so happens that the head of Communicable Disease Center, Dr. Sencer, is the head of that Committee on Back Contamination and therefore we have been in touch with him today, but not because he has any input as to whether we should or shouldn't, should do it. Now, they're going to get involved if they, this has some

BERRY import of course, because if we had this develop, you know, it's important that they be aware of this eventually whatever happens here because if we should have a red rash develop after 2 crewmen have been, and the 2 crewmen have been on the lunar surface, after they've been there, I really wouldn't like to be in a position to try and explain that one to somebody.

KING Go ahead.

QUERY Dr. Berry, what would the symptoms be in an adult of both diseases?

BERRY Well, they run a large - normally Rubella as a disease is one is characterized by some sore throats, occasionally runny nose, fever, can be some generalized aching, ordinarily the aching isn't very bad. The aching is usually much worse with the echo viruses than it is with Rubella. That's one of the differentiating things. They get some, as far as, findings are concerned then, they get some enlarged lymph nodes, particularly in the posterior part of the neck -

END OF TAPE

BERRY -lymph nodes, particularly in the posterior part of the neck, posterior cervical node, and they have this pink, a light pink rash, which tends to jump around. When you see it on one part of the body, then you may look as much as 24 hours later and it will be gone from that part of the body and appeared on another part of the body. Some people end up with a lot more rash. Frequently an adult ends up with a lot more rash than you see in children. There are a lot of things that can happen as with any disease, and you can end up with arthralgia, aching and throbbing of the joints, swelling of the joints. You can end up with involvement of the coverings of the brain. The maninges which most any viral disease can do. You can end up with enlarge-, involvement of the spleen. There are many organs of the body that can get involved, as with any kind of a virus.

KING We have one more question here and then we will switch to Houston.

QUERY Dr. Berry, in the form of background, what kind of isolation procedures were followed for 11 and 12 and 13? Was there a significant difference this time?

BERRY As you know we have what we call a modified isolation. It's not quarantine. It couldn't be quarantine in the traditional sense. The policy and the plans, the preventive medicine plans, pretty well spelled out in our medical requirements document, which I think is available to all of you. And that plan calls for the limiting of the contacts of the crew to essential which isn't well, very well, defined. It obviously means people in the training area, that they have t-o have contact with because they spend a lot of time in the training area. the people in the crew quarters. People of this sort we know are going to have a lot of contact with them, we make a special effort to brief and to check. They can see their families and this is one of the risks that you always run when seeing families too. Particularly in families with small children, you always run a risk that this sort of thing can happen to you. But we do have a policy that they can see families and they usually cut that down greatly during this period. The crew has generally moved into the crew quarters, around this period of time and this period has never been exactly on - to this date, but it is around the 21 day time period. This crew has been later in that regard. They have not done that as early as the other crews. So that's a difference here.

QUERY That's really the only difference? It's essentially the same kind of isolation procedures?

BERRY I think so. In general I think that's true. They haven't been in the same area, and of course you'd have

BERRY to go back and check specifically. I'd like to make very clear that I'm not a policeman in this regard, and it's not my duty to tell, to find out and to know exactly where all the crew men are at any given point in time. That is someone else's duty and not mine. All I can do is tell you the kind of things they ought to be doing and then where they have actually been in all things is something other and to say the exact difference is here is you'd have to do that sort of thing. You'd have to go back and find out exactly what has happened. Now some of that were in the process of doing because it is important to us epidemicalogically to us now.

KING Okay, let's switch to Houston now for questions there.

QUERY Hi. Is it correct that this was first reported this morning and the symptoms showed up Friday? If that's true, why the 2 day delay?

BERRY That sounds like Jim Maloney. Jim, it is true that there were symptoms, but these symptoms were unknown to us and I guess Charlie didn't call you. But he had the symptoms on Friday and he had them on Saturday and he didn't tell us, he didn't tell any of my people until Sunday night when it became evident that he had a rash. He then went to see one of our physicians at Houston who was on call and the first I heard about that was this morning then, because I was in transit, at that time, to the Cape.

QUERY Doctor, you've described the symptoms of Rubella, would you now tell us symptoms of the echo virus.

BERRY The symptoms of the echo virus are not too different in that they tend to be respiratory in nature involving the nose and the throat again. They can involve, as can measles, too, it can involve other portions of the respiratory tract, where you can get some ear involvement as complication, you can even get sinus involvement as complication, you can get involvement of the lungs. You can again have, and frequently do, with the echo virus, have a meningal envolvement or a meningal encephalitis type of involvement and that's the specific thing here.

QUERY This is being considered as merely an outside possibility, that you are fairly confident that it is rubella which he has developed?

BERRY I'd have to, you know if I were in practice and saw him as a patiant this way, well we certainly wouldn't be spending the money to run an immune antibody and so forth, and I think there would be no doubt in my mind that I had tagged this and reported it as a rubella. I think that in this incident I think that in the back of my mind

BERRY it might be an echo virus and you would watch it for that thing, but you would not.. Now we had a case a capability here because of our labratory facilities, we certainly had a capability to chase this down and intend to be specific about it, but if I had to lay money now I think it's most, very highly probable that it is only rubella.

KING We have time for one more question since Dr. Berry has to get back to work here.

QUERY Dr. Berry, I've got a couple here. Number 1 is just for clarification. Did I understand you to say that with the type of exposure the crew had had that they are all almost bound to come down with something? And, also there has been at least one report today that if the crew did in the unlikely possibility, come down with a moon germ that this could react with the measles, is that correct?

BERRY Well, I don't know who said that because if anybody really knows they are better off than I am because I don't right now. I don't know if anybody could make a statement about that that would be really scientifically accurate at all. Any illness of course, if you have an illness and you were to get a secondary infection from another invader of any sort, well, of course, it could make it worse. I could make a general statement like that. But to say that because it was a moon, a possible moon bug, it could be worse, I don't think you could say that. I didn't understand the first one. Did you say that I said that there was a, that I felt very definitely that they were going to come down with something? Is that what you asked?

QUERY Did you say that with the type of exposure that they had had that the odds were very high that they would come down with it?

BERRY I think that's true if we end up with no immune titers. In short, if they have no antibodies to this virus at the present time, the odds are very high that they would get it.

KING Okay, do you want to answer ,this question here? We have one question here to wind up on that Dr. Berry will attempt to answer, also.

BERRY We have a question here; do any of the three I assume prime crewmen, it doesn't say, have a past history of rubella. If so, when. Again, this is a very hard thing to pin down in childhood. Two of the crewmen feel that they have not had rubella in the past. One feels that he did but he's not totally sure about that. So this is why immune titers are going to be very valuable to us even if they had a positive history, I think that it is still very valuable to us. And have any of the crewmen received rubella vaccine? No.

KING Okay, we will be keeping contact, with a certain distance, of Dr. Berry and his people , too, as soon as we have any new information we will pass it on to you.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

POST-LAUNCH PRESS CONFERENCE
Kennedy Space Center
April 11, 1970
2:20 p.m. CST

PARTICIPANTS:
Walter Kapryan, Launch Director, KSC
Jack King, PAO

APOLLO 13 POST LAUNCH PRESS BRIEFING, 4/11/70 2:22 PM CST 13A/1

KING Okay, we are back here at Kennedy Space Center now and I guess we are ready to proceed. We are going to attempt to conduct this post launch conference between communications with the spacecraft; this gives us approximately 20 minutes and we'll do our best to try and get as many questions in in that time, but I'll be standing by for a signal also so we can go back to air/ground at the proper time so that you can keep up with every phase of the mission. At this point I would like to introduce Mr. Walter Kapryan, Director of Launch Operations for the Kennedy Space Center and Launch Director for Apollo Missions.

KAPRYAN Good afternoon, Ladies and Gentlemen. It is a pleasure to see you, on a clear day for a change. I guess there really isn't too much to report to you as far as the countdown itself is concerned. It was perfectly nominal. We had no problems whatsoever with the spacecraft, with one exception, and that was in that we do have a lock to save our pyro bus and it takes a key to remove that lock, and we broke the darn key off in the lock, and it took us a little while to get it out; we did have a spare key, and we took that off. And that's the summed substance of our problem with the space-craft. At approximately 1 hour and 50 minutes before launch, we did run into a little difficulty with a locked vent valve in the S1C stage, which we were attempting to cycle open and close as required for the venting process, and it stuck on us in the full-open position and we ran through a repeated number of cycles attempting to free it, and for some time were unsuccessful in doing so. It caused us concern in that if we had not been able to close the valve, we would not have been able to pressurize the lock tank at T minus 72 seconds. However, we did run some nitrogen gas through the system, and we were able to sufficiently raise the temperature such that we were able to close the valve, and we proceeded the rest of the way with that vent valve in a closed position at all time, and we do have a second vent valve in the stage that we relied on to give us the correct conditions at time of stage pressurization at T minus 72 seconds. That - those 2 items were the sum exception of the problems that we encountered during the entire countdown. As most of you know by this time, the first stage burn was per-fectly nominal. You may have noticed that it seemed almost like an eternity before the vehicle cleared the tower, that of course was because this is the heaviest vehicle that we have flown. It was approximately 26 thousand pounds heavier at lift off than Apollo 12 and the S1C engine were perfectly within

KAPRYAN specifications and were rated at about 100 000 pounds full of thrust less than those that we had on the Apollo 12 vehicle. This made the time about 1/2 to three quarters of a second longer in clearing the tower. All of the first stage burn, as I mentioned earlier, was perfectly nominal, the second stage was nominal up until the time that the S2 inboard engine cut off. That engine is normally cut off by switch electric command approximately 90 seconds before the outboard engine was cut off. For some reason that we have not been able to determine at this time, the engine did cut itself off approximately 2 minutes earlier than planned. Now as a result of that having happened, the outboard engines of course burned approximately a half second longer; they burned to fuel depletion and made up some of the energy that was lost by virtue of the inboard engine having cut off early, and when we burned the SIVB, it burned approximately a half minute longer than originally planned in order to make up the deficiency and at the end of the first burn of the SIVB, the deficiency was made up. Now we had approximately a 2200 pound payload margin for this mission. We used a little bit of that margin by the fact that the engine did cut off early, but we did not use up enough to -

END OF TAPE

KAPRYAN by the fact that the engine did cut off early, but we did not use up enough to lose any confidence of our ability to perform the TLI maneuver. We still do have a 3 sigma capability, so we have no reason to suspect we will not have a good TLI burn and fly perfectly nominal mission from this point on. I guess that's all I have in the way of general comments. Feel free to ask any questions if you chose to.

QUERY Why did we nominally have main stage engines lower rated in thrust, if I understood you correctly.

KAPRYAN They were - they were - well, you know, the vendor guarantees engine performance to within - to a certain specification. These engines did meet that specification. It just so happens they weren't quite as hot as the ones we flew on Apollo 12. There's nothing wrong with them. I don't mean to imply that. I'm just explaining to you why it took them a little longer to clear the tower than it had taken on previous missions.

QUERY Does the longer time for the S-IVB burn affect the timeline at all?

KAPRYAN I don't think it's affected significantly. I think we're going to be within seconds, certainly not more than a minute or two.

QUERY Do you have that total liftoff weight since they were the heaviest, other than 26 000 more than the other?

KAPRYAN No, I don't. It was - if you recall what Apollo 12 was, add 25 600 pounds to it.

KING That was about 6.4, but we'll check that figure for you. Al, I'm sorry, go ahead. Okay. Go ahead. Go ahead, Red.

QUERY You told us there was a 22 000 pound payload margin.

KAPRYAN 2200 pounds.

QUERY 200, thank you. How much of that margin has been consumed please?

KAPRYAN The best we can determine, we used up a significant portionof that margin. Now, beyond that margin we still have what we call a 3 sigma capability, so we have a full 3 sigma capability plus somewhat of a margin. At the time I left the firing room we did not have all the numbers in yet telling us exactly how much we had, but we were able to establish that we still had - we did have the full 3 sigma margin. The 2200 pounds was something that was a little bit of gravey that we had in addition to that.

QUERY Is it a fact that you've just got enough for TLI now?

KAPRYAN Yes, for a 3 sigma condition. In other words, for a worst-case condition. If you put all of your 3 sigma errors together, which is the basis on which we plan our missions we have enough reserve to handle that.

KING And still have margin.

KAPRYAN We still do have - we have all the margin we wanted to have.

KING We've not used up all our margin or even come close to using it.

KAPRYAN We have our full 3 sigma margin.

QUERY On that weight again, where do you get the extra 22 000 pounds. Is that fuel and if so, located where?

KAPRYAN As far as the margin itself was concerned, well, we fly with some extra propellants aboard this vehicle. Part of it for the reason of flying this mission and part of just get a little bit of added knowledge as a preliminary to flying the J missions which are going to be missions where we fly with heavier payloads than we've been flying to this time. So we loaded the tanks up more than was required by the mission.

QUERY Do you have enough fuel left to guide the S-IVB for the lunar impact?

KAPRYAN I asked that question when I left the firing room. The best answer I could get at that time was we should not affect our capability of flying the nominal lunar impact with the S-IVB. In other words, we expect to impact the S-IVB where we had planned to.

KING Ed, over here.

QUERY That's the question I wanted to ask.

KING Do we have any over here? I don't see any more hands. Okay, we'll take 2 over here and then we'll wrap it up.

QUERY Mattingly was in the control room. Was there no concern about his being infectious with German measles?

KING He was in the control room in Houston.

KAPRYAN Mattingly left the Cape last night.

KING We'll try to find that out for you, Ben, but I don't think we have any details. Ken Mattingly observed the launch from the Mission Control Center in Houston, not here. Do you have a question, Andy? Go ahead.

QUERY Could you give us the figures again for the additional burn of the S-II and the S-IVB?

KAPRYAN Yes, the S-II inboard engine, the center engine, cut off 2 minutes and 7 seccnds earlier than it was supposed to. As a result of that, the outboard engine burned 33.96, roughly 34 seconds longer than it would have had the inboard engine burned for its proper time. As far as the S-IVB is concerned, the DELTA in time was about the same, 33.97, roughly 34 seconds longer.

KING Okay, we'll take one here.

QUERY One last thing about this extra fuel, Walt. Did you have extra, fuel in the S-IVB by any chance as a result of running this weight up, and did that give you a little more leeway?

KAPRYAN Yes, we had some extra fuel in all 3 stages. We had about the same amoLnt of LOX that we flew on Pete Conrad's mission. We had apprximately 9500 pounds more RP-] than we had on Apollo 12, and we had more LOX and hydrogen on both the other stages. I knew those figures, but I've forgotten them. I can't give them to you.

QUERY Did that make any difference in the 3 sigma?

KAPRYAN Well, it helped us out.

KING All right. We'll take one final one up here.

QUERY Tell me that exact liftoff time, please.

KAPRYAN Let me check here. It was 600 milliseconds late.

KING 2]3.00.6. Okay, thank you very much. That completes the conference. We should be coming back up on acquisition in about]0 minutes.

END OF TAPE

APOLLO NEWS CENTER
Houston, Texas

Special Press Conference
Manned Spacecraft Center
April 12, 1970
12:20 A.M. CST

PARTICIPANTS:

C. C. Kraft, Jr.	Deputy Director MSC
J. A. McDivitt	Apollo Program Manager
S. A. Sjoberg	Director of Flight Operations
Brian Duff	PAO

APOLLO 13 SPECIAL PRESS CONFERENCE, 4/14/70,CST 12:20AM,PC 21-A/1

KRAFT Well, I guess we should start out by saying that we have a serious problem in the Command and Service Module. We appear to have some kind of accident with the - in the region of the fuel cells and the oxygen tanks. We have not tried too much to reconstruct the - what has happened because we're more concened at the moment for - getting the situation under control. As you have seen, we have begun to use the LM as a device for keeping oxygen in both the Command Service - Command Module and the Lunar Module, and we're using the power system from the Lunar Module. The - it appears at the present time that everything is under control, and that we have a safe situation at the moment. I think Col. McDivitt may want to give you some more details on the systems and Mr. Sjoberg could certainly talk about the operations plans that are going on at the present time in the Control Center.

MCDIVITT Right, Chris. The way we have the spacecraft configured right now is with the CSM powered down completely. Before we powered it down, we were able to isolate the surge tank and the emergency repress tanks in the CS - the Command Module. These provide oxygen for reentry so we have a Command Module that has oxygen free entry. It has a reentry battery. It has the pyro batteries and all the systems that are in the Command Module. Our malfunction apparently occured in the bay which includes the hydrogen tanks, the oxygen tanks, and the fuel cells, and it was in no way connected with anything with the Command Module. We should be able to provide power - electrical power from the LM for the return voyage to Earth. We should be able to return on the oxygen within the LM, and we'll be using lithium hydroxide on both the Command Module and the Lunar Module. We can still power the Command Module from the Lunar Module at low-power levels through the wiring which is normally used to power the LM from the Command Module So we expect that we will be using a dual spacecraft mode from now until the time that we get back to Earth. We'll have to - we'll be firing the LM engine sometime later to excellerate our return voyage. I think Sid could probably comment on that best.

SJOBERG Yes, the minimum return to Earth time — this would be a total flight duration - would be about 133 hours, that would result in a landing in the Atlantic. That's one option we have. The second option would be to go to the Mid Pacific Line. That would take about 142 hours total flight duration. The burns to get you back would be made at about between 77 hours and 79 hours of flight from liftoff. We anticipate that the descent propulsion system would be used for either of these maneuvers, and it has a capability - either of the ones I described.

DUFF We're ready for questions now. Please wait for the mike. We're going to have to get all this.

DUFF Are you ready? Let's start here and work across. Mark Bloom and then we'll go this way, and we'll try to move to the aisle.

QUERY For Jim McDivitt or anyone who want to answer. How much electrical lifed power - time - lifetime do we have in the LM and how much oxygen lifetime? How long do we have?

MCDIVITT Well, Mark, it depends upon how we use it. Obviously we have four batteries in the descent stage of the LM with 400 amperes each. We have two batteries each in the ascent stage with 296 amperes each. If you roughed it out, quickly says we can use power at about 25 amps - steady current until we get back. Now, we'll have to arrange the electrical profiles so that we can bring up the systems to perform the dock TPS maneuver and then we'll power down to minimum levels and then go along like that. When I left, we had a ample power supply to do the whole mission, but we were still roughing it out and trying to get in a configuration which we knew.

QUERY Oxygen?

MCDIVITT Oxygen, we have 48 pounds of oxygen in the LM descent tanks which will be more than adequate to do the mission. We also have a couple of pounds in the LM ascent tanks. I think I said descent. Descent tank has 48 pounds and the ascent tanks have about a pound or so each.

KRAFT Point out that we have locked up the CSM systems to preserve that spacecraft for reentry both in terms of power and oxygen. So, it is sufficient to support entry.

MCDIVITT The Command Module is completely intact. There's no problem with it at all.

QUERY I wonder if we can expand a little more on a possibility of an Atlantic Ocean landing, and what the recovery posture is for the Atlantic.

SJOBERG For an Atlantic landing, we would have airplanes with parajumpers on the scene at the time of landing. We're presently surveying that area of the Atlantic it's - if I remember it's about 20 or 25 degrees South and about oh, I think it's about 25 or 30 degrees North longitude. We're presently surveying the area for ships of opportunity. We do not have a planned recovery ship in that area, as you know

QUERY Let me follow up on that. Would you say that now it seems a great deal more likely that you'd go for a 142 hours and the Pacific where you have recovery capability?

SJOBERG I think that's a good possibility, but I'd like to reserve judgement until I see what happens in

SJOBERG - the next hours. We have some 18 or 19 hours until that burn has to made. I think we'd certainly be watching the situation. The Pacific is a lot better from -

END OF TAPE

SJOBERG burn has to be made so I think we certainly will be watching the situation. The Pacific is a lot better from the stand point that we have a ship there. It's better from a network stand point. So it's a prefered place even though it might take a little longer.

QUERY Chris or Jim could you tell us where the three astronauts are and how they will be living when they return to Earth?

MCDIVITT Well, when I left I think Jack Swigert was still in the Command Module and Jim and Fred were in the LM. I think they will be living between the two spacecraft until they return. Sometime before reentry, of course, the three will return to the Command Module and put the hatch back in and jettison the LM. Jettison the Service Modoule.

KRAFT If I were to guess, I would guess the two of them would sleep in the CSM while the other one stayed awake in the LM. I would guess that they would probably go to some kind of shift like that.

QUERY How are they going to be getting oxygen and heat in the Command Module? From the LM.

MCDIVITT We're going to be running one environmental control system or the other. Initially, we'll be running the LM system. That's what we're running right now. Now intermittently we'll run the CSM system to make sure we keep the atmosphere in the LM free of carbon dioxide. So we'll be alternating. That's why I say there will be people in both spacecraft.

QUERY Will somebody explain to me what you mean by a ship of opportunity in the Atlantic? Is that some merchant ship or Russian sub that -

SJOBERG It could be a merchant ship. it could be I suppose it could be foreign nations naval vessel. Any of that kind of thing.

QUERY Any ship in the -

SJOBERG Yes, sir.

QUERY Chris, has this abort situation or altered trajectory ever been run on simulators. In just this way?

KRAFT Yes, many times. We've run all kinds of aborts situations and if you recall in Col. McDivitts' flight we actually burned the DPS engine attached to the Command Service Module. The auto pilot in the Lunar Module is designed to carry the maneuver under those circumstances. That is the visual auto pilot to damp the isolations of the combined spacecraft. We are looking even at the possiblities of dropping the Service Module, but that particular type of maneuver has not been tested in flight, and we'd have to make ourselves certain that we could control the spacecraft under that kind of CGN inertia conditions. So that's kind of unlikely that you would do that. If we did that it would

KRAFT give us that much more DELTA V see, cause we get rid of quite a hit of weight from the CSM.

QUERY Chris and Jim, If you got a situation where the LM oxygen system can provide like a 50 plus hours for two guys. How do you equate that with a 146 hours return if you don't have any kind of environmental control of operation in the Command Module right now?

MCDIVVIT Normally, we, on the lunar surface, we plan on three lunar surface repressurizations. And actually has enough for 4. Now there's about 6.6 pounds of oxygen for repressurization required. And in the LM leak rate is about .08 pounds per hour. And the metabolic rate is little bit, and we're using probably .2 of a pound per hour. So we've got quite a large margin there. You recharge the PLSS's also. Pardon.

QUERY Let's get this straight. You're saying you use .2 of a pound per man per hour.

KRAFT Number is about 6 to 8 pounds for the 3 men per day.

QUERY 6 to 8 pounds per -

KRAFT Then plus what you might have for -

MCDIVITT You have to take in the cabin leakage, too.

QUERY If I could follow up here just a second. If you've got enough oxygen to get them back safely.

SPEAKER Yes.

QUERY According to the press handouts, the navy's got a standby task for us in the Atlantic to recover if necessary. You wouldn't go to this. You would go to this ship of opportunity, a merchant ship if necessary?

SJOBERG We don't have a U.S. Navy recovery ship in the Atlantic.

QUERY It wasn't deemed necessary for this mission?

SJOBERG It was not being necessary for this mission.

QUERY Where was the Atlantic recovery point again, geographically if you could? And the Pacific point.

SJOBERG This is rough, Paul, but it something like 20 to 25 degrees south latitude. And I think it's about 30 degrees west longitude. Just below the point on the side of America there, Paul.

KRAFT The bulge. In that area.

QUERY You mentioned that you should be able to generator on 25 amps per hour. And you have to divide that out against the loads. Will there be sufficient power for the transponders so that you can get a good track on the spacecraft?

END OF TAPE

QUERY against the loads. Will there be sufficient power for the transponders so that you can get a good track on the spacecraft?

MCDIVITT We'll be able to bring them up when we need to. And I believe that we will have that kind of power. I really don't have that close a handle on the power. We came over before they had all those details worked out to that level.

KRAFT With the OMNIS and the 220 foot dishes, I don't think we'll have any problem there.

QUERY Also, I appreciate it, you haven't been able to give any thought to what caused all this, but I was looking through the transcript and there were certain problems with the 02 tanks and the cryos temperatures, and problems with fan cycling, and stratification. Is this, apparantly one of the tanks was oscillating very rapidly in temperature. This was noted earlier today. Does this give you any thought to what might have happened?

MCDIVITT No, not yet. Stratification is something that typically happens in these tanks, and it's nothing we haven't seen before. Right now, I have absolutely no clue to what happened. We have something -

KRAFT It was pretty wide spread we know.

MCDIVITT - rather violent happened in bay 4, we think Something happened in the fuel cells and the oxygen tank, and they're down in that area. It was a rather violent kind of thing because it apparently reset some of the check valves and the RCS quads, which are susceptable to shock. But as far as what exactly happened, I have no idea.

QUERY Chris, are you condifent that you have enough power under the current configuration to bring the Apollo back in?

KRAFT Yes, but I think we'll have to be very frugal in how we use it. And that's what you probably heard some of the discussions back and forth between the crew. We were trying to consider whether we would keep the platform up, for instance, between now and the time to go behind the Moon in order to maintain that alignment so that they wouldn't have to do another alingnment when they get ready to do the burn on the dps and so on. So it will have to be very carefully used between here and splash.

QUERY And how do you feel in point of concern between now and Gemini 8?

KRAFT Well, I guess I would have to say I feel a great deal more concerned. We're still something like 70 to 80 hours away from the Earth. And Gemini 8 we were never more than an hour and a half to get to a recovery point and never more than 20 minutes to land

QUERY The time you left, what was the situation with regard to venting to the outside and motions of the spacecraft from that? Was there any?

MCDIVITT The venting has been decreasing and we were leaking probably from that bay. It looked like all the pressures were all dropping. I would assume that the venting had gone down, but it was a little difficult to tell from the conversation. I would assume that venting would decrease considerably.

QUERY You're not getting any particular rates anymore, at the time you were leaving?

KRAFT Not that I recall. I think they had the LM RCS system up and so it would be difficult to tell even then whether they did have any rates.

MCDIVITT They were transitioning from one spacecraft control system to another and running back and forth through the tunnel and aligning the platform. An awful lot of activity going on, and we didn't ask them what the rates were.

QUERY I believe I heard Fred Haise mention that it might be considered to use a deep space abort in order to immediately get the burn over with and power down the LM so he wouldn't have that drain in keeping it powered up till they get around the Moon. Has this been completely disregared, now?

KRAFT The position we are now on the Earth-Moon plane, we have to go around the Moon to get back if we're going to use DPS engine. You would have had enough capability with the SPS engine but, of course, we don't dare use that now. So we have to go to the back side of the Moon and come back.

QUERY I have a question in three parts. First of all if they choose the Pacific method of recovery, will the recovery point be changed from original planning or will it still be the same?

KRAFT I think it's moved west and south some. I think it's about 165 degrees west and some 20 degrees south. It is farther south and farther west than the end of mission plan.

QUERY The other two questions kind of combine. If you did land it in the Atlantic and did you have to go to a ship of opportunity, would you hesitate at all to ask any ship of any nation?

MCDIVITT No sir, I wouldn't.

QUERY Will this necessitate future thinking toward a backup recovery fleet in the Atlantic?

KRAFT We certainly will reasses that. Yes, sir.

QUERY Chris, will you come in at 400 K and will there be any problem in jettisoning the LM and entry?

KRAFT No.
QUERY What will be that mechanics.
KRAFT It's done the same way as it is around the Moon and the same way coming back from the Moon with the Service Module. You have pyrotechnic batteries and separate pyrotechnic lines.

END OF TAPE

KRAFT ... done the same way as it is around the moon and the same coming back from the moon with the service module pyrotechnic batteries and separate pyrotechnic lines, electrical sources which are dependent only on those power sources. So we don't have any problems there in terms of separation. Now, the dynamics mechanics of the thing would not be a problem either.

Query For Jim McDivitt. Is a situation like occurred in bay 4 something that might have occurred if it was hit by a meteorite? And for Chris Kraft in following up your earlier comment, do you feel that they have a good chance to make it back?

MCDIVITT He asked me first. Here is something which appeared to be quite violent to the current in bay 4 and yes if you were struck by a meteor it would be quite violent. I'm not assuming that's what happened, Mark, but that could have done it.

KRAFT Yes, I think their chances are excellent at the moment, assuming that the lunar module continues to operate well.

QUERY To follow up on Marks question, Jim, can you think of anything else that might cause such a violent event as - besides a meteor?

MCDIVITT Well, we could probably think about an infinite number of things that could -

QUERY Well, two or three that could be within the realms of likelihood, I mean.

MCDIVITT I guess I really - there are a lot of things that could have happened. It would be just pure conjecture. Anything that's down there that's pressurized could have let go and there are all kinds of pressurized things. There are pressurized hydrogen, nitrogen and oxygen, fuel cells. It's a very complicated bay that this happened in.

QUERY What is the moment that you have to get everybody out of the LM and back to the command module and seal it off and get ready for entry? How late can you get in - can you use the LM before you have to go to the batteries on the command module?

MCDIVITT It's pretty late. It doesn't take too long to get back in the CSM. The thing that you want to make sure is that you have adequate time to put the hatch in and blow the LM off and that really doesn't take very long.

KRAFT I'm sure that will be a process where a couple of them will get back in the CSM, get everything set up and they'll do that as late as possible.

QUERY How late can that be?

MCDIVITT I guess we'll have to work that out. Thirty minutes or an hour or 15 minutes or some range like that.

MCDIVITT Want to start using the CSM batteries as late as possible.

SPEAKER Okay, we're going to come up the middle. Harry.

QUERY On the present trajectory, how far beyond the moon will they go before they start to hook back and what would the misdistance that the earth be without a correcting burn from the dps?

KRAFT Well, on the present trajectory, we would come within about 60 nautical miles of the back side of the moon. We are not on a free return trajectory at present. We will take a very small burn, say in the next 5 or 10 hours to get us back on free return on the order of 20 to 40 feet per second. I can't answer your second question about how far we'd miss, I don't know.

SPEAKER Right here.

QUERY Will the DPS burn be the major rocket maneuver you will make on coming back, and if so, where will it be, on the far side of the moon or -

KRAFT It will be on the far - yes, it will be the DPS will be on the - some place between perilune on the farside of the moon and two hours after that.

SPEAKER Let's pick these up coming up the middle of the aisle. We'll just take them both sides. All right Paul, go ahead.

QUERY Do you recall the approximate mileage at which point you can still do a deep space abort and still come back? What is the crossover, 140/150 thousand.

KRAFT It's probably farther than that, Paul. I don't remember the exact number but I think at the time of this incident, if you used the SPS engine you could just about have done it but it would have taken just about the whole thing.

SJOBERG 176 thousand.

KRAFT Something like that, yes.

MCDIVITT If I recall, Paul, I think the number was 9 thousand foot per second and about 140 hours.

QUERY What would cause you to choose the Atlantic over the Pacific for the recovery? And are you now surveying the Atlantic to find out what ships are available to you?

KRAFT Yes, we are surveying the Atlantic to find out what ships are available. I think the only reason we'd go to the Atlantic is if sometime between now and the burn something would happen to make you very time critical in getting back.

QUERY Burn more quickly and sooner.

KRAFT No. It's a bigger burn to go to the Atlantic. I think it's about 2000 or 1900 feet per second and get you

KRAFT and get you back some 9 hours earlier.
QUERY How many feet per second (inaudible)
KRAFT It's about 9 hundred.
SPEAKER Let's come up a little bit. We have a gentleman in the middle of the row there. In the khaki jacket.
QUERY In the transcript, I'd like to read from this. Lovell says "Yes, I got to put the cabin re (garble) valve in there. Every time he does that, our hearts jump in our mouths -

END OF TAPE

QUERY - and in the transcript I'd like to read from this, Lovell says, "yes, I've got to put the covering repeat valve in there, every time he does that our hearts jump in our mouths." Now, I don't understand what he's talking about here, but could this have anything to do with the accident something happened that made their hearts jump in their mouths what was it?

MCDIVITT I think he's talking about the cabin repress valve in the LM which goes bang when you operate it.

QUERY And Col. Mc Divitt said any pressurization could do anything. Is there any link here?

MCDIVITT Any pressure -

SPEAKER No.

MCDIVITT I guess I don't understand the question.

KRAFT It didn't - what you're asking is did that statement have anything to do with the accident and I think definitely not. He was talking about something that went on in the lunar module as opposed to the, where the accident occurred in the command service module.

QUERY I'd like to go back to bay 4. Do you expect to be able to tell exactly what happened there and if so how soon.

MCDIVITT We have people working on it right now and I don't know whether we'll ever be able to tell exactly what happened there or not. We're reducing the data like we do on all the spaceflights and whenever we have an anomaly and to date we've been quite sucessful in determining what happened, and whether or not we are in this case, I have no idea. We certainly are going to do the best job that we can. Well, sometime it takes a long time. but I have no idea on this. I haven't seen the data myself at all. We were trying to figure out what to rather than to play out the old data.

KRAFT And that's what we'll be doing till we get them back on the water, is concentrating on eveverything that is their lives are dependent upon at the moment rather than worrying about the accident because there's nothing we can do about that now. The service module is no longer usefull in most cases because the oxygen is depleted. So, other than the fact that you've got some propulsion left and the batteries in the command module, we're going to worry about those situations from now till splash.

MCDIVITT Initially we're trying to find out what was wrong down there so we could possibly correct it before he lost the oxygen. We weren't able to do that in titime, and I think that we'll put that effort on a very low priority right now and work on the other stuff.

QUERY (Garbled)

SPEAKER Pardon. No, no hints.

QUERY What about your thermal control situation

QUERY do you expect any problems from heat because of your configuration now.

MCDIVITT Well we're not going to be able to just maintain a single attitude hold all the way to the moon and back. We're going to have to do something. We've been working on the, I guess the guys have been working on that now aren't they -

KRAFT I don't think we can answer that question truthfully, because we've never had a situation where we have now had powered up conditions in the command module and powered conditions in the LM. So, that's probably going to be a real time situation.

QUERY Chris, at the risk of asking you to oversimplify a very complex situation, and certainly I don't mean this facetiously. Is there any concern, real concern, can you get them back? Taking in consideration the imponderables the power, the oxygen, the landing area and all this sort of thing. Is this -

KRAFT If the situation remains stable as it is at the moment there's no question but what we have the thing under control and we can return the crew safely to the earth. Now we're going to have to make some compromises in procedures as to how you do that, but that can be done. We've got a number of different ways of doing things, like reentry. If we couldn't for instance, we couldn't get the platform up, we have the, what we call the entry monitoring system. We can enter at constant G if we had to with no entry monitoring system. If everything remains as is we can get them back sucessfully. Now, if there was some change in the status of the lunar module, then that might mean something else, and we keep you appraised of that situation.

QUERY I've got right here that

QUERY Chris (Garbled)

QUERY - might happen that already hasn't happened. Can you give us an indication of what could happen?(Garbled)

KRAFT Well you might have some problem with some system in the lunar module that would put **us** in a very serious situation like a leak in the oxygen system, or something that would happen to the electrical power.

MCDIVITT There's no indication now that there's anything wrong with the LM. It's performing properly and like Chris said if everything works the way it is now, there's no doubt that they will come back all right.

QUERY What time did the accident occur?

SPEAKER I don't have an exact time -

SPEAKER I guess its something like -

SPEAKER - 56 hours.

SPEAKER Yes.

KRAFT 55 1/2 to 56 hours in that time period

SPECIAL PRESS CONFERENCE 4-14-70 12:20 am CST 21E/3

SPEAKER (Garbled)
SPEAKER Right.
QUERY Will the crew be wearing their spacesuits or will they be shirtsleeved or how will they be traveling the rest of the trip?
MCDIVITT Well, they're shirtsleeves right now. I would guess they would probable stay shirtsleeves. I see no reason to go back to the suits.
QUERY Are they both (Garbled)
SPEAKER Yes.
SPEAKER Yes.
SPEAKER All right we're going to take these two here and then we're going to come back on this side.
QUERY Jim, I'm not clear on what the venting did to the spacecraft's attitude in pitch roll, and yaw.
MCDIVITT Well, he had a negative pitch and a negative roll, and that's one of the clues that we had that something happened in bay 4, in addition to the fact that we had all these other anomalies to the equipement that's in there. I meant that it was pitching nose down and it was rolling to the left.
KRAFT I thing the other thing you have to remember is that we have certain instrumentation that we can believe or not believe. I mean by that, that when you have something like this happen you don't know that you're not reading false information from some of the instruments. So, you have to look at those and see how they failed et cetera, and see what the measurements are and see which direction they went when they began to fail, to see whether you're reading true information.
SPEAKER All right. This one and then we're going to come back over there.
QUERY Chris, could you put this in a somewhat larger perspective. It seems obvious that if this happened on the way back the situation would be critical, and it would be fatal.
KRAFT Indeed it would.
QUERY Could you discuss this thing from a standpoint of the resources you're left with when it fails at this point in the mission.
SPEAKER Well, any time that you still have the lunar module in the condition that we have it in and -

END OF TAPE

QUERY would be fatal. You discuss this thing with a stand point of the resources you're left with when it fails at this point in the mission.

KRAFT Any time you have the Lunar Module in the condition that we have it in in this case where we've not used any of it's consumables. Then we're in a very good situation. We've always called the LM a good life boat under those circumstances. If at any time in the mission, however, the LM had separated and we would have gotten ourselves into a rendezvous situation or the Command Module being around the Moon, then what you state is absolutely true. It would be a fatal situation.

QUERY What is the critical consumable? Water lithium hydroxide, oxygen, electrical power, or what? And how long will it last?

MCDIVITT Well, as I mentioned earlier, it varies on how you use them. If you turn everything off then electrical power's not a problem but, of course, we have to use it. Oxygen, we have more than the sufficient quantity, and the LM is self sufficient except for the lithium hydroxide. We're going to have to be using lithium hydroxide out of the CSM to maintain the CO2 level at a lower level. So, from that standpoint we'd have to use both the Command Module and the LM. From an electrical stand point and oxygen stand point we can use the LM alone.

QUERY Is there enough water?

MCDIVITT Yes.

QUERY When the fuel cells aren't functioning?

MCDIVITT Yes. The LM has a large amount of water that they carries. The LM cooling is done by water. It uses a sublimator rather than radiators. So we'll be using that water for cooling. There is enough.

QUERY The individual life support system packs that were meant for the Moon walk. Can they be used inside of the spaceship.

MCDIVITT Yes.

QUERY How about cutting down on communications to conserve electrical power? To setting a timeline of we'll talk to you thus and so at such hour?

KRAFT I don't think it makes that much difference.

MCDIVITT At this time I don't think we think we have to do that.

MCDIVITT Initially, we wanted to get the spacecraft configuration under control so we knew where we were. And as I said we got an average of about 25 amps or something on that order plus or minus a few amps. And it's better to burn a few extra amps right now and figure out what you're going to do and have all the capability of taking things out later. But you want to make sure you have a condition you can live with now.

KRAFT I might say, that when we're in a condition where we don't have the 220 foot dish, communications may be somewhat sporatic for the high gain antenna which we would probably not want to bring out because of power reasons in the LM.

QUERY I know it's probably a little premature, but seeing they have had a rough time have you worked out any schedule for a sleep period for any of the astronauts?

KRAFT No, I think this is a little premature for that.

QUERY Chris, if the LM continues to operate well, what is your - you know when the systems and the power and all that kind of jazz - what is your primary concern. Do you have any concern about the spacecraft? You know things working sufficiently in it to bring it back.

KRAFT No, I think that with the ground situation that we have, that is the tracking we have from the ground, and the maneuvers we can give them from the ground, I think we're perfectly satisfied that that situation is well under control

QUERY Would extreme weather conditions effect your choice of landing sites. And do you have any idea what the weather will be like in all of these sites?

KRAFT Ok, I haven't looked at the weather yet. But we would still have range control during reentry. Some hundreds of miles, perhaps a thousand.

QUERY What will the procedures be for the rest of the night?

KRAFT They are not defined yet.

QUERY Chris, you were in a cat-bird scene on John Glen and a RETRO pack that didn't come off. Scott Carpenter and an over shoot. Dave Scott and a stuck thruster. How would you - forgive me if I put you on a spot - How would you classify this situation? As regards to these that we are familiar with a little bit.

KRAFT I would say that this is a serious situation as we've ever had in manned spaceflight.

QUERY Jim, two questions. One with the situation of using the lithium hydroxide in the lunar module will there be any chance the air might get stuffy and all before this is out. And could you paint a picture for us of what it's like in the command module with the power down. What does Swigert, or whoever is in there, see? Is it just the lights from the computer, or the DSKY blinking or What?

MCDIVITT Well, first let me answer the one about the lithium hydroxide. We'll be using the lithium hydroxide out of the LM and then we'll be using some out of the Command Module, then some out of the LM, then some out of

SPECIAL PRESS CONFERENCE 4/14/70 12:20 a.m. PC21F/3

MCDIVITT the command module. Try to keep your environments in both spacecraft suseptible. The disky has been turned off the command modoule is powered down now so there won't be any lights in it at all. He'll be using his flashlight. We have 3 reentry batteries in the command module and we've got no way of recharging these things, now that the fuel cell's gone. So we don't want to waste any of this valuable electrical power by running out of necessary equipment in the command module. Now, we will - we do have the capability of powering some things in the command module from the LM as long as we keep this power load down low. By the umbilical that runs through the tunnel.

END OF TAPE

MCDIVITT ... by the umbilical that runs to the tunnel?

QUERY In a report a few minutes from the Aquarius, they were still having problems with the roll and they had not attained the configuration that they wanted. The question is, do you know precisely where they are and are their computers operable and in tune with yours? You've talked about perhaps some of the instruments giving a bad reading. Do you know at this moment precisely where they are?

KRAFT Yes, I think we know the trajectory they're on, if that is your question, yes sir.

MCDIVITT We may not know exactly what their alignment is. I think that we were fairly well satisfied that the CSM and the LM were properly aligned with each other before we shut down the CSM.

QUERY Is there a hole, a physical hole that was caused by this -

KRAFT I don't think we know that.

MCDIVITT As far as the - we know where the LM is but it doesn't know where it is because when we went in there and powered it up we only through that part of the power up procedure that brought the IMU on the line and in a known configuration. All that equipment, all that erasable memory that has to do with where it is isn't in there and the LM really doesn't navigate normally between the earth and the moon anyway, so. We're going to have to keep track of it from the ground. The main thing is the LM provides the attitude with respect to the stars and that's the reference with which we'll use for all powered maneuvers.

SPEAKER These guys are very anxious to get back to work so we're going to take about 2 or 3 more questions and then cut it off.

QUERY Chris, I know this is very early to answer this kind of question, but Project Apollo had a pretty carefully thought out line up of things that you wanted to do. You curtailed them by eliminating flight number 20. Now for practical purposes, you've eliminated flight number 13 as far as lunar exploration is concerned. Can you give us any idea at all what this breakdown is going to do to the rest of the program?

KRAFT Well, I'm sure that we will reassess the landing sites that have been chosen; we'll reassess the command - the service module itself. We want to satisfy ourselves that we've done the best we can before we launch again. I believe that in terms of the landing sites, we will probably reconvene and go to our landing sites selection again and make sure we're satisfied with them. That is true. I think we've done that enough now where we could probably

KRAFT come prettly close to laying out the sites that we'd like to go to.

QUERY Would you think that the 6-month hiatus between shots that you've laid out for yourself now would be sufficient to get a handle on what was wrong with the service module and correct it or do you think that there might be a delay, a stretchout as a result of that?

KRAFT Well, I think that's very difficult to answer, Bill. Let me say this, I don't think we would hesitate to wait a longer period of time than 6 months if we were not satisfied.

QUERY The DPS burn that's been referred to, would that have to occur behind the moon out of radio contact or could you fix it so that you could perform it in radio contact?

KRAFT It could be in radio contact. Possibly.

QUERY On the backup systems, the way the various backup systems as far as moving into the LM and the various systems that back themselves up to emergencies systems, are you satisfied with the way they worked and is this giving you an insight into things might be needed in future flights. Even more backup systems that would backup some of these possibly that have now failed?

MCDIVITT Well, the command service module was designed to be an independent spacecraft and we built the redundancy into the spacecraft. This was - whatever happened today was one of those cases that's very difficult to design for. We had something happen which was of major consequence down in that bay I think because of the multitude of things that occurred when you lose two fuel cells and an oxygen tank and the oxygen runs out of the other one and all that. That's something very significant. It would be very difficult to design against that. We were fortunate that we were on the way to the moon with the LM onboard or LM attached.

QUERY This is something else I wanted to ask about. You say that on the return flight this could have been extremely critical. Are you thinking now in terms of something to do in the event this should occur on a return flight?

KRAFT I think that would be pretty near impossible to do at this time with that vehicle.

SPEAKER Okay, one here and then were going to take Mary and then we're going to have to close it out.

QUERY Did the fact that you went into a hybrid trajectory yesterday pulling you out of free return, is that going to cause you any troubles in trying to get back around the moon?

SPEAKER No. As I said earlier, we're not on

KRAFT free return right now but it would only take a maneuver of about 20 to 40 feet per second to get you back on a free return that could be done in say 5 or 10 hours from now. If we chose to do that.

Query Chris and Jim, do you have any feeling of how the crew feels and also Marilyn and Mary on this situation.

Kraft I would only guess that the crew feels that the situation is under control and that they were in a serious condition and they knew they had a job to do and I don't think that they stopped to consider what their personal feelings are at the moment. You'll have to wait and see how they felt about it themselves. As far as the wives are concerned I'm sure Deke Slayton has talked to them. But we have not.

MCDIVITT I think you can - when you're in a spot like that where you're busy and you just got a lot of things to do you just go ahead and do them. And the crew's been jumping back and forth between spacecraft and powering systems up and down and maneuvering around quite ably in the space-craft and they've had the situation well in hand. So I think they've been probably too busy to sit back.

KRAFT Certainly they have remained very calm and responsive to the discussions from the ground and I'd say they have the situation well under control.

SPEAKER We're going to continue to schedule these briefings throughout the mission whenever there's a point where interpretation would help and we'll be back again but I think we ought to go back to Mission Control room.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

NASA ADMINISTRATOR'S BRIEFING
MANNED SPACECRAFT CENTER
APRIL 14, 1970
5:38 PM CST

PARTICIPANTS:

Dr. Thomas O. Paine, NASA Administrator
Jack Riley, PAO

PAINE Before I accept your questions, I would like to make a few observations. First, and foremost, on my mind ever since the onset of our difficulties last night has been the remarkably cool, calm and collected reaction of the flight crew and the excellent team work of the people here on the ground at Manned Spacecraft Center. This afternoon I had a little time with Mary Haise and I think that throughout the NASA family the manner in which people are pulling together to get on top of this problem, contain it and come up with a solution is very gratifying. I would also like to thank the many people, the length and breadth of the United States and from overseas who have been sending us messages of encouragement and hope, and we certainly appreciate the support which is coming to us from all quarters. We also, in Nasa, very much appreciate the support and confidence which President Nixon is showing in the personnel at NASA and our associates in industry who Ire working to solve the problem that we have. We have constituted a special flight progress review council which is meeting at the end of every shift and is going intensively into the decisions that: have been made and the decision that open up in the next eight hours and then for the duration of the flight. We're making absolutely sure that we are bringing the best expertise across the length and breadth of the country there on the problems so that there is no stone being left unturned to bring the crew of Apollo 13 safety back to earth. The members of this team are Dale Myers, the Associate Administrator for Manned Space Flight, who is the chairman, General Sam Phillips of the United States Air Force, formerly the director of the Apollo program, Astronaut Frank Borman, Charles Matthews, the Associate Administrator for Manned Space flight, Bill Bergen the President of North American Aviation, Lou Evans, the President of Grumman, Joe Gavin, the Senior Vice-President for Space Programs. This group is meeting with several observers including the Deputy Administrator, George Low and myself, and I am confident that everything is being done that can be done to bring the mission to a successful conclusion. I would be very glad to address myself to any questions that you might have.

QUERY I have two questions, Dr. Paine. First, in reference to Jim Lovell's remark about, "It looks like this will be the last Apollo flight for a time." I wonder if you share his opinion and second, your appointment or calling together of this executive committee, if I understand you correctly they are reviewing the decisions made every 8 hours. This sounds like sort of a super, super management

QUERY thing that's looking over somebody's shoulder. I wonder if this came at the suggestion of some person, perhaps the administration or what, what your feelings are about the function of this council.

PAINE It is not a super, super operational group of any sort. It is just what the name implies namely a review and advisory council which reports to the Associate Administrator for Manned Space Flight. It has no line of authority whatsoever. The directors retain this, that is a group which help them make sure that everything possible is being done. With respect to your first question. I think that you are touching here on the future of lunar exploration and there is no question at all that we have had a setback in this mission. There's no question at all that we will very thoroughly review all of our equipment, procedures, but beyond that I can say unequivocably that man will explore the moon. Risks are involved. These risks are risks which we have accepted in the past, not only in lunar exploration, but all areas of exploration where man has pressed forward into the unknown. These risks are faced by the astronauts their families and indeed all the members of the NASA team and these risks will continue to be borne as we move forward into the future, I have no doubt whatsoever.

QUERY Dr. Paine, could you be a little more specific. You stated that there is no question that we have a setback. For example, do you foresee this having some effect on 14?

PAINE My principal preoccupation and concern at the moment is to bring the Apollo 13 mission to a successful conclusion by returning the astronauts safely to earth and I can assure you, we are spending no time whatsoever thinking about Apollo 14.

QUERY Doctor, perspective is something that has been rather elusive at times in the past 12 to 15 hours. Can you for us, place in what appears to be their proper perspective, the most critical parts of the mission now until we get the men back home. We talk about a 100 percent pad and the water supply, the electricity looks fine and the burn looks like it's coming up good. In perspective what are the dangers of getting them home.

PAINE Well, for the remainder of the mission we face, really, the question of the degree to which the expendables which we have on board will last through the return time of the flight. As you know, the most critical of these is the cooling water in the LM, the LM power is another critical item, the oxygen supply is yet another. These are in order of decreasing criticality. And the question of lithium hydroxide for scrubbing the CO2 which we have a plentiful supply of. The thing that we are watching

PAINE the most is the ability that we will have after the burn this evening to power down the LM, cut down both the power requirements and more particularly the cooling water requirements. As we review the status of the expendables and the amount of thrust which we have to shorten the mission, we do at the present time have a margin which should assure that barring other unforeseen difficulties, we should be able to make the return journey to earth.

QUERY Dr. Paine, we have here a spacecraft a function apparently which an earlier or a later malfunction perhaps on lunar landing flight could have caused a fatal accident. Do you have any indication from a congress that is somewhat hesitant already to give funds, messages perhaps that they might not look upon this as omen to get out of the space program?

PAINE I think that the question of the resolve of the American people is expressed by the congress to press onward to the conquest of space is something that time will tell. My own view of this is that the problems which we encountered on this mission are certainly things that will be reviewed by the congress. I think to be perfectly candid with you, the performance of the entire NASA team with the remainder of this mission will undoubtedly have an effect on a view that congress has of the activities that we are proposing for the future. But in the longer range sense I am quite confident that the American space program will rise above this setback and there is really no question in my mind in the long run this will be true.

QUERY Dr. Paine, has this advisory board made any recommendations yet and have they been acted upon?

PAINE At the present time the advisory board has been reviewing the decisions that have been made and the amount of additional data which should be obtained, these are the primary activities, gathering additional information, reviewing on the basis of the information which has been obtained the decisions. So far there has been no veto action or major change as a result of this. I think it is more a case of just making absolutely certain that we're doing everything we should be doing.

QUERY You mentioned veto action, does this board have the authority to veto an action taken by the Flight Directors?

PAINE No, the board has only the authority to advise the Associate Administrator for Manned Space Flight. He, however, does have line authority, of course.

QUERY Dr. Paine, you made a considerable point of your determination to go on accepting risks of space travel. I'm sure you don't mean to take on any unnecessary risks. On the light of what's happened with this flight will you reconsider the decision you made to send the Apollo 8 off without a LM?

PAINE I think it is a little late for me to reconsider that decision at this time. That mission is, of course, behind us. I think that our concern for the moment is with future missions, and it is perfectly true that a casualty of this sort occurring in mission like Apollo 8, when we didn't have a LM, or occurring in a mission at a time when for example, we had astronauts down in the surface would indeed have been a good deal more serious. I think that the general view that we have of this is that it was an extremely serious casualty, but

END OF TAPE

DR PAINE The general view that we have of this is that it was an extremely serious casuality, but it could have been worse.

QUERY Dr. Paine, has there been any discussion of setting up some type of commission, post-mission group to investigate this and if so, have you been in contact with the President about it?

DR PAINE None, whatsoever. At the present time we are devoting all of our energies to the successful conclusion of this flight and undoubtedly, there will indeed be very intensive views after the flight, but this is not the appropriate time for that.

QUERY Assuming that the astronauts of Apollo 13 do get back, and there's every indication that they will, would you consider the mission, as a whole, a qualified failure?

DR PAINE Yes.

QUERY Dr. Paine, are there any plans for the astronauts to talk to their families before they splash down.

DR PAINE We leave a certain amount of discretion to the families. They are welcome to come into Mission Control if they choose to do so. I talked to Mary Haise about this just this afternoon and we both agreed that it at least for the moment, she's probably best at home with the children.

QUERY Dr. Paine, there has been some speculation that at the Washington level, you've been thinking at least about the possibility of cancelling, perhaps 18 and 19, Apollo 18 and 19 and concentrating on Skylab. With a 375 million dollar qualified failure on your hands, will this influence your thinking in that direction?

DR PAINE Well, actually, we have been looking at a number of alternative plans as we always do at NASA as we march on to the future for the best way we can use the equipment and the funds that are made available to us. I would imagine that as we review the Apollo 13 mission, we will have some impact on our thinking but it's far too early to speculate whether we would indeed contemplate scrubbing future missions.

QUERY Yesterday, it was indicated here that Vice-President Agnew was going to visit here, tour here today and remain through Wednesday night. Did he by chance discuss his change of plans with you? We we're told that he did not come.

DR PAINE He did not specifically discuss his change of plans. Originally, Vice-President Agnew had intended to make a visit to Houston, during the time of the Apollo 13 mission, and I believe that he considered it inappropriate to do so in the great press of business that we have had in the past day, and so, the only message I got

DR PAINE was that he had cancelled his plans, but he joins with President Nixon in wishing us the very best of success in bringing this mission to a conclusion

PAO I think we are getting very close to LOS, we better wind this up at this time. Frank?

QUERY Considering the advisors you have at your disposal, North American, Grumman and so on, what have they told you about what went wrong? What is your best understanding of what happened?

DR PAINE I believe you've heard a number of discussions of "what went wrong" does seem to pinpoint down to the oxygen bottle. My own view, I am postponing a judgement on that. There will be plenty of time after the mission is concluded, to go back in infinite detail and look at every indication from every sensor. I would rather expect we probably will be able to pinpoint the sequence of events that led to this failure with some degree of percision, later. As I said though, at the moment, we are concentraiting on completing the mission and not wasteing a lot of time on the post-mortems, except in so far as it may tell us something about the present capability of the spacecraft and the options open to us to bring the fellows home. Thank you.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

S-IVB IMPACT BRIEFING
MANNED SPACECRAFT CENTER
April 14, 1970
9:35 PM CST

PARTICIPANTS:

Bill Stephenson, Lunar Mission Office, MSC
Dr. Gary Latham, Lamont Geological Observatory
Dr. Frank Press, MIT
Dr. Maurice Ewing, Lamont Geological Observatory
Dr. Kent Hills, Rice University
Bob Gordon, PAO

SPEAKER Ladies and Gentlemen, we'll begin the SIVB Impact Briefing. We have with us this evening, Mr. Bill Stephenson, Lunar Missions Office of the Science and Applications Directorate, Dr. Gary Latham, Principle Investigator on the Seismic, Dr. Frank Press of MIT, Dr. Maurice Ewing, and Miss Dr. Kent Hills of Rice, who will discuss the side experiment. Mr. Stephenson.

STEPHENSON Okay. Some of the background data, as we can tell it now on the SIVB was at the time of impact was 10941GMT. It landed about 76 nautical miles west, northwest of the ALSEP deployment site. This is shown on these 2 charts, and if later after the briefing, you want to look at the you're welcome to, and we'll have copies later on in the afternoon. We don't have the final figures. About an hour prior to the impact, our estimate of the velocity was 1.04 kilometers per second. We estimated the vehicle mass at 31 000 pounds, approximately 30 minutes prior to impact. We had the ALSEP system up and working at this time. We monitored the impact on both the passive seismometer and the super thermal ion detector experiment is where we gathered the data. And I will now turn it over to Dr. Latham to give you the rundown on the passive seismometer.

LATHAM Well, we've just acquired an extremely exciting piece of data about the moon. And we understand at the same time that we made the trip a little more cheerful for the astronauts. Have you heard on Capcom that Lovell's comment was that he was glad when informed that the impact that had occurred, and that we'd received the signal, that he was glad that something on this blank mission had worked. And also very glad that the SIVB had impacted and not the LM. We share that sentiment with him. I'd like to make just a few remarks about the signal. We left the control center just a few mintues ago. The signal was still arriving. So that you can appreciate that we're not going to be in a position to tell you in any detail about the signal or to interpret it for you this evening. In fact, we face the interpretation with a good deal of humility. A feeling that has been developing with this group since the first signals came. But we can make a few general remarks about it. First, it had the same general character as the LM impact signal. To be more specific, it built up slowly, reached a maximum, and then gradually decreased in amplitude. It probable duration is between 2-1/2 and 3 hours in contrast to the 55 minutes or so that the LM signal lasted. It's peak amplitude, that is the largest motions that we observed on our traces, was a factor of 20 to 30 times larger then the LM impact produced, which was to part of us at least, astounding. The first signal arrived about 30 seconds after the impact occurred, which gives a velocity for the energy that propagates from the impact point to the seismometer that is higher then we

LATHAM recorded from the LM impact. That velocity is roughly 4.6 kilometers per second compared to about 3.2 kilometers per second for the LM impact. The signal characters, as I said, quite similar to what we observed for LM, but there are some differences, some important differences, which we feel may open some new avenues for interpretation, and we're not prepared to go into very much detail on that until we look at the signal much more carefully tomorrow and in the months to come. But I would like at this point, now that I've done the easy part, to ask for comments from my colleagues on what they saw in the signal and so I'll turn it over to Frank Press.

PRESS To me there were several extraordinary things that occurred. We knew exactly to about the nearest second, when the signal would arrive. That is, we were counting time. We had predicted the arrival would occur 32 seconds, let's see, yes 32 seconds or so after the impact, and as we were looking at the clock ticking away, at that second the signal appeared, just when everybody expected it. And the reason we expected it at that time is that we had the data from the lunar rocks that were brought back. These rocks were taken into the laboratory and sqeezed in a pressure cell. And the velocity, seismic velocity of these rocks was measured as a function of pressure. Now on the moon, pressure will increase as you go into the lunar interior, so we could take the rocks in the laboratory, that were brought back, and make the following calculation: These rocks were present in the moon to a depth of 10, 15, 20 or so kilometers, that we could predict how long the seismic rays would take to go from the impact to the instrument. And that prediction was correct to the nearest second or so. And to me that signifies that we can say that the rocks that were brought back, the crystalline rocks, the dense crystalline rocks that were brought back by the astronauts in the preceding missions, represent the first 10 or so kilometers of the moon, that is to the depth of penetration of the seismic waves we saw. Now, the first signal to arrive from the impact was very large. There was no mistaking that we had received the first seismic wave that went through the lunar interior, the fastest wave to go from the impact to the instrument. We were quite sure about this in the preceding LM impact because it was a very gradual beginning and there is always the possibility that there was an earlier signal, which we would have missed because of the small amplitude. But there is no question about this large impact of a few hours ago. We saw the first arriving seismic wave. Now, this is very significant, because I think we can now say that we can explore the lunar interior without moon quakes. If there are no moon quakes, and we think we may not have recorded them up to now, all of the signals recorded may have been meteorite impacts

END OF TAPEe

FRANK Because of the small appitude, but there is no question about this large impact of a few hours ago. We saw the first arriving seismic wave. Now, this is very significant because I think we can now say that we can explore the lunar interior without moonquakes. If there are no moonquakes and we think we may not have recorded them up to now, all the signal recorded may have been meteorite impacts, but there are no moonquakes and there's no means of getting seismic energy into the lunar interior, that eliminates a major tool of planetary exploration, but now we can think in terms of a series of experiments in the next 4 or 5 missions or so where you have these impacts at succeeding distances so that the seismic waves penetrate deeper and deeper into the moon and so that we can get the velocity as a function of depth to a significant depths in the lunar interior. I think this is perhaps going to be the most powerful tool for lunar interior investigation. Another thing that was impressive is that the amplitude of the signal is reasonable. You can look at it this way: The energy of the impact, that is the energy of the mass times the square of the velocity of the S-IVB stage corresponds to about 10 or 11 times of TNT. That's about 10 times larger than the LM impact, so from that alone you would expect to say it will be 10 times larger. Moreover, this impact was nearly vertical. It was 75 degrees from horizontal, whereas the LM impact - so the S-IVB was near vertical, the LM impact was near horizontal, only 2 or 3 degrees above the horizon. That means that the S-IVB impact was another factor of 10 more efficient than the LM impact simply because it was going in vertical instead of almost horizontal where it bounced out again probably, and that means the signal would perhaps be 100 times larger. Now, the distance was twice the distance from the LM, 140 kilometers as compared to 70 kilometers. That would make the signal smaller by about a factor of 2 or 3, and this is where the number 25 is exactly what you would expect from the nature of the two experiments. There was other significant information. All of these signals, these long lasting signals, have some certain characteristic times. They have a characteristic rise time to where the amplitude reaches a maximum and then stays level, and then they have a decay time, how long it takes to decay to half the maximum alplitude. This signal had about the same rise time as the LM impact, even though it was further away and it was bigger, and it had a decay time of about twice that of the LM. I think this probably will be used to eliminate some hypotheses for the reverbaration and support others, but I wouldn't care to go into the detail because we really should think this through some more, analyze the records digitally on computers, before we're willing to say such and such hypothesis is eliminated and

SPEAKER such a hypothesis is reported. In any case, with this new datum you might say, I think we're in a position to narrow the possibility for the explanation of the signal. Let me stop here and turn to Dr. Ewing and perhaps we can come back to some more later.

EWING Well, I would just like to reinterate that what Frank just said about the quality of that record. It was a beautiful record. The trace on all three components - the traces on all three components were perfectly quite and straight, there was no background noise showing before the signals arrived so that it was possibly, as he said, to pick the events with absolute certainty. I believe that the quite background can be attributed to the fact that this happened early in the lunar day so that we didn't have the disturbances caused by sun-rise and by the big changes in temperature that would have been encountered a little later. This large signal, as Frank said, indicates that with events, with energy sources of the size that was provided by the impact of this S-IVB, we could get good records to much larger distances. I would be quite certain that we could go to 4 times the distance and I'd make a prediction that in all probability we could to 10 or 15 times the distance, that of 140 kilometers that we used this time. When you're exploring the subsurface by propogation of waves of this type, a rough rule of thumb is that the depth to which your exploration is effective is more or less a quarter of the distance to which - the distance between your source and your receiver, so this means, just to repeat what Frank said a minute ago, that we have a powerful and effective method for investigating the lunar interior even if we never get a big meteor impact and even if we never get a moonquake. I wasn't at all certain that this was the -

END OF TAPE

SPEAKER is that the depths to which your exploration is effective is more or less a quarter of the distance to which - the distance between your source and your receiver. So this mean, just to repeat what Frank said a minute ago, that we have a powerful and effective method for investigating the lunar interior, even if we never get a big meteor impact and even if we never get a moonquake. I wasn't at all certain that this was the case before the test today. I also am quite confident that there is enough similarity in the pattern, in the signature of the signal received, enough similarity between that from the LM impact that from a number of small meteorites that we've had in the interrim, and that from the S-IVB today that we have in our hands the means - enough material that when we study it we can give I think a firm answer on all the characteristics of the signal that puzzled us so much before. One last point. The propogation from the LM impact and the propogation from the S-IVB impact were both studying only one type of lunar surface. They both are in the Ocean of Storms, they both are relating to conditions under one of the maria, and we still look forward to the information that we would have gotten out of 13 if it - if the trouble had not developed. We look forward to a comparison of the structure in the highland areas with the structure in this area that we've now sampled two times. Thank you.

SPEAKER I'd like to just mention one thing here. As a result of tonight's signal we've been tossing around the possibility of using an impact like this to explore the mascon basins. I think you're all familiar with the concentrations of mass in the ring basins on the moon which have raised a great deal of controversy as to what these mascons might be. One can now image an experiment of having a seismograph, an ALSEP, at the edge of one of these ring basins and impacting the S-IVB stage in the middle of the basin and having the seismic waves penetrate this anomalous mass to see how the seismic velocity through the mascon compares with the velocities that we've been getting in the Sea of Storms and that comparison in velocity might lead to a definition or an explanation of what the material is that is responsible for this excess mass

SPEAKER I think that we might add that copies of the record that we obtained on one of the recorders will be available. It may be quite late tonight or first thing in the morning.

SPEAKER We have a photograph in the system now which should be available later this evening. Dr. Hills.

HILLS The superthermal ion detector again saw an increase counting rate of positive ions after the impact. In this case, our first indication came some 22 seconds after the impact. We're interested in this in comparison with the LM

APOLLO 13 S-IVB IMPACT BRIEFING, 4-14-70 9:35 PM CST 25C/2

HILLS impact on the previous mission where we saw for a short time a flux of positive ions and we weren't really sure whether those ions were related to the LM impact or whether they just represented an ion flux that happened to come at that time. We now know that it is related to the LM impact. Tonight we saw a counting rate of some 10 times the counting rate that we observed on the previous mission from the LM impact. The energy was peaked at 70 electron volts and we are measuring only positive ions. We did also get a mass specturm. Right now I would only say that at least 10 percent of this flux that we're seeing is heavy masses, that is, 10 to 80 mass units. The rest would be protons and maybe some helium. It may well be that most of the flux are from the heavier masses, but right now we would only say that at least 10 percent are. We have also again as with the seismometer, since we are still in the darkness, the background is very low and we have a very clear indication of the counts. Our signals do not hang on as long as the seismic signals. Our duration is only about 70 seconds from first indication to when it goes away. It builds up rather gradually and falls off rather suddenly in a manner similar to the way the fluxes were recorded -

END OF TAPE

SPEAKER so the counts - our signals do not hang on as long as the seismic signals. Our duration is only about 70 seconds from first indication to when it goes away. It builds up rather gradually, and falls off rather suddenly in a manner similar to the way fluxes were recorded on the Apollo 12 Mission. The fact that we are in the darkness makes some difference, perhaps, in possible ways to create these ions and we do not have the sunlight shining on this area so we don't have the possibility of solar ultraviolet ionization of a neutral gas cloud. We also have a considerably reduced possibility of some acceleration by the influence of the solar wind. So we're still having to study this now to see what we can learn about the mechanisms for creating these ions, getting them to this particular energy and getting them there as rapidly as we do. We kind of favor some idea like a gas cloud in expanding from the impact site and what we see is a shell of gas as it expands out past our sight. Some of the details as to when the ions are created, where they are created, and how that particular energy is obtained will have to wait for some later consideration. We have also seen, as I mentioned, after we mentioned the duration of about 70 seconds. Then again, some 2 to 7 minutes later, we see some other ions, which range in energy from 10 to 250 EV. These are much smaller. These only give us up to a couple hundred counts, whereas we get about 2500 counts in the main event. So we still have to figure out if these later events are also part of the impact or if they are fluxes which are expected in this region. They would not be unusual fluxes to see at this time and place, based on our previous experience with this instrument. But the 2500 counts that we saw right after the impact is clearly a factor of at least 5 times greater than anything we would have expected to see there, and greater then anything we have seen in this region to date. There is no doubt that it is associated with the LM, I'm sorry, that it is associated with this impact.

SPEAKER All right. Ladies and Gentlemen, please wait for the microphone to ask questions.

QUERY Dr. Latham. During Apollo 11, right after the passive seismic experiment was placed on the surface recorded a large event of some sort. Now, the speculation was at the time that this was perhaps a Russian spacecraft that was at that time orbiting the moon and may have crashed on the surface. I was wondering if the impacts that have been recorded now by the passive seismic experiments that are on the surface, bearing resemblance to the first large event that was recorded right after the Apollo 11 placement. And if you've reevaluated your original thing about the first event not being the Russian spacecraft.

LATHAM I think that we never believed we detected that impact of the Russian spacecraft. We looked pretty hard at the time and did not see a signal which seemed

LATHAM to correlate. The signals, which we do believe to be of natural origin, which we observed at that time are much smaller then these impact signals, but all have the same character, identical character and much shorter and presumably they are produced by events that are much smaller in energy release and much closer to the instrument.

QUERY Is that to say then that the natural events, which you have recorded, bear strong resemblance to the ones that you perpetrated by throwing these objects to the surface of the moon?

LATHAM That's one of the strongest reasons that we are led to the hypothesis that they may be meteorite impacts, since we see that in the case of man made impacts, we get signals which are, if not identical, in all cases, very very similar to those we observed from natural events. And when we compare the numbers that we have observed, with those you would expect from meteorite impacts, the agreement is very good. We can't exclude the possibility that some of them are shallow moon quakes at this point. But at least as a working hypothesis the assumption that they are of meteorite impact origin, seems to fit all the facts that we have.

QUERY How have the results that you have received from this impact affected your plans for an active seismometer? Would it make it more or less necessary. Would it affect the placement of the seismometer? What affect would it have?

LATHAM I think that the active seismic experiment is attempting to do - it's objectives are quite different from the objectives that we seek to attain in the large range impact experiment with the passive seismic. The active, we'll try to detail local structure, that is out to a mile or so from the seismometer. Will provide very detailed and accurate information on velocities near the instrument whereas we're trying

END OF TAPE

QUERY more or less necessary would it affect the placement of the seismometer or what effect would it have?

SPEAKER I think that the active seismic experiment is attempting to do - its objectives are quite different from the objectives that we seek to obtain in the very large range impact experiment with the passive seismic. The active will try to detail local structure, whereas we are trying to that is out to a mile or so from the seismometer and will provide very detailed and accurate information on velocities near the instrument, whereas we're trying to get more gross estimates over much larger ranges and to much greater depths within the moon so the 2 dovetail in that they provide accurate control near the instrument and we're looking for the longer range and greater depth results. Wonder Bob Couatch I think is here. Do you have anything to add to that, Bob?

QUERY Without wanting to press you beyong the interpretations that you want to make now, do you see any thing inconsistent tonight with the idea of perhaps it's broken up into large blocks, the sort of thing you've talked about before on the strength of the LM impact?

SPEAKER I think we need all three of us to comment on that, because I'm sure our ideas will differ some, but I would say generally that the possibility is raised that this is not the whole answer. The possibility is raised because the signal increases at a much faster rate to its maximum than we had anticipated, but we really have to think that one through in detail and see if we can't explain it despite this observation and I wonder if Frank or Dr. Ewing have any. Would you like to comment on that?

SPEAKER I would only say that I believe there's enough systematic relation between the small meteor impacts and this signature from the small meteor impact, the signature from the LM impact, and that from this big impact today that when we get to work on it I think we'll all be able to agree as to the cause of the prolonged signal.

QUERY You mentioned a piece of exciting data. Did you cover that, or was that merely referring to the quality of your signal, and the second question, would you name a alternate hypothesis to the rubble layer?

SPEAKER When I characterized what we obtained tonight as exciting data, it is after all the second data point and that fact by itself makes it exciting to us, a much larger aplitude at twice the range so that the raise now that we're seeing - the energy is penetrating to much greater depth into the moon than was the case on the LM impact. It was very well recorded so that we could see very clearly the early part of the signal this time, and we think by comparing now these 2 pieces of data that we're

SPEAKER going to clear up a lot of the mysteries that have necessarily existed by virtue of the simple fact that we only had one piece of data. For example, whether or not some of the signals were really produced by ejecta thrown out from the impact and landing in the vicinity of the seismometer, which some scientists believe may be the explanation to the signal. That would be an important point to try to clear up based on this comparison, and I think the nature of the structure of the outer shell of the moon which produces this very unusual signal character will if not at least - if we don't arrive at a firm explanation we certainly will arrive at a much narrower range of possibilities than we've had before. What was your second question.

QUERY What other than a rubble layer could cause this kind of signal propogation?

SPEAKER Well, we have talked about a rather unusual velocity depth function, that is, the way in which the velocity of the rock changes with depth as a possible explanation, one in which the velocity is extremely low to rather large depths. We've also begun to look very carefully at the source mechanism itself as a possible way of explaining some of this signal character, that is the fact that rocks are thrown out and that presumably a volitolized ejecta thrown out and spread out over the surface of the moon may tend to extend the effective source in such a way as to produce a very unusual signal character. So I would say that these are two of the aspects or alternates that we're looking at. Would you like to comment on that?

SPEAKER One of the problems - now this is a personal opinion leading to a personal working hypothesis, which is an excuse for saying I don't believe it a few days from now - one of the problems I've always had with the LM impact and with the impact of the S-IVB stage is that the signal is so large for a relative small energy source. It's not a very big source to have one - ten tons of TNT equivalent sitting at the surface rather than being buried in the medium, so I've always looked for a mechanism of making the signal stronger, and the working hypothesis that I have relates actually to this expanding gas cloud that you heard about a few minutes ago. This would be an expanding cloud of debris thrown out by the impact, and as this debris moves horizontally along the surface, it continues to pump energy into the ground, it continues to excite seismic waves and the seismic waves that it would excite would be particularly strong at the velocity of the expanding cloud of debris. Let me see if I can say that better. Just imagine a disturbance which moves along the surface of the moon with a speed that's equal to the speed of some seismic wave in the lunar interior. If this does occur, I'm not sure that it does, but if it does

SPEAKER occur, it's an extremely efficient means of a resident transfer of energy from the impact to seismic waves in the interior. So this is one mechanism that might be envoked to explain the very large amplitudes. This is not a unique explanation but it's my working hypothesis at least for the next few days.

QUERY Dr. Latham, we seem to be talking about quite a successful experiment with the impact here, but isn't this far over shadowed by the fact that you're going to have at least a one year gap between the placement of 2 seismometers on the moon that possibly you will not have 2 seismometers again working together on the moon for a long time to come?

LATHAM Well, the relative merit of this piece of data versus the clear possibility that we'll never have or will not have for a while 2 instruments working simultaneously is hard to judge. The piece of data is obviously an extremely important factor in our ability to interpret lunar structure. I think we can leave that aside. The second point of not now having the possibility of having 2 stations operating simultaneously is obviously a great disappointment to us and a great loss to the experiment, but we do feel that the possibility is still open and will probably not be in the Fra Mauro region unless we go there on the next mission instead of Litro, for example, but if we land at Litro on 14 and then the site for 15, which escapes my mind right now, we'll still have the possibility of having simultaneous operation between stations in the later stages of the Apollo program, and of course we badly need that. It increases the power of the seismic method a great deal and we are deeply disappointed right now as everyone else. We're hoping the men get back safely, first, but we are disappointed in this abort on the mission.

press Can I make a statement?

GORDON Certainly, Dr. Press.

PRESS Along these lines, I read some articles recently. We seem to say why go back to the moon so many times and repeat the same thing over and over again? I think what we saw tonight perhaps is a very good answer. We're not doing the same thing over and over, again what we're witnessing is an evolving technology so that the later missions to the moon represent a more advanced, a more sophisticated, a more elegant science and technology. In later missions to the moon we may be doing twice as much or three times as much science as these earlier missions because we're gaining in sophistication of interpretation, we have the lead time to get more advanced instruments to the moon. It took Apollo 13 to get the S-IVB stage, for example. We couldn't do it as early as Apollo 11, and I think the answer to that is if you look at the total lunar program with the much higher return of data in the later missions, you can see a reasonable conclusion to this first stage of lunar

PRESS exploration where the first order picture of the moon is understood. So we're not doing the same thing over and over again, we're continually advancing the techniques and the state of the art, and in this way I think we'll have a cohesive program, which if it is cut off in advance or too early we may be left with a lot of unresolved scientific questions.

GORDON Laides and gentlemen, Dr. Latham and his colleagues would like to get back so we have time for 2 more questions. We'll go to Mr. Pease right here.

QUERY I don't want to take -

GORDON I was trying to give you a doctor there, Harry.

QUERY Yeah, thanks. I don't want to take both questions, but I do have 2 in mind. One was for Dr. Press. Isn't your feeling about this subject to pretty fast mathematical analysis? Can't you compute the size and the velocities and the ejecta particles and figure out where they hit and see what sort of an expanding wave pattern is set up?

PRESS That's right, and that's exactly what we're going to do. This hypothesis is about 4 hours old. It hinges - let me tell you what it hinges on. We just read some papers today of experiments that were made projecting - of impacting projectals on earth, bullets on earth into debris in a vacuum and studying the way the debris is shot out, and I've only seen that today in detail and that lead to this next step which you heard about tonight, so I think this is subject to calculation and we'll - after calculation we may reject it keep it.

GORDON Mr. Hodge in the front here. Right here, right next to you, right in front of you.

QUERY Do you - after the LM impact you described the vibrations there or the impact as ringing the moon like a bell in a bellfrey. How would you characterize the signal you got tonight?

SPEAKER That's very simple. Quite similar, much louder.

GORDON Jack Strickland here. Right in the blue jacket.

QUERY Begging your forbearance, Dr. Press, after your discussion about why we should go back to the moon, what would you have learned if you had had another seismic experiment -

END OF TAPE

SPEAKER - right In the blue jacket.

QUERY Begging your forebearunce Dr. Press, after your discussion about why we should go back to the moon, what would you have learned if you had had another seismic experiment - say 13 and 12 - and had recorded the LM impact, what would you have gotten with 2 seismometers that you didn't get with one?

PRESS Well you *see,* each impact recorded by a single detector gives us the elastic constant - the velocities at a certain depth in the lunar interior, so now we have two depth points. For example, on the LM we have a depth point of say, 20 killimeters, and we know what the velocity is there, as a result of today's experiment, we have a depth point, lets say of 30 kilometers; if we had 2 instruments today we would have had 3 depth points and gradually you build up the whole sequence, and its like drilling through the lunar surface if you have enough points in finding out what the material is, and its just drilling that much farther, with each additional seismograph. Dr. Young, you want to add to that?

YOUNG Could I have a little bit to your answer? When the event that is being recorded is an impact, at a known place, and a known time, you don't gain any more than Frank indicated by having several instruments. If you've got 3 instruments recording, you've got 3 times as much data. But, when the event being recorded is a natural event, whose time and place are unknown, then, you have very great need for having several instruments recording simultaneously so we can triangulate on its distance.

SPEAKER Gnetlemen, thank you very much.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

SPACE SUIT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 15, 19 70
11:12 AM CST

PARTICIPANTS:

Bruce Ferguson, ILC Industries
Al Gross, ILC Industries

FERGUSON Good morning, Gentlemen. I'm Bruce Ferguson, ILC Industries in Dover, Delaware, prime contractor for the Apollo spacesuit. Today we would like to give you a brief description of the Apollo spacesuit concerning its function within the command module which qualifies it as a redundant spacecraft in the event of cabin depressurization. Demonstration will be given by Mr. Al Gross, Lead Engineer of the systems and design group with ILC INdustries here in Houston. Now, I would like to give the program to Mr. Gross.

GROSS Thank you, Bruce. First, I would like to introduce our suit subject for today. His name is Mr. Bob Urert, he's the engineering captain of our suit qualification team. He is currently wearing our Model A7L spacesuit which is virtually identical to the suit flown on Apollo 11 and 12 and is also identical to the suit currently returning from the moon at this time. Assuming that most of you are thoroughly familiar with the functions of the spacesuit on the lunar surface, our topic today, as Bruce mentioned, is to cover the function which the spacesuit could play could it be needed inside the spacecraft for an emergency return to earth. As you all know, the spacesuit can retain pressure and provide ventilating oxygen flow to assist in breathing and basically maintain life on the lunar surface. HOwever, inside the spacecraft its function in that area is similar but we have other things to consider. As an example, the emergency return from the moon requires a much longer time period wearing the spacesuit. During this time period it's conceivable that the astronauts would like to eat and drink water and perform functions of this type. This is our current Apollo helmet. One of the features it employs is what we call feed port. By removing this cap a water gun or food probe inside the spacecraft can be injected through the port without breaking the pressure integrity of the spacesuit allowing the crew members to ingest food or water. During a mode of operation of this type, the chances are the crew members would probably be strapped into their couches for most of the ride back. However, there are various stowage areas which they may desire to gain access to within the spacecraft. Some of these areas are beneath the couches and what's known as the lower equipment bay and some of these areas are in general in the rear area of the spacecraft. When the suit is pressurized to its current design limit value of 3.8 psi within the spacecraft, the astronaut has the mobility to get around within the spacecraft to a level perhaps a little better than he would on the lunar surface and one reason is he is not wearing

GROSS In zero g versus 1/6g you have a tendency to float around a little more and it makes it relatively easy to get around inside the spacecraft and gain access to these stowage locations. The primary functions of the spacesuit while in the spacecraft, are concerned primarily with the oxygen ventilating loop which gives the man adequate pressure retention, it provides breathing oxygen, it prevents fogging of the helmet shell and it removes excessive carbon dioxide levels. Basically the spacesuit in the spacecraft would look as Bob is wearing it here. He currently is wearing an EV configured spacesuit. One of the items to take note of are these two valves on either side of the blue gas connectors. These valves are called the verter valves. Normally on a lunar surface they are in the vertical position which directs all flow to the helmet. However, in the spacecraft due to the long time period involved, it could be desirable to have oxygen ventilating in various areas of the body rather than only through the helmet. These valves can be placed in a horizontal position and divide the flow approximately 50-50 between the helmet and the torso. On the downstream side of the loop, the flow leaves the suit through the arms and through the legs so by placing these valves in a horizontal position you get more adequate body coverage. While in the spacesuit, communications are always desirable and we have a communications carrier. This particular connector on the COMM carrier connects to the electrical connector that Bob is showing here. The other end of the loop goes down to a bio instrumentation belt. While in the spacecraft, heart rate and respiration rate can be monitored by medics in Mission Control. So basically while inside the spacecraft, all functions that are needed can be handled by the spacesuit alone in the event of depressurization return from the moon. The next topic of discussion concerns the reentry configuration which could be attained during the mission. Thus far, reentry has been an unsuited thing where basically the only items which a spacesuit had to provide were impact protection. Some of the astronauts have chosen not to wear a suit to be strapped into the command module couches and to place the Apollo helmet over their heads. The helmet has an impact pad in the back which also serves as an oxygen ventilating path to distribute the oxygen across the entire scope of the bubble assembly. Another device we have is called a valsalva device which serves the purpose of blocking off the nose and blowing hard to clear the ears via the Eustachian tube. This device is used during reentry due to the pressure chang , basically increase pressure from the 5 psi spacecraft level back to the 14.7 psis we have on

GROSS earth. In the event that the astronauts do come in suited, the helmet would normally be in place, they would have use of this valsalva device and there's always a possibility of a suited water egress. Thus far, we haven't had this situation in Apollo. However, should a suited egress be required, we would like to demonstrate the configuration that the crew members would be in. Bob. This item here is called a neckdam. It has a flexible ring so that it can be folded up and stowed in a pocket on the spacesuit. Actually, this pocket right here. It's basically made of neoprene and it fits around the neck quite snugly so as to provide a seal at the neck area. In addition to the neckdam the astronaut must wear his gloves so as to completely seal the suit to prevent water from entering it. These are the IV gloves or intravehicular gloves used inside the command module. Quick reference to these gloves indicate that they look quite a bit different from the extravehicular gloves used on the lunar surface and that thermal insulation is not needed inside the spacecraft as it is on the moon. So this right here is the configuration that a suited egress would attain. Basically, about one and one-half cubic feet of air is captured inside the spacesuit. Excuse me, one item we haven't put on is the dual lifevest assembly. This assembly is a dual redundant pouch assembly strapped beneath the arm pits and in the event that the crew member falls into the water attempting to get into his raft, he can pull on the drawstring on the lifevest and have two redundant pockets pressurized with air in addition to the one and one-half cubic feet trapped inside the spacesuit which gives him the adequate bouyancy that he needs so as not to sink.

FERGUSON We haven't gone into any of the aspects of the suit referring to the lunar missions since obviously they are not required at this point. We will answer questions at this time if anybody has any questions as to how the suit might be used during the cover. Are there any questions?

QUERY How long could he survive?

END OF TAPE

QUERY Could you survive in that alone?

FERGUSON You mean, how much air is inside the suit in the event he would be cut off from any other, from any other...

QUERY or by using say a backpack or something like that.

FERGUSON I'd like Mr. Gross to answer that.

GROSS Well, currently, you mean with no oxygen flow coming to the suit or utilizing the current Apollo backpack. Current Apollo backpack is rated at a level, basically on an activity level, of 1600 btu's per hour. Which is a fairly good work load. Thus far we haven't seen activity levels that high. They've been in a neighborhood of a thousand btu's per hour. At that level, the backpack would probably last about six hours. The rating is for 4 hours at 1600 btu's per hour.

QUERY At a lower btu rate, you could probably last longer.

GROSS Yes -

QUERY In just the relaxed position, in the command module.

GROSS That's true. It depends on how hard you work.

QUERY If this were used as a back up, if you lost oxygen in the rest of the spacecraft.

GROSS Yes. You always have a portable life support system

QUERY as a final reserve.

GROSS as a final reserve. You also have a backup system to the portable life support system which is used on the lunar surface or for a contingency spacecraft transfer for the oxygen purge system. Basically it's a high pressure oxygen bottle designed to last between 30 and 40 minutes. Yes.

QUERY (garbled)

GROSS What we have here is liquid air. This is a ventilator which we use when we have a subject in a suit so he doesn't get warm. Basically, the liquid air is at an extremely low temperature and it's really venting. Yes.

QUERY How is the, how are suits that are up there now being utilized to help with the getting the CO_2 out of the air. Are they being used in that way now? and are the astronauts wearing the suits at this time?

GROSS As far as I know, the astronauts are not wearing their suits and the suits are not playing a role in the CO_2 situation, at the present time.

FERGUSON I think what he is refering to is that some of the, apparently some of the umbilicals are being used to recirculate the air through the lithium hydroxide containers, in a kind of a jury-rigged assembly. Is this what you are refering to?

GROSS A possibility in this area would be to use the suit as an interconnect to connect the LM umbilicals to the command module umbilicals. If they're doing that at the present time, I don't know. However, the suit could be used for that purpose, since the two oxygen inlet connectors are manifolded together, likewise the outlet connectors. So the suit could be used as an interconnect if needed.

QUERY How are the umbilicals being utilized at this time, could you elucidate a little on how they're being used.

FERGUSON The reference that I heard, in regard to using the umbilicals, was that they were using the umbilicals alone, and running the air through the lithium hydroxide. In another words, they were using it as a channel, to channel the air through the lithium hydroxide canisters. That, I believe, that they said this morning that the canisters from the LM would not fit the holders in the command module. Is this the reference?

QUERY Then they're not using the tubes to or the umbilicals to run it through the PLSS. They're using it with the lithium hydroxide canisters, and not the portable life support systems.

FERGUSON This, my understanding was that they were using the hoses to recirculate the air through the lithium canisters. However, I may be wrong in that. I don't have all the information in that regard.

GROSS Is there any more questions? Well thank you very much gentlemen.

END OF BRIEFING

APOLLO NEWS CENTER
Houston, Texas

Deke Slayton's Press Briefing
Manned Spacecraft Center
April 16, 1970

Participants:

Donald K. Slayton, Director, Flight Operations, MSC

Howard Gibbons, PAO

DEKE SLAYTON's PRESS BRIEFING 4-16-70 CST 10:05A 32-A/1

SLAYTON Just to explain to everybody what I think this is about so some of you can go start drinking coffee again. I had about 20 requests for Interviews today and obviously I couldn't handle that many so I decided everybody that was interested in interviewing me - we'd try to get them all together at once and try to talk to them and that's what this is all about. I have absolutely no briefing as such to make and no statements to make. I'm just available for questions so if anybody didn't understand it that way why I apologize and you're free to do anything obviously.

QUERY Deke. At this stage of the game we always start thinking about post-recovery plans, I wonder if you could give us any kind of a fix on assuming everything goes well, you have a recovery tomorrow, what are the plans for the crew?

SLAYTON I just happen to have a draft here in my vest pocket which we haven't printed yet, but the last thing I got from the recovery guys would be arrival at Ellington at 8:00 Sunday morning. Now the times before that, Roy, I'm not too clear on, but in rough numbers they'll keep them on the carrier over night. Tomorrow night go on into Samoa, pick up a C-140 from there and then nonstop into Ellington. And those exact times I don't have, but they end up at Ellington at about 8:00 on Sunday. We would then start debriefing Sunday afternoon, technical debrief and all day Monday have a program project debrief on Tuesday, follow on crew debrief Wednesday and on down the line. I can give you all that detail if you want it or (GARBLE)

QUERY We would be interested in it and, of course, too most of the news people in this room would be interested in when would we, do you think, get a chance to talk to them?

SLAYTON Okay, let me follow on through then with the rest of this since we are on the subject. Thursday the 2 rd then we would program a photo debrief, whatever science we got, which, obviously, isn't much in this case, that morning a medical debriefing and afternoon and then finish the day with a - work in our a pilot report. The same on Friday and Saturday, give them Sunday off. Monday and Tuesday we program systems debriefing - details systems debrief - the experts in this case, of course, we anticipate that this is going to be a fairly lengthy process considering our problems whereas on the last missions where things have gone clean, about one day has been enough of that. So as a preliminary that looks to me like we come out with a press conference on about the 29th, Wednesday the 29th.

QUERY Would you think in terms of an earlier news conference than that, just perhaps a short one?

SLAYTON There has been some discussion of that, but I think that, again, is a decision that will be made by Dr. Paine and Bob Gilruth and if somebody decides it is desirable to fit one in there someplace before that I'm sure it'll happen but this is the only plan that I can draw up at this time.

SPEAKER Okay, thank you.

QUERY Deke, can you give us a fairly thorough run down of Tuesday, night - Monday night in the simulator, Gene Cernan and Joe Engle spent the night, what did they do, what kind of problems were they looking at? You know, how long were they in there, that sort of thing.

SLAYTON I know we've had people in the simulator all night and all day every night and trying to figure out exactly what happened Monday night at this point it's kind of difficult for me to back track. We're in' running right now and have been part of the night on the reentry part of the stuff. Essentially, what we've been doing in the simulator is looking at what their next milestone is, things we don't have a good detail checklist on and trying to work out the details in the simulator and feed it right on up to the crew. I think the things we were working on Monday night, we were concerned about PTC using the LM instead of the Command Module which we hadn't done before and work that out in the simulator. Of course, we worked out the AGS PTC thing that we've been doing here this last day on the simulator, worked out the AGS DPS Dock burn on the simulator, the one that we made last night. There again we have contingency procedures for dock DPS burns but we assume you do those with the PNGS normal instead of the AGS. So it's these kinds of things that we've had to vary due to the particular situation that we're in, that we've tried to work the details out on the simulator first.

QUERY Deke, two questions. First of all, from what you know about the conditions what - can you give us some idea what it's like up there for the men and secondly is there anything in particular that's impressed you, they've obviously all gone magnificently, but anything in particular that's impressed you about their handling of this emergency?

SLAYTON Well, as far as the conditions are nothing unusual about them, they're a little colder than normal up there, of course. The Command Module is running about 52 degrees, the last count I had. The LM was reasonably warm. So it's colder than we're used to, and of course with the Command Module power down it's darker than it used to but that's no big problem. I think in terms of crew comfort we don't have any problem, we're in good shape. We've

SLAYTON got enough food and water and so forth and I guess if you want my opinion on how they handled the situation when it happened. They handled it exactly how we'd expect them to. They were about as well on top of it as anybody could he with knowing what we knew (which wasn't very much) I'll have to admit, but I think they did everything right within the knowledge that was available to us in a timely fashion which was what all we expected of them. In fact, they did a beautiful job of it.

QUERY Deke, how is Ken Mattingly's health now. Any signs of Rubella?

SLAYTON Well, I was just talking to him before I walked over here and I still don't see any spots on him. He seems to be feeling reasonably well.

QUERY Slayton, we've had reports of haggard astronauts spinning wildly off course, how haggard are they and how wildly were they off course?

SLAYTON That doesn't mean a thing to me. I don't even know what you're talking about. I don't mean to be smart. I really don't know.

QUERY Are they haggard?

SLAYTON Are they haggard? I don't think so. They haven't had as much sleep as we would like to have them have but nobody else has either and I think if you can get 4 hours here and there why you're in pretty good shape. I think they're rested enough to do a reasonably good job. That spinning off course, I don't understand that, I don't know what it means.

QUERY Are they more off course than is normal for a ship returning from the moon.

SLAYTON Off course?

QUERY Yes, in other words they needed a course correction to get back in the corridor.

SLAYTON No. We made a midcourse last night which is normal.

QUERY Normal - was it an abnormal correction?

SLAYTON No. Totally not. I guess that's what's been confusing me here. There's been nothing abnormal about the trajectory at any time. We ran a hybrid trajectory at the time the incident happened. We burned back on to a free return and then we made the burn on the loop around, VC plus 2 to get us on a faster return. We expected we'd have to make a midcourse on that burn which is the one we made last night, and they're a little bit out of the corridor until they make that burn but that burn is insensitive as hell, you could make it about any time and in almost any direction as long as you're pointing approximately so as far as

SLAYTON trajectory we haven't been concerned about that at all at any time and still aren't. We may make another midcourse somewhere around 5 hours someplace in there could come out a couple of feet per second, whether we make it or not doesn't make a bit of difference. It just tunes things up a little bit.

QUERY How would you evalutate the value of Jim Lovell's previous experience in space in coping with the emergency and does it raise any thoughts in your mind about the possibility of having an experienced man in the crew in future flights.

SLAYTON Well, that's a tough thing to put a handle on. I guess you aren't experienced in anything until it happens to you. This particular thing hadn't happened to any of us so he wasn't any more experienced with this particular thing than anybody else. On the other hand, I'm sure of the fact that he's been there before is bound to have some benefit. To try to put a number on it, frankly I can't but I think we've always felt that we can start in with anybody and train them up to the condition where they can fly a very good mission and the experience factor isn't all that great, because if we didn't have that capability we wouldn't have flown to begin with anyway. You just have to assume that you can train people to do anything that's required of them on the ground when you're in the space business.

QUERY You say you're not concerned about the trajectory, what is your chief concern now in the next 24 hours?

SLAYTON What is the what?

QUERY What is your chief concern in the next 24 hours. You say you are not concerned about the trajectory, which is going well, what are the chief concernin the next 24 hours?

SLAYTON The main concern?

QUERY Yeah. What is your chief concern, yes. In the next 24 hours.

SLAYTON Oh, I think I don't have any great concern. We've got -

END OF TAPE

SLAYTON The main concerns?

QUERY Yes, what is your chief concern, yes, in the next 24 hours.

SLAYTON I don't have any great concern. We've got some work to do, lots of it, and it's primarily concerned with the entry. We've got an unusual combination of things here and number 1, we have nothing in this service module, which we normally have to provide sustenance to the command module. Normally, you keep the service module on; it provides your power and oxygen until somewhere until 30 or 40 minutes ahead of the entry. We haven't got that. So - and we do have the service module on and it's given us some thermal protection. So we're caught here with one situation of wanting to get rid of the service module reasonably early. On the other hand, we've got to make sure we don't get rid of it too early and give us some thermal problems. Secondly, we want to keep the LM as long as possible because this is where we are getting the things we normally get from the service module, at least to a limited extent. So trying to work out this timeline from both ends gets to be a little bit sticky and we've got a preliminary one that's been worked out yesterday, through the night last night. We're simulating it this morning. We hope to have it in pretty good shape by noon today. We may have to do a little more work this afternoon on it.

QUERY Do you expect any problems, in fact, in the jettison of either the LM or the service module.

SLAYTON No.

QUERY presumably with your responsibilities for Apollo 14 training. You're already wondering what should be done about that. Whether to delay it or not. And a more personal thing, can you tell us if Ken Mattingly is now feeling more friendly disposed towards Chuck Berry?

SLAYTON Well, as far as 14 is concerned. We're pressing on as usual. We've been using the 14 crew to work out some of these procedures that we didn't have a handle on. As far as Ken Mattingly's interface with Chuck Berry. I'd prefer you talk to them about it. I don't think we've got any problem there on the part of either one, however.

QUERY Deke, have you figured out yet what you think happened within the service module. What effect it might have and can you follow that through in terms of the sequence of events as you begin to peel off the LM and the service module and prepare for entry.

SLAYTON Our preliminary plan right now is to dump the service module around 4-1/2 hours, and to dump the LM at about 1 hour. Make it clear. These are preliminary at this point because we've got a lot of work to do yet. We

SLAYTON we would like to back the service module jet out farther if we can reasonably, and we'd like to hang onto the LM as long as possible, and so what these times turn out to be is going to be a function of how well our timeline integrates.

QUERY How will you achieve separation? In this case from the service module and from the LM?

SLAYTON Oh, oh, I'm sorry. Well, with the LM attached, and the service module. We can just put a little DELTA-V in with the LM and separate from the service module. There's no problem there. Of course, separating the LM, we've got this pop gun effect. We have a DELTA-V in the tunnel and as soon as you pop the ring why you're going to get a separation of something like 2 to 3 feet.

QUERY And finally, have you figured out yet what you think happened down there in the service module?

SLAYTON No, I sure don't have any wisdom on that subject at all. There's all kinds of speculation, but I don't think anybody knows the facts and we probably aren't going to for awhile. We hope to get some pictures that might help give a little enlightenment to the subject, but there again we can't plan too heavily on that either. We'll do the best we can with it.

QUERY That knowledge would effect your plans for future missions wouldn't it?

SLAYTON Oh, we'll definetly have to do a systems analysis to pin it down. I don't think there is any question. We have to understand this before we can probably commit too much farther. It's this kind of a failure that can give you a pretty bad day if you don't have the LM around.

QUERY Has there been or is there likely to be any more discussion about the members of the astronauts families possibly talking with the astronauts before reentry.

SLAYTON I don't see any particular reason for them to do that. I doubt whether we're frankly going to have time, and I'm not sure they even want to, but if they'd expressed an interest -

QUERY You're not sure they would want to?

SLAYTON I don't think it's even been discussed with them. At least I haven't discussed it with them.

QUERY Dr. Payne has hasn't he?

SLAYTON Pardon?

QUERY Dr. Payne has he not?

SLAYTON I don't know.

QUERY Do you have any idea how many people in and out of NASA, that would be NASA and industry personel, works out the solutions to the problems that Apollo 13 encountered in flight, and also, casting back over all that's happened since Monday. If you had 3 decisions to pick out that you think are the key ones, what would they be?

SLAYTON Well, to answer the first question. You're right. They're are an awful lot of people been working on the problem. We have here and of course the whole contractor support base, Grummand, North American, MIT. Everybody that has had a piece of this thing have had their people working the problem. So, I'd expect in terms of the numbers, you could say it's about the whole government industry team that's been working Apollo as a steady state process. I don't know what that number is.

QUERY Hundreds or thousands?

SLAYTON Oh, it's thousands, if you want me to pick one, I guess it's somewhere between 50 or 100 thousand I suppose. It's awful hard to put a handle on that. You've got to go way down through the - the primes alone I guess would come out somewhere

QUERY What was that number?

SLAYTON I'm making a wild guess, here. If you want a number, I think we ought to have our PAO people, Howard Gibbons can probably get you a number. I'm not a statistician when it comes to those things. Let's see, your second question was "What was the most critical decision point?" Oh, that's a tough one to answer. It's kind of like you seeing you talk about a mission from take off to landing, and in this case, it's been about that. Well, I don't think any decision was really very tough because we didn't have a whole lot of alternatives. Probably, the one you would have preferred not to have to make was to essentially crank up the LM and use that as your prime mode of operation, but that wasn't a very tough decision because we didn't have any choice. So that's kind of been, you know, you've got a certain number of options, but not too many, and none of them turn out to be too tough a decision. It's a process of technically figuring out the best way to do something you know you have to do anyhow. I don't know if I answered your question or not.

QUERY Deke, are there reasons, other than thermal protection, that you have kept the service module for this long and could you go into what kind of thermal protection it gives. How this works?

SLAYTON Well, the heat shield on the command module, for example, the main heat shield of course, was not designed to operate in free space for extended periods of time. It's designed for reentering the earth. And it was some concern that if you jettisoned the service module real early that you'd cold soak that heat shield and possibly get debonding or some other problems. It's just an area that hasn't been looked at in great detail. We understand how it works with the service module on so for that reason we preferred to keep it. Of course the other thing you've got is, we've still got the RCS quads on the service module, which are usable, if for some reason you had to use them. You can take a real extreme case, and I gather there has been

SLAYTON Some handering about that midcourse last night. Well, man, we could start in, we had the DPS, okay, that didn't work, we got the APS, if that doesn't work we've got RCS on the LM. If that didn't work we still had the quads on the service module. And if that didn't work, we'd have probably gone to the big engine, you know, whether we thought it was going to work or not, if we thought it was important, but before we got to that point, I suspect that we'd have taken what we had and come in and entered. It wasn't that big a deal. So that's kind of the factors that enter into it.

QUERY Has any decision been made about a second burn? And if that doesn't take place, what difference, in terms of distance would it make to the splashdown point?

SLAYTON If we do not make another correction.

query Yes.

SLAYTON I don't think we know that yet. We still have to do some more tracking.

QUERY Would it just be a marginal difference or would it be considerable?

SLAYTON No, I don't think there is any question. In a return trajectory right now, it's going to be an entirely safe and nice and clean, and we've probably alined it as close as we're going to aline it anyway. But they probably want to tweak it up and I don't think we're going to know that until there has been a lot more tracking. But it will be a very small correction, if any.

QUERY How much concern, if any, do you have for those chunks of debris, things like a pice of 4 inch metal that floated by the window, as it pertains to entry?

SLAYTON I don't think that kind of stuff is going to bother us much because that's all going to be behind us when we get - in fact, things like that, should have disappeared behind us when we made that burn last night. That would have given us enough DELTA-V to separate whatever might have been floating around up to that point. Now, if you assume that some other things are going to bust loose someplace in the interim, I think we're not really very concerned about that.

QUERY Could you give us an idea of the temperatures inside the command module and the LM. We've gotten some reports that the astronauts had experienced some very cold temperatures. And could you give us a range of temperatures inside these modules, and perhaps the latest reading?

SLAYTON I didn't come over here with all the numbers on the latest status of the spacecraft. Glynn Lunney and Milt Windier have those. I'll give you my best guess on what I remember on it and I think the command module was 52, the last data point I had. The exact LM temperature I don't have a number on.

END OF TAPE

SLAYTON they'd been floating around up to that point; now if you assume that some other things are going to bust loose some other place in the interim; I think we're really nut very concerned about that.

QUERY Could you give us an idea of the temperatures inside the command module and the LM? We got some reports that the astronauts had experienced very cold temperatures, and could you give us a range of the temperatures inside these modules? And perhaps the latest reading?

SLAYTON I didn't come over here with all the numbers on the latest status of the spacecraft; Glenn Lunney or Milt Windler will have those; I'll give you my best guess on what I remember on it I think the command module was 52 the last data point I had. Or the -

QUERY Deke, from LM separation on down to interface do you expect this entry to be quite nominal all the way?

SLAYTON Yes

QUERY There are no special plans being made for that particular area of the flight?

SLAYTON We intend to bring up the PGNS and the platform and make a normal reentry.

QUERY Thank you.

SLAYTON Now if we - for some reason or another - don't get a good alinement or something, we can always come on in on EMS anyway, we think we've got about a 25 mile capability just on the EMS alone, so we are really not too concerned about it; we like to have everything going for us we can, obviously. Try to make a good normal entry.

QUERY Unrelated point here - when you had the pop gun affect to separate the LM from the command module, you say the separation is just a matter of feet. How do you keep that tail of the kite from crashing into your command module on the way down; is there anything that you have worked out on that, or is that not a concern or -

SLAYTON By feet; I was talking feet per second. So if you've got a - for example - a two foot per second separation, you're separating 120 feet every minute.

QUERY So you don't see any hazard from this thing being that close?

SLAYTON Not at all. No.

QUERY You just mentioned that when the DPS wouldn't have worked, you would have tried the APS, and if that wouldn't have worked, you would have had to try the reaction control system of the service module. When you turned that around, and first tried the reaction control system, before using the APS, because you would have to lose the descent stage then of the LM?

SLAYTON Oh, that's all speculation; the only reason I went through that sequence is to explain to you that this is an ace in the hole way down the stack if you had to use it, which is very, very improbable. If it had got to the point here

SLAYTON you had, then we would have got around to worrying about how you were gonna do it, and had all kinds of time to worry about that, so - I don't want to mislead you on that subject.

QUERY Now, I understand that, but I just thought that because there are the descent end stage contains all the consumables and so forth, it was needed until splashdown, so - you would rather use the reaction control system first before -

SLAYTON Probably - yeah.

QUERY Thank you.

SLAYTON I didn't mean to outline the program plan for that operation, I was just trying to make a point.

QUERY Is there any concern that the heat shield might have been damaged by whatever happened in the service module?

SLAYTON No, don't think so. I haven't any concern.

QUERY I came in late, and you may have gone into this earlier, but have you made any revised plans in view of this situation in no quarantine for what happens after splashdown, where they are going to go after getting on the ship and when they get back here and so forth?

SLAYTON Yeah, I went through that briefly earlier, but the plan is to stay on the ship overnight and go into Samoa by chopper, catch a C140 and straight on back to here, and of course no quarantine. So one good thing came out of this flight anyway.

QUERY Deke, will you tell us the attitude the spacecraft at the two paints of separation relative to Earth?

SLAYTON At the time we separate the -

QUERY The LM and the service module.

SLAYTON I don't think we've got that totally worked out yet - either -- we are talking about a radio separation; the exact attitude, we haven't really got that in our flying yet,

QUERY How do you see the water situation?

SLAYTON I think we're fat; we got a 162 hours the last count I had, and that doesn't count our 20 pound contingency, so I don't think we have any concern at all about water at this point.

QUERY Was a decision been made about wearing the spacesuits during reentry period?

SLAYTON No it hasn't. We're still vacillating around on that one - there are some advantages to it; there are a lot of disadvantages; we've got to do some more scurrying around on that subject.

QUERY Mattingly wasn't seen around the control room last night during the burn; does that have any significance?

SLAYTON You say he was, or wasn't?

QUERY He was not seen.

SLAYTON Oh, he was not seen. He's probably over working on these procedures we are simulating this morning.

QUERY What do you see as the most difficult steps on the separation preceeding reentry?

SLAYTON There is really nothing very difficult about any one of the procedures by themselves. They are all straight forward and we know how to -

SLAYTON I'm sorry - I'm not hearing you.

QUERY They are not difficult, but relatively difficult?

SLAYTON Well, no, I think the point I was making is, maybe I didn't make it very well, is there is that the problem is one of integrating all these procedures into a reasonable time line, where everything fits, gives the crew adequate time to do everything we have to do; there is not any one procedure by itself that is all that difficult - there are all fairly simple and straight forward and we know how to do them. It's just the problem of trying to keep the LM as long as possible if we have to make a midcourse correction, of course, that again adds a little bit more into the time line, in fact, we've got to be playing games with the power between the LM and the CSM; these are the kinds of things, its not the procedures, its the time it takes to do them and try to fit them into a limited time span.

QUERY An SIVB tracking picture taken Monday night showed what appeared like an explosion in the vicinity of the Apollo - does it have any bearing on your study of what happened?

SLAYTON I'm sorry; would you repeat that? Either my ears are bad or that mike is bad - I'm sure not getting these questions.

QUERY The SIVB tracking people have taken a picture which showed what apperared to be a bright and increasing spot in the vicinity of where the CSM was supposed to be at the time, and there was some speculation that it might have indicated an explosion on the ascent.

SLAYTON On the SIVB?

QUERY They were tracking the SIVB and suddenly in the same vicinity there appeared this bright spot.

SLAYTON I see. I hadn't heard about that. I frankly don't know anything about it.

WARD Deke, I think he is referring here to a photograph that was made here which shows a cloud around what our people think was the - a spacecraft and SIVB speculated might have been the venting at the time the accident occurred of the oxygen; that's what he was referring to -

SLAYTON Oh I see. I'm sorry. I was not familiar with that.

WARD We have information on that over at the news center if you will come over afterwards.

QUERY Slayton, nothing seems to be difficult, nothing seems to be of concern; do you feel the situation is being overdramatized? From the moment of this fuel cells going off line?

SLAYTON I guess I haven't been paying much attention; to people's interpretation of what's happening, so I can't answer that question. I would not underestimate our concern; we were damn concerned Monday night; no question about it. But we've got things well under control, have had now since the middle of the morning on Tuesday when things stabilized. And I don't think - sure we would like to get that thing back, because if things keep going the way they are, we are in beautiful shape and have been, but you can't discount the fact that something else might crap out on you before you get home. So - no, I wouldn't want to minimize the fact that we were concerned - on the other hand, I would also like to make it clear that as long as things kept going the way they were, once we got a handle on the incident, we weren't concerned about getting the crew home safely.

QUERY Is there any discussion about whether the command module hatch will fit okay into the tunnel, having been open this long, and so forth? Is this part of the reentry thoughts and so forth?

SLAYTON We may make a fit check on the thing if we have time, but we're not really very concerned about that; that hatch has been very reliable, it is simple to install, and we think it is a very little probability that that thing won't work as designed.

QUERY Deke, again you may have gone into this before, I got here but what is your latest report on the weather, and is there any -

END OF TAPE

(Note: This page not in NASA release but transcribed from tape)

QUERY any possibility that the craft may be enough of course to hit this tropical storm that's running around down there.

SLAYTON The last report I had on the weather - it was no sweat. It's better than it's been and it wasn't ever very bad. They have had aeroplanes flying through the area and haven't been able to find the so called storm and right now it's apparentntly clear down there.

QUERY Deke, do you plan to transmit a new checklist once you work out these rather complicated procedures and -

SLAYTON Yes…

QUERY …this will be kind of the first time that they have had such a checklist and everybody will kind of - except for the sims - will be doing it for the first time and do you have any estimate of when the first of these procedures would start in CST — or whatever time you want to name and would when they end?

SLAYTON No. We're running - we want to run those things end to end on the simulators. We started that first thing this morning and we're running right now and we want to go through that whole thing from one end to the other. I'm sure we'll run into some things we don't like and we'll want to change 'em and re-run those. So I cannot extrapolate an exact time on who will be able to read those up but obviously the sooner the better within reason. If we get them up to them this evening - why - we're in good shape. And I'm sure the crew is up there scurrying around on their own looking at few things too.

GIBBONS That about it?

SLAYTON Any other questions?

GIBBONS I think that's about it Deke.

SLAYTON Thank you.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON TEXAS

REENTRY HARDWARE BRIEFING
MANNED SPACECRAFT CENTER
April 16, 1970
11:09 AM CST

PARTICIPANTS:
Keith McClung, North American-Rockwell Corporation

SPEAKER Some folks have ask for a rundown on the Apollo command module systems, so we've asked Keith McClung who is our local Houston manager of Flight Crew Operations to give you a rundown on that. Keith interfaces pretty closely with Deke on this and we'll limit our discussion pretty much to the 400 000 foot interface and not try to get into the procedures cause they are working those out, but give you a rundown on the spacecraft and that kind of think. Keith.

MCCLUNG Thank you, Earl. As Earl pointed out, we've had some inquiries on the entry portion of the mission. Of course, we've been trying to emphasize that entry is going to be a nominal occurrance. We'll be following the timeline that would be followed on any lunar return mission. Just to perhaps enforce that idea we would like to start just prior to entry interface and in a normal mission we have a sequence of slides that we use in briefings describing the normal entry sequence and I'll pick it up at service module jettison. As you are well aware, of course, service module jettison will be handled differently on this mission. However, in a nominal mission this would occur at approximately entry interface minus 17 minutes is the way we had it timelined at present.

QUERY (garbled)

MCCLUNG Okay, could we have enough house lights for the people to make notes? Maybe just a little more, can you see now? Okay. In the case of this mission, of course, the final separation that will occur will be separation from the lunar module and Deke has quoted you a time I'm sure. The numbers that I have may be older than his, but at last glance we were looking at something like entry interface minus an hour. The lunar module will be jettisoned employing the atmospheric pressure that's closed in tunnel as a sort of a minor propulsive source and should give us something on the order of 2-1/2, 3-1/2 feet per second relative separation. Okay. From this point on, our entry should be nominal. If you could give us the next slide, please. The command module will reorient, blunt end forward, and will hold this attitude. The lift vector orientation will be contained in the pad that the crew receives with their separation. It may be up or down depending on which side of the corridor, the entry corridor we're flying. Nominally on a lunar entry return it would be lift vector down. They'll hold that attitude until they begin to sense acceleration. You'll hear the call for 05G, which corresponds roughly with 400 000 feet entry altitude. Next slide, please. This is the graph that we have used to illustrate the relationship of the entry corridor and the lift vector orientation. As you'll notice, the corridor that we're shooting for is approximately 2 degrees wide and the target that this mission expects to hit is approximately a gamma of 6-1/2 degrees which, as you see, is fairly close to the center of a nominal

MCCLUNG entry corridor. The lift vector would be held down if we are on the shallow side or the yellow line on this diagram in order to improve our capture probability. If we were on the high side of the corridor or the red line, we would roll lift vector up and would do a minor skip out here. It's actually sort of a roller coaster ride which takes the command module back up in altitude to dissipate as much energy as possible in that first encounter with the atmosphere without exceeding the acceleration that is comfortable for the crew and the command module systems have been designed to provide for. Then once that energy has been dissipated, we will fall back into the atmosphere again with the lift vector probably rolled to 90 degrees, that's the nominal lift vector orientation for this particular situation. We try to hold the g's below 6-1/2 for one of these high angle entries. If you have any questions on this particular segment now might be the time to ask them while we have this slide available. Yes.

QUERY (garbled)

MCCLUNG A little over 300 K high, but that - then -

QUERY May I repeat the whole question for the tape?

MCCLUNG Maybe you should.

QUERY All right. The 2 skip outs that you're making. Essentially what you're doing is you come in and you drop down to 150 000 feet, you go up again to roughly 350 000 feet and then down again to about 175 000, up again to 200 000 and then you just sort of smooth in, is that the way it goes?

MCCLUNG That's correct. I should point out that these are roughly outer limit drawing - this is roughly an outer limit drawing and it's a strictly a function of how close you hit the center of the corridor. As you notice on the yellow line it's essentially a straight path in until we get to the point where we're falling almost straight down. Then on the red line you see that's again a worst case on the upper end of our entry angle we do get that skip out and as I recall that is approximately 300 000. The graph kind of exaggerates it a little bit. Then we would roll the lift vector to the right or left, depending on which ones the computer picks as the easiest and hold it at 90 degrees. Okay? Yes.

QUERY Is this reentry going to be under computer control or manual?

MCCLUNG Well, it's a little early for us to commit to any particular entry mode until we have the spacecraft powered up and are able to evaluate the system, make sure what the performance of the primary guidance system would be. Of course, the primary guidance system is preferable, but the backup system is perfectly acceptable. I believe the number that I've heard Mr. Kraft in particular quoting in terms of

MCCLUNG accuracy the backup system can be expected to puts us within 25 miles of the targeted point, as opposed to approximately 5 on the guidance on the primary guidance system.

QUERY Just to make sure, the heat on the shield during the reentry is about 5000 degrees F.

MCCLUNG Pardon?

QUERY About 5000 degrees F on the shield?

MCCLUNG Right, that's the max heating on the heat shield, would be approximately 5000 degrees F and that -

END OF TAPE

QUERY about 5 thousand degree fahrenheit on the shield.

McCLUNG Right, that's the max. heating on the heat shield, would be approximately 5000 degrees F and that's at the stagnation point, which receives a maximum heating. Okay. Let's have the next slide please. From there it's a matter of getting the earth landing system through that sequence. As you noticed, the first step in the sequence is to jettison the forward heat shield, which has a little drag chute on it to pull it away from the command module. Then shortly thereafter, the drogue chutes deploy. Those 2 drogue chutes are primarily for stabilization and to absorb the initial shock of parachuting. The pilot chutes then, are deployed, incidentally, the drogues are deployed by mortar, by a mortar system, which is an explosive charge that just fires the chutes away from the command module. The pilot chutes are also deployed with a mortar, and the pilot chutes which are small hankie size, handkerchief sized parachutes, will more or less act like ripcords for the main parachutes and pull them out. You'll notice they're initially out in the reefed position. Then, when they disreef, the mission is basically over by that time, and I'm sure we'll have some relieved astronauts about that point. And we should touch down, the jolt of hitting the water, we've designed for an envelope of between 12 and 40 g's, as a result of hitting the water. It's really only been 12 on 1 mission that I'm aware of. Yes.

QUERY Do you need those times precisely?

McCLUNG We can probably dig those up.

QUERY Now, times and altitudes and control mechanisms on the chutes.

McCLUNG Okay. All right, the earth landing sequence begins at 90 000 feet and that is sensed by monitoring the steam pressure duct and once it pegs, the astronauts know they are at 90 000 feet. At 50 000 feet they monitor - they place the cabin pressure release valve to boost entry position. The purpose for that is to allow increasing pressure from the earths atmosphere to fill the command module. At 30 000 feet they enable the logic for the earth landing system, and disable the command module RCS. At 24 000 feet the APEX cover is jettisoned, 2 seconds later the drogue chutes deploy. At 10 000 feet, the main chutes deploy, and let's see, are those all the good numbers that you need to know? Oh, they're reefed for about 15 seconds as I recall. The purge of command module RCS propellants begins shortly after the main chutes are deployed, and then continues down to approximately 3000 feet, at which time the propellants have all been dumped overboard, and the pressurization system has been purged. We close the cabin pressure release valve just before we hit the water at approximately

McCLUNG just 800 feet. That's the sequence, that's the normal sequence and that's the sequence that we expect to follow on this mission, as well as all the previous missions.

QUERY If they don't make the next midcourse, 5 hours before interface, the approach angle will be 6.24 rather then 6.5. What difference will this make or what parameters will this change in your sequencing?

McCLUNG That would put us on a lower gamma, which would mean that we would hold the lift vector down, it would correspond more closely with the yellow line that we had on that roller coaster chart, a little earlier. Could we back up to that chart?

McCLUNG Oops that was it. Let's see if I can operate this gadget. See the yellow line here. That is a low gamma angle. The center of the approach corridor would be let's see, would actually be 6.2. That's a right down the middle of the approach corridor. So, on the low side of the corridor, we would hold lift vector down. Essentially, it would amount to slightly lower decelleration in the initial phases of the entry.

QUERY I don't recall the horizontal distance across the face of the earth athat the entire landing sequence covers.

McCLUNG I - well I, horizontal distance across the face of the earth, the sequence takes. Are you talking about a footprint now.

QUERY Yes, from 400 000 feet.

McCLUNG From 400 000 feet. That would be roughly 400 nautical miles. Yes.

QUERY Are they anticipating the whole systems of the spacecraft being up for the reentry, that is normal, the entire system full up.

McCLUNG Well, we've got to get in there and find out exactly what the status of each of the systems are before we know what systems will be up and what systems won't be up, but we do expect that if all the systems are available we probably will use them all.

QUERY What can you do without.

McCLUNG Well, as you know. The primary guidance system is probably the most susceptable to cold temperatures, and we do have a backup system. This crew has flown many simulations making entries using the backup system, and that would be at this point and time, I would guess, would be the most likely system that we would be without. We have had an opportunity to look at the other systems, the environmental control system, for instance, we've had a chance to look at that and

McCLUNG it's in good shape. The electrical system, we've looked at, it's in good shape, the pyro systems are in good shape so all those that are essential to the entry have been verified.

QUERY If you haven't got the primary guidance system, does that mean that they have to guide it by hand during the reentry?

McCLUNG It means that they have to make the manuevers manually. The computer is able to rotate the spacecraft automatically, however, we find that some flight crews prefer to actually make the maneuvers manually, depending upon the primary guidance system to give them the cues. The primary guidance system is simply more accurate in its ability to measure and predict the entry perameters. The manuevers themselves are made quite simply, and would essentially, it would be nominal as far as manuever time

END OF TAPE

SPEAKER - are made quite simply and would essentially - it would he nominal as far as maneuver time is required. The crew would have no additional effort, if that was the intended question.

QUERY But if the primary guidance system isn't that to prompt them with the ques? Would the ques come from Ground Control or where?

SPEAKER No, the ques would come from the back-up system. The entry monitor system is available for the entry and that's the backup system, along with the stabilization control system that would be used as the backup system.

QUERY And those backups are in good condition are they?

SPEAKER That's right. The backup system is much less susceptable to temperature excursions.

QUERY Is there any chance of survival if the chutes don't open?

SPEAKER Is there any chance of survival if what?

QUERY If the chutes do not open?

SPEAKER If the chutes do not open? Well, as you noticed, there are - we have redundancy throughout the parachute system, and we have - we have designed the system to operate practically nominally. I forget what the increase in landing velocity is with only two chutes, but it's really quite close to the full three-chute system. We did have an inadvertent test of the single parachute landing early in the program. When a command module was pushed out the backend of a KC-135 in a land landing test very early in the program and only one of the chutes opened and the results of that test indicated that survival would have been quite probable. It did damage the heatshield quite extensively, but here again, we were landing on land and with the water - water is a much more effective energy absorber.

QUERY Well, if for some reason, all three chutes failed, would there be a chance of survival?

SPEAKER We just consider that out of the realm of probability.

QUERY When the command module and the service module separate, is that powered just by the air pressure between the two or do engines have to be fired?

SPEAKER The command module and the service module?

QUERY Right.

SPEAKER No. Let's see. Back up one more slide - two more slides, please. Under a normal mission situation, the service module - the service module reaction jets are fired automatically through a little sequencer

SPEAKER - system we refer to as the service module jettison controller. However, the service module jettison controller is dependent upon electrical power, and as you know, the fuel cells are dead, and we're taking the batteries with us in the command module. So this sequence will not work. They're playing with several little techniques and procedures for creating a separation between the command module and the service module. Did Deke make a comment on that this morning? The last one that I was involved with late last night, was what we call the push/pull. And it involved using the reaction control system of the lunar module to push forward - I believe it was a half foot per second - then we would cut the tension ties between the command module and the service module, then we would fire the reaction control system on the lunar module in the opposite direction for a half foot per second. So it would give us a net separation velocity of a half foot per second between the service module and the command module. So this is different from a normal separation.

QUERY Do you anticipate any problem there?

SPEAKER Oh, no. There should be no problem at all.

QUERY (Too low)

SPEAKER Okay, now we had a request to run through that sequence again. Including the normal sequence, or does everybody understand? The normal sequence is that the command module/service module sep switch is thrown; the tension ties explode in the little explosive train around the base of the command module, and then the service module jettison controller fires the RCS engines for 25 seconds or so and pulls the service module away from the command module. The command module then reorients for entry interface. In this mission, the fuel cells are dead, therefore, the service module jettison controller will not function. In order to achieve a separation velocity between the command module and the service module, they will use - we are currently looking at a little push/pull technique, which involves the RCS in the lunar module accelerating the combination really, of the command service module and the lunar module half foot per second forward while we separate, then firing in the opposite direction for a half foot per second, and letting the service module, then, fly on away. See, it's the only one that would retain the half foot per second of the push, because then we would then pull on the command module. Does that help explain it?

QUERY (Too low)

SPEAKER Oh, the whole thing is lunar module RCS.

QUERY (garble) once again before reentry? and also, there was a problem on one of the former space flights concerning the LM - this sticking action - We have

QUERY - any problems here?

SPEAKER I'm afraid I'm going to have to bow to someone else who's more familiar with he time line than I at this point in time. I kind of got behind the power curve on keeping up with that. So I can't really tell you when they plan to begin powering up the command module.

SPEAKER The problem with the LM sticking? Gee, I don't - do you remember what mission that was on?

QUERY I was trying to remember, but I can't recall. I think it was - was it 10 or 11?

SPEAKER On 10? We had a - you're talking about the time Snoopy took off like a scalded dog. Yeah, okay. Now, that was not a problem with the sticking. That actually, was a problem with out inability to vent the tunnel. Normal LM jettisons would be done with the tunnel vented. In other words, no pressure in it, and if you can have that situation, the lunar module does not receive any accelaration. The problem with that type of separation is that in the case of a lunar landing, we do not want any propulsion being provided to the lunar module that we cannot measure quite accurately, and that would be the type of propulsion that we couldn't measure. So that technique was - the technique was developed to separate with an empty or an evacuated or a vented tunnel. Now, in the case of Apollo 10, now you recall, we had some fiberglass insulation type material that was kind of floating around in there and got stuck in the vent valve and we were unable to vent the tunnel and when we cut the connection between the command module and the docking ring, the pressure in the tunnel reacted somewhat like a balloon. You know, a kid's balloon that you've blown up, and you turn loose of the end of it and you know how it takes off? Well, the lunar module did essentially the same thing, and what we're using for this lunar module jettison is essentially that same technique that we have used by mistake before, and that is, that we'll leave the tunnel pressurized and we will then get some propulsive - propulsion from the pressure in the tunnel that will push the lunar module away from the command module.

END OF TAPE

Page Missing

Page Missing

MCCLUNG That's a good question. I assume that that would be possible, however, the nominal LM jettison is intended to cause the lunar module to land on the lunar surface, in other words, that sequence burns out the propellants that are remaining in the lunar module, and causes it to land on the lunar surface, and the LM is the least of our worries at this point. So I assume that it would be possible. But what we are trying to do is come up with minimum impact on the command module's activities.

QUERY Does the fact that you will have the descent stage of the LM still attached make any difference in the separation?

MCCLUNG No. It just makes for a heavier vehicle.

QUERY Would that be a problem with imparting a velocity vector to the command module if you made an active maneuver with it?

MCCLUNG No, I don't think it would impart any velocity to the command module, but it would require some ground control activity - I think they would have to real-time command the engine ON or something of that affect, and we just don't want to interfere with - you know - we don't want any extra activity going on at that time.

QUERY Why is this tunnel separation procedure simpler than the one you would nominally follow if you were jettisoning it?

MCCLUNG Well like I just alluded to there; in order to light an engine in the lunar module, the ground would have to send a signal, a real-time command, to light that engine, and if we can do without that, why bother. This is conjecture on my part; I would appreciate not being quoted, but it is a very simple procedure to follow, I think you would agree, just let the tunnel provide that propulsion. And it is a nice neat little velocity.

QUERY What is the name of the engine that you use during the push pull technique? The backwards firing bit.

MCCLUNG Lunar module reaction control system.

QUERY The push part is the engine you have been using all along -

MCCLUNG Well, we've been using all these engines, the reaction control systems - this is a little out of realm of knowledge, but I believe they also have 16 engines on the lunar module, I stand corrected if that is not true - but - beg pardon.

SPEAKER Yes

MCCLUNG Okay, they have 16 reaction control system engines on the lunar module - the aft firing reaction control engines would be fired to give you the push then the forward firing would give you the pull.

QUERY I see. But it is one engine for the push and several for the pull?

MCCLUNG No, It would be more than one - I'm not sure how many engines they actually would fire, it would be two or four - see, we are getting out here in a pretty far area, that procedure has not been defined.

QUERY I see

MCCLUNG I only referenced to it to give you some idea that there are several things under consideration that would accomplish the essentially the same thing that we would do in a nominal mission.

QUERY Is there any possibility of the LM coming down not burned up?

MCCLUNG Is there any possibility of the LM coming down where?

QUERY Intact; into the Pacific.

MCCLUNG Oh, I don't think so; I don't know about that. One more up here, and I think they are getting ready to kick us out.

QUERY I apologize for being a little late. What is the velocity that you hope to achieve by allowing the LM push out away from it as a result of not depressurizing the tunnel; do you know what the velocity is?

MCCLUNG I've got only just kind of a gut feel here that it is going to be 2 and a half, 3 and a half, feet per second.

QUERY Is that anywhere near what it was during Apollo 10, when it accidentaly happened?

MCCLUNG No. First place, we have a heavier vehicle. They were jettisoning the ascent stage only.

PAO Thank you very much.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON , TEXAS

NEIL ARMSTRONG'S PRESS BRIEFING
MANNED SPACECRAFT CENTER
APRIL 16, 1970
3:00 PM CST

PARTICIPANTS :

Neil A. Armstrong, Astronaut, MSC
Brian Duff, PAO

DUFF Ladies and gentlemen, we're ready to start with Mr. Armstrong. I might explain that this is not a press conference as much as it is a mass interview. When we got to 22 re - Do I got anything? - When we got to 22 requests for interview we decided we couldn't possibly get them all done before the mission was over. So we decided to do them all at once. And so it might be a little bit more informal than the normal press conference. Neil do you want to start by saying something yourself or do you want to go right to questions?

ARMSTRONG No. I think questions.

DUFF Right to questions.

DUFF I'm going to - I should explain that I've been asked to take the EVU correspondents all at one time. I'd like to take - to go into about 10 minutes and then go to them and then take all the EVU correspondents at once. If you don't mind, we'll do it that way so I'll hold the EVU questions until we're in about 10 minutes.

QUERY I have 4 questions and I'm - first is would you know if there is any situation now left which is not being rehearsed in some simulators which could occur in a mission? I think perhaps one - like could LM pull the CSM out of lunar orbit when it's just well, normal orbits, lunar orbits and another question. What do you think of the future? Could the section 1 which is now I think empty, left empty, be used for extra consumables? And my other question is, would you have any press conference coming very soon with the crew now?

ARMSTRONG I think I can answer all of the questions but -

DUFF I may be able to help with the press conference when you're through.

ARMSTRONG Probably ought to point out that I'm probably not the most expert person to answer - to ask - to answer some of those questions with respect to Apollo 13. I am not - I do not have an assignment in Apollo 13 except when I'm occasionally called for conference. Consequently, I'm not perhaps as up to date on a number of the details that are occurring on Apollo 13 as those of you who are following it minute by minute. So I'll have to preface my answers with the statements I'm not here. These were requests for interviews that really didn't have to do with Apollo 13. I'm not here attempting to be an expert on Apollo 13 now. I'm not.

DUFF On the question about the press conference of the 13 crew, the best thing is to keep checking with the News Center across the sidewalk cause there's no final decision on that. But they'll know before anybody else will.

ARMSTRONG We are still using - have the simulators on standby for problems that may be arising in the flight and they have been In Lhe process of course of reviewing the procedures prior to the entry in the simulators. But beyond that, I'm not aware of any additional simulations that are going on at the present time. You can in fact use the LM to pull the command module out of lunar orbit. Yes. However, you can't find a likely situation in which that is a realistic occurrence. You can conjure one but it's unlikely. Once you get into lunar orbit usually there's a very short time period then before you separate the LM and it starts its descent. So something would have to happen in that very short time period that would require you to recognize it before you burn the propellant that was in the lunar module. However, yes, the answer is you could do such a thing should the circumstances were.

QUERY The use of section 1 in the future. Section 1 is now is in the service module. Is - empty. Is that right? You know.

DUFF Bay 1.

ARMSTRONG Bay 1.

QUERY Yes? Could you use it for extra consumables because now it's for the extended lunar exploration - it's meant for that. But would it be used for anything else?

ARMSTRONG I can't answer the question except that for example in skylab kinds of service modules, the arrangement of the systems in those bays is considerably different than is in our current lunar service modules. However, they can be retrofitted and changed before - there is some flexibility in choosing day 1, day 4 configurations.

QUERY Now if you had been commander on this mission instead of your tremendously successful one, how would you have felt in space faced with this kind of an emergency?

ARMSTRONG I'm particularly glad that I didn't have to face that problem. I think I can however accurately guess how those crew members felt because in Gemini 8 we had sort of a similar circumstance where we were unable to complete all the things that we had hoped to complete and while you're flying you really concentrate on the job to be done. But I know when they get back on the ground, and think about it, they'll be considerably disappointed that they weren't able to use all that practice they've had in the few months and had that wonderful opportunity to walk on the moon surface on this flight.

QUERY Should there be in your opinion any opportunity given to them for another trip should they so

QUERY - desire?

ARMSTRONG That's outside my province to answer. I know - I suspect that at least some of them will hope they get another shot at it. It's not practical to stick them right back in the next spacecraft's configuration - they're different and so on but I know at least some of them will like to get another shot at it. I certainly did. Once I got on the ground, the thing I wanted to do most was get right back in the spacecraft and try to do identically the same mission profile over again. Not the emergency one, but the planned one.

QUERY Neil, in a situation such as the one we're faced with now, Apollo 13, the crewmembers have not talked of concern or anything like that over the radio. But what really goes through the astronaut's mind when he's faced with this type of situation? Is there a concern that you don't speak but yet you do feel as to whether you'll be able to get back safely and whether any other mechanical failures will come up to hamper you?

ARMSTRONG That concern is a real one. It always exists in the back of your mind. But I suspect that the attitude that they reflect over - over the communication loops reflects what they're really thinking. Namely, they're trying to do each and every job precisely as well as they can and not overlook anything such that the situation you conjure won't happen at least as a result of their own doing. It would have to be - you know, some unavoidable situation.

QUERY I'd like to ask if you ever felt any similar doubts - any doubts that this sort of thing could happen to you just as you were about to begin your mission? Or while it was under way for that matter.

ARMSTRONG No. When you're flying you don't concern yourself with those things. Those judgments and decisions are made before flight. When you're reviewing the systems and the flight plan and anytime you find what you think might be a weakness, you attack it at that time in the preparation phase. And once you lift off, you don't worry about those alternatives any more. You just do the best job that you can with the commitment you've already made at that point.

QUERY I'm sorry I'm French - Try to address you in English. If you go back safe on the earth, do you consider it a successful rescue first foot on the moon?

ARMSTRONG I'm sorry. Would you repeat it please.

QUERY Yes. If they go back safe on the earth do you consider this as successful as your first foot on the moon? Understand my question?

NEIL ARMSTRONG'S PRESS BRIEFING, 4-16-70 CST 3:00P 35A/4

ARMSTRONG Yes, I understand the question. Well I feel quite certain that from an overall mission standpoint they, nor anyone else will consider it as successful but from a performance point of view, both on the part of the crew-members are flying and also for the people on the ground who - in the control center that are supporting them, that they're ever bit as successful and perhaps more so in terms of doing perhaps even more difficult job and doing it correctly.

END OF TAPE

ARMSTRONG every bit successful and perhaps more so, In terms of doing a, perhaps, a more difficult Joh, and doing It correctly.

QUERY Do you think the Apollo electrical system should now be restructured?

ARMSTRONG No, I don't think it should, although I should temper the remark by saying if the analysis, the data, in the coming week shows that there is a identifiable failure, that could be prevented by a simple design change, I'm sure that that would be seriously considered and I would support that sort of a change. There's always a balance in the design of systems of this nature. One is that you will take the design approach that is the most simple and straight forward and therefore the least likely to get you into difficulties. The alternative, is one that by design minimizes the possibility of these kind of problems. For example, they could have the components that were effective simultaniously and widely divergent parts of the spacecraft, for example, such that local catastrophic failures wouldn't knock, tend to knock out three fuel cells at the same time. That's certainly consideration, but it's a much more complex design problem to do that so you buy yourselves additional problems as well as solutions. So again it's the old matter of a compromise. I think we can see in this case, it's a good demonstration the worst kind of things that can happen to you, if you select the way in which this design was selected.

QUERY You don't think then, that something was overlooked? A contingency was overlooked.

ARMSTRONG I'm not aware of it, but it's certainly possible. I don't think so, but it's possible.

DUFF Okay, now we'll take the EBU questions in series, we'll just go through, just begin at your own order.

QUERY Mr. Armstrong, if this accident had happened after the moon landing, the crew would not have had the LM as a life boat, and presumably would have been killed. There any way for future missions that the command and service module could be adapted to meet the situation. Do you have any proposal to this?

ARMSTRONG I haven't reviewed the possibilities extensively. I know that should you get in this situation, that you described, that you would in fact turn the batteries on in lunar orbit and fire the SBS engine and get on a trajectory coming back to earth. Then you of course would be faced with the problem of maintaining life support temperature and oxygen and so on, through that two or three day period without benefit of very much power to use because there would be very little left. You would certainly try that. I wouldn't say now that it's impossible, but it might be

ARMSTRONG unlikely that you could successfully complete such a return. We, of course, were aware of these risks throughout the design phase and felt that they were acceptable.

QUERY Following that up, Mr. Armstrong. Do I gather that you rather discount any ideas that it was a meteorite strike, and if that's right, do you think the moon missions should be suspended until this is sorted out?

ARMSTRONG I think that there's some possibility that it was a meteorite strike. I think it's rather less likely than an internally generated failure of some type, but I wouldn't completely discount either one at this point. I haven't had the advantage of seeing what the analysist are now proposing, perhaps they have more information than I do, in that area. I think the meteorite strikes should not affect the over all program planning, should that be the case. The chances are still pretty low. We still have a quite a few meteorites hitting the surface of the earth, everyday and hardly ever hear of anybody getting hit by one.

QUERY The follow up to that was whether you thought the moor missions should be suspended while it's sorted out.

ARMSTRONG I'd have to reserve judgement on that until that I had heard the best summary that we have available from the analysis with the data, and I just don't what that is.

QUERY Do you forsee any fundamental changes in the Apollo program and the following programs on account of the emergency?

ARMSTRONG I don't at this time, although, I'm quite certain there will be a very careful review of a lot of suggestions from both competent people and those less so about what the future course of the program should be.

QUERY If you were in the spacecraft during re-entry which would you regard as the most critical moment of all, from the point of view of the commander and the crew.

ARMSTRONG The parachute. I think that's unquestionably the most serious time-point in the entry from my point of view. The reason is that unlike, let's say you're sitting on the moon, and the ascent engine doesn't fire, at least you have the benefit of time to consider and discuss it with the control center and consider possible alternatives for getting that engine started, but when the parachutes don't come out, you are rather short of alternatives and considerably short of time.

QUERY I have kind of a personal question, Mr. Armstrong. How do you yourself react to the other astronauts riding wildly swing-shift type of stuff?

ARMSTRONG A report put in this kind of a context, well, I suspose I'm somewhat more conservative than writers

ARMSTRONG who choose to put it in that kind of context, and I guess I would not write it that way myself.

QUERY Mr. Armstrong. During your Gemini mission you had to pass through a phase of imminent danger. How does a human being feel at this moment? Did you think about death?

ARMSTRONG No. I didn't. There was really inadequate time, for those sorts of considerations. I've heard people say when they got in a really tough spot, they had their life story flash in front of their minds and I didn't experience that in that case. It was much more like a pilot getting into an inadvertent spin in an airplane and recognizing that he absolutely must solve his problem and correct the spin before hitting the surface of the ground and all his attention is directed toward that end and that was rather the way we felt.

QUERY Was there any piece of advice or experience you could contribute to Apollo 13 after the incident of last Monday?

ARMSTRONG I don't see any reason that there would be anything that I could contribute that would improve their performance any beyond what they've been doing so apparently they're pretty good hands by themselves.

QUERY Sir, how do you interpret the remark of Commander Lovell, that this is going to be the last Apollo mission for a long time?

ARMSTRONG I heard that someone on the crew made such comment, but I suspect that they felt that this kind of a difficulty would have to be rectified before the next flight and it might take them a long time to figure it out since there doesn't seem to be very much information to go on.

QUERY You spent a long time in the lunar module. Now there seems to be all three of them there for a long time. How uncomfortable are they, would you say? How does that affect their work?

ARMSTRONG The lunar module is actually quite voluminous since there is standing room for at least two people and probably three in the crew station area, in addition there's quite a good sized volume on top of the ascent engine cover which opens up immediately into the tunnel into the command module, so there's really very little problem to have three or more in the lunar module simultaneously. Of course, you could not do it comfortably with out the zero gravity or weightless state. That of course makes the whole thing really quite ...

END OF TAPE

NEIL ARMSTRONG'S PRESS BRIEFING, 4-16-70 3:00P CST 35C/1

ARMSTRONG - course was you could not do it comfortably Without the zero gravity, or weightless state. That, of course, makes the whole thing really quite - quite possible, and I suspect that they've had three people in there together, quite a lot of the time, comfortably.

QUERY Mr. Armstrong, everything seems to be under control right now. Would you say that the hazardous moments in this flight are over?

ARMSTRONG Well, I think all the difficult hazards are behind them. I wouldn't say that the remainder of the trip is hazard free; that certainly this last 6 hours before entry tomorrow will be quite critical in terms of performing that series of events properly, in order to - to prepare for what we would hope will be a normal entry procedure, tomorrow. Should all those things occur as expected, though it's a considerably more favorable position to be in than we had a couple of days ago.

DUFF I believe that completes the BU series. We'll go to open questions now, again. Right here, (garble).

QUERY Mr. Armstrong, can you say on behalf of all the flying crews; how an accident like this affects your faith in the adequate control and supervision of the engineering the design of the Apollo Program?

ARMSTRONG We - I think I probably reflect the feelings of most crew members, at least most of those of us who have been flying for a long time; in that we inherently expect a certain amount of these things to occur and it's no great surprise. Perhaps, I think we're more surprised when things run perfectly well, as they did on Apollo 11. Matter of fact, I'm still somewhat amazed that everything worked so well during that flight. We spend a great deal of our time in preparing for these kinds of situations, and usually when they do happen they're a little bit different than anything we ever prepared for, though. I - I don't fault the design engineers or the test teams, in this case for this particular incident. I'm - I'm sure that it was just one of those million to one shots that you just can't properly prepare for - don't adequately know how to prepare - prepare for in this case.

QUERY Mr. Armstrong. Have you spoken at any great length with the immediate families of the two married astronauts? And, if so, how would you characterize their taking this whole incident?

ARMSTRONG Well, I did spend a good - good bit of time with Mrs. Haise during the critical phases of the flight, and she took it - very, very well, and she was - she always believed that the guys would do a good job and - But she was very interested also in what the details of the - of the problems were and tried to understand them real well, did a good job.

NEIL ARMSTRONG'S PRESS BRIEFING, 4-16-70 3:00P CST 35C/2

QUERY Mr. Armstrong. What were your own feelings during the most crucial times of the emergency?

ARMSTRONG I think my - my own feelings were very much those that I saw - among the people in the Control Center, also not so much wringing hands and - and trying to figure out what happened, but rather trying to - decide what the best course of action was with the situation we had at the time. And looking ahead rather than looking backward.

QUERY If the Apollo 13 Mission had been successful; they had landed on the Moon and come back; was it going to pose or provide that vital an answer concerning the long drawn and out ritual of quarrantine; since it's not going to be used this time? Or are we going to have to wait until Apollo 14?

ARMSTRONG I guess the crews have never had anything to say about whether or not the quarrantine existed or not. I - I really don't know what they'll decide. I suspect, it would be my guess, that the same people who made the decisions on the quarrantine for this flight would probably make the same decision for the next one, on the same bases in the absence of any new information.

DUFF Take one or two more.

QUERY I realize that you and most of the people here have been most concerned with getting the - the mission - the people of that crew back safely. But you must, with your intimate knowledge of the spacecraft, have some idea about what happened yourself. What is your best guess?

ARMSTRONG I think that the highest probability would be an internally generated structural failure, due to probably due to an over pressurization, but - now, that's the reason for the over pressurization, I'm not sure - that's in a - some local area.

DUFF And one - right here he is.

QUERY Mr. Armstrong, will you fit into the program now? Are you going to make another trip to the Moon?

ARMSTRONG Well, I'm - I'm just standing by for assignment at the present time.

QUERY To check the backup systems for reentry, and, if so; if they have to go to another alternative, what do you think that would be?

ARMSTRONG Under the current plan, the - spacecraft will make a normal entry on the normal primary guidance system. And hopefully, then it would arrive in the vicinity of the ship as previous flights. Now, the alternate procedures of the - there're actually several available should that primary system not be available. All of these alternates will not - land you - none of the - none of the remaining alternates will bring you to the ship, or that area of the ship; they also - they all have some predictable built in biases. However, the trajectory, itself, will he largely the same as - geometrically, it'll be approximately the same, and the

NEIL ARMSTRONG'S PRESS BRIEFING, 4-16-70 3 :00P CST 35C/3

ARMSTRONG - accellerattons involved and temperatures and so on will be by and large the same.

QUERY Is there anything that can be done manually?

ARMSTRONG Yes, first there's the entry monitoring system; EMS, that can be used that allows you to - in a closed loop fashion guide yourself toward - to the proper down range distance. And, you would then land - the proper downrange distance, however, you will have an error in cross range. In other words, you'll land out of plane to the North or South of the recovery fleet. Should that system also be inoperative, you can make a successful entry on the accellerometer, alone; a independent normal manual accellerometer like you find in aircraft. That's satisfactory, and will get you to within several hundred miles of where you expect to be.

DUFF Thank you very much.

END OF BRIEFING

APOLLO NEWS CENTER
HOUSTON, TEXAS

APOLLO 13 REVIEW BOARD BRIEFING
April 12, 1970
3?04 PM CST

PARTICIPANTS:
Edgar Cortright, Director, Langley Research Center
Brian Duff, PAO

APOLLO 13 REVIEW BOARD BRIEFING 4-21-70 CST 3:04P 39A/1

DUFF Ladies and Gentlemen, this is a briefing by Mr. Edgar M. Cortright, the chariman of the Apollo 13 Review Board. Mr. Cortright.

CORTRIGHT 1 thought that it would be beneficial if we got together for a few minutes to day to give you some idea of how this review board will be conducted, and to announce the members of the board. The membership has just been selected by Dr Paine. Basically, as you k now, from the material you've received already, and to paraphrase my detailed instructions, the function of the board is to perform an independent assesment of what happened, why it happened , and what to do about it. To do this, we have selected a group of senior officials from both within the agency and without the agency. These gentlemen will meet here with me during the next few weeks in intensive sessions, which will probably run days, night and weekends, without let up, in order to get an early determination. The group will be supported by an additional - the board will be supported by an additional group of experts, and we will select these gentlemen within the next two or three days. In addition, we'll draw on the work that the project is now carrying out under the direction of the project manage to determine on their own what happened. Now, the members of the board are as follows: Mr. Robert Allnutt, who is assistant to the administrator in NASA Headquarters; Mr. Neil Armstrong, astronaut, from the Manned Spacecraft Center; Dr. John Clark, Director of the Goddard Space Flight Center; Brigadier General Walter Hedrick, Jr., Director of Space, Deputy Chief of Staff for R&D office, Headquarters, USAF, Washington; Mr. Vince Johnson, Deputy Associate Administrator for Engineering, in the Office of Space Science and Applications, NASA Headquarters; Mr. Milton Klein, Manager of the AEC-NASA Space Nuclear Propulsion Office; and Dr. Hans Mark, Director of the Ames Research Center.

QUERY How do you spell that last?

CORTRIGHT Mark. M-a-r-k. In addition, the counsel, legal counsel, for the board, will be Mr. George Malley who is Chief Counsel for the Langley Research Center. Mr. Charles Mathews, Deputy Associate Administrator, Office of Manned Space Flight, will be named to work with the board to help provide the technical support we'll need to get our job done. In addition, there'll three officially named observers to the board. Mr. William Anders, former astronaut, now Executive Secretary, National Aeronautics and Space Council. Dr. Charles D. Harrington, Chairman, NASA Aerospace Safety Advisory Panel, is also President and General Manager of Douglas United Nuclear Incorporated. And Mr. Irving Pinkel, Dorector, Aerospace Safety Research and Data Institute, Lewis Research Center. We'll be assisted in our relationships with the press by Mr. Brian Duff of the Manned Spacecraft Center. And we'll be assisted in our

CORTRIGHT relationships with the Congress, during the course of this investigation by Mr. Gerald Mossinghoff, Office of Legislative Affairs, NASA Headquarters. It will he our policy during the course of this investigation, to keep you informed of what we're doing, and how we're going about our business, insofar as that is practical. One thing I'd like to avoid however, is speculation. I must avoid that with this type of a board. So, if sometimes I appear to be not as communicative as you would like, it will only be because I'm not in a position to say something with authority and certainty, at that time; but otherwise we'll do all we can to keep the members of the press fully informed of what we're doing. And, I think that is about all I really planned to say. I make myself available for questions within the groundrules that I just specified, that I'd like to avoid speculation, and further, since the Board has not held its first meeting, I can't very well represent the Board at this point.

DUFF I'd just say one thing, before we get the questions - have questions the - the biographies of all the members, and the documents -

END OF TAPE

DUFF ... before we have questions, the biographies of all the members and the documents relating to what Mr. Cortright has just said will be available after this conference is over. Now we'll take questions.

QUERY Can I add one point, Brian? I think I forgot to mention that the first meeting of the board will take place at 8:00 p.m. this evening.

DUFF All right Bob, we'll start across the front row.

QUERY I realize it's impossible for you to say precisely how long the board will take to reach the determination but do you have any estimate at this time? In other words, would it be a matter of perhaps 3 or 4 weeks or do you think it would last through the summer?

CORTRIGHT It's my ,hope that we can reach adequate and effective determination within 3 or 4 weeks. As a matter of fact I - that 's the number I had in my mind. But we'll have to take as much time as required to do it properly. It could run longer.

SPEAKER Bob.

QUERY What procedure will you follow for calling perhaps contractor experts and so on? Can you - you said you would talk about them a little bit.

CORTRIGHT Yes we identified the need for speciality information that's best developed by a contractor. We'll call on that contractor to provide us information and/or to appear before the board to testify on this information.

QUERY Do you have any names or companies already formulated?

CORTRIGHT No.

QUERY What is going to be the possibility, Ed, on making your releases? Are you going to do it on a regular basis like once or twice a week, or just whenever you have something to say? How are you going to arrange this?

CORTRIGHT The releases of the board will be made only with my approval and through the office of the Public Affairs here at Houston. Now there may of course be releases by Dr. Paine or Mr. Low based on information that I can provide them on regular meetings. We'll probably meet once a week. And I would envision the use of bulletins for the press. How much information they would contain would be dependent on how much progress we will make. But at least it would keep you informed on where we are and what activities are facing the board that week.

QUERY Do you intend to break the board down into teams similar to what was done for the 204 review board?

CORTRIGHT That's my current plan. But until the board meets with me and expresses their individual opinions and negotiate a little bit I won't know for certain.

DUFF Here.

QUERY Ed, when will you have all the telemetry data reduced, do you think, with the board then in a position to move at full burner?

CORTRIGHT Well, the telemetry data are being reduced at the moment by a pretty sizable team of engineers, both here and in the contractor's plant. I don't have specifics on that yet, Jules, but I have the impression that they expect some milestones to be reached before the end of the week, in terms of telemetry data reduction. Of course, that's sort of first time through perhaps and we'd have to iterate that to get the last little bit out of it.

QUERY Was consideration given to appointing Lt. Gen. Sam Phillips to the board?

SPEAKER I'm not certain. Dr. Paine selected the board. I know General Phillips is extremely - extremely busy with his present assignment and it probably would be an impossibility.

DUFF Right here, Mary Bubb.

QUERY When you finally do pinpoint the cause, sir, how long do you think it will take you to decide whether you have to go into redesign or some modifications? I would presume anyway that you would make recommendations along these lines.

SPEAKER Well, of course that depends on what the problem is. Generally, speaking, you work on potential fixes at the same t⁴me you're homing in on the probable cause. So that there need not necessarily be a long period of time between the two, the determination of the problem and what to do about it. On the other hand, there could be on certain

END OF TAPE

CORTRIGHT what to do about it. On the other hand, there could be under certain circumstances, and my position at the moment is that I can't - I have a totally open mind. I'm trying not to prejudge anything. As the facts unfold, then we'll start forming opinions.

DUFF Ed.

QUERY Two questions: I assume that the bulk of the investigation will be conducted here at MSC. Is that correct?

CORTRIGHT That is correct.

QUERY And what will the relationship be between your board's investigation and the investigations already underway by individual contractor teams and by the initial review board that was set up right after the accident? And what is the status of that board, by the way?

CORTRIGHT Well, I'd rather not comment on the status of the Manned Spacecraft Board. That's Dr. Gilruth's board, but I can tell you a little bit about how we plan to work together. In the first place, most of the detailed technical work will have to be done by the men who know that area the best, and these are the engineers and scientists of the Manned Spacecraft Center and the prime and supporting contractors. We will follow their work and audit their work and make the best possible use of their work that we can. At the same time, we'll maintain sufficient independence so that it will constitute a true independent check on what's done here and an independent assessment of what corrective measures should be taken. Does that answer your question?

QUERY Mr. Cortright, in your experience have you ever conducted a similar investigation having to do with unmanned spacecraft, trying to find out what happened?

CORTRIGHT I have not chaired a board of this type, but I've been involved in a number of investigations of various unmanned spacecraft projects, such as Ranger, Surveyor, and Centaur.

QUERY What was your rate of success in these investigations?

CORTRIGHT Well, all of the projects that I mentioned succeeded to a rather high degree. The extent to which the review board helped that process is something we'll probably never know.

DUFF Here in the front row.

QUERY Will your reports - your periodic reports to Dr. Paine be released to the press?

CORTRIGHT Probably not.

QUERY Will we know that there are these reports and will be even know the gist of them, if you're making progress or stymied, or what.

CORTRIGHT Well, as I mentioned earlier, we will try to keep the press informed as to what's going on with the board,

CORTRIGHT but we'll stop short of speculating or prematurely judging the results. That, of course, if quite a constraint in terms of making public what our current opinions are as to what happened, and I think we'll he fairly limited on what we can say until this job is done. Now, my reports to Dr. Paine will be informal progress reports and will contain just the sort of material that it would be improper to release in totality because it's somewhat speculative in nature. I don't think you'd really want that any more than I would.

QUERY Ed, I'm not quite clear on this point. You may have made it clear and I may have slipped a cog. Does - is corrective work, such as deemed necessary by various groups here at MSC or the Cape, or wherever else it might be, is corrective work suspended or held in obeyance while the board meets? For example, if it were found that the liquid oxygen tank, for example, was suffering from stress corrosion or metal fatigue and blew at too low a pressure, and Beech or North American or somebody wanted to go ahead developing new tanks, would that effort go ahead in tandem with the board's investigation or be held up for the board's findings?

CORTRIGHT I'm not positive, but I believe the procedure that would be followed would be that a major corrective work which might impact the existing system and result in
changes to hardware that's currently assembled would be held in abeyance until the board's report -

END OF TAPE

CORTRIGHT - currently assembled would be held in abeyance until the Board's report was in. On the other hand, it is not unreasonable that certain things could go forward in parallel for possible incorporation later in order to save time now.

QUERY Dr. Cortright, does your franchise possibly extend to the early shutdown of the second stage engine and second question, is it likely that you would make any recommendations on the deployment of rescue ships in the Atlantic or even possibly the Indian Ocean?

CORTRIGHT The instruction does not require us to examine the early shutdown on the second stage engine except insofar as the peak g loads might have influenced the anomaly we're looking into. I don't anticipate that we will he considering deployment or any other aspects of rescue ships.

QUERY Along the same line, it is in your charter to examine the adequacy of the measures taken in Mission Control to see whether there are some improvements could be made in those or whether that response could be improved in any way. That is still your understanding?

CORTRIGHT Yes, sir. That is in the charter, the instructions.

DUFF Thank you very much.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

McDIVITT PHOTO BRIEFING
MANNED SPACECRAFT CENTER
APRIL 19, 1970
7:30 PM CST

PARTICIPANTS:

J. A. McDivitt	Apollo Program Manager

McDIVITT Hello, this is going to be a short briefing, there are just two photographs and they just show the Service Module. And the door is missing, and I will describe it to you in just a minute. Let me -

QUFPY Can we get the photographs as you stand there?

McDIVITT Yea, I'll just stand here and you can look at me until then -

QUERY We would like to get the photographs in your hand -

McDIVITT I might just say that the fact that the whole door is missing is not a surprise, we had a lot of - two big tanks and one of them ruptured for sure and the other one sprayed a lot of oxygen out and when we get the schematic you'll see that this is a rather enclosed volume and we had about 250 or 300 psi - 250 or 300 pounds of oxygen in the tank in each of the tanks, that's about 1000 psi, that would make a lot of gas to be released in that rather enclosed bay. And this door was never designed to take internal pressures like that, so it probably just pulled it off the bolt.

QUERY What do you mean by doors?

McDIVITT Well, the Service Module is made up of six bays of varying sizes and we put propellant tanks in four of them. We have two other ones that we have - one has nothing on these particular missions, later on it will have some instruments. The particular bay that we are talking about now is that one which holds the two - the three fuel cells, two of which you can see here -

QUERY (garble)

McDIVITT Yeah, this is the top, this is where the Command Module would go up here on the top.

QUERY (garble)

McDIVITT Yeah, the service propulsion system is down here.

QUERY (garble)

McDIVITT No, it is over - If I were in the - if I were in the spacecraft looking this way, out the front, it would he hack down over here. So it's on the lower left side, as you are looking forward. Now, on the top deck, up here, we have three fuel cells, one in the back and two in the front. Number 1, 2 and 3. Then on a shelf right below that, where the tanks are half above and half below the shelf, we have two oxygen tanks. The one out in front is called oxygen tank two and the one in the hack is called oxygen tank one. Number two is the one that we had trouble with, that is the one in the front. Below that we have two hydrogen tanks, one above the other on a shelf, like this. One hanging down and one up above. This door is bolted on with a whole bunch of colts around it and when you load up this thing from the inside with this big pressure, it probably just blew the door off. These are all suppositions, I've

McDIVITT only seen the picutres a few times, and we really haven't had the experts look at the photographs yet.

QlWRY What sort of pressure would blow the bolts?

McDIVITT I don't have any idea, we could get that for you, but - I didn't run back and find out how many bolts we had and what the tensile strength on each one of them is. The thing is not designed to carry large pressures from internal. It is not a pressure vessel or anything like that, it's a structural thing, takes bending and tension, and torsion and compression and all those things that you get during launch and it provides a load carrying path vertically through the spacecraft. It is not designed as a pressure vessel.

QUERY Is this a large number of bolts -

McDIVITT It's a large - It's ten and tens, there's probably 100, 200, 300 or maybe as many as 400 or 500, I can't tell you, but there -

QUERY Hundreds of bolts.

McDIVITT Yea, the bolts run all up and down the side and across to over there.

QUERY Was the whole panel blown off of it?

McDIVITT The whole panel is gone, you'll see as soon as you get the picture here.

QUERY (garble)

McDIVITT Ed, I knew you were going to ask -

QUERY (garble)

McDIVITT Yeah, you can only see number two tank, in this picture. It's the one out here in front. Number one tank is back behind it.

QUERY (garble)

McDIVITT I hope they will. The real key to the investigation is going to be the telemetry, not the photographs. But, the photographs will, every little bit of information provides some help.

QUERY (garble)

McDIVITT I couldn't see that, no. One thing that you have to remember when you are looking at these photographs, the outside of the Service Module is a reflecting surface, it has gray or silver paint on it. And it tends to reflect those kinds of things which a mirror would reflect, and if you take a mirror and put the black sky above it, the mirror is going to look black, if you put the white earth above it, it is going to look white. If you put a silver spacecraft above it, it is going to look silver, so you've got to be careful of what kind of color assumption you draw from these things, you go back and look at all the photographs we have taken of the LM and the Command Module with it's shiny surface and the Service Modules previously. And they look all different colors, it depends on whether you are flying over the brown earth or the blue water or the black sky.

QUERY (garble)

McDIVITT I can't hear ya'll.
QUERY (garble)
McDIViTT I can't. No, I can't and nobody that has looked at them yet can.
QUERY (garble)
QUERY How long will it be
McDIVITT Well, I know that -
QUERY before you know what you are talking about.
McDIVITT Bill, they will he here in a minute, Bill.
QUERY (garble)
McDIVITT I could stop talking until they come Bill, would that make you fell better? (LAUGHTER)
QUERY (garble)
McDIVITT I didn't, what -
QUERY (garble)
McDIVITT Well, we know that the whole door is missing, as opposed to a hole through the door. I know that, just a second, let me finish. We know that the two fuel cells are there, because you can see them. And that's all we could tell by looking at these things quickly like this, now we expect to find a lot more than that, by looking at them with a more exotic photographic equipment that we have. We have a lot of equipment here that we use for looking at photos of the moon and things like that and we can adapt it to looking at - adapt it for engineering purposes like this.
QUERY (garble)
McDIVITT I couldn't see anything. We need a lot higher power magnifier then I have.
QUERY (garble)
McDIVITT Not that I could see
QUERY (garble)
McDIVITT That's a structural member of the space-craft, that - the whole outside cylinder is a load-carrying path and -
QUERY (garble)
McDIVITT It's a panel, that's right, I shouldn't have called it a door, it's a panel.
QUERY (garble)
McDIVITT Well, now I'm with Bill, if you looked at the photograph you could see, it's a photograph of the Service Module with a great big panel missing and you can see the two fuel cells in it and this - these things are just now coming off. I - you're getting them at exactly the same time that the engineers are getting, and it's going to be late tomorrow or later before we have done any kind of a thorough analysis on these things. The first thing you do is you look at an 8 by 10 phonograph and you say, "Well, the door is missing", and then the next thing you want to do is, you want to get a magnifying glass and look at it, and I've done that. But, after that you want to get bigger and better photographs and you want

McDIVITT to get transparents so you can see, you want to get stereo pairs and you want to put it on the big machine and we haven't done that yet.

QUERY (garble)

McDIVITT Yes,

QUERY What kind of a big machine?

McDIVITT You know what a big machine is, don't you, it is a truck, it's a car. (LAUGHTER) No, a big machine, we have a building out in here in the back that you guys never see, I'm sure, and we do a lot of photography of photo mapping and things like that and these machines that have all kind of nifty optical devices where you can enlarge things, you can make stereos out of them. They are the kind of things that we can take a picture of the moon and we can tell elevation above some bench mark and things like that.

QUERY Are they photo interpretation?

McDIVITT Yeah, they are photo interpretations.

QUERY (garble)

McDIVITT Yeah, they have limitations, but they are the kind of photos - they are the kind of machines that you use when you are interpreting photographs.

QUERY (garble)

McDIVITT Hey, Brian, how many do we have?

McDIVITT I think that we have about 25 or 26 color frames, and during; these frames you see the Service Module is rotating and you can see that you have our - those two that give you the best view.

QUERY (garble)

McDIVITT No, I've seen all of the transparentcies, these are the best two of the bunch.

QUERY (garble)

McDIVITT We're still looking at the telemetry data and yes, we are still learning things, but we are not going to jump to any conclusions about what this is. You have to look at so much data before you can come to a logical conclusion, it's foolish to look at one piece and come to a conclusion that may be wrong.

QUERY (garble)

McDIVITT I can't tell whether tank two is missing or not.

QUERY (garble)

McDIVITT Just a second.

QUERY (garble)

McDIVITT I don't know what the percentage is, and I don't know what the dimension of it is.

QUERY (garble)

McDIVITT There were about 25 frames on a 70 millimeter color Hasselblad flim strip which these were taken - these were the first ones that we got out. You are getting the first pictures that we could lay our hands on.

QUERY (garble)

McDIVITT There are 16 millimeter frames where it goes in and out of the frame a couple of times, but, as Brian told you we are going to take two of those and enlarge them and give them to you. They give you a little bit different lighting- lighting is the main thing. The lighting is very critical, of those 25 frames, you can't even see into the bay on a couple of them. On a lot of them as a matter of fact. And these two that we have got are the two that show the best lighting on the interior of the bay, and when you see it, it is not that goood.

QUERY (garble)

McDIVITT I don't know.

QUERY Hey, get those pictures will you Brian? (LAUGHTER)

I couldn't tell, it looked all right to me.

QUERY (garble)

McDIVITT Well, the third one is back behind it and I assume that it would be, Mary. You can see too in the way that they are mounted, there is one in the back and two in the front. You can see the two in the front.

QUERY (garble)

McDIVITT No, the question was are the bulkheads between the bays such that the panels would probably blow first, and I can't answer that I don't know what the structural loading on these particular things is. We have probably - I am certain chat we have tested it for this kind of load, where you develop an internal pressure and then we would really have to go back and do a load analysis or something like that.

QUERY (garble)

McDIVITT Yes, a vacuum.

QUERY (garble)

McDIVITT Well, in fact the whole Service Module is a vacuum except inside of these tanks and the service propulsion system tanks and water tanks and the hydrogen tanks.

QUERY (garble)

McDIVITT That's right, we make no effort to seal the Service Module itself. Here are some pictures now, you can all have a picture.

QUERY (garble)

McDIVITT The SPS engine bell does not appear to be damaged on any frame that I have seen.

QUERY (garble)

McDIVITT I have no idea, like I said we have never, I have never seen a structural analysis on loading and that direction.

QUERY (garble)

McDIVITT None that I saw.

QUERY (GARBLE)

McDIVITT No, I don't know who took the pictures.
QUERY (garble)
McDIVITT I'm going to have to go before then.
QUERY (garble)
McDIVITT Okay.
QUERY (garble)
McDIVITT Let me describe these things to you, like I said, they are not going to tell you anything really startling, they are just going to let you see what they look like, now the top of the Service Module is up this way and the - this thing that you see hanging out-here is the umbilical. There is a big umbilical that runs from the Command Module to the Service Module that is severed at the same time that we separate the Command Module from the Service Module, so you see the big umbilical up on the top. The quad down next to it that you see and as you can see here, the sun is shining on the Service Module, right down here and around that side is in the shadow and around this side is in the shadow. That's why a great number of these photographs don't really show you anything down in the bay and we have selected those two photographs which show you the most about the bay. On the top, you can see if you are looking at those schematics that you have, you can see the two silver fuel cells shining in there. And you can see that apparently that they are intact, but you can't - I can't tell myself.
QUERY (garble)
McDIVITT Well, here, that's not going to be too much help - Okay.
QUERY (garble) Laughter
McDIVITT Fortunately I recognize him, he is from Michigan. (LAUGHTER) Down here on the bottom is the high gain antenna and you will see a bunch of what looks like garbage down there and that is the antenna, so don't let that confuse you. Don't think that that is something that fell out of the Service Module, it is really an antenna that is supposed to be out there. Now there is a whole bunch of other stuff sticking out and it looks to be like it is insulation, but I don't know what it is. The hydrogen tanks are in the bottom as you can see here. And they would be down in this part - right in this part here where you can't see very well, are where the oxygen tanks are.
QUERY (garble)
McDIVITT The Service Module, no it is longer than that.
QUERY (garble)
McDIVITT No, I don't have those dimensions here at my fingertips.
QUERY (garble)

McDIVITT These two silver things at the top are the fuel cells. Down on the bottom you can see what looks like to be the hydrogen tank. I would assume that it is the hydrogen tank, it is not very distinct. And in the middle is a void, it is dark and if you look in your pictures you see that there should be one tank out in front and there should be another -

QUERY (garble)

McDIVITT No, if it -

QUERY (garble)

McDIVITT I looked at this and I can't tell what that is, there is something sticking out, it looks like a bunch of insulation, I can't tell whether that -

QUERY The Service Module is 12 feet 11 inches long and 10 feet, 10 inches in diameter?

McDIVITT 12 feet, 10 inches in diameter.

QUERY Yes, 12 feet, 10 inches in diameter.

QUERY (garble)

McDIVITT No, they are not, Bill, this is a smaller bay. A smaller bay.

QUERY (garble)

McDIVITT No, listen, you will never find that dimension in the book. These bays vary in - they are pie shaped, there is a cylinder - there's a cylindrical hole running down through the niddle and I don't know what that dimension is, each one is different.

QUERY (garble)

McDIVITT This photograph and this drawing go like this.

QUERY (garble)

McDIVITT This quad is this quad - the umblical is right up there.

QUERY (garble)

McDIVITT No, this is a different profile. That's the way they should go.

QUERY (garble)

McDIVITT Okay, now here is the other photograph. And it is a picture taken from the back end, you can see the SPS bell sticking out, I'll show you where, this is the SPS bell, right here, it's black and it is very difficult to see, what you are looking at is what we call a base heat shield. It's the back portion of some metal that goes around the back end of the Service Module to take the heat from the SPS engine when it is firing and prevent it from going up inside the Service Module and changing the thermal characteristics.

PAO (garble)

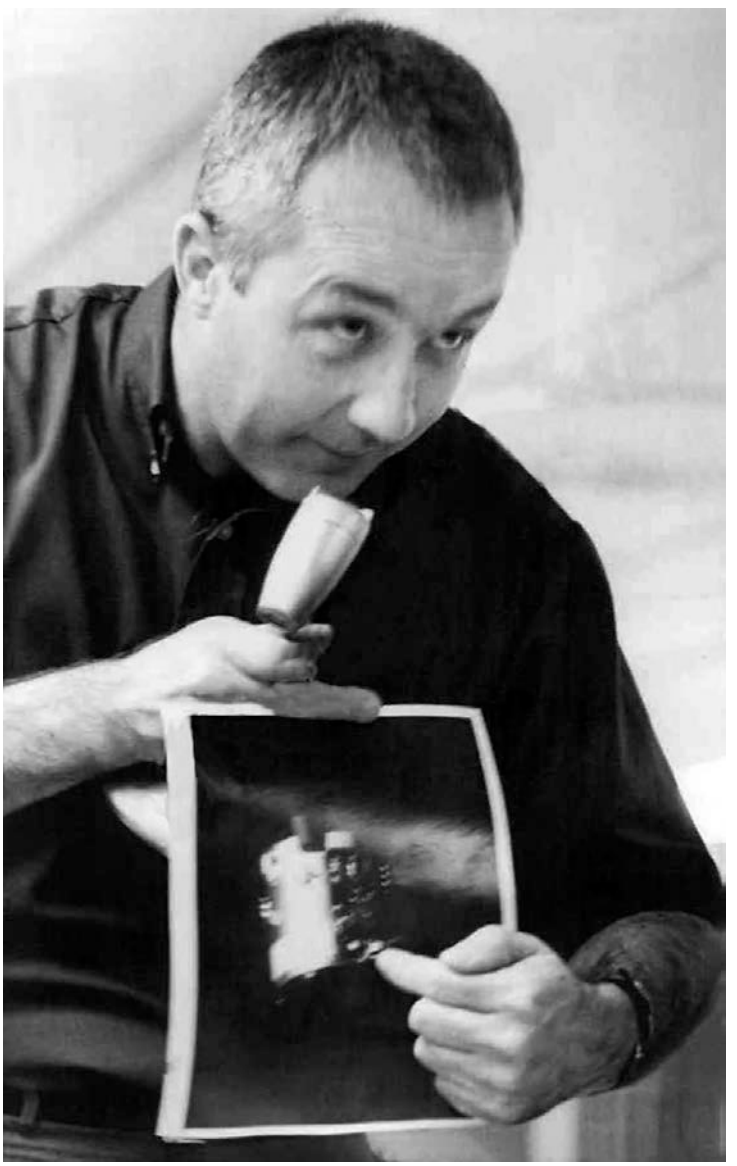
McDIVITT 50 degrees, thank you. 50 degrees. Boy, these PAO guys are really great aren't they?

QUERY (garble)

McDIVITT Now, this picture, you're looking right at the back end, you can see the umbilical sticking out right here in front again, it's got a great big cover on it and then

McDIVITT You can see the things sticking out which in my estimation is probahly Insulation. But, I can't tell.
QUERY (garble)
McDIVITT No, we've got a data, we have got it over there by the piles. Okay, thank you gentlemen, I hope that helped you, but, I'm afraid it didn't.
QUERY (garble)
McDIVITT Okay.
QUERY (garble)
McDIVITT Look we've got a whole bunch of tests going on and the data of the pressure gage was 1008 psi's, that we've got. That's good telemetry data, now whether that was the pressure in the tank or not, I have no idea, I can't tell you today, we'll have to wait until we have completed a bunch of tests and we have looked at a lot of this other data.
QUERY (garble)
McDIVITT Laughter. Yeah, everything in that data is interesting as a data point. Even the nominal stuff is interesting, because when you are' looking for a failure, you've got -
QUERY (garble)
McDIVITT The best way to reach a conclusion is to eliminate all the things that didn't happen. That's a start you know, so all the nominal stuff looks good.
QUERY (garble)
McDIVITT 50 degrees, now come on Bill, you know some of 12 point something -
QUERY (garble)
McDIVITT I'll lend you my slide rule.
QUERY (garble)
McDIVITT Pardon.
QUERY (garble)
McDIVITT No, it went down after that.
QUERY (garble)

END OF TAPE



APOLLO NEWS CENTER
HOUSTON, TEXAS

George Low Briefing
Manned Spacecraft Center
May 1, 1970
3:10PM, CST

Participants:

George Low, Deputy Administrator, NASA
Brian Duff, PAO

APOLLO 13 GEORGE LOW BRIEFING, 5-1-70, 3:10P PC42A/1

DUFF Press conference this afternoon with Mr. George Low, Deputy Administrator of NASA.

LOW Good afternoon. I have just spent the day since early this morning receiving my first status report from the Apollo 13 Review Board. I received briefings this morning from Mr. Cortright who is Chairman of the Board, several members of his panels, and also from Mr. Scott Simpkinson and Col. McDivitt and Don Abrabian who are conducting the Apollo Program Office investigation here at the Manned Spacecraft Center. There is a major effort on the way as all of you know to determine the cause and the possible fixes for the Apollo 13 accident. I don't have an exact number, but I would estimate that between 2 and 3 hundred people are working on the problems associated with this event. We do have excellent telemetry data, and a great deal of information from the spacecraft about the sequence of events that occurred on April 13, about 55 hours into the flight of Apollo 13. And as we said before, the major source of information is the telemetry data. We also have photographs of the Service Module taken after the Service Module was jettisoned just before reentry. And as of today at least, the information given by these photographs is still inconclusive. Specifically, there is still no firm decision based on the photographs as to whether the oxygen tank number 2 was still in the Service Module at the time it was jettisoned or not. Review work is on the way in enhancing the photographs, getting the maximum possible information out of them, but it is certainly not clear that we will ever get that answer from the photos themselves. In addition to the telemetry and the photograph, there's also on the way now a very significant effort of tests and analysis. And it will take a combination of all of the data from telemetry, from all of the testing of all of the analytical work and perhaps information from photographs to determine the most probable cause or causes for the event that took place on April 13. But from what I've heard today, and from what I've been told previously, I'm fairly confident, quite confident that we will be able to bound the problem, that we will be able to determine it's limits, and that we will find corrective action that will encompass all possiblities Both the Board and the project people told me today that the most probable sequence of events on Apollo 13 was as follows. First, a short circuit occurred in oxygen tank number 2. This short circuit most probably caused combustion within the tank. This in turn caused the pressure and a temperature within the tank to increase. The tank then ruptured. This rupture of the tank caused the pressure in the compartment in which the tank is located to increase which then caused the panel, the big covering panel in the Service Module to blow off. And if at any one fact then that I had not known

LOW before today is that the blowoff of the panel most probably when the panel flew off and then hit the high gain antenna which temporarily knocked it out for a matter of a second or two, and this led to the loss of data for that very short period of time.

END OF TAPE

LOW high gain antenna which temporarily knocked it out for a matter of a second or two and this led to the loss of data for that very short period of time just about the time that the panel did fly off. We also discussed today the preflight events that might be of importance in connection with the Apollo 13 accident. These included the facts that the motors, the fan motors, the fans inside of the tank were changed early in manufacture at the vendor's plant; later on the tank, itself, was removed and reinstalled; moved from one spacecraft and installed in spacecraft 109 and during the removal from spacecraft, I believe it was 106, it was jarred or dropped an inch or two, and this may or may not have had an influence on the well-being of the tank. Finally, during the loading and unloading of the tank during the countdown demonstration tests at the Cape there was an anomaly which made it very difficult to get the oxygen out of the tank. This was several weeks before the flight and a new procedure not previously tried, was used in this de-tanking. These three factors are also being looked at by the Board and by the Review Team to see whether there's any possible connection between those and the accident, itself. The Board, today, estimated that they will make their final report to Dr. Paine and myself about the first of June. This is a very brief summary of our discussions today. I also spent time this afternoon then with Dale Myers and Rocco Petrone and Jim McDivitt and discussed possible alternatives of design changes that might be made to the spacecraft without in any way prejudging what the conclusions of the report would be. But no decisions in any such changes have been made at this time. Be glad to answer any questions you might have.

DUFF We'll start with Art Hill and then go back.

QUERY George, how certain can you be that a short circuit was responsible for initiating this series of events?

LOW As I said, Art, the conclusion by the Board and the Review Team was that this was the most probable initiative of the events. I don't think that anybody, as of today, can be positive that this was the - that this will be the final answer, but, as you know, there were a number of electrical glitches, high currents, low voltages, just preceding the rest of the events and the investigation today was focusing in that direction.

DUFF Ed DeLong

QUERY In what component would you estimate that that short circuit happened and when you say combustion in the tank, does anyone yet have any idea of what combustion in a high pressure LOX tank is?

LOW First question, what component - what component did it happen on. Short circuit could only be in the wiring leading to the fans, to the temperature sensor, to the quantity gage or to the heaters. Now the preliminary conclusions today are that the heaters were not powered at the time so they're eliminated. And the current to the quantity sensor and to the temperature fills were so low that they are unlikely components. So the most likely source would he the current to the fans.

QUERY Before you go further, you say wiring leading to the fans. Would that include wiring in the fan motors themselves?

LOW It could certainly include that, yes.

QUERY What component reacted or where was - where did the combustion take place?

LOW Again, the people have looked at what might burn in this oxygen environment, and it would have to be the insulation on the wiring or the wires themselves or some of the aluminum components.

DUFF Paul, you had one.

QUERY Have you all simulated this failure with the tank rupturing, and if so, -

END OF TAPE

DUFF Paul, you had one.

QUERY Have you all simulated this failure with the tank rupturing, and if so, does it cause shrapnel that would damage other components in the same hay.

LOW The complete simulation - there has been no complete simulation of the tank rupturing or of the entire events in the full scale tank and it is certainly not clear today whether the tank would rupture or whether it would spring a leak or whether it would open a small hole only.

QUERY (garbled)

LOW I was told today that all possible tests are still being examined and that no firm test plan has yet been developed. Again this will depend in part on the analyses and part in the small scale tests and part of it is also the - of looking at the data before the people here will come up with a plan for an overall test program.

QUERY Dr. Low, you indicated that during the countdown demonstration tests at the Cape that there was what you said was an anomalye which caused difficulty in detanking the 02 tanks. The other two factors were physical factors like a fan changed or dropped. This is a procedural change. Would you explain how that could possibly be a contributory factor to the series of events?

LOW Only in that it may - well, first of all it may have - going back to this prelaunch event now, the - at the time that it was difficult to detank the oxygen, an analysis was made and it was concluded that there could have been a buildup of tolerances between various types in the standpipe and the vent line that could have led to this difficulty in detanking. In looking back over the records, one can then ask the question could the detanking difficulties be an indicator of something else being wrong inside that tank, and we don't know today that it was. Also, could the specific procedures in the detanking have caused something else to be damaged? For example, during the detanking the gaseous oxygen was pumped into the tank and released again, the heaters were turned off and on, these procedures are now being examined in detail by the Review Teams and by the Board to see if any of it could have had an effect on the tank itself.

QUERY George, at what point in the history of the tanks were the fans changed and why were they changed and was it both fans we're talking about or just one or what?

LOW At what point in history were they changed? Before the tank was delivered to North American, I believe, so while they were still at Beech. They were changed I believe, because there was a reading of voltage or current or something that was not completely with in specifications, so they were removed and a new set of fans was installed.

QUERC So the fans that were in the tank that the explosion occurred in were new fans?

LOW As far as I know, that's right. They are not the original fans that were removed at the vendor's.

QUERY The old fans weren't fixed and then put back in, or anything like that?

LOW l don't believe they were.

QUERY (garbled) 66 are we not -

LOW I don't know the date, but I would imagine it was at least that early.

DUFF We could help perhaps afterward by going back and finding some of these. Do you have a question?

QUERY Two or three here. One, do you have any idea what combustion would be - I mean, would it be flame, what would the physical process of combustion be under those high pressure or low temperature liquid oxygen conditions? Two, yesterday we received from, I gather Jim McDivitt's group, although it came out through the Public Affairs Office and was not tagged specifically as to who it came out through, very firm assurances that, although the shelf had been dropped an inch, this did not contribute to the problem and you seem less certain of that. Could you explain that a little bit, and has there been any speculation at all about what might cause a short circuit and really what do you mean when you say short circuit? Do you mean two wires crossing, do you mean something -

END OF TAPE

QUERY Has there been any speculation at all about what might cause a short circuit and what do you mean when you say short circuit; do you mean two wires crossing, do you mean something stalling the motor and overheating it, what's included there?

LOW To the first question, do you remember it? Okay, what is combustion like in that environment, its super critical oxygen at minus 150 degrees and 900 pounds pressure. I really don't know. We had an interesting discussion about this at lunch time whether - I asked whether we had ever seen or been able to take pictures of something reacting violently in that environment. And I was told no, we had not yet, at least the people here had not seen this, and we are going to look at the possibility of putting a window or a port into a test model so that one can take films of this. So combustion really means a violent reaction, release of energy of so many BTU's which are needed then to increase the pressure and the temperature. I don't think anybody today can really answer that question in any more detail. The second question concerned the - I try to point out here the three things that we discussed that were anomalous in the preflight situation. The fan change and the removal of the oxygen shelf, and the two inch drop that was involved there, and third, the detanking. And I brought these out only because they are unknowns today; I mentioned also that at the time that the shelf was removed and was dropped a couple of inches there was a normal discrepancy procedure followed, in other words, it was examined and was looked at, it was analyzed and the conclusion reached at that time was that certainly the tank was all right to reinstall, where it would not have been done. What the people are now beginning to do is take a look at this again, to reanalyze what might have happened at that time, to see whether higher loads could have been imposed on it than was known at that time. To see whether anything else could have happened that was overlooked at that time. And I mention it only in that light. And if - do I have them all?

QUERY What do you mean by a short circuit?

LOW A short circuit means an abnormal flow of current which could be caused by insulation missing off the wire, or the wire touching the ground or it could be almost anything.

QUERY Does that include the fan motor stalling?

LOW My recollection from previous knowledge I have had is that the fan motor even in the complete stalled condition will not generate enough heat to cause any kind of a problem.

DUFF We will get Jim because we haven't gotten to him yet, then we are going to Washington for a few questions, then we will come back.

QUERY Will any or all of the fixes that you have discussed delay the launch of 14?

LOW I don't know. I think the important thing here is to fix what went wrong. I should have mentioned of course that everybody here is also looking at all the many other possibilities in many other areas where similar or related events might occur. So we are going to take whatever time is necessary to make right what went wrong, and until I get the complete board report, and this may not even he on June 1st, this was the estimate today, if they need more time, they will get more time to do their job, and until the job is done both by the people here at MSC and by the Board, we won't really know whether or not we will delay Apollo 14.

DUFF We are ready for questions from Washington now.

SPEAKER Okay, please wait for the mike now. Don.

QUERY George, could you tell us when and where the tank jarring occurred?

LOW Where and when the tank jarring occurred; it occurred at the North American Rockwell Factory in Downey. And it therefore occurred before the spacecraft was delivered. We will have to get to the exact date; I don't have it. I am told November 68.

END OF TAPE

LOW I'm told November '68.

QUERY George, could you tell us - you were speaking of separating the oxygen tanks makes some equipment change to do that. Are you also thinking - 1 to 3 months in this whole thing?

LOW I missed the middle part of the question Could you repeat it please?

LOW Could you repeat the question, please. I did not get it.

QUERY George, are you thinking of separating the oxygen tanks some physical way, not putting them into a different bay, but maybe armor plating them? Are you also thinking of removing the fans and the heaters and any other source of electricity, and if you are thinking of this, wouldn't this mean a delay of anywhere from 1 to 3 months in Apollo 14?

LOW First question concerned the separation of armor plating of the tanks. This is being looked at also but it is as of today not proposed as a solution. The removal of fans, specifically the removal of fans, and the changing of the wiring to the heaters instead of removing them or even the possibility of removing them is being examined by Jim McDivitt and his people. Again no decision has been reached. As far as time is concerned, I cannot give you an answer. I know that there was a time when we launched Apollo flights on 2 months setters and made some very major dramatic changes in those fairly short periods of time. As I said before, we will take whatever time is necessary to fix it.

DUFF All right. I am told that October is the correct date.

QUERY Dr. Low, while you were talking about the change and relocating them and so on, you discussed something in general about what design modifications you talked to Jim McDivitt and also what area is it you're looking into where you could through a single event loose your safety redundance other than the -

LOW I can answer the first question. The design changes today are the only design changes. They have not yet moved out on any hardware changes. The design changes that are being looked at include the removal of the fans, the changing of the heater wiring, or the heater location so that all of the wiring into the heaters can be enclosed in a metal sheath going to the outside of the tank. The relocation of the quantity probe or the redesign of the quantity probe to remove the aluminum in it, and at the same time make it possible to assemble the heater and probe device without needing flexible wiring leading to them. And the removal of all nonmatalic materials from inside the tank, and the removal of aluminum and anything else that may react with oxygen Now, again let me emphasize that these are changes that were

APOLLO 13 GEORGE LOW BRIEFING, 5-1-70, 3:10P PC42E/2

LOW being discussed and not yet being persued at North American. At the same time as looking at these and other changes and until all these get together no decision has been made on any changes.

QUERY - some of the possible errors where you could loose your redundance.

LOW This we did not discuss today.

QUERY Did you say McDivitt has some people looking into those other possible areas.

LOW Yes.

QUEY - Yesterday that after they're manufactured the oxygen tanks were rejected two times before hasitily being excepted on the third inspection as the deadline approached. Would you comment on that?

LOW This is the first time that I've heard this. We'll certainly look into it and get you an answer. I have no information on this.

QUERY I'm kind of confused on these fans. When you changed out these fans, did you put back new -

END OF TAPE

QUERY Well, I'm kind of confused on this fan. When you changed out these fans, did you put back new ones of the same model or were they different models, different in design than the fans that had flown on all the previous Apollos?

LOW The fans in Apollo 13, to the best of my knowledge, were the same fans that we had flown in previous Apollos. The fans that were removed from the tank back at the vendor's plant apparently did not quite meet specifications when they were tested in the tank. They were rejected, removed, and other fans of the same kind were reinstalled.

QUERY Okay. Did this happen in any previous Apollo flights, that you had to remove the fans?

LOW If it did, it was not discussed today.

QUERY Dr. Low, again along with Paul's question, could you compare these anomalies with anomalies of similar nature of other Apollo flights? Have you had things of this nature happen on other flights that you might be able to compare with the anomalies on 13?

LOW It's hard to form a comparison. We had, of course, some anomalies in every Apollo flight. None of them was as critical, none of them could potentially lead to as catastrophic a result as the anomalies on Apollo 13 could have led to. Going back in history, of course, we had Apollo 6 where we lost 3 engines on the Saturn V launch vehicle on the way out and had a very - had the POGO problem on the first stage and also had a very major damage to the service module LM adapter. Apollo 7, I don't remember the list. We did lose, during the flight of Apollo 7, momentarily all AC power as you'll recall. Apollo 8, we had very few, although the list of details was quite long still. Apollo 9, you're making me go back in memory here, but we had some kinds of problems in every flight, up to and including the computer alarms on Apollo 11 and the lightning strike on Apollo 12, but none of them, as I mentioned before, were potentially as catastrophic as these might have been on Apollo 13.

QUERY Well, I was basically thinking that not of the overall flight but on the LOX tank itself. If you could compare all of the Apollo LOX tank situations, what would 13 look like? Would it look like really a bad tank and if you'd have compared them all would you have gone with it?

LOW I can't answer that question. It is not at all unusual to have countdown problems or countdown demonstration problems and - because this is why you conduct a countdown demonstration in the countdown. I remember in Apollo 9 we had a very significant problem the entire night before launch on the super critical helium tank where we did not know whether we had a blockage in the tank or not, and we decided at that time that we were satisfied that we understood

LOW the problem as we did on Apollo 13 on the oxygen tank, and went ahead with the launch. That's a related problem that they were both cryogenics that we had problems with and only in that sense. I don't think you should consider any single countdown problem or a single countdown demonstration problem or a single checkout problem at the Cape to be unusual. We've changed engines, we've changed fuel cells we've done all of these things and that's why you conduct tests at the Cape. It's only today in retrospect, now that we've had the accident, we're looking at the procedures again, that we're looking particularly at the procedures in connection with that tank to see whether that could have had an effect on what happened later in the flight.

QUERY If you're moving the fans from the tank, what mechanism would be used to stir that oxygen? The second thing, what is your opinion now of the possibility of flying another Apollo flight this year?

LOW The first question is a technical one and even that does not have a complete answer, Jim. Based on information by Jim McDivitt and his people to date, it is possible that we can conduct the flight without stirring the cryogenics with the fan. This is based on looking at all the information from all of the Apollo flights to date and looking at the times and the fairly long times that we've gone on some of these flights without turning on the fans, it appears to be possible to eliminate the fans entirely without replacing them with anything else. This is not yet a firm conclusion. What is the probability of an Apollo 14 flight this year? I can't give you an answer.

QUERY You talked about possible design changes in the hardware. How about design changes in the flight itself? The trajec -

END OF TAPE

QUERY - the possible design changes in the hardware. How about design changes in the flight, itself, the trajectory and the use of this hardware. Specifically, there has been a suggestion that you might possibly carry the ascent stage back as a possible life-boat. Is there any consideration being given to design changes in this area?

LOW That was not discussed today and has not been discussed with me at all, so I really can't answer that. I don't know whether or not it is being considered and if it is being considered, whether it has a positive outlook or not.

QUERY Dr. Low, based on the thinking of your investigative board that it can have a final report ready for you and Dr. Paine by June lst. Does this mean that you have arrested a prime suspect and now you're just going to give the guilty bastard a fair trial the rest of the month or have you got some other - (laughter and garble)

LOW That's a good way of putting it. No, I told you all that I know. However, the people here are quite confident, that given another week or two of proceeding with the analysis, of doing some of the tests that are under-way, that they will have enough information to bound the problem to decide on the design fixes. Now, it may be, as I said before, that they will not be finished by the first of June or it may be that they will give a report on the first of June and we'll ask them to reconvene in July or August or some other time to again look at what has been going on within the program, and to make sure that all the loose ends, if any, will cleanup.

QUERY Among the possibilities of solving this problem, have you considered any that are not directly related to the structure, itself, such as carrying another set of bottles or dividing them into two small bottles, or carrying a reserve supply somewhere else so that a flight would not be impeded?

LOW Yes. I listed, a moment ago, those avenues that the project people here are looking at most seriously, today. They, then, have a whole list of other things that they are also looking at which include, perhaps all of them that - all of the ones that you have mentioned.

LOW Have it one at a time, Ed.

QUERY Okay. You reminded me when you mentioned the POGO problem and the engine failure that we did have an engine-out on this flight and that I have heard some project people say that if there is a delay in l4 that the fixes for that engine- out may be more responsible for it than any mods to the spacecraft. What is the status of that engine situation and how accurate is that assessment of the possibility of delay?

LOW Ed, I know that people at Marshall are

LOW working very hard on that. I have not been briefed on it and I have not reviewed it and I honestly don't know.

DUFF Thank you all very much.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

APOLLO 13 REVIEW BOARD BRIEFING
June 2, 1970
1:59 PM CDT

PARTICIPANT:

Edgar Cortright, Director, Langley Research Center

APOLLO 13 REVIEW BOARD CONFERENCE 6-2-70 1-1

CORTRIGHT Good afternoon. The purpose of this particular conference is to bring you up to date on where the Apollo 13 Review Board stands, tell you a little bit about why we've delayed our report and a little bit About what our prospects are of making the current date. Now, in particular, I want to tell you something about the tests that are going on. I will refer to a few notes here and which I hope I didn't leave anything out. First of all, let me say that the general status of the review is that it's nearing completion. I'm generally satisfied with the results that have been turned up in the investigation to date. I think the understanding of the accident is good. We've delayed the report, as I mentioned in a bulletin which came out within the last few days, because there are critical tests being carried out which will help pin down some of the details of what took place. The board has not been satisfied until recently that these details were pinned down. There are still a few key points to clear up. Now the tests that are being carried out are being carried out all over the country. For example, here at Manned Spacecraft Center, there are a number going on. They are also being conducted at the Ames Research Center, Langley Research Center, Marshall Spaceflight Center, Kennedy Space Center and at North American Rockwell, Beech, Boeing, and a few other places. One of the key tests is - one series of tests relates to this special de-tanking procedure which you heard about before which was conducted and the checkout proceedings at the Cape, prior to launc h. Now the tests so far have found the faulty thermal switches, or the failed thermal switches, which were mentioned the other day. They've also demonstrated that if these thermal switches had failed as we now are relatively certain was the case, that the temperatures that would have been reached in the heater tube assembly could have exceeded 1000 degrees F. in some spots, although not everywhere. There were tests conducted here at the Manned Spacecraft Center that showed that when the thermal - when the heater assembly, the heater tube assembly, reached temperatures like that it baked the Teflon coated wires and destroyed the insulation. And a little bit later I'll show you some samples of this insulation and what happens to it when it's baked in an oxygen environment. Now the clincher from this information is going to be conducted at Beech Aircraft Corporation this week wherein an actual flight tank will be cycled back through the same series of de-tanking operations that took place on the 02 tank number 2 from Apollo 13. These tests began yesterday with a normal detanking and will procede now into the special de-tanking. Following the tests, the tank will be disassembled and the wiring damage examined. Another series of tests that are appearing important are being carried out at the Manned Spacecraft Center

CORTRIGHT and Ames Research Center and the Lewis Research Center relate to the ignition and combustion processes in the tank. Now the first tests on ignition of Teflon by means of an electric arc, were run at the Ames Research Center, they demonstrated very low ignition energies. In fact, the initial test indicated less than one joule of energy and the short circuits that were measured' in flight showed energies of at least 20 times that - 10 to 20 times that. Ssbsequently, the values required to start an insulation fire in the tank fluctuated it a little bit, but generally seem to show one joule or less minimum energy. If the fire or ignition were by means of an electric arc. Just plain heating takes a lot more energy, but an electric arc concentrates the heat. The most recent test at Ames has shown that if the wire is baked in an oxygen environment and damaged it still ignites and burns much as if it were in its

END OF
TAPE

CORTRIGHT in its original condition. Now, the test at the Lewis Research Center designed to check these phenomena in a zero-g environment. Now, the way this is done is that there's a facility at Lewis which consists of a tank which is dropped from a 500-foot tower. Actually, it's dumped into a 500-foot hole and I think you can get 5 seconds of zero-g flight that way, and if you toss it up from the bottom and let it get almost to the top and come back down again you can get 10 seconds, and basically what they've shown in the combustion rate or propagation rate tests is that in one g the rate of propagation of combustion along a Teflon insulated wire depends on whether it's traveling up, down, or sideways because of the convective currents. The direction which most nearly simulates zero-g is down, and that is about twice the rate that really takes place in zero g. These are just rough numbers but they are generally right and all of this information has been determined since the beginning of this test program. As far as the tank rupture is concerned, there has been a lot of question about just how much of a rupture it was, and the guesses have ranged all the way from a small half-inch hole, which might have occurred if a conduit burned out at the top of the tank, to total rupture. Now, here's why that's important. We feel that we'd like to know how much the tank ruptured so that we can understand what caused this rupture. We can readily conceive of a burn through at the top of the tank because there are many wires that come together at the top of the tank and run out through this small conduit. This makes sense to us. Tests were just run here the other day that showed that not only might that small conduit burn through but as much as a two-inch hole in this particular case could burn through very rapidly. Now, this ties into another series of tests, and that is how the panel came off the service module. The pulse required to take that panel off has been under study at the Langley Research Center with a very large crew of people working on this problem. The service module bay number 4 has been mocked up in about one half scale, and so far I think the series have about 15 tests have been run to attempt to pop the panel off in a realistic way, and this has all been scaled dynamically and structurally so that it does simulate the actual conditions. The first thing that was found out was that if you pulse a very rapid pulse in a local area which say simulated a very rapid, rather large rupture of the tank, that it tore a hole in the panel, but if the pulse were just a little bit slower and gave sufficient time for the gas to spread throughout the whole bay and pressurized that panel fairly uniformly, it came off completely, and it came off at about the pressure it was designed for, which was say between 20 and 25 pounds per square inch. Now there was some problem

END OF TAPE

CORTRIGHT with these tests in the sense that the slow pulse which took the panel off pressurized some of the rest of the service module more than we think happened, because under one condition the pressure could have separated the command module. The command module was designed in such a way that if it had been pressurized at its heat shield area to 10 psi about, it would have come off. So we have been looking for a pulse that would take this panel off more abruptly and get it all off and this was achieved yesterday morning where we were running our first - actually our second honeycomb reinforced panel. Prior to day before yesterday actually the panels were single sheets simulating the tensile strength and the membrane properties of the actual panel. Some of the stiffness properties were injected the other day when we got our first scale honeycomb panels. They have now come off in total, not in one piece, but they've all come off with a sharp local pulse.

END OF TAPE

CORTRIGHT -come off, in total not in one piece, but they all come off with a sharp local pulseof the type we think occurred. We've also been running extensive theoretical calculations at Langleyto try to relate the shape of the pressure waves and the total energy in it to what you might expect from various size ruptures in the tank. We're getting close to a match but we don't quite have it yet. Now if we've got a 2-inch hole in the tank, and we're not sure we did get it, just one test sample showed a hole about that size , that would about give the right size pulse. If it was something less, we might need an augmented force and there's one way you can get an extra kick into that pulse and that is by burning of the Mylar insulation in the bay. Bay number 4 which - and actually this Mylar was right over the top of the tank. There's a test being run at Langley today to try to demonstrate that if the tank had burst, flooded the Mylar insulation with liquid oxygen or a spray of liquid oxygen or gaseous oxygen and had ignition sources present, this would almost certainly have been there with a burn through at the top of the tank. That it would in fact, ignite and supplement the pressure pulse from the cold gas alone. Now this isn't quite pinned down yet. Obviously, I'm giving you some information in advance of conclusive results but I'm doing this so you'll understand what we're about. I guess the last thing I would say then is that the tests are all coming to a focus here this week. It's going to be very difficult to get the report in by next Monday. The administrator is not putting me or the Board under pressure to get that report in but rather is urging us to take the time required to do a good job and we're going to do that. So that if additional time is required, we'll take it. I won't know for a few days yet. That's what I thought I would tell you except to answer the questions.

QUERY Would you just summarize for us the probable sequence of events that happened on Apollo 13 based on all the knowledge to date?

CORTRIGHT Where do you want me to start?

QUERY When the problems developed, what had happened that lead up to this problem on Apollo 13 (garble) based on the investigation?

CORTRIGHT Well, I'll tell you part of it but I don't want to attempt to give you the whole sequence because there's some steps in it that we're still debating and in fact, I have to leave here before too long to go back and participate in a meeting with officials from the prime and subcontractor who built this tank to discuss some of the events that preceded the accident. But in a gross sense,

CORTRIGHT that was believed to be something like this. The switches which failed at the Cape, we think, were not rated to the voltage levels to which they were subjected at the Cape. Normally they would not have been counted, these voltages at the Cape, but they did so in the special detanking. This higher than rate of voltage failed the switches in a manner in which they could no longer function as protective thermostats. This in turn resulted in the heaters operating for a long period of time without interruption. The heater tube assembly reached temperatures which we suspect, locally, may have been as high as a thousand degrees fahrenheit. We have demonstrated that this seriously damages Teflon insulation Inflight, when the fan motor wires were energized for a normal stir of the oxygen, they short circuited at a point where the insulation had been damaged by this heater cycle. The short circuit was of such a nature that it created an electric arc which in turn, ignited the Teflon insulation. The Teflon insulation burned - -

END OF TAPE

CORTRIGHT Tefloninsulation burned towards the top of the tank, when it reached the top of the tank it ignited additional Teflon insulation around other wires which come together there creating a local furnace which burned through the top of the tank in some manner. The high pressure oxygen rushed out into the bay number 4, pressurized it with a sharp quick pulse, separated the panel, damaged 02 tank number 1 system, resulted in the total loss of oxygen and power ultimately.

QUERY What evidence is there that this happened before launch? The switches were damaged before launch?

CORTRIGHT The tests the other day showed - indicated that the switches can weld closed when they attempt to interrupt a current of the strength which was used at the Cape during a de-tanking procedure. Now the details of that, with regard to the actual rating of the switch, how it came to havethat rating, I'm not prepared to discuss that today.

QUERY How many times where the fans used before the explosion and why?

CORTRIGHT I don't have that count, but they were used.

QUERY More than once?

CORTRIGHT Yes.

QUERY Who authorized this special procedure for de- tanking?

CORTRIGHT This was authorized through normal procedures at the Kennedy Space Center with checks with responsible individuals.

QUERY Had they ever been used before?

CORTRIGHT No.

QUERY Do you know why they had trouble with these tanks?

CORTRIGHT We suspect a loose portion of a filter assem bly in the tank but I'd rather defer discussion of this aspect of it. I think I will defer at about this point because there are elements of it that are not yet clearlyestablished and they will be in the final report to the Administrator which I'll make next week.

QUERY Why was the failure of switches not discovered early in launch?

CORTRIGHT The Ground Support equipment which monitored the tank did not readily or visibly display the heater operation and the operation of those two switches.

QUERY And was no special step made to check those switches due to the fact that they had been taken above their rated voltages.

CORTRIGHT No. I defer that question for the next time we get together.

QUERY Well, what kind of voltage did your tests show? What voltage did the switches draw?

CORTRIGHT 65 volts dc.

QUERY When you said there was nothing on the ground support equipment, what do you mean, there was no indicator or gage or something, or what?

CORTRIGHT I'm not sure I understand your question.

QUERY You said there was nothing on the ground support equipment that would indicate (GARBLE)

CORTRIGHT (GARBLE) the equipment is recorded but as far as I know and this is one of the things we're checking into, there is no convenient way that would illustrate the cycling of those switches to the observer, so the conductor could, so they come back (GARBLE). They would assume (GARBLE)

QUERY Do you have a de-tanking procedure which was not normal, which has been described to us since is very strenuous, hard on the equipment, etc.? (GARBLE)

CORTRIGHT There were tests run in support of that operation to determine whether or not it was a safe procedure to follow the (GARBLE) one as possible. (GARBLE) it was and there was no mechanism hypothesized that could damage the tanks.

QUERY No special tests were run after the procedure was completed to back check (GARBLE)

QUERY Cortright you say that welding occurred at 65 volts DC.

CORTRIGHT I'm not exactly sure of the exact number so I'd rather not (GARBLE)

CORTRIGHT I feel it's very important to be accurate in regards to this switch malfunction because it probably was the final thing that occurred during ground tests which caused the accident. I think it'd be seriously wrong on my part to speculate in any way.

CORTRIGHT Dr Paine testified on May 19 before the Senate Appropriations Committee that modifications are being made. Is that true?

QUERY What does that mean?

CORTRIGHT It means that work is going ahead as planned.

QUERY But no nominal gain made is that right?

CORTRIGHT The fix has not yet been authorized.

QUERY As I understand it, this heater switch business is something that you became fairly sure of last week, is that correct?

CORTRIGHT Yes

QUERY That would have been after Dr. Paine said that

APOLLO 13 REVIEW BOARD BRIEFING 6-2-70 RB-D-3

QUERY modifications are being made, it raises a question of will this neccwssitate further modifications?

CORTRIGHT This switch, I believe, had already been taken out for subsequent flights prior to the accident, and the discovery of the switch problem merely helps us be certain we knew what happened, it doesn't change the approach to the fix.

QUERY What about pinning the fault of the explosion on the de-tanking operation? Does this mean the whereas the de-tanking in the past has been sort of thought to have been a one-of-a-kind failure and there may be some modifications coming out of it now? Further modifications?

CORTRIGHT I don't believe that the normal detanking procedure will be changed as a result of what we learned certainly the special (GARBLE) de-tanking procedure will not be followed again.

QUERY This sounds like not an equipment failure, but human failure in not using the equipment properly, is that right or not?

CORTRIGHT There appears to have been a mismatch between the ground support equipment and the switches which were used on the spacecraft and what we're trying to pin down now is how that occurred.

QUERY you're saying that the people conducting the test felt that these switches could handle the current used in the test. Did they use too much cur-
rent?

CORTRIGHT It was for switches that were on board. (GARBLE) 65 volts.

QUERY Are you saying in essence that you think it means they know what kind of switches were onboard?

CORTRIGHT Yes. They didn't know that the switches would not handle that current.

QUERY Had there been a change in switch specs some where along the line?

CORTRIGHT I understand why you want the answers to all these questions but I am not prepared to give much more than this today because I don't have all the answers yet. As I say, we're meeting at three o'clock, to attempt to pin some of these things down, if I attempt to answer any more questions about these events, I'll be changing the answers tomorrow.

QUERY (GARBLE) switches to be set, was this known?

CORTRIGHT It was known to some.

QUERY To the people operating the ground support equipment?

CORTRIGHT No I said that they -

END OF TAPE

QUERY the people operating the ground support equipment.

CORTRIGHT No, I said that they felt the switches were rated at the level to which they were using them.

QUERY Has NASA called for a - requested a change in switch specs any where along the way here?

CORTRIGHT (Garbled)

QUERY What are the switches rated at? What were the switches that were in there rated at? We've got 65 (garbled)

CORTRIGHT We/re double checking that, and we'll tell you when we know.

QUERY You said that this thermostat switch had been taken off in future flights.

CORTRIGHT I think so.

QUERY Do you know why?

CORTRIGHT Pardon?

QUERY Do you know why that it was taken off?

CORTRIGHT I'm not positive that I have all the information on it, but normally those switches are never used. They would normally be used in very unusual condition where the oxygen in the tank got down to a few percent of maximum during flight, and the tanks aren't used that way, but they were used that way during this detanking procedure.

QUERY The switch removal then is not one of the steps that you ordered as part of the fire proofing procedure?

CORTRIGHT No, sir.

QUERY These switches, are they inside the tank, outside, or where?

CORTRIGHT They are inside the tank, mounted on the inside of a heater tube, near the top.

QUERY Then Apollo 13 would have been the last flight to the best of your knowledge at this point time that would have had those switches in it?

CORTRIGHT I'm going to ask Brian Duff to check that for me. I'm not certain. That's my recollection.

QUERY We've got one question from Washington, Wait a second.

QUERY - and the mismatching of switches in GSE etc., are you coming to the conclusion that perhaps there has been over a period of time a letdown in quality control and attention to detail that's got to be shaped up?

CORTRIGHT We're not going to come to that conclusion today. We're trying to reach conclusions so that we can make recommendations to the administrator next week. I guess that will have to be my answer for today. Let me say one other thing in answer to that question. I have not detected any let down in quality assurance as set up for this program and as carried out. In fact, we have found that the quality assurance program is about the most rigorous we've ever seen and that it's carried out to a letter, that does not mean that the best systems can't let things slip through occasionally.

QUERY You said that the ground support people didn't know that that switch couldn't take that current but that some people did know it. Were these some people that were at the Cape that were involved in the procedures?

CORTRIGHT We're trying to determine today and this week who did and who didn't know and what information was exchanged among them.

QUERY You certainly have given an overall impression at least that there was either a substandard switch involved or that some documentation along the way didn't get passed along, or that something in this area probably occurred. Is that what you're looking at, at least is that possibility you're looking at?

CORTRIGHT I think it's clear that a mistake was made. That's what we're looking for.

QUERY Does it look more like a hardware mistake or a documentation mistake?

CORTRIGHT I'm not certain just what aspects have been (garbled) most significant.

QUERY Then why (garbled)

CORTRIGHT I'd rather not get into the discussion of the fix today, if you don't mind.

QUERY Dr. Cortright, how did you come to suspect the switches? Was it because the detanking procedure was a deviation from the normal way of doing things, that an investigation of this type you would normally look into a thing like that?

CORTRIGHT That's the first part of it. It was an abnormal thing. The tank failure was abnormal. You try to put 2 and 2 together. We did recognize immediately that if those switches had not operated that the heaters could have gotten quite hot, so we undertook with the Manned Spacecraft Center to conduct tests to determine how hot the heaters might have gotten. In the process of conducting those tests, the switches actually failed in the manner I described. It wasn't actually during the test of the switches themselves but they did weld themselves shut and therefore one test which more or less pinned down a key step in the whole process.

QUERY Well, do you feel that the sequence was a failure. When the switches failed at Cape Kennedy and generated possibly 1000 degrees of temperature this in effect did some baking of the insulation. Subsequently, use of the fans and the heaters continued to bake and on April 13 the insulation just gave way and arced. Is that what happened? After a continual exposure to this high heat?

CORTRIGHT We expect that the insulation was in bad shape at launch and just why it took as many hours as it did to strike an arc we don't know, but there are mechanisms that you can speculate on. For example, there are wires that are relatively free. They are loops in the tank, and these loops

CORTRIGHT no doubt do some moving around each time the fans come on and stir the fluid. They conceivably get moved back to a point where they had once been in contact with the heater and was damaged and if at the time they moved back they were bare, partly bare because of the damage it would strike an arc. That's one way it could happen. We may never know.

QUERY Do you have a certain amount of sloshing in those tanks by just attitude changes? Do they slosh (garbled)

CORTRIGHT Well, sloshing is not the right description, but a gentle reactive motion.

QUERY The loops - the wires could move within the tank in this kind of motion?

CORTRIGHT Yes, but when the short circuits took place was immediately following turn on of the fans.

QUERY When was it first discovered that more voltage was applied to the switches than should have been?

CORTRIGHT Last Wednesday. We reported it to you last Thursday.

QUERY Was that just a studying of documentation of tests at the Cape? Is that right?

CORTRIGHT That was by having the switches fail during the ground tests and attempting to understand why they failed.

QUERY How did you become positive that the switches were failed at the time of launch? Is this hypothesis based on these tests or was there some documentation that you could go back to for the GSE to determine this?

CORTRIGHT The records I've seen to date indicate that the rating of the switches was lower than the voltage supplied to them and that this makes it seem rational that since they failed in ground tests at the voltage used at the Cape that they in turn had failed at the Cape. Now, some of the tests that are being run this week, and I 'd like to make a strong point of this, are to validate in fact that these switches would normally fail at the applied voltages and that it wasn't simply an odd occurrance here in a test at MSC.

QUERY That's the purpose of the voltage test for the flight model.

CORTRIGHT Actually - excuse me, I want to answer that question. That isn't one of the main purposes of that test and I don't know what the configuration those switches are in in that tank. They may in fact be wire closed, but there will be more switches tested here to get a little bit of a statistical sample as to whether they would always weld closed.

END OF TAPE

APOLLO 13 REVIEW BOARD BRIEFING, 6-22-70, 1:59 PM CDT RC-F/1

QUERY Would you run through in a very brief capsule summary, the tests that were conducted, in the sequence in which they were conducted and the place they were conducted leading up to this day and this week, this month. MSC switch failure found and pick up from there.

CORTRIGHT I guess I won't try to do that because I don't have all those dates and sequences that sharply in my mind. The key test was from, I believe, here at MSC last Wednesday in which the switches failed.

QUERY Is there any sensor (static)

CORTRIGHT No. The thermal switch itself is set to open at 80 degrees fahrenheit plus or minus 10 degrees.

QUERY Yeah. (Static) thermal switches, is there any idea (static) it's two dimensional.

CORTRIGHT I'm not prepared to discuss the fix details of that. Now I can guarantee you that there will be thought given to need for such a measurement. I'm not sure if it's needed.

QUERY Plus or minus 80 degrees - plus or minus how much you can handle. (garble)

QUERY How did you decide that the insulation was in bad shape or not? I would (garble).

CORTRIGHT Just happened to have. (Laughter).

CORTRIGHT I intended to bring along and show the original condition so you could imagine that. This is aligning it with a piece of wire that was baked for one hour at 752 degrees fahrenheit. This - let's say that the insulation is cracked and opened up at various positions on the line. Well, that represents one degree of insulation damaged and it's a degree where subsequent movement of shaking and thermal stresses this might have caused pieces to flake off. Now a little bit higher temperature, 860 F you can see the insulation is largely gone. That was after 1/2 hour. Now we know that we were quite sure that some portions of the heater tube reached 1000 probably most of it didn't but it could have been local damage perhaps as bad as (garble).

QUERY You'd call that thing cooked, wouldn't you?

QUERY Several hours, at the Cape at 1000 and this burned off in a half hour; how did he even get airborne?

CORTRIGHT That's a good question and I just don't know the answer to that question. We don't know for example - we only have a few measurements in our tests so far that give temperatures on that heater 2 and one of them went as

END OF TAPE

CORTRIGHT high as I mentioned and it was very close to the actual heater element. The temperature dropped off fairly rapidly as she went away from that, I've been led to believe. And therefore, the wires may not have approached these temperatures on most of their length. All we have established really is that the potential was there to destroy the insulation on the wires at least locally.

QUERY How close is this fan wire adjacent (garble)

CORTRIGHT The lower fan motor wires run through the heaters making a small conduit.

QUERY What's the material of this conduit?

CORTRIGHT Aluminum textranox. I think I'm going to have to limit you to about one more question then I have to get back to the meeting.

QUERY Can you even ball-park roughly how this 65 degree did you say the voltage it was suppose to be in the switches was two times as high, three times as high, four times as high?

CORTRIGHT No. I'd rather not. I have an Approximate number but we're checking that today and I'm just not want - -

QUERY Could you even just give us a rough thing like it was quite a bit higher?

CORTRIGHT Was larger.

QUERY Was it quite a bit larger?

CORTRIGHT It was enlarged enough I think to weld them

QUERY What was the material that (garble) checked?

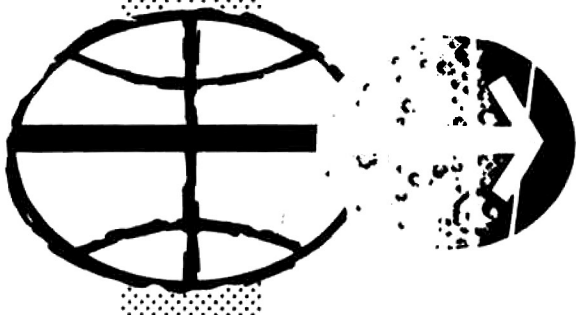
CORTRIGHT (Garble) (Laughter)

END OF TAPE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 13 MISSION

CONFERENCES



MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

APOLLO NEWS CENTER
HOUSTON, TEXAS

POST RECOVERY PRESS CONFERENCE NUMBER 1
Manned Spacecraft Center
April 17, 1970
1:30 PM CST

PARTICIPANTS:

Thomas O. Paine, Administrator, NASA
George M. Low, Deputy Administrator, NASA
Julian Scheer, Assistant Administrator for Public Affairs,
Headquarters, NASA

ANNOUNCER This is the first of the triple header. We have a red team, a white team and a blue team. We've got the red team with NASA's Dr. Thomas O. Paine, the Administrator of NASA, Dr. George Jow, the Deputy Administrator of NASA. A few remarks and then we'll have questions and answers. We'll wind up your questions and answers on this. We'll go right into the second and then finally the third which will be the technical people who should have their numbers ready for you by that time. So without further ado, Dr. Paine.

PAINE Good afternoon. George and I come before you today with a great sense of gratitude and thankfulness. Jim Lovell, Fred Haise, and Jack Swigert are safely home. There's never been a happier moment in the US space program. Although the Apollo 13 mission must be recorded as a failure, there's never been a more prideful moment in the space program. Jim, Fred, and Jack represented of behalf of NASA for people all around the world the great spirit of exploration, of bravery, men who are willing to go out into news areas and overcome tremendous problems as we push forward to explore the unknown. Come to understand and realize also this week that NASA and the astronauts are not alone. The heartwarming messages of encouragement that have poured in from all around the world, have meant a great deal to us. We've had the wishes and the prayers, men and women, every walks of life, with us. The thing that I think has impressed us, perhaps the most, has been the tremendous effectiveness in team work of our ground support operation as they've worked so closely with the astronauts. From every state of the union, we've had people connected in by direct wire, working to backstop the many different system decisions that had to be systematically and methodically faced up to and made in these very trying hour after hour that this mission represents. All of this work has been done under great stress, it's been done, however, with competence and with precision. The Flight Operations Directors, including Sig Showberg, completely unflapable people, certainly demonstrated that flight controllers can operate under these very adverse conditions. They've been able to do things in a far short a period of time, than we'd ever thought possible, before. I know there's a great deal of questions now with Apollo 13 safely home — where we go from here. Certainly we recognize that Apollo 13 was a set back, but in many ways we are going to learn more from this mission from the struggles that we've had to overcome the difficulties that we encountered, than we would have had we had another flawless mission, repeating the past successes of Apollo 7, 8, 9, 10, 11, and 12. I want to

PAINE finally pay a special sincere tribute to the astronauts wives. Marilyn Lovell, Mary liaise have been really people of tremendous courage throughout and I have the utmost respect and affection for them. The way in which the NASA family gathered around them and supported them, of course, is just wonderful from all of our standpoints. Last night when I left Mary Haise I was particularly impressed as she sat there and after we discussed her concern for her husband she indicated to me the tremendous concern that she also felt that the space program continue to move forward. She was particularly distressed at some rather faint hearted comment that she heard on the television that now we ought to turn back and she said with great spirit and with some indignation "Don't they understand what we're doing this for." And I certainly pay great tribute to Mary's courage. She's a great little gal. Finally, I'd like to close by saying that we will press on. We have had a very difficult job. We're rescuing the crew, bringing the spacecraft back to Earth but I think the lessons that we have learned will indeed be things that we will very quickly be able to apply. Now, starting today, we are official start, beginning an intensive investigation of the accident which happened to the space-craft Odyssey on this journey. To accomplish this George Low and I have jointly established an Apollo 13 review board, which will report directly to us. We have appointed Mr. Edgar M. Cartwright, director of NASA's Langley Research Center to serve as chairman of this review board. The board will consist of senior NASA individuals and experts from other parts of the Government and the special competances that we need will be provided both inside NASA, inside other parts of the Government and also from industry and the academic community. We will have available for you. The instructions to the review board that Dr. Low and I have signed. In conclusion, I think I can summarize our feelings as we appear before you a little tired and bedragled but feeling 10 or 20 years younger than yesterday. The offers of help from all over the world, I want to express again, our appreciation for messages from the Soviet Cosmonauts, from Premier Kosygin, from Aeademician Blagonravov before the UN yesterday. offers of help from Australia, and France, and England and every part of the world. We're very pleased of this and, I think, that it bowed very well for our future international cooperation and participation in man's exploration of space. And, finally, final tribute to the men and women on the ground and to the astronauts in flight who worked together so beautifully as a team to identify the problems, overcome them and move forward, just as, indeed, we shall do

throughout the spaceprogram in the future. Thank you.

SPEAKER Ready for questions if you'll wait for the mike, please.

QUERY Dr. Paine, in your opinion, I realize that you have an intensive investigation into the explosion and exactly what happened, but in your opinion, based on what you know now, do you think that a design change will be necessary - the kind of thing that would postpone Apollo 14 until next year or even later? And, secondly, the overall impact of this from the public and other people, do you think that this will hurt the future space program such as the shuttle space program - you know, station and so forth, and hold up the funds for that?

PAINE In respect to the first question, if it's all right with you I'd like to defer because as soon as George and I leave we are going to bring before you technical experts who will give you a line by line rundown on all we know about how this accident happened aboard the Odyssey. We'll be able to give you the timeline, although we won't be able to give you a complete description of precisely what happened. We certainly are in a position to give you far more detail that we could have as late as yesterday. With respect to the second question, I think that all of you in this room are a better judge than George and myself as to what the public reaction is, very frankly we've been very isolated in Mission Control. We haven't been reading the newspapers or watching television but my feeling about this in general is that the American people, I believe have probably learned from this entire Apollo 13 mission what you in this room and the professionals in the NASA program have always pretty well understood that the business of the exploration of space, of developing new technology, building experimental equipment and flying it, indeed, always a risky business. We try to build into it every possible way minimizing the risk, if accidents happen, bringing people back and - safely. I think you've just seen a tremendous demonstration of the flexibility of our systems and our ability to do this. I think what the public thinks about this when the Congress considers it that we indeed will continue to get the support that we have always had.

QUERY Mr. Low does the - on the positive side of things does a near disaster show you, just following up on what Dr. Paine has said, that some of the design equipment actually exceeded its potential, for example, did you expect to get that much out of the LM?

LOW I think we were tremendously pleased to have the LM there and to perform as it did. We, of course -

END OF TAPE

LOW did we of course knew that the LM could be used for this kind of rescue mission. In fact, this type of mission had been simulated and rehearsed before, so that although we were very tight on the consumables and the LM systems all performed exactly as they should, it was a LM performance within its own design. I think the most important thing about what was done on this flight is the ability of the people here on the ground and the pilots to be able to react to this kind of situation as quickly as they did and this they were able to do of course because of the tremendous effort that they had spent in preparing for all kinds of contingency situations.

QUERY Dr. Paine, would you elaborate a little bit on your comment that we perhaps learned more out of this flight than we would have from a flawless mission. Perhaps Dr. Low answered that in part, but I was wondering if you had anything else in mind.

PAINE We have always, as Dr. Low mentioned, exercised a number of contingencies in our training program and indeed many of our simulator runs I would guess by far the majority of them are runs in which we simulate many different kinds of casulties. In addition, you may recall that on Apollo 9, which was the very first flight of the LM and the command service module together in earth orbit, Jim McDivitt and his crew deliberately ran the LM through this tug boat sort of operation in order to prove out our ability to carry out this kind of a flight, so that we went into this mission with a good deal of you might say theoretical understanding of what we would do in various contingencies, but we had never planned for as complete a rupture of a system as we encountered in the service module so that in spite of all our preparations we were put to an even greater test than we had anticipated. I think the point that George was making and that I would reemphasize is that the process of overcoming these difficulties we learned a great deal about what we could do under these circumstances even above and beyond what we had planned in advance, although every specific action we took was an action that we had at least thought about in advance. But putting them all together and doing it in real time is a little different than doing it in a simulator where when you make a mistake you just reset the computer.

QUERY Dr. Paine, could you quote the odds on the possibility of Apollo 14 going on October 1 as scheduled?

PAINE That's odds that I don't think I would be able to quote. As you know, the review board is going to take some time to dig in to what happened. We're going to have to look very carefully at the whole Apollo program to decide just what fixes we want to make. Until we have pinpointed the source of the accident more than we have this

PAINE morning, it's just too early to speculate

QUERY It's not definitely off for October at this point?

PAINE Well, it's not definitely off for October but it certainly isn't definitely on for October.

QUERY Would you elaborate a little bit more on the people on this review board who are going to be outside government and outside NASA, in other words outsiders who will come in and participate in this?

PAINE We have not yet named the individual members of the review board although we are now going through the candidates and we have - beginning to list the skills that we want and the kind of judgement that we wish to bring to bear. The review board will be appointed within the next few days and we'll be in a position then to give you the individual names. The members of the review board will all be people from either NASA or another government agency. We will call in as consultants and experts people from industry, the academic community.

QUERY Dr. Paine, shortly after splashdown there was a break in tradition in Mission Control. The first time the minature American flags were not placed atop the consoles and I wonder what the significance might be in that.

PAINE I don't believe that this represents any loss of patriotism. I noticed that the traditional cigars were indeed passed out. There was another slight break in tradition, too. I had received a call from the President just a few moments before the helicoper arrived and he had asked me personally to express to the people in Mission Control and to the ground people of NASA everywhere his personal appreciation and thanks for a job well done and I had the decision to make as to when I would deliver the remark and I decided that even before the helicopter wheels touched the deck, which is our usual time for celebration, I better pass this message on because once they touched the deck I figured I'd never be able to get the message across to this gang again. There were 2 breaks with tradition.

QUERY Again asking odds, what are the odds of a meteorite striking a spacecraft? Are there any - is there any shielding at all on the spacecraft of this kind, and was there anything said about the condition of the SM by the astronauts that would give you any clue at all as to what might have happened?

LOW I don't have the number of the odds but we can get that for you. There's a statistical curve that exists based on information gathered by unmanned satellites concerning the probability a meteorite of a given size hitting

LOW the spacecraft, but the odds are extremely small. We can get you the exact numbers. Now, is the spacecraft protected? The answer is yes. For those very small meteorites that had the largest probability within the very small odds. The outer skin of the spacecraft and even the heat protection of the outer thermal layer on the LM perform very adequately for protection. In face, the spacesuit itself is designed and was tested against meteorite impact. For the very large meteorites that would occur very, very infrequently where the probability is extremely low, of course, the spacecraft is not fully protected. Now, the last part of the question, do we have any clue from the appearance of the spacecraft as to whether or not it was hit, no we do not yet.

QUERY Dr. Paine, in this perspective of the service module blew its stack, if it had happened 24 hours later we might have had a less happy ending today. We've landed twice on the moon so far. So I wonder if you could address yourself to why NASA feels the requirement from this point in to further explore the moon.

PAINE We're exploring the moon for many reasons. One of the reasons is the scientific return which we get from the moon. As you well know, we're not only visiting another world here, but we're visiting an incredebly ancient world, a world which was formed probably the same time as the earth, but which preserves on its surface the record of the first billion years of the existance of the solar system. There's enormous value to be obtained by understanding and learning about the whole origin, the whole beginning, the whole place really from which man and all life came. Beyond that we're also pressing forward because this is the place where we will learn how to conquer space, how man will be able to set forth from the whole planet earth and travel to many other parts of the solar system. We're in the first 12 years of the entire space program. It was only a couple of weeks ago that the first satellite that America put up reentered, so in this period of time all the advances that have been made have occurred and I would like to point out also that in the course of this progress in Mercury, Gemini, and Apollo American astronauts have flown 66 million miles and we have yet to lose an astronaut in space so that we're pressing on because we're at the beginning of man's conquest of space, just as in the early days of aviation we'll have accidents occasionally. We hope that with modern technology at our disposal the results of these can be minimized and that the loss of human lives can be minimized and that we will indeed learn how man can sail on this new ocean of space, use it for practical applications, use it for new science, and use it to advance our technology.

QUERY Are you saying, doctor, that a single setback, no matter how dangerous it might have been shouldn't set back the entire program?

PAINE Exactly.
SCHEER George Wilson, right there.
QUERY I wonder if each of you would tell us which was your most anxious moments?
LOW All of them, from the time I first heard about this until the 3 astronauts had their feet -

END OF TAPE

QUERY - from the time they first heard about this until the three astronauts had their feet on the deck of the carrier?

SPEAKER That's a very difficult question to answer. The earlier part of the crisis, in my view, were probably, for me personally, the worst. George and I summoned our airplane up from Langley Airfield, where it's normally kept right after midnight on Monday night. It seems hard to believe it was only Monday, and we took off in a driving rainstorm in Washington and flew out around 2:00 in the morning to come to the Mission Control. We were in communication with the ground over a comm system as the first burns were being set up. The reports of the damage at that time were very accurate, and we understood what a serious casualty had occurred. I think the next 12 to 24 hours probably were the worst for me.

SPEAKER Let me add one more thing. I've participated in some capacity in every manned flight that we have had and certainly none of them has taken as much out of those of us on the ground and none has demanded as much from the guys flying the machine as this one has.

QUERY This question to go to Low. To what extent were the astronauts able to fall on predetermined and standard emergency procedures, and to what extent did they have to improvise?

LOW The basic procedures that they used for every phase of the mission, I believe, are predetermined. For example, the burn made behind the moon or 2 hours after pericynthian, when we came around to the front of the moon, the burn had put us back to a Pacific landing, was a standard emergency burn that would be used in case the service propulsion system would not work on a normal lunar mission going into lunar orbit. Each one of these steps had been predetermined and also simulated. But putting them all together into a sequence of steps, as was done this time, and working out some of the detailed procedures on how to save power and how to save batteries; how to save water; those things were determined during the course of the flight, both by the men here on the ground and by the astronauts.

QUERY Dr. Paine, you announced last Tuesday the appointment of a Special Flight Force Progress Review Counselor. Can you tell us about the work of the Counselor. Have they made any recommendations? Is their work completed now after splashdown? Will they be in touch with the new group appointed with Dr. Cartwright as its head?

PAINE Well, Mr. DeRoach, the board which we are appointing is being appointed in accordance with the NASA standing policy that when we have a failure in a mission, when we have an accident, we immediately set up a board to review, to bring the best experts we can in to establish precisely

PAINE what happened, to recommend the action which should be taken to prevent a reoccurrence. This Board is reporting directly to Dr. Low and myself so that we can get a review by independent people, principally, outside of those responsible for the Apollo 13 activities themselves. They will draw on the best talents across the United States that can be brought to bear to solve this problem. I think that the nature of this will be a little more apparent to you when Rocco Petrone comes up here in a few moments and describes to you what we know about the incident. Now we will also be asking the NASA Safety Advisory Panel to look at the procedures that have been established by the Board as they begin their deliberations and report directly to Dr. Low and myself, and we will also ask the Safety Advisory Panel to review the findings of this Board and give us their independent comments on this. Besides that, the Office of Manned Space Flight will be conducting its own investigations and providing all of the material desired by the Review Board so that the specific things that must be done in the program sense can be carried out by the lying organization responsible.

QUERY Dr. Paine, I understand that Congressman Miller and Congressman Teague were in the Control Room with you this morning. And I wonder if these two ranking members of The House Space Committee either one indicated that they were going to have an investigation of the accident or, two did they ask you for a report to the committee?

PAINE We will be reporting to the Committee, and we will be reporting to the Committee, I would guess, in the very near future. I would like to emphasize that in setting up this Review Board, as well as in our reports to our Congressional Committees, we will be looking, not only at the specific accident which took place, but we also want to review very carefully, in the light of this real-time experience, what our reaction to that accident was, make sure that if there are any better procedures that should have been followed, any additional lessons to be learned, that we also are in a position to take advantage of that. We will be testifying before our Committees, I'm sure, with respectable to these aspects of the Apollo 13 mission.

QUERY Dr. Paine, have you given the Review Board a date when you want a preliminary report and secondly, is it likely that one or more members of this crew will serve on the Review Board?

PAINE We will definitely have an Astronaut on the Review Board, but it will be an astronaut not as directly closely involved. One of our senior astronauts, but not one of the astronauts who flew the Apollo 13 mission. As to the other part of the question, excuse me there was one other.

SPEAKER The timing.

PAINE Oh, the timing. Now we have asked the Board, itself, to review the length of time they believe they

PAINE would require to make a completely thorough and intensive investigation and to let us know what the time should be as one of their first actions. We will give you the charge to the Board.

QUERY Dr. Paine, just before the spacecraft went behind the Moon, I believe it was Commander Lovell who said something back to Houston as to the effect of: "It looks like it may be a long time before there are any more manned flights to the moon." If I'm not mistaken, someone here said something about "mikes being alive and be careful what you say, fellows." What kind of problem did this create and what was the possible intent of the statement by Commander Lovell?

PAINE I haven't seen that part of the comm. I wasn't in Mission Control when he said it. I was on the circuits this morning, and perhaps you heard too, when the comment came back on the status of the service module when, for the first time, they were able to get a good look from the lunar module, as to what had happened back there and after Commander Lovell had commented to the ground on the rather demolished condition, you may recall, there was a comment from the ground that "if Jim Lovell couldn't take any better care of the spacecraft than that, we were darned if we were going to give him another one." I think all of this instant comm is something we'll have to look back and I can't comment on Jim's comment because I haven't really read it.

SPEAKER Okay, I guess that's it for right now. We've got the Flight Team coming on with Brian Duff.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

POST RECOVERY PRESS CONFERENCE NUMBER 2
Manned Spacecraft Center
April 17, 1970
2:00 PM CST

PARTICIPANTS:

Dale D. Myers, Associate Administrator for Manned Space Flight
Robert R. Gilruth, Director, Manned Spacecraft Center
Rocco Petrone, Director, Apollo Program, OMSF
James McDivitt, Apollo Program Manager, MSC
M/Gen. David Jones, USAF, DOD Manager for Manned Space Flight Support
Christopher C. Kraft, Deputy Director, MSC
Brian Duff, PAO, MSC

DUFF I'll introduce the participants from left to right. Mr. Dale Myers, Associate Administrator for Manned Space Flight, Dr. Robert Gilruth, Director of the Manned Spacecraft Center, Dr. Christopher Kraft, Deputy Director Manned Spacecraft Center, Dr. Rocco Petrone, Director, Apollo Program, Col. James McDivitt, Apollo Spacecraft Manager, MSC, M/Gen. David Jones, DOD Recovery Manager. We will open with statements from the participants and then go to questions.

MYERS I'd like to say for all those people that are involved in the manned spaceflight program, how extremely thankful we are for the safe return of the astronauts, Apollo 13. I'm proud of those people in NASA, and in private industry that played the key rolls that were involved in this operation, and in the safe guiding of Apollo 13 back from the Moon. Too numerous to mention, too numerous to name, they are in Mission Control, they are in the backup rooms, they are back in the laboratories at NASA, and on back into the prime contractors and their subcontractors who all pitched in, in this crisis we went through and brought these guys home safely. We face the kind of a problem here that I think we all have expected to have happen some time along the line; a serious problem within the spacecraft, that took some very quick response on the part of the mission control people first, and then the backup people to bring themselves into position with the crew, to recover as well as they did. And I'm sure we all are very pleased with the background, the testing, and the background of thinking of all the missions that went on to get us into the position we got to here. Our preliminary analysis indicates that we had a rupture of an oxygen tank in the service module, and a high pressure liquid oxygen system, Rocco Petrone will later go through the time lines here in more detail of what we know today about it. We deliberately didn't concentrate on trying to understand this failure except for the depth required to support the mission that was underway. We did not go into the detail that we now will be going into. We did have some people who were not specifically connected with the mission, operating to gather data and start collating that data, and Dr. Petrone will have some of that for you. As far as the Apollo 14 mission, scheduled for later this year, of course we will not launch it until we fully understand this accident, and find the corrective action for this problem, and our actions in the office of Manned Spacen flight will be to support the Board fully as far as our investigative actions are concerned, the many data that is needed by them to run this investigation. I personally think that since this is a single system that was involved, a single subsystem that was involved, we will be able to find through the data analysis, what occurred, find the corrective action for it, and that we will not have a major delay in our Apollo 14 launch.

GILRUTH Well as Head of the Manned Spacecraft Center, I would like to tell everyone how very proud I am of the great performance of the Apollo flight crew in overcoming

GILRUTH this emergency, so we all know they performed in an outstanding manner throughout the whole flight. I am also very proud of the ground support teams which are hacking up and include the mission control group themselves. I'm not surprised at the high degree of perfection shown by both the flight and ground teams; that pointed out earlier these people train for every kind of an emergency we can visualize, and they learn to operate in all the simulations through emergencies such as the one that we experienced. I think we are extremely fortunate to be able to overcome an equipment failure as serious as the one that appeared last Monday night and still get back to Earth, and of course this would not have been possible without the out standing performance of the lunar module in the lifeboat role that it was able to accomplish. I think the events of this flight have made it clear beyond any doubt that the gains in space exploration are made only at the expense of some considerable personal risk by the flight crews, and I think it is quite clear, more so than by any of the Apollo flights up to this point, that flying to the Moon is not just a bus ride. It takes all the skill that men have to do it. I'd like also to say that I am very proud of the wives of the flight crew - they have shown a great deal of courage and faith throughout this whole difficult time, and I have one final comment that relates to the pace of the space program. I don't disagree with the classification technically that Apollo 13 is a failure, but it is still true that it flew around the Moon, and 2 years ago this would have been an outstanding triumph. Thank you.

PETRONE As was commented earlier, we had all the people we could muster working with the prime objectives since Monday night, to get the crew home safely. We also had a very small effort trying to pull together time lines and things that happened, one, so we would understand the conditions we were facing, and until Lovell described the service module, we could only imagine what happened, yet we had to know what happened to make the decision that we were able to make concerning the service propulsion engine and the various things in the service module. But that effort of then putting a time line together, we have come up with times which thing happened, we can not tell you yet why they happened. To avoid spending time here with all the time, I have a 4 page document in our public relations office, and I will reproduce them for you, and it goes through the exact sequence of all the pressure, the steps, the anomalies, the things that were striken, this is about in 3 minutes I might add, it goes from 55:48:37 to 55:55:50. In there, when you have this, I must say this; you have all we have. Today. We expect to be getting some more data in; whether we will change any of these numbers or not, we don't believe we will, but we'll get more tracking data in, we have the master tapes coming in, but this gives the total sequence such as the condition of the fans, when we have fans to be turned on, pressure oscillations,

PETRONE - all the things that we could read on that ship. And I say it from this information that now through our testing on the ground, through our analysis, we have got to come to the point that gave us this pressure rise, that caused a tank, the LOX tank, to burst. So rather spend time going through all the events, this handout should be available within a few minutes; I gave it to the public relation office about a half hour ago, and I think that is the best way to use your time and ours is to say we will be available for all of you - with all the information we have in terms of things that happened. Now why they happened, is the effort we must carry on in the immediate days and we will have people starting on this immediately.

END OF TAPE

SPEAKER days and we'll have people starting on this immediately.

SPEAKER All I can say is that today is one of the happiest days of my life, after what probably has been the longest week of my life. And there is no way in the world that I'll ever be able to express my gratitude to the tremendous number of people who helped us find the really obscure bits of information that went into making the last part of the mission as successful as it was.

JONES Well, I think, needless to say, we in the Department of Defense were very pleased to be able to be in the proper spot and to effect a very rapid recovery. In fact we were able to put the spacecraft - put the astronauts on the deck within 45 minutes, which is considerably faster than previous times. And also, the command module was on the deck at 13:36, about an hour and a half after touchdown. I think it is noteworthy that during the early part of the week when the touchdown point was sometimes in doubt, and certainly moved around the world several times, that NASA and the Department of Defense and the United States did receive from so many nations around the world offers of assistance. And certainly it was a spontaneous, generous offer. We did not require the services of any of our friends, but certainly it is appreciated by us and by the country. I thought it was a very generous gesture. As it was, we were able to use our normal forces and deploy it in the normal manner, since as you all know, the landing point came down very close to the one originally planned. Thank you.

PAO Are we ready for questions? Ladies and Gentlemen, General Jones has a pressing engagement in Florida and he's asked if there were questions, involving recovery aspects, could we take those first. Recovery in particular so that he will be able to leave. If there aren't any why-

QUERY I have one sir. General Jones, I wonder if the 4 mile estimate from the carrier to the splashdown point still holds or if that has been revised. Also, I wonder if there is any comparison, this was a very swift recovery, between 40 or 45 minutes, if I recall correctly. How does that compare in your memory to past recoveries and how does the performance on this recovery compare?

JONES As far as I know, the touchdown point was the same. I have not heard any change on that. I thought the performance, again, as I remember, one time we were just under an hour so that's 10 to 15 minutes faster. There are some procedures, that even now, we could obviously save time on, but I think we feel that we better do it, we want to do it thoroughly and not try to cut corners, but I think the

JONES procedures now look prettty sound. My engagement is selfishly with General Jimmy Doolittle in Coco Beach and I'm going to go down and join him for some sort of a libation, I think this evening. (applause)

PAO Alright we're ready for questions. Art Hill.

query Dr. Petrone, I wonder if I could get you to give us a general interpretation of the timeline that you were talking about. Not a play by play, but - and something not in technical terms, but just generally, what happened in general language.

PETRONE Let me go back and play this so we can put the pieces together. It was in 02, the oxygen tank number 2 where we had our difficulty. Going back over the timeline, we find that the quantity gaging system in that tank went off early that afternoon. It was at about 46 hourrs. Now at the time, that didn't tell us anything. We have many - in other words it going off, we have 2 gages, we'll work with 1 of 2. I think it went off scale, it went high. Whether that plays a part or not, we don't know. We've got a downer, that was an anomalie and it was in that tank. We don't believe - we're just not sure now what part it played, but from that time on, we did have fan cycles requested to stir the liquid oxygen, and what one sees through this is a buildup of pressure. But there are also drops in pressure, now that tells us that a sensor, working a certain way, this last part happened over a few minutes, about 3 times in the total timeline; I've talked about something that happened about 46 as contrasted to 55:48 when the incident started. We got a spike on a BAT, AC Number 2. We don't know what that means today, a spike is a main volt rise of about 130 volts on that BUS. But through it, it would look like we had a rise in the pressure in that tank, and we had the relief valve open, and had a number it was set for, and shortly after this period of time, the pressure dropped essentially to zero in that one tank, followed by a drop in the second tank, but much more slowly. Now, why it dropped more slowly, certainly has to do something with how the lines or the tank were affectedd by the first one going. Back when the first tank went, we immediately lost our 2 fuel cells, and from that period of time on, you see the results of losing your oxygen system. So, in terms of what it tells us, it tells us in that tank we had this pressure buildup, we had an event like a rupture occur. It affected the second tank in someway that we then lost pressure there too, over a much longer period of time. It took about an hour. It was an immediate drop from about 3 or 400 pounds and then a sustained drop over a period of about an hour and thirty minutes which allowed us to keep the

PETRONE fuel cells, that one cell up and take our steps to get into the LM and takes those ACCS without draining the batteries in the command module. I say, more then that, you could see from the time, that there are anomalies, the quantity jumps and things that can happen for different reasons. We're going to have to fair it out, which of these are normal, which are abnormal, and from that, piece together the puzzle.

PAO Let's take this one here and then we'll go over -

QUERY At what point of this sequence did you realize that you had a serious problem?

PETRONE I believe we knew immediately we had a serious problem, it was a question of how serious, there is no question, when the fuel cells come off the line, we have an immediate pressure drop, and that was seen, and the crew called it, and the ground saw it, we knew within, what you might say, a minute or so, whatever it takes people to react there, that we had a serious problem. Within a number of minutes, 10 or 15 minutes, it was apparent how serious the problem was; the mission had to come home. Do you have anything to add to that, Chris?

KRAFT I think in about, just about 20 minutes after the event occurred, we knew we had an uncontrollable situation in the command module. One where we were not going to be able to sustain the fuel cells, and we were not going to be able to sustain prolonged oxygen usage in the command module. That we had to lock up the tanks to preserve the oxygen we had. So I think in about 15 or 20 minutes we were absolutely certain we were going to have to go to the lunar module as a lifeboat.

query Chris Kraft. Chris, this morning, when Jim Lovell reported that the whole side of the spacecraft of the service module was blown out. Did you have any concerns or any fears over the integrity of the heat shield.

KRAFT To some extent, yes, but the way that Jim described it, it was obvious that he had no great concern over the heat shield. He pointed out that the whole side of the service module was gone. I interpret that as that panel was probably blown off, which is what you expect to happen in that it's almost the pressure vessel itself, and he pointed out that the - there were some things hanging out near the high gain antenna, and that's where you would also expect the structure to give, but the heat shield itself is

END OF TAPE

McDIVITT but the heat shield itself, it would not be subjected to any damage as a result of anything in that area, so I think we were all fairly confident that the heat shield was okay.

QUERY Dr. Petrone, a couple of days ago it seemed that some people here had a little bit of a clue as to what happened, and then when Jim described the condition of the service module today did that change that at all? Did you think it was any worse than you thought, say a day or two ago based on the clues that you had?

PETRONE I'd have to say not really. When one has a rupture of a pressure vessel, which we pretty well knew we had, we knew we had a serious effect back there. In discussing whether or not, for example, we'd get pictures and get Jim to look, we made that strictly provisional, that he would look if possible without affecting his flight path. The extent of blowing out that panel you might say was a bit surprising. We knew we'd see a large hole of some type, so I think that the fact of the decisions that were made, for example, not to use the service propulsion engine and not to do things in that area, that we did make over the Monday night, Tuesday, Wednesday timeframe were based on the fact we had a serious event, an uncontrolled event, and I think Jim's word just reinforced that and the pictures we hope to get back will give us some clues. But we knew that we had a serious you might say event and a posture we were not certain of, therefore did not want to use that engine for any activity.

QUERY Chris, back in Gemini your favorite used to be realtime flight planning. How would you compare the magnitude of the effort on Apollo 13 compared to what you used to do in the Gemini flights?

KRAFT Well, I think you would call that the epitome of realtime flight planning. I'd like to point out that the flight control team did one of the most outstanding jobs, if not the outstanding job, that I've ever seen accomplished. The men were right on top of that situation at all times and they discussed all the ifs, ands, and buts and I felt extremely confident that they knew what they were doing. You asked about the damage. I think we all knew there was apt to be a great deal of damage in the spacecraft on the part of a rupture of a hard vessel like that and that was the reason we chose not to use the service module propulsion system. We talked that over a great deal and the flight control people had come to the same conclusion in that we shouldn't use it, it was only an absolute emergency that we would use it. I think it was truly an outstanding job by Sig Sjoberg's people in the flight operations organization.

QUERY Dr. Petrone, it's been suggested the explosion could have been caused by a bit of hydrocarbon grease

QUERY in the oxygen system. Does that sound possible from your point of view?

PETRONE I had not heard that or suggested that. I would say we have records on the purities of the oxygen, taken very meticulously at the time it's taken, including what's been in and from the vamp, and those records will tell us the purity in the oxygen system, and those are the type of things we'll be reviewing and I know they will tell us - I frankly do not believe cause the techniques we have to measure the oxygen and hydrogen and all other things we put in the space-craft are very well developed. However, those are records we'll have to look at to make certain we know what was in there.

QUERY When do you expect the photographs of the damaged service module to be available for us?

McDIVITT The photographs should be back in Houston I believe on Sunday. We hope to have them out that afternoon. I'm not sure when. I think a lot depends on our knowledge of which film pack they're in and how we get them developed and things like that. We certainly don't want to lose them.

KRAFT We won't do that in anything but orderly haste because we don't want to lose those pictures, so we'll take our time and make sure they get developed properly.

QUERY I have two questions. For Jim, do you — did you expect ahead of time that the command module electronic systems would be working as well as they would after being cold soaked so long? I understand, for example, the IMU, which is quite sensitive to cold, went way down to like 40, and for Chris, I think your flight controllers did a simply out-standing job, but I was wondering if in the group was there any one man or several men that came up with any particularly great ideas in helping you solve this?

McDIVITT As far as the thermal situation in the command module, about Wednesday afternoon or early evening I gained a lot of confidence that the systems would be working at the time that we got around to reentering. We had been doing an awful Lot of work on Tuesday and early Wednesday and we had computer runs on the expected temperatures of every sensitive component in the spacecraft by early Wednesday morning and Wednesday afternoon, when we were able to get the data back on what the spacecraft temperatures actually were and found that these points fell right on these curves or slightly above them and that the curves showed that each and every component would be in a condition to operate by the time we got around to reentry, I think at that time I had a lot of confidence the spacecraft would perform exactly as it did today. As far as the specific question about the IMU, we had run a lot of work on these things at MIT a long time ago and it was everyone's feeling that the performance might be degraded slightly and we might have had a miss as great as 10 or 20 miles, but we would certainly expect that the systems

McDivitt Would perform in acceptable manner to land. However, it showed that they were equally as good after having been cold as they were prior to that.

QUERY Dr. Petrone, realizing this will have to be an educated guess until you have a chance to sift through more data, if indeed the safety valve was open on a pressurized tank of liquid oxygen, what conceivably caused it to burst?

PETRONE For this incident we don't know yet, but for any incident you can overpower a relief valve. You can't generate, under certain conceivable conditions, possibly more pressure than it could relieve. Now we don't know that's the case here, but that has happened on certain incidents, I'm sure that pressure vessels on the ground where in effect you can overpower a safety valve by having a greater quantity of gas to relieve than it is capable of discharging.

QUERY Dr. Petrone, is the spacecraft designed and the service module designed with bulkheads to localize and compartmentalize just such an event and explosion? Have you actually ever exploded a tank on the ground on the service module to see what sould happen?

PETRONE I wonder if I could let Jim McDivitt that's got the design responsibility answer that question.

McDIVITT The spacecraft configuration, as far as the bays go, is not designed to structurally protect one bay from another. It's done to provide structural integrity. to the whole vehicle in the range of loads that it will get. As far as I know, we had burst these tanks. We always burst all of our pressure vessels to see what pressure they actually burst at. Now, as far as putting them in a service module or structure like that and bursting them, no, we don't do that. We burst all pressure vessels by themselves under controlled conditions to see what the burst pressures are, not exactly how the shrapnel would fly and that kind of thing.

DUFF We'll take one down here and then we'll come back up front again.

QUERY Throughout the Gemini and Apollo programs there have been numerous problems of sorts - this is for Jim McDivitt, I'm sorry - numerous problems of sorts with fuel cells and they seem to be the weakest link. Everything else seems to work pretty well. Has thought - is thought being given to a major revamping of fuel cell design?

McDIVITT Well, the fuel cells perform exactly the way they were supposed to. We had some problem with the supply to the fuel cells, namely the oxygen tanks, and no fuel cell will operate without oxygan. To date we've seen nothing at all in the data that would indicate that anything happened to the fuel cells. We did have some anomalous data on it, but it's pretty hard to sort out the data dropouts from the real events and so far it looks like the fuel cells were operating properly.

KRAFT I'd like to reemphasize that every time we've ever had an electrical problem starting with Gemini, the people on the other side, namely the press, get the idea that fuel cells are problems, and I'd like to correct that. I don't think we've had very much trouble with the fuel cells at all. We've had trouble with the ancilliary equipment and the supply to the fuel cells, but we've never really had any trouble to speak of with the fuel cells themselves. I think they've been an outstanding piece of equipment.

QUERY Well, I gather that -

END OF TAPE

QUERY Well, I gather that basically what you were seeing then, during the evening, before the event was pressure rising and falling in the vehicle.

PETRONE Was your question, what we saw the evening before the event?

PETRONE Roughly the time of 3 minutes before the event. The thing I talked about earlier in some nine hours was a pressure gaging system but the pressure changes and quantity changes that are referred to, roughly 3 to 4 minutes, within the event timeline and the handout will give you that very clearly.

MYERS There may be more to your questions, I'm not sure. We were having an oscillation in one of the condenser exhaust temperatures, is that what you're asking about on the fuel cell?

QUERY I wanted to ask a further question - at a first look would the kind of behavior you saw, in just a few minutes before the thing let go - was that commensurate with say heating in the fuel cell, I mean in the - excuse me, in the 02 tank.

PETRONE I have to say, the immediate, the early numbers see your pressure can drop in a fuel cell. As you - excuse me, we're talking oxygen tanks, let's forget it. The pressure can drop in an oxygen tank because you're using the oxygen both to feed the cabin and feed the fuel cells. Now when this happens fans or heaters that could come on to give you a energy source inside to bring the pressure back up in the neighborhood of 934 pounds per square inch. So a pressure oscillation in real time doesn't necessarily mean there's something anomalous, but if it continues upward or downward then you have an abnormal situation. Pressure fluctuations by themselves are not an immediate indication

MYERS At this particular point in time, as you recall the crew was getting ready to go to sleep. Now the flight control people tried to get the fuel cell in the condition where it's not going to trip a CAUTION warning during their sleep period so they are trying to get the oxygen tanks in a position where the pressure - that is the heat you apply — and the use of fans to stir it up because the stratification to get it in the right condition so that for about a 10 hour period they can expect the right kind of performance on the basis of it's own heat leak.

QUERY Could anyone describe the force of this explosion in the 02 tank comparing it with something we all might be familiar with or put some kind of a number on it?

MYERS Well, I certainly couldn't. That's really a

MYERS function of the what was going on in the tank and the size of the disturbance - too many things make up that problem.

SPEAKER We have no data at all on what the force was. It was a rupture of the tank probably, and we don't know what it was.

QUERY Can you tell me just what kind of things you think that you would have been able to learn had you had the service module back here to examine, that is turns out you will not be able to learn and also do you have any idea as to what those things are that are hanging out of the opening.

McDIVITT Well, it's - I hope we can learn the same things - I hope we would have learned the same things with the service module back as we would without not having it back. It's one of the facts of life in space program that all the pieces don't come back to Earth when you have an anomaly like this. The, as far as what was hanging out the back, and I have no idea and I'll have to wait until I see the photographs. We do have data on the systems that were operating in that bay and we're just going to have to reduce the data a bit and see what all these things did. One of the things that's really more important is what's going on at the time of an occurrence like this rather than looking at the bits and pieces afterwards. Sometimes the bits and pieces give you a clue but most usually the data that's being recorded from those bits and pieces is the one that opens up something like this

DUFF One on the isle and then on the front row.

QUERY On the basis of available data that you will have available to you will you be able to come to a positive decision as to what happened or only at best probable. That's question 1 and question 2 is was there any time during this entire flight that any of you gentlemen had a serious concern that you might lose your ship?

KRAFT Well, I don't think that we can answer the first question because we have not analyzed the data and let me point out to you one fact, for instance, we are getting data back here at a rate of 1 data point per second out of the computers at the remote site. Now the data comes down at a much higher rate than that and when we get the tapes back from the remote site then we'll have a closer fix on time - in other words - some measurements are made once every 1/10 of a second, 1/100 of a second, 2/100 of a second. So that will give us a much better feel for the data than we have at the moment. I just don't think that we have any idea yet what we'll know about the occurrence, just remains

SPEAKER to be seen when we get the chance to really analyze it there.

SPEAKER We're going to break here for a moment.

PAINE Excuse me for just a moment, I just received a telephone call from President Nixon and I'm pleased to announce that he will come to Houston tomorrow, close to 11 o'clock in the morning and at that time he plans to present the medal of freedom to the entire NASA organization, it will be accepted, I believe, by one of the members of our ground crew here. President will then fly to Hawaii with Marilyn Lovell and Mary Haise and the Apollo 13 astronauts will fly up there from Samoa and he will be arriving in Hawaii with the astronauts wives to greet them at about 4:30 in the afternoon, 4:30 P. M. Hawaii time, Saturday afternoon. Thank you.

DUFF We have another group waiting so one or two more questions and then we'll let this panel leave. Mary.

QUERY I just wondered if you'd answer the other question there Chris.

KRAFT Well, I don't think that in this - if there were a single person in there that I could do that, Mary, I would do so, but I would have to say that in this particular incident the flight controllers were all up against the problems of each one of the spacecraft systems and all of those, each one of the members, each one of the set of teams, all of the men that work in the backup rooms were called upon to bring about everything they knew and come up with any of the bright ideas you were asking about. Gene Kranz was the flight director at the time of the occurrence and he did his usual superb job and one of the things he did which I think was truly outstanding was the fact that it was near the end of his shift, Glen Lunney was there when it happened, about to take over the shift and he said to the team that was gone his team, let's get off the consoles and get these fresh guys on there, get this new team in so that they can start working with a fresh look and we'll go take a look at the data and see if we can help them out and I think that was a classic example of the team work that was going on within the control center.

DUFF Two more questions. One in the front row and then (GARBLE)

QUERY I'll address this to whoever would like to answer. On Missions 8, 10, 11 and 12, if this explosion had occurred early in trans-earth coast, we would have lost a crew and any reflections about future missions, this area of vulnerability between when we begin trans-earth coast and when we get back close to reentry.

GILRUTH Well, I don't think there's any question about what after the events of Apollo 13 we will have to find the cause or cure of this before we'll feel it's possible to fly a mission to the moon. It's inconceivable that we would fly another mission to the moon without having carefully analyzing this,found a cause which we think was - was the real cause and have applied to some change to the design that would correct it.

END OF TAPE

SPEAKER - of the design that would correct it.

QUERY I've a double-headed question. One for Rocco and one for Dale Myers. Rocco, you indicated awhile ago that had not the second oxygen tank depleted slowly and kept the third fuel cell going, this gave you a cushion of time. Shortly before reentry, Mission Control, said that — told the spacecraft it would lose one battery right at splash-down. Without this cushion of time, do you, in your opinion, think that the spacecraft could have made it back?

PETRONE Yes. You may have misunderstood. The drop - the ampere hours running out on that third battery. Those three batteries were not turned on until this morning. Those are batteries A, B, and C in the command module that we shepherd very carefully throughout the flight. We kept charging them occasionally. Now we didn't use those - didn't turn those on until about 2 hours and 15 minutes before entry this morning. As far as other power - amp powers, we finished with a considerable more margin of amp hours yet in the LM batteries we did not use. Considerable. Maybe as much as another 24 hours. I just have not seen those numbers, but I would say it was considerable margin. These batteries that you heard this morning were other batteries inside the command module, which the people here, Deke and his people in the flight, worked out a timeline knowing that we were tight, to take an Apollo profile right down to even allowing enough for the batts to be opened if they had to. Now they worked right according to the plot.

QUERY Now, I have another part to Dale Myers. As you read that North American gave a sort of manufacturing burst to the service module. Do you have any idea what could have let go back there, Mr. Myers?

MYERS No, I'm going to have to look at the data along with everybody else to see what we had there. I think that the - it's clear that we had a rupture in that tank, and the question of exactly what occurred there is going to come out of a tremendous amount of data that we're collecting now and will be going into now that the mission is complete.

QUERY I've got three quickies. Number 1 for Rocco to go back to Zack's initial question in that double barrel burst. If both oxygen tanks had let go at the same time or let go quickly and close together, what would the effect have been on the crew's ability to get over into the LM and get it powered up and get into the life-boat configuration? Number 2. Dale Myers, you mentioned that you think, because it's a single subsystem failure, that maybe 14 won't be held up. Dr. Gilruth, however, thought that there'd be some mods. How extensive do you think those mods would be and would you go a little bit more into the velocity of why you think there may not be a delay in 14? Finally, for Rocco or anybody who wants to take it, do the things that you see there admit a

QUERY preliminary look point toward any group of 3 or 4 types of potential causes or point away from any potential causes such as the fabled meteorite impact theory?

SPEAKER Could I again give the words we have earlier? We just cannot speculate on that. One doesn't want to. You don't want to close your mind to any possibility. So you take your raw data, for which you're going to see a timeline, and from that you keep looking further. So speculation which would tend to zero in on something that is wrong, we want to look at the whole picture. I've got to remember what your first question was there.

QUERY The tanks - you exploded two tanks.

SPEAKER Oh, if both tanks had gone. I'd say, seeing the consumables, yes, we would have made it. We have oxygen in a surge tank and three 1-pound bottles in the command module. All that we came home with, you might say, free. There was oxygen remaining in the LM; so if we had lost both maybe I'm sure we would have worked out the consumables to fit the pattern for coming home.

SPEAKER Pardon?

QUERY The surge tank was charged after the first bottle let go, wasn't it?

SPEAKER No, the surge tank you always keep charged. It's just like your parachutes. You keep it with you. And the three 1-pound bottles were charged. So that's in there all the time. When you get a susation, you're going to have a minimum from 6 to 8 pounds of oxygen there plus the cabin, itself.

SPEAKER Just as a point, there. The fuel cells didn't go down before the crew finished doing all the jobs that they had to do in the command module. They command module battery out. So the fuel cell was gone before they finished up and that's what they would have done a little bit earlier. Then we were able to recharge the battery for reentry from the LM power.

SPEAKER I think one of the very interesting parts of this operation was the review we had at the end of each shift on where we stood on consumables. Of course, that was the first worry that we had when this crisis arose, and the activities of the Mission Control guys immediately hit on those consumables that were important. The water, the power, and the oxygen picture. And we began to get a focusing in on those consumables and the real key that was impressive to me was how each of the subsystem guys that are involved in this operation were able to trade off together what they could shut down and what they had to keep operating and balance these consumables and as you see the pattern as it develops here, we just ended up with a good margin all the way across, when we reentered. Now as far as this comment concerning our next

SPEAKER operation, what I said was that it's a single subsystem. It appears associated with a single subsystem. That subsystem is relatively simple compared to the other subsystems of the spacecraft and I would expect that we would be able to absorb and analyze this data in a way that will bring us to a conclusion to what change to make. I'm certainly not disagreeing with Bob. I know we must make some change before we commit again to a flight, but I just - maybe I'm a little optimistic, but I do expect that to occur fairly rapidly.

SPEAKER Thank you very much. In view of Dr. Paine's announcements, you might like to know that we plan now to have the crew press conference in Houston late Tuesday. Tuesday evening, probably.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

Post-Mission Crew Press Conference
April 21, 1970
6:33 P.M. CST

Participants:
Captain James A. Lovell, Jr., Commander
John L. Swigert, Jr., Command Module Pilot
Fred W. Haise, Jr., Lunar Module Pilot
Julian Scheer, Assistant Administrator for Public Affairs

APOLLO 13 POST MISSION CREW PRESS CONFERENCE 4-21-70 CST 6:33P 40A/1

SCHEER Ladies and Gentlemen this is the Apollo 13 Mission Press Conference, and we use the same format tonight that we've used for previous post-mission press conferences. The crew will go through a narrative of the mission, then we'll have question and answers; there will be only one slide tonight. And, when we get to the questions and answers, if you'll wait for the microphone, we'll appreciate it. I'd like at this time, to introduce the Apollo 13 crew: Captain James Lovell, Mr. John Swigert, Mr. Fred Raise. Jim.

LOVELL Fine. Thank you. Thank you Julian. I'd like to start out the briefing by saying that I'm not a superstitious person, and therefore, when we were assigned Apollo 13, I thought nothing of it. As a matter of fact, some of my friends of Italian descent had said that 13 was a very lucky number, and they were happy that I got that number. It all sort of started actually, just before the flight, as was well documented. As we are approaching the final phase of our training, the last couple of days are usually ones which are taken very leisurely. We try to keep a couple of days free just to let ourselves unwind from the long training cycle. We get plenty of rest so that when we've launched, that we're in good shape, and we can go with a - sort of a easy mind. As you well know, a turn of events occurred, and Ken Mattingly, who was our Command Module Pilot, was exposed to the measles, and at that time we had to make a big decision to bring Jack along or to delay the flight. It was one which was not easy for me to help decide, and when they asked me what I wanted to do, because we had worked as a team for a long time, but I also realized that the - that the space program had matured to that degree whereby we had quite a few people who were well knowledgeable about the spacecraft, and who were well qualified to fly. As a consequence, on Friday, we decided to take Jack along, and I'd like to say right now that I have never regretted that decision. We, as a team, I think, can - Jack particular helped us out during our ensuing odyssey tremendously. At this time I think I would like to just break off just a second, and introduce a couple of other people of our team that also served, although were not as - in the same position we were. Marylin, would you take the stand, please? This is my wife Marylin. (Applause)

HAISE And, right next is my wife Mary. (Applause)

LOVELL Now, I think the entire crew of the Continental stewardesses are here tonight, for Jack. (Laughter) Jack had a lot of help on this flight. The launch Saturday morning was not unusual. It was a very nominal launch, the suitup, the entrance to the spacecraft was very smooth. We had practiced it before. It seemed even a lot easier than I've experienced on Apollo 8. Liftoff came just as I known it before.

LOVELL Communications were excellent. And, the entire boost phase was, as compared - was compared very favorably with what I had experienced before, except during the S-2 burn, at which case I noticed the inboard light come on, indicating a - on the second stage, indicating that an engine had shut down. I felt inboard, as was the normal procedure, and realized then that it had come about 2 minutes early; and the ground confirmed this, and as a consequence we had an early engine out in the S-2 stage, and our total boost time was about a minute longer. This did not impair our, our flight however, we had enough fuel to relight the third stage, and go on into a translunar injection, and a trajectory towards the moon. The flight, up until about 56 hours, was, I guess what you'd call entirely nominal. We had followed the flight plan. We were ahead of the gains. It took us a little bit longer to get rid of our pressure suits than we thought, and we had asked the ground about 55 hours, if we could -

END OF TAPE

APOLLO 13 CREW PRESS CONFERENCE 4-21-70 6:33PM CST 40B/1

LOVELL and we had asked the ground at about 55 hours if we could indeed get into the lunar module about 3 hours early. The flight plan called for us to go into the spacecraft at around 58 hours. The ground said fine, why don't you open up the LM and go on down and do your housekeeping chores. There was one of the little engineering tasks that we had to perform and also with that; was a television program which we were supposed to put on, so we decided to open up the lunar module. Fred got into the spacecraft, went down, looked at the super helium - the critical pressure of the super helium tank to make sure it was nominal. We were having some problems with that before the flight. It was, and then we put on the little TV show which was called for in the flight plan. I guess the show lasted for. about half an hour and just after we had turned off the camera, Fred was still in the lunar module, Jack was back in the command module in the left-hand seat, and I was halfway in between in the lower equipment bay wrestling with TV wires and a camera and watching Fred coming on down, when all three of us heard a rather large bang, just one bang. Now, before that, Fred being in the lunar module, had actuated a valve which nominally gives us that same sound, and since he didn't tell us about it we all rather jumped up and were sort of worried about it, but it was his joke and we all thought it was a lot of fun at the time 'til something happened, so when this bang came we really didn't get concerned right away, but I looked up at Fred and Fred had that expression like it wasn't his fault, and we suddenly realized that something else had occurred, but exactly what we didn't know. I'd like to go on now and let Fred and Jack explain just what their impressions were at this very same instant that I heard the explosion in the lower equipment bay. Jack.

SWIGERT Okay. Excuse me. The sensation I had was that I had felt a vibration accompanying the bang, not a large vibration or shudder. I proceeded to look at Jim and at about the same time, I guess about 2 seconds had elapsed, when I had a master alarm and a main bus B undervolt light. I transmitted to Houston that we had a problem and proceeded to go over on the right-hand side of the spacecraft to look at the voltage. The voltage at that time was completely normal, the current was not high, and the fuel cell flows were normal which indicated to me that whatever it was it was some sort of a transient that didn't exist at that time. It - me being a Command Module Pilot and the source of the bang not immediately determinable, it was my thought - of course I had a little more confidence in the command module so I thought it occurred in the LM and I said let's get the hatch in here and so we can sit back and think about it because we had the tunnel open at this time and I thought we might be vulnerable to losing pressure, so I proceeded to get the hatch in - to begin installing the hatch and at that time Fred went back over to the lunar module pilot's couch and I'll let him tell what his observations were as far as the instruments

SWIGERT and the other caution and warning alarms.

HAISE First of all, due to my position being a lot more familiar with the LM side of the house my natural first impulse on feeling this shudder and explosion was to make sure the LM hatch was latched fully open because I was just as equally as sure that the problem was upstairs and not down in the LM, and I proceded as best as I could from there to my normal position to start looking at the one caution and warning that Jack had mentioned. The situation had changed by the time I got there. When I looked at this bus, it was indicating - as far as my gage read - lower scale, and I looked at the fuel cell, which happened to -

END OF TAPE

HAISE - and I looked at the fuel cell which happened to be still showing that it was connected to that bus, fuel cell 3. It was not outputting any amps, so my first sinking spell was mainly due to considering the fact that this indeed really meant that we had lost the fuel cell. Also meant by a mission rule that we wouldn't be burning LOI and, without that one problem, we had already lost the landing. Subsequently, I also had two other lights, an AC2 and an AC overload and, indeed, we had lost the inverter that was being powered off that bus. So, I proceeded to switch some of the loads from AC2 to the other inverter that was on the other main bus. This induced an undervoltage on the other main bus. That's when I got a little smarter and thought maybe I'd look at the other fuel cells which I had not considered as having had a problem. And I found fuel cell 1 also not outputting any amps. From this point on, we were kind of under the hands of Houston and further trouble shooting and looking at a few more dials down on another meter and the LEB to look at regulated pressure and, eventually, we got to the point where Houston called up and asked us to shut down fuel cell 3. I shut down the reactance valve and I asked for reconfirmation since since when you do that it is sort of irreversable. If you shut one of these things down, they only can be restarted from ground support equipment. They assured me they really meant it, so I went through with it and, subsequently, the same command was given for fuel cell 1. About this point in time the cryo pressure, the oxygen pressure, had gone in cryo tank 2 and the pressure in tank no. 1 was rather steadily, slowly but steadily decreasing. It was obvious it was not holding its own. Right about then, it was quite apparent to me that it was just a question of time that the command module was going to be dead. We were going to lose that fuel cell also. So, I kind of lost interest in position and headed for the LM.

SWIGERT I think one of the things that we neglected to mention: I bent in my efforts to put in the hatch when Jim noticed that we had considerable venting out the side of the command module and that indicated we were losing some sort of liquid or material from the area of the service module. So it indicated to us that we truly had a problem in the service module.

LOVELL I guess it is kind of interesting to know the feelings of the crew when something like this happens. When you first hear this explosion or bang, you don't know what it is. We've had similar sounds in the

LOVELL spacecraft before that were nothing. And then to me my impression was, as we came back, that we had an electrical problem that caused this bang, as in previous testing we had some problems along these lines. That quickly went away and then I looked out the window and saw this venting and my concern was increasing all the time. It went from I wonder what this is going to do to the landing to I wonder if we can get back home again. It sort of went into that type of seriousness. When I looked up and saw both oxygen pressures, one actually at zero and the other going down, it dawned on me and I'm sure Jack and Fred at about the same that we were indeed in serious trouble. It was apparent, and the ground told us so, and they were on the ball all the time, that the only way to survive the situation was to transfer to the LM and so at that time, Fred, first of all, went into the LM, got out the activation checklist. The checklist normally is not used prior to firing up the LM to detach from the command module and prepare to go down to the lunar surface. We started going through procedures to get LM power on and to aline the platform

END OF TAPE

LOVELL ... power on and to aline the platform. The first milestone and I consider this after the accident, I guess more or less the survival now. The first milestone was to get alinement on a LM platform. Alinements are important, you know, because without knowing exactly which way the attitude of the spacecraft is in space, there's no way to tell how to burn or how to use the engines of the spacecraft to get the proper trajectory to come home. So we had to have an alinement onboard the spacecraft. We knew that the Command Module was going to lose it pretty soon because we were going to lose power. So as we worked, Fred and I went into the Lunar Module, picked up the power on, we started to aline the platform. We used a procedure that was in the activation checklist, Jack gave us the angles there was a little bit of arithmetic involved in all these procedures and I had an occasion during practice to fail my arithmetic test and I was so concerned about being sure that this arithmetic, that I had actually called down to the ground and let them do the math. Came back in and put it in. But we did get a platform alinement and that was our first milestone. From then on it was an entirely different situation. This little model might tell you exactly how - how we were. Up until the incident, the normal command is in the Command Module. Control is by the Service Module engines, the RCS engines as far as your control goes. But we transferred the command to the Lunar Module and we are using the Lunar Module engines for control. We had done some practice in this before but really had never thought we'd ever have to use this particular control situation. And to get control of this vehicle, in pitch you have to use one transition controller one way and in roll another way and in yaw you can use the ACA. So what we did, Fred would handle one part of the control and I would handle the other in controlling the maneuverability of the spacecraft. We also had back here a Service Module that was completely filled with main engine fuel and it used very little of it just in one small midcoarse burn. And also we had RCS engines that were almost completely filled with fuel. An important point to remember at this time too, is the fact that we had gotten off what we call the free-return trajectory

LOVELL We had done our midcourse maneuver sometime before and this meant that we were no longer on a path that would allow us to be swung around the moon and come back towards a landing spot on the earth. We had gotten off this trajectory because we wanted to go into a landing site. So the first the ground told us to do was burn the descent engine, the descent propulsion engine to get us back on that free-return trajectory, which if I remember correctly was going to get us into the Indian Ocean, wasn't it?

SPEAKER Yes.

SPEAKER I think I lost track of oceans after a while there.

SPEAKER Yes, it was the Indian Ocean after about 155 hours.

LOVELL About 155 hours. The controlability of the spacecraft was okay as long as we had our - our indicators up because we had practiced that as I had said but suddenly to save power we shut that down for a while and we had to control it by plain looking at our computer display and I had never tried that before, I really don't know who had and it's a very difficult task and we spent a lot of our - first part of our emergency survival time just learning how to control the spacecraft in this mode. Our second milestone was what was know as the pericynthion plus 2 burn. Our first maneuver was to get us back into free return, the second one was to get us home early. The nominal flight time back home was 155 hours if we had done nothing else. But because consumables were critical and the ground was calculating consumables and Fred was also doing the back-of-the-envelope type calculations, we figured if we were lucky, we had about one hour's spare consumables left before we landed. We had decided - the ground had decided to burn at 2 hours past the moon at about 79 hours, a maneuver to shorten the time to get home again. This was also going to be an automatic burn using the descent propulsion engine. And this burn was also very successful. After that, the ground was very much concerned with power and we were too. And we decided to go -

END OF TAPE

LOVELL very successful. After that, the ground was very much concerned about power, and we were too, and we decided to go into a powered down mode, we turned off just about everything and I'l like to have Jack and Fred to tell about our powered down situation and some of our survival and environmental problems.

HAISE Well, on the LM side of the house, we actually had already canned a pretty good procedure in the book called the "Contingency Checklist", which was pretty appropriate, and I guess - well first of all to back up the console business, the one hour reserve I computed was on water and that was for the longer return, so as soon as we got the second burn in we had a little pad even. But at any rate, I guess everybody, myself included, got a little bit fooled about how low the LM actually could get down to and after completing this power down it settled down on consuming about 11 amps an hour, and that combined with the Command Module being completely inert led us to another environmental problem that Jim will discuss again very shortly.

SWIGERT Okay, on the Command Module side of the house, as soon as I found that I had the batteries on the line also to help out fuel cell 2, and as soon as I had ascertained that Jim and Fred had powered up the LM we shut down and fuel cell 2 gave out on us, we powered down the Command Module completely. Just prior or subsequent to pericynthion plus 2, we set all the switches in the Command Module in a basic switch configuration. This configuration so that the ground and us could work on a standard switch configuration, and then we began a series of procedures. We were interested in did we indeed have a main bus B or had we lost it, and the ground passed up a procedure for determining that and I read up - read out that we had adequate voltage on main bus B, we did have a good main bus B. The second situation was the fact that we were very short on LM water, so we were not given any LM water to drink because we needed that for the LM cooling system, so I had to go back into the Command Module and repressurize part of the environmental control system in order to obtain drinking water. There were a number of other procedures during the transearth coast phase which developed, and that was the procedure for powering the Command Module from the LM, which was exactly opposite from the normal - from the usual procedure where the Command Module normally powers the LM. We did power up the Command Module, we did charge battery B to fully charge over a period of 15 hours, we did top off battery - or battery A for 15 hours - we did top off the charge on battery B so we had 3 fully charged batteries for reentry and then just prior to the entry phase we powered up some of the subsystems of the Command Module from the LM. I think that's - one, just one, a couple of the anomalies that we had, we did find that we had one water leak in the LM which I discovered when my feet got

SWICERT wet. The LM water gun was leaking and we shut that off and I guess it had leaked about a quart of water I would estimate, but it took me about 2 days to get my feet dry and of course I think you are all aware that the temperatures were going down in both vehicles and made for very chilly feel for a couple of days.

LOVELL I might give you a little impression of just what the environment was like. When the incident, of course, first occurred, everything was nice and comfortable and we of course had powered down the command module and we used that as a bedroom. When someone was off watch they'd go back into the Command Module and it was quiet, nice and comfortable, and they'd try to get some sleep. Of course, in the early periods of this particular flight now we didn't want to sleep too much. We were sort of worried as to what was going to go on. I went in there one time to go to sleep, and Jack was on top of the couch, and I said, "Jack, put up all the window shades, let's get the place nice and dark, we'll just relax and have it nice and dark in here and we can really get some sleep." And I woke up a couple of hours later and I was freezing. As normally happens, putting up window shades in space cuts out the sunlight and normally cools down the spacecraft, but in most flights the heat from the systems will quickly rewarm it and as soon as we get the window shades up you'd be in normal position again, but we got the window shades off after that and the spacecraft never did warm up again. The Command Module just slowly kept going down in temperature until I think prior to reentry, it was down to about 38 degrees. Along with that, it is a rather chilling coldness. The walls were perspiring, the windows were completely wet, and it wasn't too healthy. I recall that we went in to get some hot dogs one day and it was like reaching into the freezer for the food. Jack, why don't you tell them about some of the innovations that the ground gave us, for instance the lithium hydroxide canisters, which I thought was very interesting.

SWIGERT Well, we did have a shortage of lithium hydroxide and the ground read us up a procedure in order to adapt some of the command module lithium hydroxide canisters for use in the LM and as they read this thing up Jim and I constructed one of these things. At this point in time I think the partial pressure of carbon dioxide was reading about 15 millimeters, and we constructed 2 of these things and put them on aline and I think within an hour the partial pressure of the CO2 was down to 2/10th, so these were very effective devices and we used 4 of these, the command module canisters, and never did use the secondary - the main canister that we had in reserve that was for the lunar module.

LOVELL Of course, as the temperature went down, we became concerned about keeping warm and Fred and I broke out our lunar boots which we had stowed away in the Lunar Module

LOVELL and Jack looked at his wet feet a couple of times, but he had an extra set of underwear, so he put that on. We actually had a third little sleep restraint which Fred had put on and buttoned up and kept a little hit warm. One of the biggest problems we had was one which might have hurt our trajectory, and that was that we didn't want to dump things overboard. As it turned out later on, it was more of an imaginary problem than we thought at the time. However, we thought we were told anyway that don't put any waste water dumps over the side because it might disturb the trajectory and we're tracking you and we want to make sure that you come back and hit the proper angle to reenter. And Fred, why don't you tell them what we did with all that stuff?

HAISE Well, the things we had onboard that were built for that sort of purpose were 3 bags onboard the command module, oh, about that size square, that were really a backup provided for backup mode of operation in case the normal system failed in the command module, still for over board dump. But they did have a reservoir. On board the LM for draining out of the suit on the lunar surface we had 6 little bags about this size in the LM. Beyond that we had the three UCDs, which are bladder pieces of apparatus that we each wear normally under the suit, and that was about the only natural sort of gear we had for this sort of storage, so we looked around and in the LM we had a tank that's mounted in back of where the flight data file was located on the left side, it's called a PLSS condensate tank, and its purpose is when you're refilling the PLSSs on the lunar surface some of the water that's outside the water vessel is allowed to escape and it's supposed to drain into this tank. So we had enough, fortunately, enough combinations of hoses and quick disconnects between the two vehicles using both LM and command module gear that we found a combination that we could hook up our UCDs to the fitting that went to the tank, so that saved us for a little while. Then after that when that one got full we looked around some more and we came across 2 bags - fairly large bags, they are about that long, were in the LM and their purpose was after the first EVA -

END OF TAPE

HAISE - about that long that were in the LM and their purpose was, after the first EVA, in fact, there was one I showed on the TV show, we were to use these hags to drain the remaining water out of the PLSSes and determine actually how much water we had left. So, again this turned out to be a rather weird cluge to get the drain in that bag. I think there were - later on you may get to see that piece of gear but it involved the use of a 66-foot long hose with a T in the middle hooked up to this bag. So we succeeded in using both of those large bags for the stowage.

LOVELL So you see that survival now became one of initiative and ingenuity and it was one which the ground continually helped us on. We had all kinds of people on the ground trying to think up ways of extending our lifetime. We were also thinking of ways of using perhaps the PLSS system, to use it for oxygen or for emergency oxygen supply, in case we ran out, but as the flight progressed the ground calculating our consumables, saw that we were actually using less power, less water, less oxygen and our lithium hydroxide canisters were holding up quite well so it was getting better all the time fortunately. We did power down everything though and in 105 hours the ground after some tracking realized that we were not on trajectory that would get us safely back home and that we would have to make another maneuver. By this time the crew stations became a lot different. There were 3 people in the lunar module now, usually built for two, because the cold had driven Jack away from the command module and Jack's normal position was on top the ascent engine can overseeing what Fred and I were doing. This last maneuver was going to be unique because we did not have the platform powered up so we didn't have a normal method of determining the attitude of the spacecraft in order to perform the burn. On Apollo 8 some time ago we were concerned with perhaps losing a platform on the return voyage home and since no one had ever made a lunar trip before, we were looking at way-out ways to determine how we could make these corrections home. Some of our people here at MSC had come up with an idea about using the terminator of the earth to orient the spacecraft and then the sun position to get orientation in pitch. With that knowledge we could then make a correction to correct our angle of entry into the atmosphere. As you know, I think, the angle of entry into the atmosphere is a very small angle, only about 2 degrees, so it has to be controlled very closely and that is what the main tracking is for. So after 105 hours, they

LOVELL gave us instructions to relight the descent engine to orient the spacecraft in this manner and give this particular procedure a try and when they read up the procedure to us, I just coundn't believe it because even on Apollo 8, I thought I would never in all the world have to use something as way out as this. Here I was on Apollo 13 using this very same procedure that was developed some time ago. This maneuver again was completed on time and because it was an angle burn we had a 3-man operation. Jack would take care of the time. He would tell us when to light off the engine, when to stop it. Fred handled pitch maneuver, and I handled the roll maneuver and I pushed the buttons to start and stop the engine. So maybe we ought to recommend a 3-man LM after this. I don't know. Again after this maneuver, we were again powered down and it became one of just merely hanging on. Our maneuvers from then on were just merely drifting and they were done to keep the thermal control on the spacecraft as even as possible so that one side wouldn't cool off too much or the other side wouldn't heat up. Our flight progressed that way down to about 5 hours prior to entry whereby throughout the night and throughout the day just prior to this thing the ground, of course, was working feverishly with crews in the simulators and with the engineers looking at the systems to read up to us a set of procedures which we would be able to follow to make a successful entry. I kind of think one of the most important points that came into this flight is the cooperation and coordination and the initiative that people have when suddenly faced with an unusual situation that can respond to come up with the answer and they did. They read us some procedures. Fred, Jack and I practiced these procedures by reading them and then completing them. It is amazing in the way people can respond so fast to get this job done. We were in a different situation now because normally when you come home, you have only the command and service module. So the only thing we have to get rid of is the service module just prior to entering the atmosphere. Coming home now, though, we had a dead service module, we had a command module but it had no power to it, we had a lunar module that was a wonderful vehicle to travel home with but it didn't have a heat shield unfortunately and shortly we would have to abandon her. Our procedure basically was at about 5 hours to make another short midcourse correction, zero again, change the angle to make sure we had a good angle of entry and then at about 4 and one-half hours to maneuver to a position to get rid of the service module. Jack, why don't you discuss that a little bit.

SWIGERT Okay. The ground had read up a very nice timeline for the whole procedures as far as the Command Module went from 6 and one-half hours through splashdown. A part, about 4 and one-half hours, was where we jettisoned the service module. The only, I guess, nervous moment we had at that point of time is - the normal procedures require an extensive pyrotechnicue system in this spacecraft and normal procedures require arming the logic c buses first and letting Houston look at all the relays and make sure that all relays are indeed latched up properly so that we don't jettison or fire a pyrotechnicue device which we don't want to. At this point in time we didn't have any telemetry with Houston and Fred came up and I said, "Well, Fred, I am already ready to jettison the service module. I am just getting ready to arm the pyros". He said, "Ill get a GO for MSFN". I said, "Fred, we don't have any telemetry with MSFN, so you are just going to have to put your fingers in your ears and stand by". So I armed the A-system and I could hear the relays and nothing happened. And I armed the B-system and nothing happened so I kind of felt we were home free.

LOVELL Meanwhile, I am back in the LM with an open tunnel hoping that nothing happens.

SWIGERT The procedure went well. We used a push-pull method and Jim and Fred were in the LM using the translation controller to give us some velocity and when Jim yelled "Fire," I jettisoned the service module and it went off midst a lot of debris which is usual and Jim began to pitch around to try and photograph them. Fred, you might tell them about that.

HAISE I'll try. You got the first look.

LOVELL Well, the ground had told us that the best view of the Service Module as soon as jettisoned it was through the number 5 window. This was in the Command Module. One of these side windows. So, as soon as Jack had jettisoned the Service Module, he went over to the number 5 window. The force of the jettison had pitched the - you might say what we have now, we got rid of all this, so now we have the Command Module and the lunar Module together, which is an unusual combination. We've never flown this before. It forced the Lunar Module to pitch down rather than to go straight. Instead of pitching up right away, I couldn't see it. So, and Jack couldn't see it. So, then I finally started pitching up and through the this overhead window, this docking window up here, I finally caught sight of the Lunar Module, of the Service Module as it tumbled around in view and it was to me sort of an amazing sight

LOVELL I didn't realize that this whole panel by the high gain antenna was blown clean off straight along the area where the panel normally swings open. I could see the interior. I couldn't see exactly what was damaged. I could see material hanging out from the interior and about that time, because a description wouldn't be half as good as a good photograph, I reached for my camera. WEe had 3 cameras and I started taking pictures through this little docking window. Jack, then knowing that he didn't see anything from his window, started to come dowh through the tunnel to the LM and Fred in the meanwhile got his cameras ready and the spacecraft had maneuvered to a point where the Service Module was then visible in the front window. Fred was taking pictures and Jack was taking pictures of the Service Module trying to capture some of the -

END OF TAPE

LOVELL - Jack was taking pictures of the Service Module, trying to capture some of the damage that we could see. The remainder of the flight went just as the ground had told us to do it. We had kept in that position. I had gotten an alinement, which - from the earth, and from the moon and the sun, which was good enough to transfer back to Jack, an alinement, a rough alinement, so that he could get a very fine alinement in the - in the command module. And at 2 1/2 hours he started powering up and getting this alinement, and my only thought then was, as I was sitting by myself inside the lunar module, I could see the earth, because it was a nice big triangular window, while Fred and Jack were powering up the command module, and even though it maybe wasn't noticeable to me, it looked like it was getting bigger and bigger and bigger, and I kept yelling back to Jack, how are you coming; are you doing fine, you know, when can I leave Aquarius.

SWIGERT He was - he was a little bit nervous, he - when he said he was kept asking he kept saying, Jack how you coming; the earth is getting bigger. I thing he was trying to hurry me, but I don't know.

LOVELL But, Jack did a fine job. He got a very good alinement, which was, I think, accountable for some of our good automatic guidance into a landing. And, finally, when he got the alinement, and all powered up, I - by that time the lunar module looked like a - it looked like a packed garbage can. We had the big drogue in the probe, big bags full of debris that we had accumulated during the 6 days, and I then went from the lunar module, closed the hatch, came on down, and we jettisoned the lunar module and came on in with a recovery, which I think that you people saw better on TV than we felt in the spacecraft.

SPEAKER The slide.

LOVELL Oh yes. We have one picture which we thought Fred might explain a little bit about.

HAISE Well, let's see, this makes a little hard to see. Let's throw a couple of floodlights on it, upstairs here. The point in the foreground, which you can see is the hose, hose arrangement I discussed earlier, draining into the, the PLSS bag. This is the long object here, water collection bag. The other point I hope to show, now maybe you can pick it up, right in the background here is the modification we made to the ECS system, whereby we used the lithium hydroxide canisters out of the Command Module, and with the use of plastic and some of our onboard data, the stiff cardboard from some of the precedures we didn't need, and grey tape we have on board, we jury-rigged this thing with the plenum to the LM ECS intake post. And this shows only a one - one cube bond; later on we further moded and ended up with a stack of a tube on this

RAISE hose, and I assume we could have accepted the geometry and continued to do so indefinitely. Lights please.

SCHEER We're ready for your questions, and we'll go down the line, and wait for the microphone, please. Okay. Just start right here and go down.

QUERY -

SCHEER Go ahead

QUERY Jim, which hoses were the easier to use for your jury-rig system there?

LOVELL Those are the LM ECS hoses that we were using to - to attach the lithium hydroxide canister to.

QUERY - system that you were describing.

LOVELL The urine dump system?

QUERY Ye

LOVELL Well we - as Fred said, we used the - the overboard dump hose that was originally in the command module, and jury-rigged it to the feedwater bags and to the condensate container that was in the LM. So, we were using systems from both - both spacecrafts.

QUERY Captain Lovell, we've heard a lot about how Apollo 13 was unlucky, I wonder if you could tell us a few things that made Apollo 13 lucky, particularly that - that lining up on the earth and the sun when you were coming down, that manual business of alining the platform and particularly again, about when the supercritical helium tank burst, I understand, that when you did a non-propulsive maneuver, you were suddenly ricking in the right way.

LOVELL Well, there was a lot of fortunate incidents in 13 that wouldn't make it a completely unlucky flight. We - at the time it happened, I thought it was the worst possible time. Obviously, it was not the worst possible time for this particular incident to happen. We were lucky in the fact that we - that we had a base support that was - fully receptive to immediate organization, and getting us - the problems and procedures to continue. That we were extremely lucky in. We found out that we could operate the spacecraft and do procedures with a lot less systems than we anticipated. I was very reluctant to turn off the guidance system, the platform, because I knew that once I did that, and we could not see stars outside the windows, especially because of the debris that was lying out there, venting from the service module, that it would be very difficult to get alinement on my own. These were areas I think, that we were lucky in.

SCHEER (Garbled)

QUERY Captain Lovell, what did you have in mind when you made the remark, I think this is going to be the last moonflight for a long time?

LOVELL That's a good question. We were, of course, you must realize our position, we were going around the moon -

LOVELL we didn't know what happened, and we looked at the moon - I had, I had been there and Fred and Jack were taking pictures, because regardless of anything they were bound to take pictures, and I said, come on, we have a burn to go in 2 minutes, or 2 hours. At that time, not knowing what we were going to do, and we were getting as many pictures as possible, I had perhaps, thought that maybe this was going to be the last moon flight for a long time. But, looking back on it now, and looking back on the way that NASA had responded in helping us get home, and analyzing the thing, I don't believe that anymore. I think it's going to be one where we can analyze our problems, and I foresee that we can get this incident overwith and can charge ahead. I wouldn't be scared to fly with the fix.

QUERY Jim, speaking of that subject, flying again, you told us this was going to he your last flight, but that you did want to walk on the moon before giving up flying. How do you feel now? Would you want to go back and take a crack at Apollo 14, 15, 16, or is Marylin -

LOVELL Well, I'm very much disappointed just as Fred is, and Jack, that we couldn't complete the mission. We certainly wanted to - to make a lunar landing. Fra Mauro has so much to offer, we thought. We've spent an awful lot of time on it, but this was my fourth spaceflight, and there are many people in our organization who have not flown, and who deserve to fly, and who are talented enough to fly. And, on my own, they deserve the mission. If they feel that this team should go back there, I'm certainly willing to go back, but otherwise that - I think other people ought to do it.

QUERY You feel cheated (Garbled) you are ready to go back, you don't feel cheated if you don't go back.

LOVELL No. I of course, would like to have landed on the moon, but I feel that perhaps, what we got out of this flight was also well worth it.

QUERY Captain Lovell, in that connection, we were told at all the briefings before this flight, that Apollo 13 flight plan was a very important one, not only for the science you would get off the moon, but also because of the path-finder photography that you would do subsequent to the landing. Now, I'm wondering, if in your mind you think that it will be necessary to refly the Apollo 13 profile, and if so, what crew would be better qualified for it than the one which is trained for it for 3 years.

LOVELL Well, let me answer that question sort of backwards. As I said in the beginning of the conference, that on 2 days notice, that Jack Swigert replaced Ken Mattingly. Ken, I think, was - is perhaps, one of the most conscientious pilots we have in our space program. He really knew that command module, he knew the flight plan of Apollo 13 better than anybody. Yet that Jack could replace him and do a good

LOVELL job. I think that it's not so much an individual crew anymore in NASA. I think that any crew that is put together can do any job, and if the scientists feel that Fra Mauro is necessary to revisit, then I think that -

END OF TAPE

LOVELL ... and if the scientists feel that Fra Mauro is necessary to revisit, then I think that crew that happened to be assigned to that particular mission can take what we have already done, and we have done a lot of ground work on Fra Mauro, and improve upon it perhaps and do a good job.

QUERY Just to follow up, are you saying then that Young, Mattingly and Duke would be a good crew to fly Apollo 13 and do you think Apollo 13 should be reflown, which is really my basic question?

LOVELL Well, you're basically asking the wrong person. First of all, I'm not in the selection of the people who fly spacecraft and second of all I'm not in the scientific area to find out what area should be revisited. Obviously we have lost one lunar landing. We didn't make it. If Fra Mauro is worth it, in our training Fra Mauro had a lot to offer, then we should go back there. Bootstrap photography is very important, we should do that. But this is up for larger decisions and longer decisions.

QUERY I wonder if the two newcomers to the moon could just tell us whether they had any impressions of it as they went whizzing by.

aSWIGERT Well, we'd already been told by Jim what color it is. (Laughter)

SWIGERT But I think my impression of it as we passed, the closest we got was 137 miles and I think I had about the same impression as the men who had visited it previously. That it's very stark, it's desolate; it's almost awesome in its desolation. And we didn't get the chance because we were going **to** be doing a burn, to really do any real detailed looking at it but I guess that would be my summation of my viewing, that it was almost awesome in it's desolation.

QUERY What implications, if any, could this accident of Apollo 13 have on future Apollo missions and deep space missions, say Mars or Venus?

LOVELL Pass. (Laughter)

HAISE Well, I'm not sure there is any sort of direct correlation that I can think of. With the exception of maybe bringing home rather early some of the problems concerned with powerdown modes of operation and making sure environmental control system can work equally well to keep the occupants comfortable, both for normal operating power levels as well as emergency powerdown levels.

QUERY Jim, you said, "You people on TV saw a better recovery than we felt in the spacecraft." Can each of the three of you comment on what your feelings were during the time of splashdown.

LOVELL Well, of course when we hit the water, we were very happy to he back home and we commented on that fact. The recovery of 13 was almost a textbook recovery. It was a calm day, the actual splashdown itself was very mild and the Navy did a grand job. I'm not prejudiced, of course. But we were of course disappointed that we did not complete the mission.

QUERY How about - how about the other two of you telling us how you feel about flying again, what this experience has meant in terms of your professional career?

SWIGERT I think that what this has done for me if anything, has increased my confidence in the ability of this nation's space program to take an unusual situation and react to it and come out with a successful conclusion. I consider recovery of the crew a successful conclusion. But I have nothing but the utmost admiration for the people on the ground who worked tireless hours to get us back.

QUERY (Inaudible)

HAISE I guess I might answer that by saying sometime this year I'll have had 15 years with NASA and I don't figure I'll retire for another 30 maybe, so I'll just do whatever, whatever job the agency decides is the best place I can be and can contribute the most.

QUERY Lovell, was there ever a moment when you or any other member of your crew thought you did not have enough consummables to make it back in those first hours? And if so, what were your feelings.

LOVELL As I said, our feelings varied during - during the emergency. There were moments when I didn't know how much consummables we had, whether we were going to make it back or not but in a situation like that there's only one thing you can do. You just keep going and you just keep thinking of where you can get more consummables and so that's exactly what we did.

QUERY Lovell. Have you made any recommendations thus far on changes and procedures or redesign of equipment, based on your experience?

LOVELL No we haven't. All this will be taking place in the ensuing week.

QUERY While looking at the service module after you jettisoned it, one of you said and I'll quote that, "I think the explosion, from what I could see, Joe, had stages." What made you think so and do you still think so?

LOVELL The explosion had what, sir?

QUERY Stages, the explosion had stages.

LOVELL I don't recall that incident. I was the first one to see it and I said it looked like a mess and that I could see the panel missing. But I don't recall any comment I made.

SCHEER Jerry Moore. Jerry.

QUERY Thank you. Gentlemen, all the time that you were in trouble coming back you obviously extremely grateful and you told it again and again.For the cooperation of the ground crew and rightly so naturally. Was there an awareness, or the same sort of an awareness of the infinite power watching over you and caring for you to get down? Were you aware of that?

SWIGERT If you're asking me whether I prayed, I certainly did. (Laughter) And had I had no doubt that perhaps my prayers and the prayers of the rest of the people did an awful lot, contributed an awful lot for us getting back.

QUERY At one point just prior to the - to jettisoning the LM there was a comment about the flight plan being read up to you and it was akin to reading War and Peace over the air. I'm wondering what it must have been like to take it down in a spacecraft where at one point someone also said they were running out of flight plan pads.

SWIGERT This was the I assume the procedure in command module which was quite lengthy because one of the things I think that's evident from this thing is we really threw away the book. We had never powered down the command module in space and we had never reactivated one and we wanted to get it right and so I read back every switch and every circuit breaker and it was a lengthy procedure it was one that was worked out and verified by the ground and it's success I think is well documented.

QUERY Jim, did you notice any unusual vibration when the S2 - the J2 shutdown? And if so could it have any effect at all on the service module's trouble?

LOVELL Well, we did notice an unusual vibration just prior to or just during the number 5 engine on the S2 shutting down during the boost phase. I doubt seriously if it had any trouble with - gave any trouble to the service module but I have no evidence to say yes or no on that.

QUERY A question for whoever wants to answer it. Would you tell us, twice during the mission you made- you asked the ground if the flowers were blooming in Houston yet. Apparently this was a code. Would someone explain that. And then the second question is for Captain Lovell. There's a movement in Wisconsin apparently growing now to nominate you to run against Senaton William Proxmire and we were wondering if you would comment on that? (Laughter)

LOVELL The first question, it was again a sort of a code you're right, that we had worked out with our CAPCOM's. Really in asking a question about Ken's condition. As to whether he had come down with the measles yet or not.

APOLLO 13 POST-MISSION CREW PRESS CONFERENCE 4-21-70 6:33P CST 40H/4

LOVELL And we're still waiting for Ken —

END OF TAPE

HAISE come down with the measles yet or not.

LOVELL And we're still waiting for Ken to come down with the measles.

QUERY Jim, what about your political future?

LOVELL Oh. Jack, would you like to answer that question? No, I don't have any political affiliation in the state of Wisconsin at this moment.

QUERY When you saw the damage that was done to the service module were there any fears that the heat shield might have been damaged by that?

LOVELL I had no qualms about it at the time. I guess I really wasn't thinking along those lines, because I knew we were reentering very shortly and that regardless of the damage to the heat shield that we had to take it or not take it. Did you have -

SWICERT I had no qualms at all. That heat shield is - I don't know whether you're aware of how thick it is, but it takes an awful lot to damage that, and I had no qualms at all

QUERY Jim, you were faced with perhaps as precise flying job as you ever will face, yet you say you had to fly the LM a completely new method. Will you elaborate a little bit on how you and Fred worked this out?

LOVELL Well, the methods of flying the stack as you see it here had been worked out before by crews and the procedure which we normally practice for and that is in lunar orbit, as we were slowing down to go into lunar orbit with this complete stack, if something happened to the propulsion system on the main engine we might have to use the descent propulsion system engine to get us back home again. This is called a DPS burn, and to control this system if the automatic control is not working requires this translation controller. Fred and I had practiced that like previous crews and that's the way we flew this particular device, but in part of our power down sequence, we had to power down the attitude balls, the FDAIs as we call them, and because our platforms in Apollo are 3 gimbaled type platforms that can go into what we call a gimbal lock and we can lose our alinement that way, we had to make sure the spacecraft didn't in its gyrations get in that area. We had to look at the computer that read out these various angles and it wasn't obvious how to fly it by looking at this computer as it was by looking at the FDAI. In learning to fly just the command module and the LM it was found out that the attitude controller itself was adequate to control the vehicle in the response that you wanted it to do. This was a new mode of operation and I don't recall us having practiced in the simulator before and certainly no one's ever flown it in a flight before, but the attitude controller itself worked quite well.

QUERY You said in light of the experience you had on this flight it would be advisable in the future to always remain on a free return trajectory, or do you think that would limit future flights too much to a particular time or place?

LOVELL Well, I think it would probably limit our flight operations somewhat on free return trajectory, and I think the fact that we were not on one when the incident occurred and the fact that we could get back on one indicates that it's not required to stay on one during most of our lunar missions.

QUERY I'd like to ask Jack Swigert, as a last minute substitution, did you at any time have any doubt of your ability to step in 24 hours before and fly the aircraft or spacecraft?

SWIGERT No, not really. The only apprehension that I had - of course, as Jim says, you work together as a crew and I hadn't had much experience - I'd just worked with Jim once or twice, Jim and Fred once or twice previous. We did find that the two days we had working together, that we did almost everything the same and once this was determined I had no apprehension at all. I felt that it was my job to get Jim and Fred there rested. I felt I could do that, I felt I could accomplish the majority of the orbital science trajectories of the flight and I felt that we had a good mission and 'we could do it all.

QUERY Captain Lovell, did you consider at the time and do you consider now that this could have been a meteorite strike or something internal?

LOVELL This thought crossed our minds that it could have been a meteorite. I really don't have a complete answer whether it was or not, except the fact that the panel was completely missing which indicates that whatever went in must have caused a larger bang to blow the panel completely out and that's all I know about so far.

QUERY Jim, after 2 days of crew debriefing, could you give your estimate of the best probable cause of whatever blew your oxygen tank and ended your mission to the moon?

LOVELL Jim, I don't think I can. I don't think I'm in a position to because our debriefing so far have been from the crew point of view. It's unique that we were only a few feet away from the accident but the people on the ground had a lot more information via telemetry than we had concerning pressures and temperatures and possible causes of the accident and have perhaps a better indication right now than we do of exactly what caused it.

QUERY You referred to whether the Apollo 13 crew might fly again to get to Fra Mauro. We're informed today

QUERY that such discussion did take place at debriefing and I wonder if you could confirm this and tell us under what circumstances.

LOVELL No discussions of that nature have taken place at any debriefing. As I said, if the agency wants this crew to go back to Fra Mauro, we'll be glad to go. If they decide to send another crew or not to go to Fra Mauro, that's their decision.

QUERY Question to all three astronauts. Physically speaking, what hardship did you suffer most from? Was it the cold or was it lack of sleep or was it cramped conditions in the LM?

HAISE Sorry, I didn't understand the question.

QUERY What were the worst physical hardships for you? Was it the cold or was it the lack of sleep or uncomfortable positions in the LM?

HAISE Well, it certainly was a combination of all, although the overpowering one was the slow chill down until about the Last 15 or 16 hours. It was just - well, we were just chilled down to the bone from there on in. We really didn't get warmed up until we went through the power up and started getting the LM back up and we started getting comfortable again.

QUERY Along with this hardship or lack of sleep. On at least 2 occasions it was recommended that you might want to take a stimulant, a dexedrine tablet. Did you do anything to get yourself up for the reentry?

LOVELL We took dexedrine just prior to reentry. We didn't want to take it too early because I was afraid that with - in my condition with the lack of sleep that if the effects wore off I'd be in worse condition than I was right there then and I didn't feel too tired. You work a on lot of nervous energy in this particular situation and I didn't want to suddenly get exhausted whereby I wasn't in good shape.

QUERY I'd like to address this question to Jack Swigert. This is a lighter question. Has anyone nominated you as Bachelor of the Year, being the first bachelor to go into space?

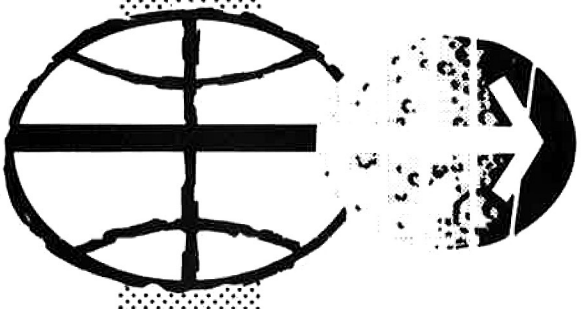
SWIGERT No, mam, they haven't.

SCHEER I think on that profound question we'll knock it off. Thank you very much.

END OF TAPE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 13
CHANGE OF SHIFT BRIEFINGS



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

APOLLO NEWS CENTER
HOUSTON, TEXAS

CHANGE OF SHIFT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 11, 1970
8:00 PM CST

PARTICIPANTS:

Milton Windler, Flight Director
Douglas Ward, PAO

SPEAKER Okay, (garble) are you ready?

SPEAKER Go.

WARD Milton Windier is the Flight Director for this shift, and I'll let him take it with a summary of what happened during the shift and then we'll take questions and answers following that.

WINDLER Well, it shouldn't take very long to summarize the shift that it was a pretty nominal launch sequence with the exception of course, that the center engine on the S-2 went out earlier, approximately 2 minutes before it was scheduled to shutdown. And of course, you're aware that that engine is scheduled to terminate a little bit early anyway. And I'll tell you right now, that I have no idea why that happened. All the data is at the Cape and at Huntsville and the people down there are looking at it, and the kind of data that we get back here is just sufficient to tell us what we need to know for the flight control operation, and we're not in position to analyze that type of thing, so - we really here don't - are not able to go into why, and anything about that other than it just terminated on us. The rest of the launch, of course, was fairly nominal, the earth orbital part was very smooth, we've had no hardware problems at all. We have - oh, just one real minor instrumentation, one and we don't even know that that's really instrumentation, yet; it's in the RCS - service module RCS, and the tanks are so full it's kind of hard to tell whether we have an instrumentation problem or not yet. And we have other ways of measuring that. So, the mission has gone very smoothly so far. We've been, of course, very happy with Jack Swigert's performance. You're aware that he was the one that did the transposition and docking, and he was able to do that maneuver very nicely. The amount of propellant that he used was well within the budget, and we continue to be below our nominal RCS propellant red lines, now. Or not - not, sorry, not red lines, but our - our mission predictions which are of course, below the red lines, obviously. The - We have done the things that we planned to do with the S-IVB with the exception that we still have one midcourse setup for 9 hours, and we have been looking at the status of the S-IVB as far as the batteries and the other consumables on board. And, it looks like now that ought to be good up to 12 or 13 hours, as far as the attitude control and the propulsion capability, so they are back in the control center now building tracking vectors and we'll be deciding whether or not they do the maneuver at the 9 hour schedule time or perhaps delay a little bit in order to get a little bit better tracking, or perhaps even make it 2 maneuvers and do early. And plus our one later. So, I believe, there's really not a whole lot to say about - about the mission to date, it's gone according to the flight plan. I believe that takes care of the major items. I might just point out that the trajectory that we're now on, we - we're very close to a

WINDLER - free return trajectory within say 5 feet a second, which of course, is our goal. And we're looking at a - round a 16 foot a second midcourse 2, which is at 30 hours and we - this is again pretty close to the nominal midcourse 2, and so we are looking now at - at executing that at that time. We're on a trajectory with the early tracking that we have is about 385 miles. Approaches at the closest point of 385 nautical miles to the Moon. And, even if we do nothing else, let me point out one other thing about the S-IVB; even if we do nothing else, make no other maneuvers of course, we will hit the Moon, there's no question about that, in fact we're predicting now that we'll be at about 80 degrees West which is some 50 degrees on further around to the - to the West than we had planned to ultimately impact, so even without a subsequent maneuver, why we're still going to be able to, we think, create a few waves for the seismometer. And Doug, unless I've left something out here, I guess we might as well go to the questions.

WARD Allrighty.

QUERY From what you've been able to tell; how is Jack Swigert doing?

WINDLER Very well.

QUERY Was there anything particularly that he performed exceedingly well?

WINDLER I think he performed the transposition and docking very well. That's the main thing he's had to do so far, he's been taking some star sightings; he's done that very well too. He's done everything as expected, which is up to the standards - the high standards I might say of the crews that we've always had.

QUERY Milt, it seems to me we lost a - had an early cutoff on an S-2 once before. Was there any discussion about that at the Cape? Maybe in unmanned -

WINDLER 502 is what you're refering to.

QUERY - 502.

WINDLER Yes, we did have some engines that went out there. They were - and that was a little bit be - excuse me I'm sorry, what was your -

QUERY Wasn't it 2 in all before it was all through?

WINDLER Yes, we did lose 2 engines on that one. And - and that there were reasons for that, and they were circuit type things that I've forgotten. Had been subsequently been - they've subsequently been fixed of course, and I have no idea - like I say, I have no idea why this one shutdown early. Of course, as you're obviously aware that even if you lose an engine early you usually have that capability to perform a nominal mission. It depends on how early and lots of other things.

SPEAKER Yes.

QUERY Milt, just before TLI there was an 02 flow high light on that was reported, I never heard any further comment on that. Was - is there anything more that you can add at all.

WINDLER No, that's a normal occurrence for the configuration that we're in. The flowmeter is - it pegs out at a pretty low rate, really, relatively low, and it - it takes awhile for it to bleed down, we operate with a waste management valve in the open position, and it bleeds on down, and when it gets down to a certain level the oxygen starts flowing in and it's enough to make it go to the high - to activate this light, and it has always done that. And there's no problem.

QUERY Did you see anything significant, did you learn anything interesting about the - in the visual observation of the S-IVB?

WINDLER No, I really haven't thought a whole lot about that so far, so - everything that they've said is been as about what I expected them to say. It seems to me that they could see the things that they called contrails for longer than I would have guessed, but on the other, just thinking about it some I guess there's nothing to dissipate them, so I guess you would expect to do that. I'm looking forward to seeing the pictures, and hearing more about it, but it sounded pretty much like we expected to hear.

QUERY Milt, the crew seems a little quiet, do you reckon they're tired from the strain from the last couple of days?

WINDLER No, I think we predicted this to be a quiet crew. I think you're seeing it, sure enough.

QUERY Can you discuss what will happen to our timelines, it seems we're about 16 or 17 seconds late on some of these very precise ones, because of the loss of the engine. Will you make up this time and get back to the precise timeline of the flight plan?

WINDLER If you're going to talk about a few seconds like that, the answer is obviously no, because we never do that, in fact, we usually arrive at the Moon, what - 4, 5, 6, 7, 8 minutes off anyway. We consider that to be nominal, I mean it's, we're not going to worry about a few seconds.

QUERY Well, then, in that case, what - what - what is your time for say lunar touchdown, now?

WINDLER I really don't know. We - we're just starting to build our tracking data. I'd vote very seriously that based on anything that we know now, that it'll vary sig - any - any amount that that you'd be worried about. That the time that you descend, we'll do - presumeably do LOI very close and get back into the lunar orbit, and probably get back very close to the timeline there.

QUERY If that engine had quit earlier, could it have been a problem, and I guess what I'm really asking is: Could you launch with four engines?

WINDLER No, I wouldn't think so. The - obviously, it could have been a problem if it had gone out at the very earliest. The - the booster navigation is, the boost is very smart and it is able to - to go from wherever it finds itself in the most optimum fashion to - to where it is supposed to go to make the lunar mission. And so there's a lot of different combinations that'll still work, however, of course, you recognize it what's programmed into it is essentially the optimum trajectory and the optimum engine performance, et cetera that it gets the most payload and into the best position. Now, there's obviously flexibility there, but there's - there's also obviously a point at which you - you can't do the, the nominal mission, and I think it would clearly be if it never lite off at all.

WARD Any other questions?

WINDLER Thank you.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

CHANGE OF SHIFT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 12, 1970
8:28 PM CST

PARTICIPANTS:

Glynn Lunney, Flight Director
Anthony England, Astronaut
William Stoval, Flight Dynamics Officer
Terry White, PAO

WHITE Let's get rolling on the Change of Shift Press Briefing from the Black Team of Flight Controllers. On my right is Black Team Flight Dynamics Officer, Bill Stoval, Black Team Flight Director, Glynn Lunney, and Mission Scientist. Tony England. Glynn, why don't you sort of run down your log, Flight Director Log, over the days, the past 8 hours activities and then we'll go to questions or any statements that Bill or Tony would like to make.

LUNNEY Okay. Today's activity was characterized primarily by the activity running just about by the flight plan. The vehicle command service module works - continues to work perfectly as far as we can tell. We will learn more about the status of the lunar module tomorrow when we make our familiarization entry into it; however, all the indications we have, visual, plus the heater currents which we monitor going into the LM, all appear to be normal. So, to the best of our ability to determine, the vehicles are completely normal and the crew continues to click off the items that we have on the checklist. Very quickly, today, after they woke up we had some preparations going on, the standard housekeeping going on. We had preparations in the control center for the launch vehicle debriefing questions. We had arranged this preflight. We asked the questions that were in the flight plan and we asked several more. I assume everybody heard that conversation. If there are any questions about it, I would be glad to try to answer it later on. Next item of business today was getting ready for the midcourse correction. As you know, we have been on the trajectory which has been very close to free return. By that, we mean that it will swing back and come back into the vicinity of the earth very close to the corridor conditions we need for a safe entry. In order to arrange the conditions at the moon properly, however, today we transferred on what we call the hybrid trajectory with a small burn at midcourse 2 time and we spent several hours getting prepared for that. The burn was just slightly larger than the preflight flight plan numbers. The burn we performed was 23, 2, I believe, feet per second which was just about 8 feet per second above nominal. This could be due to any small deviation at cutoff translunar injection. Anything on the order of a foot per second would have required us to do this slightly larger midcourse. So, in that respect, the trajectory was very close to nominal. The burn was well within expectations. The burn, as performed was accomplished on one bank of ball valves. I just looked over the strip charts of the burn before we left the control center today, this evening, I should say. The parameters looked very normal, but the men will be in the process of taking

LUNNEY all those parameters anotating them with the scales, etc. , and then we would have a full scale valuation of the parameters going on, but at first glance everything appears very normal on the engine. The guidance system performing the burn was very close to zero. You heard, perhaps, Jack Swigart talking about knowing the resiudals had turned out in the X-axis, the axis of the thrust, there was no velocity at all different than what the guidance system wanted. So, he didn't even have to trim. Right now, they are preparing to go into program 23 work, which is navigation exercise at this point of the mission in order to see how well we can perform that with the sextant and the onboard computer and this is similar to activity that we have already done in the flight and what we have done on all the previous flights. At 32 hours we have an opportunity to take some photographs of the Bennet Comet, or the Comet Bennet and that will be done. Sometime here shortly they will be reading the crew some sighting angle numbers associated with that particular sighting and that particular photography. That about covers the activity for the evening in the flight plan. Jack Swigert has asked a couple of times today for some detailed words on his update to this onboard checklist for some of the modifications we have made to the photography work in lunar orbit. Those will also be going up on the radio tonight and he'll be hearing those. I assume that everyone heard what the current best estimate of what happened during the launch phase to the S-2 engine. Very briefly, preliminary analysis indicate that they have found or have observed a high vibration level right in the vicinity of the center engine immediately prior to the engine shutting down. It's currently hypothesized and probably with reasonably good assurance at this time that the vibration caused the pump in the lines to slow the flow down some and when that happends we have pressure switches down there which are designed to shut the engine down in a controlled fashion if the pressures drop below a certain level and our best estimate at this time is that that is what happened. Jim Lovell, you heard today, reported that just prior to the engine going out, he also felt a vibration. Quickly through the notes, everything else was pretty much by the book. The light moment perhaps was Jack Swigert finding out that he hadn't sent his income tax in and I was told later that as long as you are out of the country, you have an automatic 60-day extension. I assume that applies. As far as consumable goes, the consumables in the spacecraft go, we are still above the flight plan on the RCS. We have only used one or two or three pounds today, even with the burn and

LUNNEY of course, we spent most of the day in the passive control mode which is not much of a fuel user, so we are in good shape there. We also about on the flight plan but above the red line for the cryogenics in the spacecraft. We are in very good shape on the oxygen. There is a large margin and on the hydrogen, there is a reasonable margin for that system and it continues to increase as we go along. We haven't had anything else to talk about of any significance. As I say, the work tomorrow will be primarily associated with the LM familiarization work. We have all the numbers for the midcourse. Bill Stoval has them, and we also have some estimates for the S-IVB impact position, but they continue to change a few degrees as we go along and I kind of expect they will continue to change for awhile, but hopefully, by the time we get to the moon, we will know better than a few degrees where the S-IVB will hit. That about sums it up. Essentially the vehicle and the crew have been performing right by the flight plan. There are no known anomalies to the vehicle. Everything is normal. The plans for the rest of the evening are as on the book and tomorrow should be just about as you know it in the flight plan. That's all I have and unless somebody want to say anything, we can go into questions.

PAO Tony, do you have any comments regarding flight plan changes?

ENGLAND Right. Bill, as you know the program office has released a set of changes to the flight plan and I thought I might be instructed to explain exactly what this means. Ken Mattingly has a lot of interst in orbital science, the lunar science, and he all the time through this last year has said, "Hey, if we've got a man in lunar orbit, let's put him to work." And, we packed his timeline very full and he spent a lot of time working out procedures where he could do all these tasks. Everytime he would work out a procedure so that he could do the last task we gave him, he would ask for a new one. That lunar timeline was very full, and it required a great deal of specialization to do those tasks. Many of them were not in the mission requirements. They are not science requirements. Often they were things that - well, in a way it was almost an experiment to see if a guy could do this many tasks. Okay, when the Command Module Pilot changed, Jack is familiar with the tasks and has simulated them, but perhaps not as often as Ken has, so we went through the timeline and picked those places that were particularly tight and to ensure getting the important things, we cut out some of the tasks that were put in mostly as a request from Ken.

ENGLAND Now, I think it's important to know that we are still doing more on this mission in lunar science and lunar photography than we've done in any previous Apollo mission, so this is not in any sense a real compromise. I think the scientists will be pleased with the results.

END OF TAPE

ENGLAND But this is not in any sense a real compromise, where I think the scientist will be pleased with the results. Jack's very professional and he knows what he's doing. We have no fear that he will be able to do the important tasks.

WHITE Bill do you have any comments about maneuvers or should we go straight to questions then, back over here.

QUERY (garbled) maneuvers, duration of burn time and the position of the instruments -

STOVAL The burn time 3.5 seconds and the current position of the S-IVB I don't have with me. At the time that we left the control center the CSM was about 800 miles ahead of the S-IVB but I don't have that current position.

QUERY Have you figured out what caused the high vibration on the S-II, center. Any idea what could have caused it? Any hypothesis?

LUNNEY No, I don't particularly and of course the people who are responsible for the launch vehicle have been looking at that evidence since it happened yesterday. I have not heard any theories, which is all you could probably get at this time anyway.

WHITE Marty? Wait for the mike please. We want to get it on the transcript.

QUERY The card that Swigart realized he left behind in the suiting room. Do you have any comment on that. Was it noticed by anybody before he brought it up? Was it a reminder card for him of some sort?

LUNNEY It was a reminder card relative to the items that Tony discussed. The number items that were modified in the lunar plan. Actually, what we been in the process of doing today is rather than reading up a general list, we've been going through what is called the CMP solo book or the book that he uses as he is in lunar orbit by himself.. We're going through and marking up each page, just to be sure that we've got it all straight and sometime this evening that will be radioed up to Jack, for recording in his book. To answer your other question. To my knowledge Jack was the first one that brought it up, but that, it might have been known and called in that we needed an update on that. I just haven't heard.

WHITE Mr. McElheny.

QUERY I don't want to go into too much detail about what is going to be radioed up, but there were a couple of times when Mattingly was planning to try for solor corona shot and we had an indication the other day that that was going to have to get dropped cause it was in a tight.

ENGLAND That's one of the optional items and Jack will try to get a solor corona.

ENGLAND It's one of the lower priority tasks in the mission but we're going to try.

QUERY Will you explain the molten point?

ENGLAND Okay. In a two body rotating system you have several points that are equilibrium points. By equilibrium I mean, you know like in a bowl. You put a marble in the bottom of a bowl, it sits in the bottom of the bowl. If you have two stationaly bodies, with the same mass and some place inbetween it you put a particle and very carefully balance it, it will just hang between them. If you displace it either way it will go to one body or the other. Well in a rotating system, you have four equilibrium points. There are two points in the, for instance, earth-sun system. There are two points in the earth orbit that lead and lag the earth by six degrees and these are called Trojan points. There is another point between the earth and the sun, and this doesn't have a name. Then there's a point further away from the earth down sun from the earth and this is called the molten point. The check, the Gegenschein experiment is what you're asking about and the hypothesis is that dust collects in this equilibrium point and causes its shine, the Gegenschein And we're, from the moon, we're far enough out from the earth that we'll get an angle, like trianglulation looking from the earth and it's down sun, we look from the moon and we can see that it's not down sun anymore, we can measure how far out it is and see if it coinsides with where we think the molten point should be.

QUERY Does that mean that the Gegenschein is it still considered part of zodiacal light?

ENGLAND Well, that's different. Zodiacal light is just the dust and the plane of the ecliptic. It's not the same.

QUERY (garbled) the Gegenschein is no longer thought to be just a bright source in the zodiacal light.

ENGLAND It may very well be that. The Gegenschein experiment is to check to see if it is something unique. The general zodiacal light is something else. We're checking to see if the Gegenschein we can identify its being a unique thing associated with an equilibrium point that has nothing to do with zodiacal light.

QUERY So, we're not looking for the this experiment is not involved with the earth-moon system but the earth-sun system. Are we going to do anything with the L4 and L5 points in the earth-moon system?

ENGLAND I guess the feeling is that the potential wells would be so small that the solor wind would sweep them out. And we don't expect to see anything there.

WHITE Any more questions? Thank you very much.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

CHANGE OF SHIFT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 13, 1970
2:30 PM CST

PARTICIPANTS:

Gerald Griffin, Flight Director, Gold Team
Jack Riley, PAO

APOLLO 13 CHANGE OF SHIFT BRIEFING, 4-13-70 2:30 PM CST 20A/1

RILEY Okay, lets get started. It's a fairly quite shift. We have Jerry Griffin, the flight director of the Gold team. Jerry, do you have any preambles before we get to questions?

GRIFFIN Okay, I didn't work out a long preamble or anything to this because it was by and large a sleep period. We woke them up about an hour before our shift ended and updated the flight plan, on the printed flight plan that you have. The reason that we decided to do this is that we don't need to do mid-course correction number 3, so it was convenient to go ahead and get in early and we're going to add a little step to this familiarzation in that we're going to power up the she, super-critical helium gage, and read that pressure out onboard the LM. I understand there's been quite a bit of speculation why we're going this and let me see if I can explain for you simply. What we're going to do is take a look at the pressure in the super-critical helium tank. As you know, that's a cryogenic tank. The reason we're doing this, or what cued us to do it is that I think most of you have been briefed that back on the pad we did see some anomalous pressure readings in that the leak rate into the tank was a little bit high at low levels. Now there's a postulation of what caused this like some trapped nitrogen. Subsequent to that we loaded the tank and its performance on the pad was completely normal after the final loading. In fact, the rise rate was a little bit lower than normal and we lifted off a little lower than we thought we would be, so that was in good shape. Now, what we've done here is we've just kind of covered all bets. We've had a lot of time, so we've been trying to look at all the possible contingencies and it's been a good exercise because this same philosohy is good for any mission even if you just got in and found a high she tank pressure by a complete surprise and that is we're - we've got some limits established and we've got some options available to us depending on where that pressure is. Now these numbers may under go a little refine-ment. They're still being finalized right now, but basically the logic goes like this. If we get in and the she pressure is 770 psi or lower we'll just power the system down and forget it because we're well below any known curve or rise rate, and incidentally, let me for those who aren't aware of it, what we don't want to do here - if the pressure gets too high there's a burst disk, I think it's set at 1887 psi lower limit, might be a little higher than that, but there's a burst disk in there that will blow and relieve - dump all the super-critical helium overboard and that's a safety feature, that's what that's for, so that's why you don't want the rise rate to get too high as you may dump the helium overboard before you get a chance to burn the descent engine. Now, so - to get back to the numbers 770 psi or lower we won't do anything because we know we're well within

GRIFFIN any constraint. Between 770 and 800 psi we will go ahead and power the system hack down but at 59 hours we will go back in and look at it again and that's just in order to determine what the rise rate is now. In other words at this point in the flight just what the rise rate is. Take out all the stuff prior to this so that we can extrapolate to see where the pressure would be. If you can think of it in terms of 770 to 800 psi is kind of a haze area. We probably are still all right but we want to check it one more time to get a point on the rise rate. Above 800 psi, this is readout on the gauge, we are going to fire up telemetry on the LM and, let me say, turn on the telemetry in the LM, look at it for approximately - I would guess somewhere between an hour and 2 hours - and very closely determine the rise rate because now we are in a very marginal area for making the eye. If it is above a thousand psi then we know we cant make pdi and this would be true in any LM at this point in time. So we said, well, let's see, let's don't just give up, let's see what we could do in that case. Well, it so happens that there is a way to vent the helium. You can - but you have to start the engine once to do that because there is a squib in there that isolates the helium from the tanks or actually even from -

END OF TAPE

SPEAKER - isolate the helium from the tanks, or actually even from the vent values. So that doesn't get blown until you start the engine. That's one of the first events. It's about 2 seconds after the scrib blows to allow helium to pressurize the tanks. So we have to burn the engine once to get that valve open so that we can then get the helium down to the vent valve that he could open manually and just bleed the pressure back down. Now that's the only purpose - would be the only purpose of the burn is just to get this blown. So what that would involve is a very small burn, approximately 5 seconds duration; the delta V on the order of 1 foot per second. We wouldn't try to do a midcouse with it or anything like that. We'd probably just aim the vehicle in about the right direction for whatever midcourse it looked like we had coming up for MCC4, a very low delta V, so we just pop the engine and flow the squib and then he could manually hit the vent valve and delta pressure back down so that you can save what's your descent. And in a nutshell that's it. Let me see, though, if I can put this in a proper prospective. I think the likelihood of having to do anything other than power the system back down if we get it is almost O. We want to make sure of course and I don't think - I wouldn't get too stirred up about this one. And that's about all I got on the helium and I think -

QUERY (in background)

SPEAKER No. I'm going to go home and sleep for awhile.

QUERY Just one point, Jerry. If you did have to fire the engine and you have this 1 foot per second, what would this do to the remaining fuel for descent where it cut into the hover time or anything like that, assuming that you had to do this.

SPEAKER I haven't looked at that exactly, Art, but it would have to be virtually (garble) you're not going to expel very much propellant at all. So I think you could get -

QUERY Is this what you call burping the engine?

SPEAKER Yes.

QUERY I need some clarification here. You said if the pressure is above a thousand psi you couldn't make PDI. You mean you couldn't begin the burn with that kind of pressure in the tank?

SPEAKER No, you couldn't make PDI without - if we had that kind of rise rate as to now - assuming that rise rate continued, we would reach the burst disc limit and that's all. Unless we did something. And then you couldn't fire the engine at all because you don't have any pressure to push the propellant out.

QUERY Yeah, but this very brief burn plus the manual venting would save your PDI capability.

SPEAKER That's right, that's right. That's what we're looking at.

QUERY Is any sort of computer check then run to determine what will happen to the debris knocked out of the moon by the impact of the Saturn?

SPEAKER Jack, maybe ought to fill you in on this. I know of no computer, I'm sure somebody has done something, looking at scatter, because I know some of the science people have estimated the size of the crater by making assumptions on what it's like and the number that sticks in my mind (garbled) so in order to that somebody has probably had to look at a very detailed, who knows?

SPEAKER It's tumbling. So I would suspect there's probably is some data like that available.

SPEAKER I don't either, but you can get it from the query desk.

SPEAKER We'll it's all vented, so it's ...

QUERY Alright, was Mattingly there today.

SPEAKER He hadn't been in yet.

QUERY Have you heard anyone say anything about his symptoms? Whether he's showing any or not.

SPEAKER No I haven't. In fact Mark asked that question a little while ago. No, I haven't heard anybody say anything.

QUERY But you haven't seen him. Well would his absence indicate that he might be sick.

SPEAKER No, it wouldn't to me, because we've had a very quiet shift. In fact all day it's going to be kind of quiet and the only astronaut we've had in is John Young.

Query What was that master alarm that went off last night during sleep period and shook up the..

SPEAKER The reason there wasn't anything said about that at the time was that they had already, the crew decided last night they wanted to sleep without calling. Well, we saw the master alarm coming. It was a low H2 tank 1 pressure, but they didn't have any calm on and we we're going to try and sneak by without it going off and it just barely tipped the limit. And so, they didn't (garbled) we just said well we'll stand by here and let it and see if they were very concerned about it, because they would immediately look at the H2 light that was illuminated and look at the pressure. And it was already on its way back up by the time, just about the time the master alarm went off. The heater cycled back on. Now you can get yourself in, rather than tie everybody up here, I can show you some diagrams, how you can get yourself into a situation where ...

END OF TAPE

GRIFFIN - I can show you with some diagrams how you can get yourself into a situation where, with completely normal tank, you can have one tank that's about to trip the master alarm limit every time. In fact, all night long - we rode within - everytime the tank would go down low we were within 1 PCM count of hitting the alarm and we'd all kind of say please don't hit it and wake them up, and it didn't. It would squeak by and start back up again. Now today, we turned it around - we turned the control around to where the other tank or actually that low tank is now driving the system if you want to think of it that way, and we've already seen one cycle since they've awakened and the pressures are much higher, so I don't think that will happen again. It's not an abnormality, it's kind of funny the way that system works, if you get the conditions just right. And I can show you afterwards -

QUERY What were the pressures that would blow the discs again, huh? I failed to get that.

GRIFFIN 1880 - it's 1881 or 1887 is the low limit and a burst disc has a certain amount of that uncertainty, Ted. There's a range in there that it might give.

QUERY Will the crew try again to sight Bennett's comet and if so when, and will they try to photograph it?

GRIFFIN Yeah. As about 49:30 as I remember elapsed, we gave Jack Swigert a procedure to try and find it in the scanning telescope and it involves, as they're in PTC, we gave him a half unit vector assuming that that was a planet. It tells the computer where to point the optics. He's going to try to pick it up in the optics and see if there is optimum angle where it looks like to him that the LM kind of shades that sun shafting off of him so that he could look out the window and see it. Now we've given him the angles where it will be visible and we've told him that if he sees a place where he thinks he can see it out the window well enough to photograph to remember what that roll angle is. And tonight when we go back to reestablish PTC we'll establish it in that attitude - at that roll attitude, let him take a picture before we start spinning up because you need very - a very stable vehicle to photograph this thing. So they are going to try again. First with the scanning telescope if he gets positive evaluation out of that then prior to starting PTC at 56:30 tonight, he'll try to get a picture of it.

QUERY All right.

QUERY Jerry, what is the nominal pressure helium pressure at PDI?

GRIFFIN Oh, lets see. Mark let me stay off on that one. I can't remember right now - kind of drawn a blank. It peaks after the engine starts. It actually starts and then it goes pp and then comes back down. And its on the order of 1000 somewhere in there. But let me get a better number for you.

QUERY Will there be any opportunity to get a picture of this impact crater? The S-IVB.

GRIFFIN We're looking at opportunities now. It looks like on REV - best I can say - 27 or REV 28 in lunar orbit. We have a good opportunity to photograph the area where the thing is zeroing in now to land. And the plan is right now that some time during that time, we're going to do that. And exactly what REV, I don't know. 27 - 28 somewhere in there. We'll try to get a picture of that area.

QUERY Do you have any updated times for LOS and LOI?

GRIFFIN No. I don't. We can get those for you. We can get you the latest after the briefing here.

REILLY Any more questions?

QUERY Are you talking about photographing it before or after?

GRIFFIN After impact.

QUERY After.

GRIFFIN Right.

END OF TAPE

APOLLO NEWS CENTER
Houston, Texas

CHANGE OF SHIFT BRIEFING
Manned Spacecraft Center
April 14, 1970
9:35 AM

PARTICIPANTS:

Glynn Lunney, Flight Director

Tom Weichel, Retrofire Officer

Clint Burton, EECOM

Hal Loden, LM G&N

Merlin Merritt, TELMU

Major General David Jones, USAF, Commander,
DOD Recover Forces

APOLLO 13 CHANGE OF SHIFT BRIEFING 4-14-70 CST 9:35A PC22A/1

SPEAKER Before we get started, I have an announcement I'd like to read to you. "NASA Administrator, Dr. Thomas O. Paine, sent the following message to the U.S. Embassy in Paris to President Pompidou of France in response to the French President's offer of recovery assistance for the Apollo 13 flight crew. The message was: quote, My warmest thanks for your timely and generous offer of assistance of French ships in recovering the crew of Apollo 13. Should circumstances require it, we shall be in touch with you regarding the necessary arrangements. end of quote.

SPEAKER Allright. This is a change of shift briefing. We have with us this morning Major General David Jones, the DOD Manager of Manned Space Flight Recovery and Glynn Lunney, the Flight Director for the shift that was just ended. And I'd like to ask Glynn to introduce the men he brought with him.

LUNNEY On my left, your right, Hal Loden who is the - what we call the Control Officer. He worries about the propulsion systems in the Lunar Module. Tom Weichel, is the Retrofire Officer, whose job it is to assess all the options that we have on returning to the Earth and to make recommendations as to which one to use. Merlin Merritt is the - what is called in the Control Center - TELMU. He is concerned with the electrical systems and environmental systems, in the Lunar Module, and Clint Burton on the end is the EECOM who's concerned with those same systems that is, electrical environmental in the Command Service Module.

SPEAKER I think we should proceed in the order which seems most logical, whether you would start with General Jones or you, Glynn.

JONES I think I probably should come last because we're really responding and I think that as the various options are described to you, we can say that we are well prepared in all of these options as far as Aircraft availability and in most areas as far as ship availability. We've been in touch with forces world-wide, and as you've just heard we've had offers for help from many places. Needless to say all of the U.S. Forces throughout the Pacific and Atlantic area have offered their support. As far as aircraft is concerned and ships are concerned, I think we're equipped and ready for most any of the options that NASA exercises. I think that's all I've got.

LUNNEY Well if you want, I'll start with the summary of the shift and then we can go to questions and answers and the men on my left can perhaps help more than I can with some of the detailed questions you may have in the various areas. Let me start off by saying that we, in the business, have probably had the longest night we've had in the space program in a while. My team came on duty last

LUNNEY night. We got to the - we were supposed to come on about 10 PM and we got to the Control Center, as you know, about an hour ahead of time and some of the men were already there and rest of us - I - for example were in the - I was in the back room going through the Staff Support Rooms checking on the status of everything and we had just finished the television show when we found we had a problem. Now I wasn't on the console, nor did I hear the air to ground when we exactly had the problem. And let me say that since that time, my team has been primarily concerned with not what happened back there but what it is we were going to do about it. I'll tell you what I know about what happened and I probably will only be able to take that so far for you. I'm sure that when we've had time to construct exactly what happened, we'll be able to tell you more detail what it is we think caused the problem. At about 55 hours and 54 minutes Tank 2 Cryogenic Oxygen was fine. Within less than 1 minute the pressure in that tank had gone to zero. At the same time, fuel cell 3 which was on main bus B, and we have split the busses on this flight, fuel cell 3 was the only fuel cell in main bus B. Fuel cell 3 went down and the main buss B went down. We had some restarts on the computer and they were probably due to the main bus problems. The situation was one then where we had relatively uncertain situation in that with some of the electrical systems down like that, it's sometimes difficult to determine whether you have instrumentation problems or whether you're having a real problem. However, in this particular case during the whole course of the action, I think everybody in the Control Center felt that we had a real problem rather than any kind of an instrumentation prob lem. The crew reported a loud bang at the time that correlates with the tank pressure going to zero and they also reported some venting; they could see some things out the left window and they were getting some rates in the vehicle. Now the problem with the control system -

END OF TAPE

LUNNEY reported some venting, they could see some things out the left window and they were getting some rates in the vehicle. Now, the problem with the control system or the situation with the control system is that it is split. Some of the thrusters are on main bus A, some are on main bus B, and of course losing main bus B we had some amount of difficulty with control as you probably recall hearing. One of the other things that happened which substantiate that something real physical happened was that the propellant isolation valves on quad Charlie we think closed, which has been known to happen in the past, started back on Apollo 9 when we did a separation from the Saturn we noticed the valves closed. We reopened them with no trouble, but that's another indication that something happened. Now, the area where the cryogenic tanks and the fuel cells is kind of behind the commander's seat: on the left-hand side and down a little bit below what you would call 3 o'clock, perhaps at about 4 o'clock, and the venting and the particles that were being seen were being seen out the number 1 window, which again is on that side. So we had pretty concrete evidence that something had happened back in the service module. I don't think anybody fully understands it, but it appears that something gave way causing a problem with the fuel cell, something in the cryogenic tanking gave way, causing a problem with the fuel cell, probably a physical impact of some kind. And we had about that kind of situation on our hands. Now, Gene Krantz's team was on at the time and their concern was to, without taking any steps that would jeopardize or compromise the condition of the vehicle, to stabilize the condition as best we could so that they tried a number configurations with the jets in order to have proper attitude control plus we were continuing to monitor and go over the electrical system in hopes of finding something in the instrumentation, but also with the end in mind to figure out what to do about the configuration in the electrical system. Shortly after that time, it became apparent the cryogenic tank with the oxygen in it - there are 2 tanks, 2 with oxygen and 2 with nitrogen - it was apparent that the pressure in the second, that is tank number I, was going down; and this started about the time of the first tank going to zero, but it came down at a very, very slow rate. As a matter of fact, it worked for about 3 hours. We had pressure to the tank enough to feed and make a fuel cell operate for about 3 hours. While the tank was going down, while the pressure in the tank was going down, we performed a number of things la order to attempt to save that tank. The cryogenic oxygen is brought together in pipes and then fed to the fuel cells. The plumbing of the fuel cells is such that if you had a bad leak in one of them that is alined open or something, it's possible - it would operate in such a fashion that all the oxygen would go find that leak and go on out. At that time, then, we shut off what we call the reactant

LUNNEY valves which are the hydrogen and oxygen 2 of given fuel cell, in an attempt to stop flow to a position in the plumbing where a leak might be and where all the oxygen might be going. That actually was to no avail, but we did that in each cell, one by one, taking the worst cell first, and at no time did that change the leak rate, and of course once we close the reactant valves we very quickly lose the fuel cell and it's no longer available. We were relunctant to take that step, but it was out last ditch attempt to isolate leak, it did not work. At that time we moved two of the pilots into the lunar module in order to start preparing the vehicle in what I guess we would call a lifeboat mode. We'd discussed this among ourselves in the past, how we would use the lunar module to come on back. Let me say one thing about the trajectory at this time. Of all the times on the way out to the moon this is probably the most difficult for a problem like this to occur, because the DELTA-V or the propulsive maneuver that would be required to come back to earth directly without going around the moon had become excessively large. For example, we could have come back with a 6000 foot per second burn out of the service module. We don't have anywhere near that out of the LM, but in order to do that we would have had to dump the lunar module and we would not have been able to get that kind of DELTA-V with the lunar module attached, so that quickly became out of the question with the developing problem we had with the cryogenic oxygen. Quickly it became clear to us after we had time to review it that the course of action was to retain the lunar module and to swing on around the moon and to prepare to do a maneuver which would in effect shorten the return time back to earth. We got acquisition - as I said we moved two of the pilots into the lunar module at about 57 hours and a half and about 25 minutes later we got acquisition on the LM which meant that the telemetry system had been turned on. The first entry to the LM was primarily one of just making it liveable, the batteries, the power, the glycol loop flowing, etc. At this time it was obvious that the command module cryogenics were effectively lost because we had done all that we could. We wanted to retain an alinement onboard the -

END OF TAPE

LUNNEY an alignment onboard the Lunar Module, because we knew we had to do a maneuver coming up and because it is difficult to do alignments with the telescope while you are docked to the CSM. In order to do that, we put a battery on the command/service module busses, in order to supply some more power, we did this when we figured the fuel cell had just about breathed its last oxygen; we put the battery on and we used for oh, about 20 minutes, perhaps 30 minutes, while we were performing an alignment, which then gave the lunar module a good attitude reference system. The attitude reference system is mandatory to do a proper burn, its the system that points the vehicle in the engine, and it is the system that then controls the burn. At about 58:40, as I recall, 58 hours, and 40 minutes, we turned the command module power down completely and took the battery off the bus. At the very end, prior to putting battery A on the bus, we had used it previously, we charged battery A for a short period of time, in hopes of getting a little more current in; the 3 entry batteries in the command module of course will be the batteries they will use for entry, we will use for entry, and I should say that they are in fine shape. The command module, which is the portion of the vehicle that will reenter, is, as near as we can tell, in fine shape. We have electrical power, we have a cooling system, we have a command module RCS system, 2 of them actually, and all the other systems are still in fine shape. We powered the guidance and navigation system down of course, but we can power that back up prior to entry. At about this time then, we had to start configuring the lunar module in a fashion that would allow us to fly. We were looking at the fact that we knew we had to make a maneuver at about 79 and a half hours, which at that time, was about oh, 19 hours away, and we knew we had to do that on the other side of the moon, so we started to talk about how best to configure the lunar module to get to that point. We did not want to lose the alingment that we established in the lunar module, and at the other hand, we did not want to spend too much power, because we are fairly limited in the power that we can supply in the biggest users in the lunar module, or the lunar - the LTC, the computer, and the platform. So we were concerned with that, however, in my mind, we had essentially a safety problem in wanting to retain the platform, we wanted to do as accurate a burn as possible, so that in my mind, it was not too much question about turning the platform down as long as we could get enough out of the consumables to safely conduct a burn and use the lunar module then as a lifeboat on the way back. MerlinMerritt who is watching these systems in the lunar module was very concerned about the status of our consumables at this time, because when we first powered up the lunar module, with the coolant system, a larger than normal amount of water was being required to

LUNNEY cool the vehicle because it had gotten warm, and the initial flow was taking some time to establish an equilibrium and we at first were looking at fairly high water usage rates; these subsequently slowed down, and they continued to get better, and as time went by, it became more and more clear that we wanted to leave the computer and the platform up, and that we would have the consumables to do the job all the way home, and I will talk about those toward the end. At about 60 plus 23 we informed the crew that we wanted to perform a free return maneuver, very shortly. Now the logic behind this was that we had the situation which I described in the lunar module, and we had about 19 hours to go to the burn to bring us back home. At that time, without any further -

END OF TAPE

SPEAKER Had the situation, which I've described in the lunar module. And we had about 19 hours to go to the burn to bring us back home. At that time without any further manuever, we would not have been returning to the vicinity of the earth. So we felt it was wise to spend the time and the consumables at that time to do a small burn. It was about 38 or 40 feet a second, which put us essentially on a free return path back to the earth. This loops around the moon. We're still not sure at exactly what altitude we'll go by the moon. We targeted for about 137, and it'll probably be higher than that, although that's still being tracked and worked upon and I'm sure you'll hear that number in the course of the day. With this decision, we had to go through the checklist to prepare the lunar module for the burn, and we did it not quite as formally, but perhaps as completely as they do at the cape when they are preparing a vehicle for launch. We - Fred went through each page, we went down each page, had everybody in the Control Center agree that we either had to do what was on the page or could delete some of the items. We were interested in deleting what we could, of course, because some of the things used power, and in the situation we're in, it seemed prudent in a number of cases, not to use that power for that particular function. We did the burn. The numbers are all available up here. The burn went fine. The guidance system performed just fine and the tracking - the Doppler tracking after the burn has all confirmed that the burn was nominal as we had planned, which is another good indicator that the platform, or the reference in the lunar module was in good shape. I will review the consumables at the end of this - let me tell you what is coming up. At the present time we're in what you might call a modified pacified thermal control mode where usually on the way to the moon we're rolling the vehicle, and it's standing up, if you look from the earth to the moon. It's standing up and it's rolling to get an equal temperature distribution from the sun. In this case, what we're doing, since we don't have a good control mode to do that, from the lunar module, we're just cycling the vehicle about every hour through 90 degrees so as to equally heat and cool both vehicles, both the command module and the lunar module. That's going very well, and it takes not too much time on the pilots part, and we can look at that data on the ground and be sure as we go along that the attitude control system's doing the job. We have had some poorer then usual COMM in the last few hours. That's because we've taken a power ampliffier, which is essentially just a booster for the COMM, and taken it off line, and we've got COMM equivalent to what we used to have over some of the ships in some of the Mercury Program. It's saving us 2-1/2 amps and at the present time, people are being as stingy as

SPEAKER possible about how many ampheres or how much current we are using out of the LM batteries. Looking ahead a little bit, we're expecting to wake up Fred at about 69 hours and he may be up already, and the other 2 men are scheduled for about 6 hours sleep. We are looking to do a burn at 79 plus 30, although there is still discussion about doing it a little bit early. We have considered, and are still considering, what the possibilities are for dropping the service module, which is a large amount of weight, in order to accomplish a faster return to earth with the lunar module engine. There are a number of considerations involved in this, not the least of which is the new thermal environment, which the command module heat shield would be exposed to. Of course it has never flown in space like this - it would have never flown in space like this without the service module on, and there is some concern about what would happen to it if we did not have the service module on there. I say again, the reason for considering dumping the service module is that you can speed up the return and perhaps, and this is really a perhaps, land a day early, but you could end up using just about - most of the DPS fuel, and you would probably have a little bit less then we would comfortably like to have. I say that this discussion is still going on. These kind of options are still being entertained, and sometime in the next few hours I expect that we'll decide exactly how we want to do the upcoming burn and you'll probably hear it on the Air-to-ground at the same time I do. We will probably do something else on the way back, after the burn. We'll probably turn down the guidance system on board the lunar module since it is a fair user of power, and it also has to be cooled, which causes it to use water higher then if we were able to turn it off. The water usage is higher with the guidance system on. We will probably also consider going to a duty cycle on communications system in order to again save power in the lunar module.

END OF TAPE

LUNNEY - if we were able to turn it off; the water usage is higher with the guidance system on. We will probably also consider going to a duty cycle on the communications system in order to again save power in the lunar module, and probably at some point, power up the comm on some schedule, as opposed to having it up all the time. Those things are in the future, and you'll be hearing more about them. To give you some idea where we stand on the LM consumables, right now, with the water that we have in the lunar module, descent, and ascent tanks, we can follow the profile that we have intended to follow, that is powering down the primary guidance system after the first burn, and power it up 2 more times for midcourses, and land with still about 12 or 13 hours of water cooling available, so that is beginning to look like we are in reasonable shape there; we are also studying some ways possibly getting some more water into the coolant system, and we are not sure how those are going to work yet. On the batteries, we again are planning to follow a course which will end up with about 500 or so amp hours left, which is about 22 percent of the current, or the power available in the lunar module, so that is beginning to look like a fairly comfortable margin. Of course, that is dependent upon followinng the power profile that we have laid out and you'll hear people talking about a couple of amps all the way back, and the intention is to follow the profile. I don't have the 02 predictions, but that's generally better than the water in the power, the lithium hydroxide canisters, we have about 50 some hours for the 3 men, with the canisters in the LM, and we are preparing a few techniques for using the canisters and the carbon dioxide scrubbing which is available in the command service module, and you will hear some more talk about that on the loop I am sure. I think that about summarizes what I can say at first blush - and perhaps my commrades and I could help you with further questions that you might have.

PAO Okay, we'll take questions if you will wait for the mike. Lets start with Roy Neal first off.

NEAL Glenn, you have described the situation accurately in terms of hardware, how critical is this situation right now, in your opinion?

LUNNEY Well - I think it is as critical, perhaps probably the most critical situation we have faced so far in the manned spaceflight program in-flight. We are about 70 hours from home, and we think we have the situation in control and we have projected the consumables as I have described, and we have a plan for carrying out the rest of the mission, but there is going to be no relaxation at all, as far as that goes, from now until splash.

QUERY The oxygen situation.

LUNNEY The oxygen? I didn't bring any numbers. Merlin, can you talk about -

MERRITT Yes, the oxygen situation - I think we are in pretty good shape. We have about 160 - or we should have enough to complete 02 requirements for an elapsed time of about 165 - 170 hours elapsed.

LUNNEY In other words, we could fly that long. With the lunar module oxygen. Now I should be very careful to point out that we still have the normal command module oxygen supplies in tact in the command module, those are used for entry, and post entry work.

QUERY I gather that - what was the most critical single thing that had to be done last night - was it getting that reference platform set up in the LM before the collapse of the command and service module power?

LUNNEY Well - in my opinion the most critical thing was people keeping cool and getting done what had to be done. And, I think we are able to do that. I think especially the pilots remained cool throughout the whole thing, and so far we have been able to stabalize the situation, and we have every intention of keeping it that way.

QUERY What happens if you do run out of water before you come back in, and secondly, it is my understanding that if you went on the suit loop, you might save some oxygen, or conserve somewhat, is there any consideration of this?

LUNNEY If we run out of water, it will get warmer in the lunar module - we'll probably have to do something about orienting the vehicle to try to cool it.

END OF TAPE

SPEAKER We'll probably have to do something about orienting the vehicle to try to cool it. Usually we try to equally heat it on all sides but I suspect if we really ran out of cooling water we would go to something like that. There is plenty of drinking water in the Command Moudle, although we have to pressurize the system to use it. There's some extra drinking water in the LM. I don't recall how much. And you asked me a second question. Oh, the cooling in the Command Module is just fine. We just aren't using that system at all. That's buttoned up right now. But all the cooling capability in the Command Module is still there. And, as I said before, the Command Module itself is completely intact.

SPEAKER Oh, yes. Going on to suit - but we only have two connectors in the Lunar Module for 2 pilots and Merlin you want to comment on the use of these?

SPEAKER If I may, yes. No, I think that's incorrect be preferable to remain in a open atmosphere. That way, the usage rate is not as much as if you went on a closed suit loop besides that it only has the capability to maintain two crewmen in the LM, in a closed suit loop. No, in order to do anything now in the Command Module we'd have to turn some equipment on so we've just got the door open between the two vehicles and letting the Command Module oxygen - the Lunar Module oxygen come over and we've sealed up the Command Module System. Okay.

SPEAKER We have a suit compressor that circulates the air of the atmosphere in the cabin through the suit loop which does move CO2 so.

SPEAKER Something last night about moving one of these hoses so it would move the carbon dioxide or something out of the Command Module.

SPEAKER Yes, we did move a LM hose, stick it up through the tunnel area. Officially it would circulate 02 into the CSM.

SPEAKER It was to blow fresh oxygen into the CSM in order not to get a build up of CO2 while the men were sleeping in there - one man last night.

SPEAKER Answers anywhere that'll give you a chance to draw some inferences about the condition of the heat shield after that explosion or impact behind it.

SPEAKER What - I didn't hear this first part of your question.

SPEAKER Do you have any grounds for drawing any inferences about the condition of the heat shield after you had this explosion or impact behind it.

SPEAKER I don't know whether we do or not. I assume

SPEAKER people are looking into that but I don't know.

SPEAKER (GARBLE) say the life of the astronaut (GARBLE) at this time.

SPEAKER I'm sorry.

SPEAKER The Life of the astronaut, does this, eh, is security have security to the life of the three crews? And the second question is dangerous on the lives of the astronauts?

SPEAKER Are the astronauts safe, I think is -

SPEAKER Well they are safe in the sense that we have the situation stabilized now, we think. I think our only concern about safety is that we're now about 70 hours from home and we have to continue to keep the situation that way and bring them on home. And you had a second part?

SPEAKER The second part - can you explain me the what is the reason and donde esta the (GARBLE) to the home before the go to the moon. After before the moon can you return the Command Moudle to the earth?

SPEAKER If you're asking if we're bringing the Command Module back to earth - we're going to fire the engine and bring both vehicles back to the vicinity of the earth at some time of course the pilots will button up in the Command Module and power it up for entry and they will separate from both the service module and the lunar module where exactly I can't tell you. We've had some contingency procedures for where we would do that and I'm sure they are being looked at and reworked right now, to get an exact time on this as to how we would jettison both of those parts of the current stack.

SPEAKER After the DPS burn as you plotted now, what sort of midcourse correction capability do you have and what sort of midcourse corrections do you think you'll need?

SPEAKER Okay, of course, the burn that we're going to do, is as I said, still being discussed in the sense that we could do a reasonable - a reasonably average size one of about 890 feet per second or we could do a much larger one which would use most of the fuel in the DPS burn. The difference in those two burns is that for the smaller burn we would land at an elapsed time of 142 hours with a larger burn which runs closer to DPS depletion we would land at 118 hours, and you wanted me to relate that to -

SPEAKER The midcourse corrections.

SPEAKER The midcourses - well, the way we plan and target the burn we don't expect to have any but with the

END OF TAPE

LUNNEY size one of about 890 feet per second or we could do a much larger one which would use most of the fuel in the DPS burn. The difference in those two burns is that for the smaller burn, we would land at an elapsed time of 142 hours; for the larger burn, which runs closer to DPS depletion, we would land at 118 hours. And you wanted me to relate that, too.

QUERY The midcourse correction.

LUNNEY The midcouse correction. Well, the way we plan and target the burn, we don't expect to have any but with the shorter burn or the longer return time, we would have a considerable amount of Delta V available in the Lunar Module to correct it with the larger burn and the shorter return time, we would have less than that - on the order of a couple of feet per second in the LM descent propulsion stage.

SPEAKER We have about three questions in the second row we'll pick up.

QUERY Can you tell me where Fred Hays slept during the night and can you also tell us if the ground controllers ordered the two LM pilots into the Lunar Module last night or did they go in on their own?

LUNNEY To the best of my knowledge, Fred slept in the Command Service Module, probably on the couch or maybe on the floor. I don't think that we had to order them into the LM last night. I think as the situation was stablizing in the Command Module and we knew that we had the kind of problem that we did, I think they were on their way when we finally got around to talking to them about it. As a matter of fact we were just picking up with the procedures to activate the LM and I assume that they were on their way with the hatch work by the time we got to talk to them about the procedures.

QUERY When you send them up the information for that small burn last night to get back on a free return projectory, the kind of information usually includes a weight figure for the spacecraft, and that has obviously changed because of the venting. How did you know what weight to give them and how are you going to handle that problem on this big burn?

LUNNEY Well, the weight that you're talking about is the weight of the total Command Service Module. The purpose of giving that number is to have the guidance system do the most accurate job that it can in guiding the burn. Now we have a number of people who try to make that number accurate to the nearest ounce, but in all truth, the guidance system can perform quite properly even if it's off by a large amount - several hundred or several thousand pounds. So

LUNNEY whatever we assumed about the weight when we send it up, it really wouldn't make any difference to the burn.

QUERY Is it right to assume that whichever of these TEI burns that you do, you will have reacquired the spacecraft after it's passed behind the moon?

LUNNEY Yes sir. Let me say one more thing that you have just indicated. These burns will be performed after we go around the moon and on the front side. Now they won't be conducted in the usual TEI fashion behind the moon. They'll be conducted about 2 hours after acquisition as - after they come around. Okay.

QUERY Could you tell us please whether there'll be any private conversion with the crew and whether any are planned?

LUNNEY There have not been any and I don't know of any that are planned.

QUERY Do you gain any flexibility from the fact that the ascent propulsion system is there. Does that enter into your contingency planning at all?

LUNNEY We could use it. It's a more difficult task than the burning the descent stage. Hal, you want to talk about it any more?

HAL Yeah. Right now with the ascent propulsion, we have in the neighborhood of 720 feet per second Delta V capability, but to utilize that you're going to get rid of the descent stage which we don't want to do. Now we do have adequate margin in the DPS right now. We're not really entertaining any idea of using the APS, but the capability is there if we need it.

LUNNEY APS is the ascent engine.

QUERY If you do the super fast return, where would the splashdown approximately be?

LUNNEY Tom.

SPEAKER What was that question again?

LUNNEY He wants to know where we would land if we came back with the 118-hour time.

SPEAKER Okay. The longitude is about 179 East and the latitude is about 1258 South.

LUNNEY Let me ask General Jones to comment on that, too. As to what his posture would be.

JONES Well, in that particular case, as you will recognize, it's just a few hundred miles west of the normal landing point in the position of the Iwojima is such that we can be positioned between - well in the center of several of landing options. And at this point and time we see no -

END OF TAPE

SPEAKER Thank you very much.

SPEAKER You could ask General Jones to comment on that too, as to what his posture would be.

SPEAKER Well, in that particular case, you will recognize, it's just a few hundred miles west of the normal landing point, and the position of Iwo Jima is such that we can be positioned between - well in the center of several landing options, and at this point and time, we see no problem in being able to reach the landing point ahead of landing. And by the same token, we can cover with normal aircraft dispursal from Hawaii or through Pago Pago, if necessary.

QUERY Are you still contemplating a splash down in the Atlantic area, and could you name the nations in that area that have offered to assist if necessary.

SPEAKER Well, I guess we're considering it, but it is probably on a pretty low priority. And I know that the recovery folks have been assessing what is there. General Jones, can you say anything about that?

JONES Yes, we've - we have, of course, aircraft at Ascension. We could not have a trained recovery ship in all areas of the Atlantic, but we could cover the landing with HC130 type aircraft, and there is no reason to expect that we couldn't have fairly quick access by surface ship, but we have no specific deployment or surface ship in the Atlantic, or south Atlantic.

QUERY I have 2 questions. First, Glynn, I'm still a little confused over why you are using the LM for this burn as opposed to the service module, and secondly, is the possibility that a meteorite hit could have caused the situation that you described earlier.

LUNNEY By this burn, Roy, are you referring to the one coming up or the one we just did.

QUERY Right.

LUNNEY Well, the reason we want to do the burn with descent engine, at this stage of the mission, is primarily that we don't want to do it with the service propulsion system. We've had a problem, probably a physical rupturing kind of problem, in that service module area. To attempt a burn would be to deal with an area of the vehicle that wasn't as completely clean as we normally do this service propulsion burn - what I'm trying to say is, something else may be wrong in the service module area. In addition, it would take power out of the batteries, which are used for entry and landing, in order to accomplish such a burn. We can transfer a certain amount of power from the lunar module, but that lunar module, of course is critical. We can transfer 15 AMPS, but 15 AMPS doesn't do you much good at all when you're talking about powering up a control system and gimbal motors to do a

LUNNEY service propulsion burn. So for both of those kinds of reasons, we are going to stick to the descent burn. And you asked me a second one?

QUERY The second question was "Could the situation have been brought on by either a meteorite or micro-meteorite. I just realize that's conjecture -

LUNNEY I guess it's conceivable, but based on the fact that cryo pressure, that is pressure in the cryo tank, started to go up, reached what pressure it should have relieved at, and then went down to zero. My personal opinion is that that probably has not occurred, but that again really remains to be seen.

QUERY On your priority list of mode of returns, where does your free return come in without a burn -

LUNNEY Free return is what we have right now. In other words, with no further burns, we are on a coast trajectory, which, with accuracy that we can track it, will return to the earth and land in the Indian Ocean. Our only purpose in doing further burns now, would be to improve both our landing area and our landing return time, in other words, the free return time lands what at 151 hours GET in the Indian Ocean. And with the vehicle being well, the lunar module being well, I think we would choose to improve that situation. But, not being able to do that, we have established by the burn a few hours ago, the situation where we are returning to the earth, and we wanted to establish that.

SPEAKER All right. We're going to be able to take just a few more.

QUERY You said you could get 15 AMPS out of the LM back in the command module. Is that sufficient to power up the optics.

LUNNEY Yes.

QUERY Do you think then that you will use the CSM optics to try to have better angles?

LUNNEY Yes. We are writing a procedure and having one available to use the CSM optics either through the route I described or possibly even out of an entry battery on board the command module, in order to possibly check the results of the program 52, which is the alignment program that the pilots will do when they go in

END OF TAPE

SPEAKER The route I described or possibly even out of an entry battery on board the command module in order to possibly check the results of the program - program 52 which is the alignment program that the pilots will do when they go in the shadow of the moon. However, at this time, that possibility is exactly that. We are considering using that system with that technique to check the alignment results and we have every confidence that the alignment itself once we get in the shadow of the moon will work out fine in the Lunar Module. And I should say one more thing about the 15 AMPS. If we really return at the end of the flight and find that we do have the electrical margin in the LM we can charge up the batteries in the - in the Command Module - the entry batteries. One of them is down I think about 22 AMP hours out of 45 or 50. We could charge that battery back up, if we, indeed, found ourselves close to entry with a comfortable margin on the LM.

SPEAKER At this point in time where is your most serious concern to bring the crew safely home? Is it in what area of hardware or consumables or in your opinion where is the most serious area?

SPEAKER I guess the only way I can answer that is in 70 some hours we have to go, I really couldn't pick anything that was more critical than anything else, but I think it's the time factor now that we're just going to have to watch and be sure that we continue to operate the vehicles in such a fashion that allows us to live and operate effectively that long in the Lunar Module or else we're going to have to go in the Command Module and start using those batteries which we don't want to do.

SPEAKER General Jones can Iwo Jima reach the landing area - the 142 hour landing area in time to meet them?

SPEAKER I'm not sure - well yes, we can reach the area that have been mentioned in terms of planning. It is now somewhat south of that but it'll move to now is moving toward a position which is - will about split the difference between the two landing areas that have been mentioned. Not - not - not the free return - not the free return area but the areas in the mid Pacific.

SPEAKER I'm speaking of the one landing at 142 hours GET which is something like 600 miles south of Samoa as I've plotted the coordinates.

SPEAKER Oh, I'm sorry. It'll be able to reach that.

SPEAKER Glynn, how fatigued are the astronauts, and how much rest are they likely to get?

SPEAKER Well, I guess you can tell as well as I from the sound of their voice, I think they've had a long day. This actually started to happen about the end of their normally planned day, yesterday or last night and as everyone can tell we've been working at a fairly busy pace since that time. We do have some sleep time or rest time scheduled for them and I think they'll take advantage of that and continue to perform. I'm sure they'll be glad when the next burn, the one at 79-1/2 hours is behind them because they'll give them a little more opportunity to relax, and we'll just see how they sound as we go along.

SPEAKER This is going to have to be the very last one. This has been a very long shift for these men.

SPEAKER Glynn when do you have to exercise these options. How much more time do you have to mull over all the problems and decide one way or another what you're going to do?

SPEAKER As you would expect, and I'm sure you who have covered the flight, know we like to be sure that we've thought out all options as long as possible, but I would suspect that within several hours of the planned burn we will have to makeup our minds what kind of a burn we want to do and then concentrate on that, as a matter of fact, a number of times last night we had a number of problems but at some point you have to stop considering all the options and stick to getting the one thing that has the highest priority, getting that done, like securing the Lunar Module and getting it ready to take care of the pilots and I think we're going to decide several hours before this upcoming propulsion opportunity and that we're just going to press on fairly single mindedly with that approach.

SPEAKER Thank you very much.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

CHANGE OF SHIFT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 14, 1970
4:45 PM CST

PARTICIPANTS:

Gerald Griffin, Flight Director
Charles Deiterich, Retrofire Officer
Jack Riley, PAO

APOLLO 13 CHANGE OF SHIFT BRIEFING, 4-14-70 CST 4:45P 23A/1

RILEY Okay. We'll go ahead and get started. This afternoon we have Gerry Griffin, the flight director on the gold team and his retrofire officer, Chuck Deiterich, D-e-i-t-e-r-i-c-h. Jerry.

GRIFFIN Okay. I didn't have an opportunity to go over Glynn Lunney's press conference that he had after the last shift. I'll try not - I'll assume that he had told you everything that had gone up - up until the time that the gold team came on this morning. At that time, I guess the biggest test that we had yet to do on our shift was to really get nailed down for sure what maneuver that we planned to do, post pericynthion at the moon. There was several options available to us that we had talked about and I am going to assume that Glynn gave you most of those. We - I'll suffice it and say right now and I'll answer questions on it later if you have them, that we decided to go with the PC plus 2 abort of approximately 850 feet a second. Puts us back in the Mid Pac at 142 hours. Now in doing this we're going to maintain the service module which was an option that we could have looked at, by dumping that we could had done a much larger burn and gotten back approximately 24 hours earlier, although there are some tradeoffs there that were - we chose not to make. So once we made that decision in the - the rest of the shift was primarily involved in getting down to the details of the nitty gritty of the checklist of what to do in order to get that burn off. Well one of the first problems that - as you can well imagine is trying to align the platform. Now the crew has been unable to see stars although I understand they just now said they had seen some in the daylight. They've been having trouble seeing stars in this dark configuration in the daylight so we looked at ways that we might could align the platform by some other method. So there is an option available to us using the earth and the sun that we were prepared to use but prior to using that we said, well, first of all do the check of the optics - well with the optics, the AOT and check the alignment of the platform. Now that check turned out real well. It indicates that the platform is aligned still within - in the ballpark of probably a half a degree where the desired reference is. We made that check and as a result of that, we're not going to do any further alignment prior to the burn. We will be doing, when they go into darkness, behind the moon, we will give them an AOT star. That's an alignment optical telescope star to look at, to verify one more time that the platform is indeed aligned very closely to where we want it. Chuck maybe a little later could tell you how sensitive we are there. We can accept some misalignment in this burn

GRIFFIN - and still be within tolerance. And that's what we would have had with the - we had initially established on the sun check a one degree plus or minus, one degree error that we would be willing to live with. After we did the sun check, he's already back in to the burn attitude now. He'll be doing PTC every hour, 90 degree roll until, I'm not quite sure the time, but it will be sometime prior to going behind the moon. He'll go ahead and stop in burn attitude and get ready for this AOT star check. The white team that Gene Krantz is leading now is going through some very detailed mission rules, procedures type of things involving monitoring of the burn; what rates or over rates or attitude excursions to cut it off on. Reviewing all that logic and since we haven't really previously looked at the details of this type of burn to the degree now that we've got the time to do. So, we're on a trajectory now that the point of closest approach to the moon is 135 miles. That numbers holding very solid. We are still on a free return of what we define as a free return. The last figures I had from Chuck said that at 90 -

END OF TAPE

GRIFFIN - on a free return, of what we define a free return. The last figures I had from Chuck said that at 90 hours we could do a four foot per second RCS maneuver and put ourselves right back into the free return spot that we were shooting for. So the burn that we did last night was a very good one, evidently. And the platform evidently is performing real well in the LM and the drift rates and so forth that we've loaded in the computer, the compensation factors must be very good in order to get the sun check pass the way we did. I'm sure somebody is going to ask for the LOS times. The latest we've got - I'll go ahead and give those now. The LOS, AOS and the burn time. We'll lose the signal at 770821, ground elapsed time. We should acquire at 773310. The burn is scheduled right now at 792740 and the delta V of that burn is 848 feet per second. As you can well imagine, we looked at tradeoffs after this burn - what we've got left in front of us after that. Of course, the prime thing to drive that will be our analysis of the consumables situation onboard the spacecraft. Present indications are that if things hold the way they are, we'll have no problem making the 142 landing. Our most critical consumable is the water and we expect as soon as we make this burn, we're going to power down to an almost minimal level. There's a couple of things we could do to get a little bit more power out of the spacecraft but we won't do those unless we have to. And that involves duty cycling the COMM and some things like that rather than keep the COMM up for the whole time. Right now, we're going to cut down to about 17 amps which will keep all - at that level we'll have the ECS system fully operational. The suit, the fan, the glycol pump. Will also have TM and voice constant. And we expect at that rate, we expect that the water usage, predictions are that we will be able to get past 142 hours without using any supplemental water out of the PLSS's or out of the command module. But that is still an alternative available to us. We can use some water out of the PLSS or both of the PLSS's and we can also get some water out of the command module and don't ask me how much. I forgot. I forgot to check it before I left. I think that's about all we've got. If you've got questions concerning trajectory and the options available to us, I'd rather Chuck answer those questions directly. He's got the numbers and we do have some options available to us that we will be looking at.

QUERY Do you have a timeline yet in which point you'd jettison the LM and service module?

GRIFFIN We've got that in a preliminary fashion, Paul. Right now we're planning to jettison the

GRIFFIN - service module at 2 hours prior to entry interface and to get rid of the LM at approximately 1 hour prior to entry interface. Those numbers are subject to update as they - the techniques for doing all that is being gone over right now by the mission planning and analysis people, the flight control people and the flight crew people for the detailed procedures and how they do that. So those numbers may change but that's the order of magnitude on what we're talking about.

QUERY Well, does that mean you're going to use the platform in then LM to scamper back and kind of gage the entry angle and burn and hold onto it to the last minute?

GRIFFIN No. We'll bring the CSM platform up for a normal entry and we will be over into the CSM - it won't be a case of running over to the CSM at the last minute. We'll be over there plenty early enough to make the timeline comfortable.

QUERY Gerry, are you running these abort procedures on simulators right now and if so, could you tell us who's doing it, and where they're doing it?

GRIFFIN We've run the simulators both here and at the Cape and at the contractors continuously ever since last night. I can't tell you exactly who is at every place. I know Gene Cernan, Dave Scott have done a lot of work for us here. I think Dick Gordon spent some more, of course, at the Cape. We're running - we've tried to simulate virtually everything that we've had the crew do that is non-normal that they've done and we've proven most everything that we've been able to run on the simulator prior to passing it up to them. Then there maybe some details we haven't done but at least we've checked the feasibility of everything we've done and will continue to do that.

QUERY Can you give us some information on the crew's status and how many hours of sleep that they've had and how they feel and so on?

GRIFFIN I can kind of tell you what was scheduled. I don't know how much they got because we did the sun check and I know Jim Lovell was up a little earlier than he was supposed to be. But we had scheduled, I think about a 6 hour sleep period for both Jack Swigert and Jim Lovell. And as I said they were up a little bit early - or at least Jim Lovell was up a little early and I imagine Jack was too. We haven't quizzed them as far as status. They sound okay to me. I'm sure this shift may get into that eventually. There may be a crew status report scheduled but we haven't got a detailed sleep report or anything yet.

QUERY How far will the spacecraft be from the moon when the burn is performed?

GRIFFIN Jack, help.

RILEY That's pretty tough to answer. I really don't think I have the data here but it will be past the front side of the moon, I'm sure of that. It will be 2 hours past the closest approach to the back of the moon, so it will be out from the moon probably some several thousand miles and out to the side.

QUERY Won't it - less between the earth and the moon, is that what you mean?

RILEY Yes, but of course it will be closer to the moon but it will be out distinctly in front of the moon before it'd go into burn.

QUERY All right.

QUERY Several thousand miles?

RILEY Yes I'm sure at least.

GRIFFIN Okay. Let me briefly for those of you who didn't hear, he was asking what we plan to do at the platform after the burn and then how we realign it? Really what he said. We plan, yes, to turn everything down after the burn. The exact procedure for how we're going to establish let me call it a pseudo PTC. We haven't completely zeroed in on yet, but what it will amount to is - we'll do something like stabilize the vehicle and maybe start a slow roll rate and then turn everything off. And then the vehicle dynamics somewhat unpredictable because of all the slosh problems that you have with that much propellant onboard. But we'll just let that go and drift until we had - if we had to make a subsequent maneuver, then we would repower DLGC and the IMU in the LM and we've got some options available to us there. Probably, what we'll do is do this earth-sun alignment if he can't see stars in the AOT and we do an earth-sun alignment at least get ourselves to a P-51 status and maybe try the AOT again on some stars. If you still couldn't see it, then we do a P-52 using the earth-sun and that should give you - yes an alignment to a half degree. Now there's some other options there, you mentioned one, you could power up the command module and align its computer and then do a dock to line like we did last night. But of course that takes power out of the command module which we don't want to do unless we have to. But that is another option available to you.

QUERY All right.

QUERY Gerry, what is the rational behind getting rid of the service module first and then followed by the lunar module?

GRIFFIN I think it's probably because we'd have to push-pull with the service module and only do that earlier -

RILEY The point is as the normal function of the service module, jettison logic won't work and the service module won't jettison itself so we have to use the LM to actually get away from the service module and then we plan to use the pressure in the tunnel to blow the LM away from the command module.

GRIFFIN A la Apollo 10.

RILEY The point is - all these things will be done in non critical directions for quarter control. In other words we won't change the conditions at entry. Just about 2 or 3 miles of misdistancing as we come in. So in other words, the LM will be separated in distance but the entry flight path angle, the command module will be relatively unaffected.

QUERY Can you give us any examples of the kinds of tests that were run in these simulators and what kinds of things you learn from these tests?

END OF TAPE

QUERY - simulators and what kinds of things you lear from these tests?

GRIFFIN Well we did - we simulated a dock DPS burn both with the service module on and off. We did some earth-sun alignment techniques. We tried different attitude control modes using either the hand controller of the ACA in the LM or using the TTCA that's translation controller in the LM to evaluate those different handling techniques and qualities. Let's see. We've done some - this thing I mentioned a while ago about establishing PTC then turning everything off. We've done some work on that. I haven't seen the results of it but I know it's going to be run this afternoon. That's about all I can think about right off.

QUERY Was there anything special you've learned from these - that something that just wouldn't work that you thought might otherwise work in this kind of situation?

GRIFFIN I can't tell you of any big suprises we ran into. I know we found out that it was a little quicker to move the vehicles around using the translation controllers opposed to the ACA. Although, you could use a little less propellant using the ACA so we learned a little more about that tradeoff and we told Jim to use the one that was most comfortable to him, if you remember, when we did the sun check. So - no big suprises through any of those tests.

QUERY Jim Lovell made a rather cryptic remark concerning the possibility that Apollo 13 may be the last moon mission for a long time and the reception was such over the radio, we didn't get anything but garbles afterwards Or for that matter, just immediately beforehand. And I was wondering if he made any further comments concerning this particular comment and if he elaborated on that theme at all and if not, what you think he may have meant by this statement?

GRIFFIN Well, I didn't hear any of that. I've been in the control center since 6:30 this morning. I wouldn't try to speculate on what he was saying at all. Why don't you ask McDivitt. He'll probably be around. I don't mean to avoid your question. It's just that I really don't know. I don't have any idea of what he's talking about.

QUERY We keep hearing that - the object of all the saving of power - is to save power for the command module on reentry. What is the margin that you have for that?

GRIFFIN Gee, I can get that for you. I

GRIFFIN - think right now we're carrying at the latest time, about 96 amp hours capability in the command module. And the nominal entry is on the order of half that or a little less, 40 to 50 amp hours. So, we've got a margin of about twice of what we require in the command module. Do you want those numbers any closer for you? See me afterwards, would you? Talk to the query desk and they'll get it for you.

QUERY What is the duration of the burn and will this quick re-entry increase the re-entry speed?

GRIFFIN I don't know what the length of the burn is, Mark. They were working on the different - I know they're going to ullage for 5 seconds and then for 10 seconds and then 5 seconds at idle. You've got the whole burn time? Good

RILEY Yeah. The burn is about - plus or minus a few seconds, 4 minutes and 19 seconds long and it will be 10 seconds at 2 quad ullage prior to burn. The burn is basically pointed towards the earth. It will speed up the entry conditions as oppossed to the pre-return trajectory.

QUERY Speed them up to what?

RILEY Okay. This burn will put us at roughly 36,210 feet per second as oppossed to - I don't know. I thought I had it. I don't have it but it was somewhat less than that. Probably 100 feet per second less, not much. Didn't speed it up much.

QUERY Just a very small amount?

RILEY Yes. This, in fact, we've entered it in higher velocities than this.

QUERY Could you give us some kind of a feel for what the situation is with the lithium hydroxide canisters, the numbers aboard and what the maximum operational period on what you have will be? And also how is the command module ECS handling the CO-2 up there. Is it cycling through the command module canisters or is it going in some other direction?

GRIFFIN Let me answer your second question, first. Now we're doing all of the scrubbing with the CO-2 with the LM system and we've come up with a procedure and I'm not sure whether it's been read to the crew or not. We've come up with a procedure where we can fix up the command module canisters and use them, flowing, we'll have to do some taping of hoses to these things and that incidentally is in answer to this gentlemen's question - is something else taht's being simulated. In fact, I imagine that's probably been finished by now but that's another thing thats been simulated here at Houston. In order to use the CO-2 canisters in the command module up as oppossed to using the LM system up.

GRIFFIN - Now at around 75 hours which I guess has just now passed a little while ago - 75 to 76 hours, the canister that's in the LM now would be, the primary canister anyway will be used and the plan was to just switch over to the secondary canister and stay with the LM system until after or with the LM canisters until after this burn, when we get things settled down. And at that time, we'll implement this procedure and based on that theye would be all kinds of - if that procedure works okay, they'd be all kinds of lithium hydroxide canisters available. I don't know the exact number but they'd be a lot more than we'd use. If we could use the command module gear.

QUERY (garble) Command module.

GRIFFIN Then we'd have to - we'd have to look at minimizing the usage there on the thing. I haven't looked at all the procedures that we would go to. But, I don't think, we're not out in left field even if we couldn't do that. It'd just mean that we would have to push those things probably a little further than nominal so the canisters themselves can turn around. It just means that the millimeters of mercury, the PC-02 would probably get a little higher than you'd like to have it but not to the dangerous level.

QUERY Chuck, can you go into a little bit of detail as to how you'll unload the service module since it can't do it itself? You said it would be a push-pull arrangement. Would you explain this just a little bit for me?

DEITERICH Okay. They're running relative motion studies for E contact, but basically we align the spacecraft with the LM pointed straight away from the earth. And they will yaw 45 degrees out of plane. Do 1 foot per second forward. Then do a service module jettison. Then 1 foot per second backwards. So now we have a velocity of 1 foot per second between the command module and the LM combination in the service module. And then prior to at 1 hour, prior to 1 hour, we'll put the LM in its jettison attitude which is also with the command module pointed out along the radius vector, Yawing 45 degrees out of plane and get out of LM. Seal it back up and with the pressure in the tunnel, pop it off and then come in and do the entry.

QUERY I'd like to ask a further question about water. This morning Lenny said that the water usage seemed to be settling down to a much more satisfactory rate. At that time, we had a figure around 2.7 pound per hour after - in the 17 amp powered down to configuration

QUERY and that, he said, would give us about a 13 hour margin on 142 hour entry. Now can you update those figures?

GRIFFIN The best we know it right now, that's still a pretty good estimate. The - We're going to have to just get down to that level, which is a level we really haven't been to yet, and really monitor the system before we know exactly what that rate is. But that's - that's a good estimate for right now. The step that Lunney gave you this morning.

QUERY Jerry, are there any special plans to try to recover the RTG or to track it?

GRIFFIN Yes, in answer to the tracking. Not to recover it. The LM should, as Chuck mentioned, or maybe he didn't, but the LM should impact somewhere like 5 to 600 miles uprange, about the place that the service module does. In nice deep water.

QUERY How long has the LM been tested on the ground under these powered up conditions that it's under now?

END OF TAPE

QUERY How long has the LM been tested on the ground under these powered up conditions that it's under now? Has it been tested for 60 - 70 hours full power?

GRIFFIN I can't answer that. Gee, I don't know. Two TV 1 ran for an awful long time, I know, in the chamber over here. That data is probably available. I can't give you an answer. I just don't know.

QUERY You mentioned the word sloshing before. During the course of this burn, are you satisfied that you know the containment of all the fluids in the SM so that there's not likely to be any large shifting of the CG during the course of that burn?

GRIFFIN Yes. That's one reason we do this ullage maneuver course is to settle all the liquids that are free floating, to settle all the liquids in the bottom of the tank. And as long as you keep a constant g on it, then, accept for the changes, CG just give you the propellant that you're burning out of the engine itself. We wouldn't expect anything. We didn't see anything adverse on the first mark so I think we got that problem. Okay.

QUERY You're going to adjust in the service module as you come in, as far as we understand that was the primary scene of the accident that occurred. Your telemetry systems, electronic systems, sufficiently good that you will be able to learn or to know exactly what did happen on this voyage at the end of it when you have cumped in effect the thing that you could examine.

GRIFFIN I would say, unequivocally sitting here right now, that we can tell you exactly what happened without - just from the data. But I would say this, I think the people in the program office are extremely good at taking data, not only here, but Huntsville and other places, in fact they amaze me what they can tell with it. I think we've got a real good chance after we get a real good close look at all the data to be able to put together, if not one, at least maybe two or three, most likely things that happened. Of course, without retrieving the thing, you'll never know exactly the specifics. But I think we can get the major events and from that determine what happened to the level that we'll need to. And that's because I have a lot of faith in the program office people that do that.

QUERY In line with that, Jerry, is there any new thinking on what did happen?

GRIFFIN No. It appears that something let go back there. Probably in the area of the cryos - in that bay - bay 4, I think it is. I'm not sure which - how it's numbered. But anyway, something let go and the cause and why

GRIFFIN it let go, I'm not even up on that. I'm not real sure what they've looked into, but something just came apart.

QUERY I'm harping on the platform this afternoon. Having the platform closed down, how will that: effect getting into your slot on reentry? Will they power it up, for example, for midcourse correction and -

GRIFFING You talking about in the LM?

QUERY Yes.

GRIFFIN Yes. We would power up the platform to do a midcourse correction. To get us back for a (garbled) control. Is that what you're speaking of? Or if only a bit that we wanted to speed it up.

QUERY You won't seriously have trouble getting in the (garbled) then?

GRIFFIN That's right -

QUERY They won't have trouble getting out of the corridor then?

GRIFFIN No. We don't expect any. And, incidentally, that's a good point. The corridor type control maneuvers that we make, are fairly insensitive to attitude errors. In other words, a gross alinement is good enough. So that's a point in our favor, which I'm glad we can say that now. But they're relatively insensitive to pretty large platform errors.

QUERY Would you explain exactly how you're going to utilize the lithium hydroxide canisters in the command module. Someone told me there's an engineer, or at least one man that's worked up some kind of cardboard adapter with tape and cardboard, and that they may be looking at something like this to use in the capsule.

GRIFFIN There is something like that and the reason I can't give you the details is because I didn't have time to go over it. I think Kranz was about ready to talk to them about that procedure. That might not even be talked about to the crew until close to this post-burn - or post - the time of the burn. So it does involve some rather crude - if you want to call it taping of hoses and canisters together. I'm not quite sure of the configuration. That was a problem that was well passed this days - this shift's activities - but I turned it over and let the other people work on it. We can find out what that is for you. In fact, if you'll listen to the air-to-ground, I'm sure you're going to hear it in the next hour or so or few. You'll hear the details of what they're proposing to do.

QUERY Jerry, are the astronauts eating the sandwiches out of the LM or did they bring some food over from the command module?

GRIFFIN I don't know, Louie. We havn't asked them about that. They're eating - I assume they're eating something.

QUERY Do you know what the present level of carbon dioxide is in the atmosphere and what they consider the danger level would be?

GRIFFIN Do I know what the - Did you say, do I know what the current level is in the atmosphere - the cabin atmosphere?

DEITERICH We gave that information to the query desk about an hour ago. We don't know. They know over at the query desk cause we passed that over to them. And I don't recall - -

GRIFFIN I don't know what the number is. You can find several answers on the second part of your question. It depends on the - I guess - individual tolerances to some degree.

QUERY Jerry, this morning there was some commentary relating to filling some bags with water just about the time they evacuated the command module. Can you tell us what that involves, how many bags there were, and what the purpose was?

GRIFFIN I didn't hear that myself. It sounds like probably what they were doing was putting water - we want them to take drinking water from the CSM, of course, and leave all the water we can in the LM for purposes of cooling. It sounds like probably what they were doing was taking water over to the LM to drink. And just taking it in bags so they wouldn't have to go over there to get a drink of water. That's the only reason I can think of. Taking it in bags over there.

QUERY Has Swigert been in the command module all the time since last night? And will they remain like this and if so, how do the two in the LM sleep. Are they standing up all the time for 80 hours.

GRIFFIN What we're doing here - we got one guy up all the time. Now Jack has had his night watch duty and the other two guys are sleeping over in the LM - or over in the CSM.

QUERY In the couch.

GRIFFIN Yes. So the guy that's awake, the people that are awake, are over - if there's two awake, they're over in the LM. Now Jack has been in the LM also.

QUERY Who ever is sleeping is in the couch?

GRIFFIN That's right. They're back in the CSM and I don't know whether they're sleeping in the couch or whether they're sleeping in the - under the couches, but they're somewhere in the CSM. Or in the CM.

QUERY On the burn, is it going to be a full thrust burn all the way?

GRIFFIN Well, Chuck will be able to comment on that. It starts out at low thrust and then goes to 40 percent and then goes to full thrust.

DEITERICK Yes. It's 5 seconds at 10 percent and 21 seconds at 40 and then the rest of the burn will be at full throttle.

QUERY Okay. And have you looked into the situation of an underburn or an overburn. Would it effect how would it effect things.

DEITERICH Yes. The RP moves, if I can call it the RP, moves from it's present free return in the Indian Ocean, moves across Australia to the Pacific. And During this time, if the burn wouldn't shut down any time in there, the RP would be at that position until we get a burn. In all this time, we're already no more than 5 feet per second from the corridor. So if we shut down, we can always get back to the corridor with no problem and a subsequent burn would be scheduled if, I guess, if we ended up on Australia.

QUERY And I know this is a way out thing - but this is sort of a way out mission. It's conceivable that you could have an underburn which would bring them in to an impact point on land without another maneuver.

DIETERICH That's affirmative.

QUERY And if you couldn't get the DPS started, what would you try to do. Use the APS or the RCS or what?

GRIFFIN You're talking about if you couldn;t get the DPS started at all? Oh, again.

QUERY A second time to have another burn?

GRIFFIN You've got several options too, that - you've got service module RCS in the CSM that you can use by trading off a little power off to do it. You've got RCS in the LM, yaw also could ascent feed - ascent propellant to those RCS thrusters to get quite a large maneuver. And you can use lift. That's also possible. You can use lift to move your landing point.

QUERY To go back to - -

END OF TAPE

SPEAKER - use left to compare your landing point.

PAO John Lanner.

QUERY To go back to that question of partial pressure seals too in to the command module again, is that continuously being monitored while Swigert is in there, assuming he may sleep there for 5 or 6 hours. I there something watching that - seal -

GRIFFIN Not in the command module while it's powered down because we've got the instrumentation powered down on the PCO too. It is active in the LM.

QUERY (Garbled) sleep.

GRIFFIN No, this is a meter. It's a meter that I'm talking about, there's a meter in the CSM that is powered down now so he can't, he's not sensing PCO2 level.

QUERY Well, if you can't sense PCO2 levels in the command module, are you permitting Swigert to sleep there

GRIFFIN Yes we are.

QUERY Or are you bringing him back to sleep and keeping it -

GRIFFIN Yes. We are permitting him to sleep there, and we've got a suit hose hooked down into the thing to create, down into the command module, to create a flow and circulate that same air through the LM system. So we're scrubbing both the command module and the LM with the LM system.

QUERY Okay.

GRIFFIN Of course, you know, PCO2 is a, is first detected by a stuffiness, you know, so, I mean it's not something that that's going to sneak up on you all of a sudden. It's a level built up. You get stuffy. So you might move the hose around and blow it in your face for a while, you know, to get some new clean air. If you see what I mean.

QUERY Gerry, assuming a good DPS burn, I say 150 sec - feet per second, right on the money, would you dump jetison the DPS right away, or hang on to it?

GRIFFIN Now wait a minute. Say it again Paul.

QUERY Would you jettison the descent stage, assuming a good DPS burn right, 850 feet per second -

GRIFFIN No. No.

QUERY - the lines, because of the water in the stage

GRIFFIN The water and the oxygen and -

QUERY Right. Okay.

GRIFFIN - and batteries that are down in the descent stage.

QUERY What's the total time they'll be on the consumables of the command module?

GRIFFIN When, from now until the end of the mission?

QUERY Upon reentry.

GRIFFIN We're talking about a complete power up somewhere around 2 hours prior to entry interface, just about

GRIFFIN the time we're getting rid of this service module. Now, we're going to have to start back, the checklist is now undergoing development, but we're going to have to start back prior to that so we'll probably start powering up the command module back in the area of 3 to 4 hours prior to entry, and so we'll partially be on some of those consumables as early as that time. However, we won't be fully up in the LM until, or in the command module, until we're pretty close to this 2 hour time period, then we'll be fully on the command module.

QUERY Is the reason for the burn on the front side of the moon have to do with communications or with the trajectory itself, or neither?

GRIFFIN Are you talking about the PC plus 2?

QUERY The DPS burn coming up tonight.

GRIFFIN Well, the reason for that is primarily that we plan this kind of burn for a case where LOI is not performed, but it may be a case where you go behind the moon with LOI being intended before and not performed. You've got 2 hours to do the support burn, so that's where we've done most of our abort studies from. It so happens that from LOI out to about PC plus 2 there's not much change in DELTA V required to get you out, and isn't change, it grows, and the further out you go the more it costs you to get back. But, it's primarily a case here where we can get it, it is pretty good trade off. We can see the burn from the ground. It's out on the front. It's a relaxed timeline in the LOI attempt case where you end up not going. It gives you 2 hours to get into the LM and power it up. That's why we, last night do you remember, we used what we called a 2-hour activation to get the LM powered up, and that's where that was developed just for this LOI case. That's the case that we trained a lot for that case too, so it, we got check lists written for it and so that's why we're using it.

QUERY When you do start to power up the LM, will one of the steps be to set up the platform in the LM and then transfer the reference to the CM platform, in other words, to reverse last night's procedure?

GRIFFIN No. Well let me say no. That set of procedures is now undergoing, after we get past this next burn and then we'll start looking toward the entry casing, however, exactly, not power that up. But, our best bet there is to, I think probably, and this is my own opinion, is probably just to do a cold start just like we were powering up from any other power down. That is do a P51 and a P52, using the CSM optics, and go right through the whole checklist.

QUERY Do you have an estimate on the entry velocity and how this might compare with the previous Apollo missions?

SPEAKER Yes. 36 210 and we have flown, in fact

SPEAKER one of the unmanned missions came back with 36 500 and I think one of the manned missions came back at a velocity higher and this is perfectly acceptable.

QUERY Yes. Still some question in my mind about when you will switch over entirely to the entry batteries in the CM, and how long you will be on those batteries and how much, how many ampere hours there are in the batteries now.

GRIFFIN I can't give it to you exact because we haven't gotten all the details worked out, but it will be on the order, if we're going to jettison the LM at 1 hours prior to entry interface, I would think that you're talking about a number of an hour and a half to two hours that you'll be fully on the command module batteries. Now, you're going to be on command module batteries to some extent prior to that, but I don't think you'll be fully powered up prior to that. So, that number will be available for you later.

QUERY Yes. Well, what surplus do you think you have in those batteries?

GRIFFIN Well, as I mentioned, we've got about 100 percent pad right now, something on that order. So, we can afford to use some.

PAO On the front row right here on the corner.

QUERY What chance have you got of let's say using the astronauts cameras or some other means of getting data about what happened, perhaps pictures of a rupture on on the outside of the service module, things of that kind?

GRIFFIN I would say virtually none. In order, that would be a very difficult thing to have to do. You'd have to jettison the service module and then you'd have to go after it to get a picture of it, and at that point in time we're of course, very interested in controling the corridor closely, and it just wouldn't be a good trade off. There - and I doubt the value of the pictures too. That's my personal opinion . You may see a hole there but that's still not going to tell you much. (Garbled)

QUERY Gerry, you said you came on around 6:30 this morning. During the day did it look like a tougher situation this abort mission coming back, or did it grow in complexity as you learned more and more, or did you get a feeling that it would be a - that it should level and it shouldn't be as really too rough.

GRIFFIN That's a good question. In fact, I might say one of the reasons it seems like, I'm sure to some of you that I'm uncertain about a lot of things that I should be more certain about. Actually, today was a case where we had an awful lot of options at the beginning of the day that we had to wade through, and as the day went on we weeded out some of the things that we said we weren't going to do, and when we finally got down to it, not that we're not still in a complex

CHANGE OF SHIFT BRIEFING 4-14-70 CST 4:45P 23E/4

GRIFFIN situation. At least, to me, I understand now, and I'm sure and I hope you guys are beginning to understand that the kind of plan that we're presenting here. We're a lot more relaxed, if you want to call it that, than we were at 11:00 o'clock last night for sure, and I can also say that from this morning too. But that's primarily because we've had time to work the problem and we've had time to look at the trade offs and the situation hasn't looked any worse to me today. In all effect, it's - I'm beginning the light a little bit, so I can see that we've weeded out some of the stuff that we were thinking about earlier. But that's one of the reasons, you just can't imagine how many different facets that we've looked at, maybe you can, but, it's impossible been impossible for me to keep up with all of them because I was primarily involved with just the flight crew and what we were doing right almost at the moment. I think that answers your question.

PAO Let's take one more and then Dr. Paine will be available for you ladies and gentlemen.

QUERY Gerry, you say that you are planning now for the crew to go over to the CM about 2 hours out before reentry. How far out could they reenter the CM and have enough consumables on board to reach earth safely in case something went wrong with the LM?

GRIFFIN I haven't looked at that. I would imagine that, and of course there's some trade offs here because you could power, not power some things up that normally would -

END OF TAPE

SPEAKER I haven't looked at that. I would imagine that, of course there's some trade offs here because you can not power some things up that you normally would in order to get more life time. I really don't know. I would put it out in the area of something past 4 or 5 hours, I think. But I don't know exactly where you would be limited because it would depend on - you could, for instance, trade off making a G&N entry and strictly decide to go with the EMS. Well, therefore, your not going to pull nearly the power with the EMS, or you could even power down the EMS and go with the constant G entry. These are some kind of winder ups, I suppose. So, there's too many trade offs here to really answer your question. It would be several hours away from entry interface, but I don't know how far.

QUERY The figure given in the book is about 15 hours on oxygen for all 3 men. And this has been used in some wire copy. I saw today that 15 hours was - Do you disagree with this, or is that too long?

SPEAKER No. It may be longer than that. We got -

QUERY What I'm really getting at is when do you feel that you will have again the capability of the command module as a backup system for the LM? Saying 9 o'clock Thursday evening, 15 hours before reentry. Would you feel at that time if you lost the LM that the men could get on board the CM, jettison the LM and come in safely from that point?

SPEAKER I think your in the ball park there. That's probably not too far from wrong.

SPEAKER Okay. Thank you very much. Dr. Paine is here and will be available for questions.

END OF TAPE

Apollo News Center
Houston, Texas

Change of Shift Briefing
Manned Spacecraft Center
April 15, 1970
12:35 AM CST

Participants:
Eugene Kranz - Flight Director
Dr. Anthony W. England - Astronaut
William Peters - Instrumentation Systems, LEM
Richard Thorsen - LEM Control Systems
John Mc Leaish - PAO

McLEAISH Okay. Now that we're on the air I should say that we have with us this morning members of the white flight control team. Flight Director Gene Kranz, to my left. I'll turn it over to Gene at this point.

KRANZ Okay. We've got your request this evening. Tony England over here to talk to you about how we intend to use some of the command and service module lithium hydroxide canisters. We have Bill Peters, the TELEMU, whose the man responsible for the electrical and the environmental systems - instrumentation systems in the LM spacecarft. And Dick Thorsen, whose responsible for the LM control system, propulsion, RCS and certain of the guidance systems. We picked up on shift at about 74 hours and 30 minutes elspsed time. The majority of our work for the first few hours on the shift was associated with modifying the crew checklist for the dock DPS burn we performed later at 79 hours and 30 minutes, roughly. Now these were a list that we developed actually, for a lunar orbit insertion abort. And as such, a majority of the checklist were available in the Control Center for a lunar orbit insertion type contingency. And our primary problem in modifying these checklist was to make sure that we used the minimum power to accomplish the desired maneuver as well as to make sure that we put them in proper sequence so that we didn't have any unnecessary long power up. At around 75 hours we got into a relatively long discussion of passive thermal control and I'll come back to that later on. And as soon as we completed that, we went into a review of the mission rules with the flight crew. Now we actually had a very short review when we talked a little about some of our guidance and control type rules, rules we used for attitude and rate deviations. During the period of time we were reading out their contingency checklist changes. Later on we came through with a relatively detailed checklist update. This took just about 45 minutes to get the checklist information up to the crew. Around 75 hours and 45 minutes we had provided the spacecraft the state vector and the target load for the midcourse correction maneuver, we were performing. And we went through a comsumable status and I'll come back to that later again. At 76 hours and about 30 minutes we went over the rules with the flight crew. Again the - we're being very conservative on this particular burn, because I think you are aware that if we did not perform the burn, we were on a free return trajectory and would splash down in the Indian Ocean at around 152 hours. So we wanted to set the limits for the crew monitoring of the burn very tight. In other words, we had to have a nominal performing descent propulsion system in order to initiate and continue the burn and if for some reason, the descent engine should start

KRANZ deviating in performance, we wanted to shut down the burn. Now we were doing this primarily because we could make a small midcourse correction sometime later on in the mission and bring us back to a free return trajectory. So we played that particular maneuver very conservatively. I believe you've probably got a transcript of the air-to-ground communications at that time so I don't think there's any need to go through all of the rules we read up to the crew. Now one of the items that was of concern to us as we entered the burn, was how good was the platform orientation. And we made two checks. One looking at the sun and the other one - that's using the AOT - and the other one immediately prior to the burn where we were looking for some kind of a bore site to make sure we were in the right attitude for the burn and fortunately we happened to find that the moon was on the commander's LPD. So through these two checks we felt that we had a very good platform alignment. And we had almost insignificant drift on the platform from the time that we originally oriented it just prior to the time we left the command and service module. I'll talk to you briefly. We reviewed that around 77 and a half hours we review the powered down checklist. And as you're aware much discussion ensued in getting this up to the crew later on. But our basic configuration gives us low bit rate telemetry from the spacecraft, S-band voice from the spacecraft. We've got a coolant loop up and operating. We've got suit fans on, we've got the cabin repress capability, we've maintained the RCS manual attitude control capability and we've got the caution and warning powered up in the spacecraft. At around 77:56 the S-IVB impacted. I have the precise time later on here. I'll look for it in my notes and I believe you probably got that word. At around 78 hours and about 15 minutes the crew started the powering up of the LM spacecraft for the dock DPS burn. The burn was scheduled and I'll give you the DELTA V's. The burn was scheduled for 79 hours 27 minutes 38 seconds ground elapsed time and the X component of the burn was 833 foot per second and the Z component of the burn was 213 foot per second. Now an effective DELTA V was somewhere around 900 foot per second. The impact time - we've got it from the site that was recording the transponder on the S-IVB was 77 hours 56 minutes 40.025 seconds. We gave the crew their final target load and state vector as they came around from the backside of the - -

END OF TAPE

SPEAKER We gave the crew there final target load and stay vector as they came around from the back side of the Moon at 78 hours and 19 minutes. And by this time the crew was well into their activation checklist and our electrical power mean was running about 40 amps. Previous to this time we had widened the deadbands on the digital AUTO pilot to conserve some reaction control system propellants. And about TIGN minus one hour we narrowed down the deadbands and kept the communications up so we could have high bit rate telemetry throughout this entire last hour to make sure that we had a really good spacecraft for the maneuver. After - at this time we went around the horn and made our decision on the initial LM spacecraft power down. And we advised all the flight controllers that we would start with the power down on the LM spacecraft at around cutoff plus about 15 minutes. We again wanted to make sure we had a good spacecraft post burn. And we wanted the system stable down before we started powering down the systems on board the spacecraft. We gave them a go for the burn at 79 hours and 18 minutes, and that's 79 27 40 approximately we initiated the ullage. The burn looked very good. In fact, it was an excellent burn. Our P current during the burn was around 50 amps, and the burn terminated roughly at 79 32. Immediately thereafter, we gave the crew their initial power down information to bring the majority of the spacecraft systems down with the exception of the communications system, and the guidance navigation system, because we had to keep that up to initiate the passive thermal control. The crew spent about 45 minutes getting into attitude for the passive thermal control on about 30 minutes to allow the rates to DAMP out prior to initiating the ROLL. The tracking in the burn came in at about 81 hours and about 15 to 20 minutes. And initial cut on the trackings said that we'd had a very good burn. Preliminary indications were that we perform a midcourse correction 5 at around a 104 hours elapse time and the DELTA V would be between 4 and 6 feet per second. It may turn out to be something less than that by the time we get more tracking in this evening. We have a long discussion on the lithium hydroxide canisters. And I believe Tony can fill you in on whatever questions you may have there. We got into the attitude for PTC at about 81 hours We gave the crew a total briefing on the consumables, and I summarize the consumables as they stood at around 81 hours, 24 minutes elapse time. Electrical system we had 1498 amp hours. This means that we must maintain a average load in the spacecraft at less than 24.5 amps. At the present time we expected to be able to power down to around 14 amps main bus current. We're running somewhere around, I guess 13. Is that right, Bill?

KRANZ We're running 12 to 13 amps right now. So looks like we'll start making some money in electrical power system throughout the night and throughout the next day. From a standpoint of water, we got 215 pounds usable. In order to complete the mission without going into some contingency procedures, like using plus water and connecting hoses over to the LM and command service module spacecraft to get at some of the water in there. We must maintain about 3.5 pounds per hour. To date we've averaged about 4.3, but that again was due to the relatively high current Loadings in the LM spacecraft we expected after the evenings up. And we've looked at the spacecraft and started to cool down. We'll be in the ball park of around 2.7 to 3.2 pounds per hour. We have considerable amount of oxygen. Now, we're using about .36 pounds per hour. We've got 44 pounds total as our best estimate right now, and that should give us 120 hours or more of oxygen. I believe the 120 hours is slightly conservative. From stand point of the reaction control system, we have around 49 percent usable in each of the systems. You probably heard the number 62 percent but actually about 13 percent of that is unusable. From a stand point of DPS if we'd have to come up for another burn. We got pretty close to 1200 foot per second capability there. We briefed the crew on the consumables, gave them essentially the same information I've given you right now. And we read the crew the communications procedures for the remainder of the night. If we get any bidding in the spacecraft or if we start to move out of our PTC YAW orientation, we may start seeing some broken communications. It has not happened yet. It seems we've got a good stable PTC. But if the communications should become broken, we may be able to communicate to them only 50 to 75 percent of the time. We gave the crew gross procedures they could use for selecting the antennas for us to allow us to communicate with them much more of time. That was about it we got off shift around 82 hours 30 minutes.

MCLEAISH Okay. Why don't we open up for questions, now. Please hold your hand and wait for the mike. This gentleman over here

QUERY Mr. Kranz can you tell us two things? Those reported what may be some new venting. Can you tell us about that? And could you tell us what sort of physical discomfort the crew is in? That's another one.

KRANZ From a standpoint of new venting, we had not been aware of any venting during our shift. As you're aware we had some problems in establishing our passive thermal control, although we finally established it, and it look good. And we thought we'd have problems in as much as we're using a very low thrust pulses on the RCS system.

KRANZ may have come from the sublemator in the LM spacecraft. So that is the only knowledge I had, now. They may have tapped something in the subsequent ship. When did that occur.

SPEAKER About the time you were changing, I think there was this report that they had seen some new gas and they were asking them from here. Rather it was residual from the original thing or rather it was new. Whether they thought it was new.

KRANZ I'm not aware of that.

QUERY What about the crew itself? Could you tell us what sort of physical discomforts they -

KRANZ I'd say the crew is probably reasonably uncomfortable right now, but they're doing an excellant job. I think if you take a look at the job they've done over about the past 14 hours. Particularly getting ready for this burn, this continual communications between the spacecraft and the ground. They're doing a great job. So obviosly whatever discomfort they have is not affecting their performance.

QUERY Too, that, especially Fred Haise had had very little sleep last 24 to 40 hours or so.

KRANZ I'm not aware of that. I thought it was we have -

SPEAKER Haise is standing watch now.

KRANZ I think Haise is standing watch now. I think he was resting throughout the majority of the pre-burn type procedures and postburn type procedures. And I believe Jim Lovell's the man that seems to be so much behind -

SPEAKER Haise is the watch now.

KRANZ We're trying to work out some kind of crew rest cycle right now to give them an adequate amount of rest between now and the possible midcourse correction at 104 hours.

QUERY A couple of questions. How much better off are you on consumables tonight than you thought you might be last night? And secondly, what does the flight plan call for in the next 24 hours?

KRANZ I'll answer your last question first. The flight plan for the next 24 hours is basically going to be passive thermal control, minimum activity and we're going to stay powered down as long as we possibly can. What was the other question you had? I'm sorry.

QUERY I was wondering about the consumables. How much better off than you thought you would be tonight?

KRANZ I think, at least from my stand point, I feel we're much better off than we were last night. I thought we'd have to maintain our bus levels at about

KRANZ 14 amps throughout the rest of the mission, but it looks like we have a bit more flexiblity. I think tomorrow we'll have a much better hack in this, because I think the key consumable now at the present time seems to be water. So once we get a hack to how much water we're going to use in the fully powered down state. Then I think we'll be able to give you a good answer, but from my stand point it looks a lot better than it did last night. Although, again, last night we had the capability of coming back. We just got a better margin to work with, more flexibility now.

END OF TAPE

SPEAKER From my standpoint, it looks a lot better now than it did last night. Although, again last night we had the capability of coming back. We just got a better margin to work with more flexibility now.

MCLEAISH Carl Abraham.

QUERY Could we have a rather detailed explanation of the tests that were run in the simulations with the lithium hydroxide canisters, and a description of how this hose is being attached or will be attached to a canistet, and particularly what hose that is? Where does it come from and what is coming through it?

SPEAKER - got that when he brought you over -

SPEAKER (garbled)

SPEAKER - one of our canisters.

SPEAKER This is our mail box. As you know, we use the lithium hydroxide to scrub CO2 out of the spacecraft atmosphere. Okay, I'll talk more directly into it. We have a limited amount of lithium hydroxide in the LM, and it would releive a lot of the pressure on the environmental control system if we could use some of the canisters - lithium hydroxide canisters from the Command Module. Actually, Jim Correale, over in Crew Support Division designed this thing, and it does an excellent job. What we do is we use the suit loop in the LM and this is the scavenging hose - the exhaust hose, if you will, from the suit, and we just put the lithium hydroxide canister on the end of it. It's not so easy to fasten this on there. We've used a data card out of the flight plan to make a structure so that the plastic cover here won't collapse on the end of the hose. The canister, itself is coated with Teflon, and none of our flight tape would stick to it, so we designed sort of a grid system that goes around it that allows us to add some things to it. We've had one of these running for about 3 hours over in the 11 foot chamber in Crew Systems, and it all indicates that it's doing a pretty good job. I understand that we have about 16 cartridges in the Command Module, and each one will have a lifetime of about 12 hours, and we'll be running two at a time. One of them on each of the suit loops in the LM.

QUERY I have a number of questions about the test and also about one condition in the spacecraft. Are we correct in assuming that they're still running at 5.5 psi in the spacecraft now? What was the pressure in the the absolute pressure and the partial pressure of carbon dioxide at which you ran the canister tests?

SPEAKER The canister tests isn't complete yet, and the last I saw, it: was just building up. I'm not sure but, I think it was 20 millimeters of water pressure that we

SPEAKER - were going to build up to in the tests, and we're not going to allow it to get above 15 in the spacecraft. The test isn't complete yet. It'll take several hours.

QUERY The other question was; is the cabin atmosphere in the spacecraft now at 5.5?

SPEAKER Yes. Go ahead, sir.

MCLEAISH Bill.

QUERY - 4.7?

SPEAKER No sir.

QUERY 4.7 - 4.8?

MCLEAISH Dr. Campbell.

QUERY What is the humidity situation at this time, and how do you control the humidity?

SPEAKER The LM has some water separators in the suit loops of the Lunar Module, and they are working and separating the water and controlling the humidity properly right now. There is no problem with humidity.

MCLEAISH Mark Bloom.

QUERY Gene, you've always been recognized as the LM expert, how would you - how would you classify the LM as a spacecraft that can get these men back to Earth. Could you say it's in good shape and how is your confidence factor compared to say last night at this time?

KRANZ It's interesting - Bill, I forget when we got started - gee, I think back in Apollo 9 we first started looking at the use of the LM as more or less as a lifeboat and fortunately although the exact procedures do not tailor the exact case we've got, we had looked at the utilization of the LM for an awfully long time so we knew what the limitations were. We developed to work around procedures whereever it was possible. I think the LM spacecraft is in excellent shape, and I think it's fully capable of getting the crew back. I think as we have found before, every time we have put the LM spacecraft through a test, it has always done much more than was guaranteed to do, and I think this is good case in point.

QUERY What was your confidence factor anywhere near this high last night about this time?

KRANZ Yes, it was - let me put it this way. Last night, I felt we were going to have a much trickier management problem on our hands. It is not the easiest right now, but I thought that the overall management of all of the energy, water, all of the consumables in the spacecraft, were going to be quite difficult. I think that one of the things that was very pleasing to me this morning - or actually when i got on shift around 12 o'clock, I guess it was, was

KRANZ - that we were still running at relatively high power levels that our consumables rates had steadied down to slightly less than what we had anticipated and we were also happy that we were pretty well off in the RCS systems. So, from that standpoint - I think we have a tricky management problem coming back, but I feel that we have a good handle on the situation and know how to manage it.

MCLEAISH Jack Jones.

QUERY You described the crew as reasonably uncomfortable, what is the discomfort besides maybe the tension? Is there some physical -

KRANZ No, I'd say that the primary discomfort would be from trying to rig up some adequate sleeping capabilities in the LM spacecraft. I have not had the opportunity - maybe Tony can answer a question on that - I really haven't looked into that in detail because our primary job has been managing the systems and getting ready for this burn. I would believe that it would be primarily in getting those guys into a point where they can sleep comfortably in there while somebody is moving around using the communications and making periodic checks on the spacecraft's systems.

QUERY You don't -

KRANZ - that's right they could very possibly be. I guess I ought to correct myself.

QUERY If they are testing those canisters set up, how are they handling this in the spacecraft at this time?

SPEAKER Well, it's not necessary to put this in the circuit until some time tomorrow. We're going on the secondary canister in the LM any time now. The CO2 level is getting up near 15, and we'll have - I believe it's 8 hours.

QUERY Is that right on the second?

SPEAKER We've got 3 additional secondary canisters and one more primary canister in the LM that - before we'd have to resort to something like this.

SPEAKER But we'd planned to use this after this secondary canister, so in about 8 hours, we'll probably try to have something like this working so that we'll still have the tried and tested systems in the LM if something should fail in this.

QUERY You'll have the system for the next 8 hours that is normal, and then you have to go to some make-shift or -

SPEAKER Time we will - to save the systems we know work.

SPEAKER Sort of like keeping something in reserve. I believe that they've got a total of 44 hours worth of good canisters in the LM spacecraft now. What we want to do is to find out if this procedure is going to work. Whether it's going to scrub the CO2.

SPEAKER Right. Rather than wait until all 44 hours are gone then plug this in and find out that there's something wrong, and we won't have time to find something else.

QUERY My question is: you do have to somewhere before they get back revert to some - I don't know if emergency is the word - but some other than normal system, is this correct?

SPEAKER Yes. Now, you've got one option Bill, that you might want to talk about briefly. It looks like we may have an excess of 02 in the LM spacecraft. It could go into a cabin enrichment procedure to start washing the CO2 overboard.

PETERS Yes, that's true.

SPEAKER That is always an option that we've got available. So really we've got two options.

QUERY Have the doctors been telling you about the physical condition of these three men in the last 24 busy hours, and has it been necessary for them to take any pills or anything to stay awake?

SPEAKER I really don't know. I think the crew status report comes when the crewmembers are awakened in the morning, if I remember right from the flight plan. That's right in the front of your flight plan. I didn't have any crew status reports in my shift, and the doctor did not indicate that they have any problems. That was basically the status we had when we left.

MCLEAISH Paul Resser.

QUERY Gene, and perhaps Dr. England, I'm sure that y' all gained a picture of possibly of what life is like up there. Now, -

END OF TAPE

SPEAKER - but the doctor did not indicate that they had any problems. That was basically the status we had when I left.

MCLEAISH Paul Reiser.

QUERY Gene, and perhaps Dr. England, I'm sure you all have gained a picture of possibly what life is like up there, and I'd kind of like for you to share it with us. Are they - there's some confusion about where the astronauts are spending most of their time. Are they all huddled in the LM. What are they wearing. Are they having to dodge some foods because of the salt content would make them crave water. This sort of thing. Any observations like that would be useful.

KRANZ They seem to be spending one fellow in the command module all the time, two in the LM. The guy in the command module should be sleeping, but these fellows are pretty diligent and I'm beginning to sense that they're taking a lot of pictures of the moon and the earth, and they're even doing some studies on some of the particles that are flying off the service module back there. I don't know whether that answers all of your question. I wouldn't describe them as all huddled in the LM. They're pretty busy. Yes.

PAO Paul reiser.

QUERY Are they dodging certain foods because this would make them crave water for instance.

SPEAKER I don't know. I haven't heard anything like that.

PAO Joe.

QUERY What garments are they in? Do you know? Are they constant wears?

SPEAKER Well, they'll be in the constant wear garment with their coverall.

PAO Jim Long.

QUERY Two unrelated things, one, is there any way for the medics to know what their condition is. Are any of them at any time in the biomed harnesses? Has anyone come up with a way of finding put what the cause of this explosion or accident is?

SPEAKER To answer your first question, yes, we're looking at biomed data tonight on, I'm really not sure, I think its Fred Haise, and what we're interested in there is to just monitor his condition as function of, I'd say a backup measurement of any possible CO_2 buildup in the spacecraft. Now, we don't expect that but we are monitoring it. The problem we've got there is that since we are operating in a low-bit rate mode, with the spacecraft on the OMNI's, we do lose some signal margin there, and if this turns out to be a problem later on in the evening we'll probably switch off the biomed instrumentation, because what it amounts to, it wipes out

SPEAKER the rest of our other instrumentations at the power levels we're at. From a standpoint of what's being done to try and determine the cause of the explosion, or whatever the problem was that happened in the service module, equipment bay in the area of the cryo tanks and the fuel cells, I really don't know Jim. It's pretty much tough staying on top of our job without worrying about what happened many hours ago. Now, we are looking pretty deeply into the entire status of the command service module and we're trying to come up with, tomorrow for instance, we expect to read up to the crew more or less a standard configuration we want them to go to for all of the switches, circuit breakers, and everything in the command and service module. We're looking for a - to see if we can make a test to verify whether the main B bus has any problems associated with it. And then tomorrow afternoon, we're spending a large amount of time looking at such things as reentry checklists, and particularly from a standpoint of establishing a timeline for separation form the service module and subsequently separation from the LM spacecraft prior to coming into our entry interface time. So, the primary work we've got going in the command and service modules, to make sure we've got a good one, and do whatever troubleshooting we feel may be necessary and then to really shake down those procedures.

PAO This gentleman here.

QUERY Can you explain this collecting of water they're doing in the plastic bags, where they're getting it or what they're going to do with it or -

SPEAKER Yes. I believe that's - they're collecting the water for their drinking and food purposes from the service module potable tank, and they're just using their normal procedures. You remember they use to have this technique they use for separation of the H2 that maybe in the tanks from the water. So, it's just normal water collecting procedures in the service module, or in the command module.

PAO Okay. Let's take Carl Abraham and then 2 more questions. We're going to have to break it and let these gentlemen get some sleep.

ABRAHAM We were told before the burn that two people would be in the LM and one would be in the command module, and later on I got a part of a quote which seems to indicate that maybe that wasn't the case. This quote was "He's the only CMP that's ever witnessed a DPS burn sitting on the ascent engine can.", which would lead one to believe that all 3 of then were in the LM at the time of the burn.

SPEAKER Yes. This is an interesting item. Yes. All three crew members were in the LM at the time of the burn and we had computed on our DPS gimbal trim position for the man in the command and service module spacecraft which caused

SPEAKER a center gravity movement that caused the engine gimbals to compensate for the fact he was in there so, we saw that excursion and then once we found out that, yes, we had a CMP in the LM spacecraft we knew why the excursion.

PAO Okay. Let's take Arch Schnid- oh - followed up the phone call.

QUERY Would you care to speculate why all 3 of them got together in the LM at that time?

SPEAKER I think the third man wanted to see what was going on.

PAO Arch Schnider and then John Harris will close it.

SCHNIDER In the discussion of food, about mealtime, was there some fear of contamination of some of the food in the command module?

KRANZ Not to my knowledge. I didn't hear any. Tony, did you, or Bill, or Dick?

SPEAKER They were trying find something that would use less water.

KRANZ Is that right?

SPEAKER That's all.

KRANTZ Now, at the time they were going into mealtime we, as you were aware, were having some problems in establiching our passive thermal control, and that became an end in itself for about a half hour period there, and generally during that periods of time a handover either to the assistant, generally to the assistant flight director, to be following the normal course of the mission.

PAO Okay. Let's close it with John Harris.

HARRIS What single factor if any, has given you the most concern at this time?

KRANZ Gee, it's probably one that, I'd say the one thing if anything, is bothering me is a large amount of checklist changes we're making. That's why we're always trying to stay several days ahead of them and verify them in the simulator, because once you've got tried and true procedures you like to stay with them, and I think we've gone through the major portion of the checklist changes now, so I think we're pretty much over the hump from that standpoint. It's always nice to be operating in a mode where you've used, where you're actually using procedures you've used before and that's a good way to be.

HARRIS By checklists, do you mean reentry checklists? Does that mean the reentry is giving you concern.

KRANZ No, no, no, no, no. I'm saying all the checklist changes we have made up to date, from a standpoint of discomfort, that was not the major item because I think we thought we had a good angle on how to manage the systems now, and how to go about making this burn. We'd made long dock DPS burns, for instance, back in the Apollo 9 mission. So, we

KRANZ were pretty confident of those procedures.
SPEAKER Thank you very much Jim.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

CHANGE OF SHIFT BRIEFING
April 15, 1970
10:09 AM CST

PARTICIPANTS

Milton Windler, Flight Director
Tom Weichel, Retrofire Officer
Doug Ward, PAO

WARD I think we're ready to begin. This is the flight director for the maroon shift on my left, Milt Windier, and our retro officer Tom Weichel. Milt.

WINDLER Okay, we might start off by giving the status of the crew. Fred Haise is asleep at the moment. We think he has had about 10 hours sleep now since the incident. He got 4 or 5 hours earlier and he's been asleep for something like about 5 hours new unless he's awakened since I left to come over here. The commander has probably not had a whole lot of sleep, perhaps on the order of 3 or 4 hours plus some naps, which we're not aware of. If you recall or if you listen to the air-to-ground there he was asleep for a projected 6 hour period and he got up actually about half way through it and said that he had gotten some rest and so he was going to go ahead and send Fred on to bed and I think he's, however, comtemplating now going back and getting some more rest now. The commend module pilot, Jack Swigert, has had a good 8 hours of sleep. He seems to have slept pretty solidly for about that long at one time. He perhaps had some rest earlier that we don't know about because we only are able to listen to 2 at a time now with the LM communications system, and frequently only 1 person is plugged in anyway. Also we of course are getting no biomed data. It was fairly erratic and it wasn't really doing us a whole lot of good so we wanted to improve our voice capability so we turned that off some hours ago. The term "retro officer" is for the return to earth officer and I'm going to ask Tom Weichel to just take a couple of minutes here and tell us about the trajectory status and our trajectory situation and then we'll go on to some other aspects.

WEICHEL Well, we're in pretty good shape on our return. Some of the numbers were about 186 000 miles from the earth right now and about 35 000 from the moon and we're looking at a mid-course now of on the order of 7 to 9 feet per second and at a GET of about 104 hours or 118 hours. This decision will be made later depending on a few things, the weather and some tracking schedules, something like this, so it looks like we're in pretty good shape. This will be targeted to the MPL landing time aabout 142 hours and 40 minutes and be a longitude of about 165.2 or in thereabout - that's west - and 2140 south and that's about it there.

WINDLER The only other point we might make is we're not yet in the corridor, the reentry corridor, and we will have to make this maneuver to get back in. Another point there perhaps is the crew does have onboard a maneuver that they can execute 8 hours before entry interface in case we lose communications. You probably heard us read that up to them, plus the procedure, that is if you were awake this morning about 4:00 or have read a transcript,

WINDLER but they also have the procedure that's involved to determine a correct attitude, which is not a problem but it's something we have to do in a little different fashion since we've turned down our reference, our attitude reference. Some comments here on the consumables and what we've done over the past several hours since we've had our last briefing is to try to get the consumables under control and I think we've done that. For the first time we're looking at everything at a rate which will allow us to go beyond our 142 hour entry interface, with the exception of the lithium hydroxide and we fully expect to get that under control. We're looking at a - with the normal LM equipment we're looking at around 37 hours of capability or 37 to 40 say remaining. We have a number of lithium hydroxide canisters in the command module and we -

END OF TAPE

SPEAKER remaining. Now we have a number of lithium hydroxide canisters in the command module and we have already given the crew a procedure to make a kind of a jury rig where they attach the canister to the end of one of their hoses and suck the air through it, which has been tested here at MSC and has shown to be effective in flow and air. And if you can get the air through the canister, it will scrub the Co2. So we have not yet tried that, although perhaps at this moment they are doing it. We are waiting until the present canister that we are using - just the normal LM canister, called the secondary canister, a somewhat smaller one, is depleated. And then we plan to remove that and try this other device. Now we have 2 alternates of course in case that doesn't work. Well - we have more than 2. We can still work on other types of arrangements with the command module cartridges however, obviously we can put about 8 amps into the command module and run the command module suit fans which will also scrub the Co2 in this same manner we are using the LM fans now. And another option would be to kind of go into a make-up or purge mode where you supply some pure oxygen, and kind of blow it to Co2. So there are several things going for us there. However, we do expect this other - this kind of jury rig, if you want to call that - to work, and we should know that oh - in the next few hours anyway. Our next consumable that we have been worried about - the next worst consumable I guess you'd call it, is the water supply in the lunar module, which is used to provide cooling for the equipment, including the crew. We are boiling water as our method of operation there, and we have - this is at 90 hours by the way - which we are some 3 or 4 hours past now I guess - we had 188 hours, 188 pounds remaining and we have gradually as we powered down the equipment some hours ago and have cooled down the lunar module, the usage rate has gone down gradually from about 4 and a half pounds on down to about 2 and a half pounds now. And that rate will get us up past 160 hours GET. So, we expect to have that - or we think we now have that under control. In addition, there are several alternate methods that we can use to supply water to those tanks, and I won't go into those right now. You've probably already been briefed on those. The oxygen - there is no problem there, we have about 40 pounds of oxygen remaining, we use it at about 3/10ths of a pound per hour, which is the same rate that we were using it in the command module, before we had the problem with the fuel cells. And that will last us for 134 hours, so we are - that's from the 90 hour time, so that gets us way up past 200 and some hours, and we're okay there. The battery power, we have gotten down, since we powered down after the PC plus 2 maneuver down to somewhere in the order of around 12 amps, and we are now looking at 100 hour life time on the lunar module batteries, which gives us close to 200 hours there. So we think our consumables are essentially are in pretty good shape, in fact, one of the options that we are thinking about now is that we perhaps will have enough lunar module battery power to think in terms of doing some

APOLLO 13 CHANGE OF SHIFT BRIEFING, 4/15/70 CST 10:13 27B/2

SPEAKER things that we have to before the entry, in the command module. We are able to transfer 15 amps of power from the lunar module back into the command module. The only thing that - or the problem there - is that, this does does through the main bus B, and we think that this main bus is okay, however, since we had the fuel cell anomaly we have not tried to put power on the bus. But we fully expect to be able to do that. In fact, the thing that they were doing as I left the control center, they were reading up what we call a kind of initial switch in circuit breaker configuration; we cut into the command module in somewhat of a hurry the other day, and no body is just real sure what the switch configuration is, and so people have sat down and compiled a configuration which gets us kinds back to ground zero, and we will - were reading this up to the crew, and they were configuring the switches, and then from now on, whenever we pass them checklist type procedures, we will be given them procedures which are Deltas from this known configuration. And its kinda like the prelaunch thing - configuration - where you start off with all your switches in a previously set configuration, and you go from there. So they -

END OF TAPE

WINDLER which is in a previously set configuration and you go from there. So they are doing that now and as soon as they do that the next thing to do would be to go to a relatively simple procedure of applying power to main bus B to see if we have in fact a good main bus and we'll verify that and if we can do that, of course, we can pump power back into the command module through the LM and we may - we are considering doing that, not right now of course but later on as we get close to entry interface. You'll recall that there are some things that need to be preconditioned, command module RCS heaters for example have to be above a certain temperature and as we come back from the moon we always verify that they are either up to a certain temp or else we apply power to them as a normal procedure, so that's one type of thing that we might do. Another is that we might apply heater power to the command module guidance and navigation system. The communication system has been holding up very well. You probably had trouble listening to the air-to ground. I know I've had trouble myself. However, considering we're down to about 12 amps of power I think we're doing very well. We actually have data on the ground about 97 percent of the time, so we're able to monitor the systems quite well. We can probably look - this is also an indication that the passive thermal control is going well. We had earlier had monitored to a rough extent I guess you would say the way it was going by having Fred Haise tell us the path of the earth and the moon as - or the apparent path - as he rotated and we were getting around a 20 degree wobble at that time. We'll probably see that progress until it gradually gets worse and I fully expect some hours from now that we can probably expect some periods where we have no telemetry data for, you know, 5 or 10 minutes at a time perhaps while we rotate around until we get back on a good angle for a communications antenna. Right now we're going at about 10 minutes per revolution. We've already talked about the trajectory. The weather situation is - I've got it down as medium. There is a disturbance out in the Pacific. Earlier it was a storm that only had about 35 knot winds I believe in it and now they think it's donw to around 15. Our reconnaissance plane has already been out there and looked at it and it really doesn't find anything that really can hardly be classified as a disturbance. We'll send planes out again, but it looks like now that this will be fairly close to our end-of-mission point but really the weather is not right now thought to be a very big factor and we don't see any reason to change our landing point. Some of the things, in addition to those that I've already mentioned are being worked on or that are available anyway - well, actually I guess I really have talked about all the things that we have completely available now. There's a whole

APOLLO 13 CHANGE OF SHIFT BRIEFING 4-15-70 CST 10:18 AM 27C/2

WINDLER host of people at the Center here, as you're probably well aware, that are working on looking at all the things we have to do between now and the landing time. The first thing that comes up are the real detailed procedures to execute this mid-course 5 that Tom was talking about a little while ago, the actual circuit breaker configurations, the way that we would bring the AGS up to give us an attitude reference for that maneuver, those sorts of things. People are working on all the entry procedures, the way in which we would bring up the command module -

END OF TAPE

SPEAKER - reference for that maneuver, those sorts of things; people are working on all the entry procedures, a way in which we would bring up the command module, how we would jettison the service module, how you would jettison the LM, all those sort of things that we have to come up with, as well as these tradeoffs that need to be made as to whether you use some of your battery power thats available in the lunar module to do some primary power up in the command module. We are thinking about whether or not we want to turn on any instrumentation in the command module to have a look at how some of the pressures and temperatures are going. Another type of thing that is being looked at is an attempt to come up with a procedure for initiating the passive thermal control with the abort guidance system, with the AGS. Those sorts of things, and there are literally hundreds of people working on all those aspects. In fact, we've taken the entry team in the control center under the shift schedule, and freed them; you know, we operate with 4 teams, and we've gone down now to 3 teams from now to entry innerface, or not entry innerface exactly, to about 6 or 8 hours before entry, so we've freed Gene Krantz's team, the white team, to be free for the next couple days to help work out these procedures that they will have to implement and to work over the things that they have actually simulated several times here, as we prepared for the mission. I believe the only other item that we might mention here is the crew did report that they had noticed some venting from somewhere down on the service module; we don't know exactly what is yet. The thing that you would expect to be venting is the hydrogen tanks, the cryo tanks of course, and the hydrogen cyro tanks are still in tact, and they would have a normal heat rise, and you would expect those to vent, they area that he reported the particles coming from however, was not the exact area, was not the quadrant that we would expect the hydrogen vent to be coming from. It appeared to me though, in listening to what his comment was, later on, he indicated that he was not able to tell exactly where the source of the venting was, and so perhaps it truly is coming from the area of the hydrogen tanks, and because of this roll attitude that he has in the DTC, he is not able to really pin point it. So it may in fact be the hydrogen tanks. He also mentioned something about a piece of metal he saw drifting by - a 4 inch square of metal. And there is not much we can do about that; we are thinking, as you've probably guessed, we've given him some settings to take pictures of anything that he sees, for whatever that is worth, and we are trying to think of some ways that we might jettison the service module, and some attitudes that we might take the command module to get a picture of this area in question now, during the

SPEAKER separation procedure, or the jettison procedure. That doesn't look too promising and obviously the first thing you want to do there is be sure that you are doing the safe thing, and so if there is any question about that, why, you would be unable to do it. I believe Doug, unless you can think of anything else, well, that about sums up what we've been doing over the last 8 or 10 hours.

PAO We'll take your questions; wait until the mike arrives.

QUERY Can you tell us how and when you might know that the CM canisters are working? What tells them that they are actually functioning?

SPEAKER No, we have 2 measurements of the partial pressure of the Co2; we have onboard readings plus telemetry. And that would be the criteria that we would use. We would be able to see this decrease.

QUERY Milt, how would you compare the mood in Mission Control this time, as with the last shift that you worked? And I got another question after that.

SPEAKER Oh you do. Well, I don't remember the last shift I worked. It was before all the activity. I think it is - I don't know how to say it - we see a lot of things that need to be ironed out, new procedures and things like that, and have spent most of the night thinking about those sorts of things. The first thing that we tried to do was to get into a safe configuration and of course, before this time, before any incident, why, we felt like we were always in that condition. So, its kind of a relief to get back into what we think is a posture that is stable, if that is the right word to use. That you feel like you really have the situation under control.

QUERY The other question, when you get back to using CSM power, you have some left in one fuel cell, do you, that you -

SPEAKER No - the fuel cells are completely gone. That's an irreversible process when you latch them like we did there. We have 3 entry batteries essentially. Roughly, about 100 AMP hours in those. Total.

QUERY Milt, I wonder if perhaps you could go a little bit more into the conditions as you expect to see them, based on what you know now - the command module in particular, the heat shield area, and the service module, at the time of separation and for entry.

SPEAKER Well lets take the command module -

END OF TAPE

QUERY - and for entry?

SPEAKER Well, lets take the command module first. I expect to find the command module in good shape; I think we'll find that all the things that are anomolies that we saw as we closed it down are either instrumentation anomolies that are not true ones, or we'll be able to get the bus powered back up again; I think we'll find that system in good shape. And I don't realy see any problem in jettisoning the service module. This is more in Tom's area, and I know they've been thinking about it already; the thing to do here is you think of a whole bunch of different ways of doing it, and you decide on which one is the best, and we haven't decided that yet since we don't really have to - I don't know if you have any further comment on that Tom or not.

SPEAKER No, they are still reviewing all the procedures.

SPEAKER Excuse me; I'm sorry. Then you asked about the service module, I guess that is just an unknown quantity; we really don't need to use it for anything now, really.

QUERY Well, to follow it through, what I'm looking at now then, is you've made the separation, you're condition is you have chunks of metal floating around, similar things; can you apply that knowledge now to conditions as they might apply to the heat shield during entry? What is your area of concern there?

SPEAKER I thought I said I wasn't. You mean with the separation maneuver?

QUERY No, after separation.

SPEAKER I guess right now I don't see anything to be concerned about. I don't understand your question, I'm sorry. All we know now tells us the command module is in good shape.

QUERY Conditions surrounding the command module in space don't concern you?

SPEAKER No, and the - looking at where the hardware, the service module, the way is put together, the locations of things, and whats in between that and the heat shield for example, leads you to believe its very unlikely that that's damaged; there's items in the way, and there's blankets and things like that; I mean, there's parts of the fuel cell; the problem appears to be essentially localized you might say to the tank area, which is below all the fuel cell structure, and those as you recall worked on for awhile, one in particular continued on for quite a while. Two hours, or whatever it was.

QUERY Is any electrical power needed to jettison the service module and the lunar module, and if so, how much of it?

SPEAKER it: depends on what you call jettison. A normal mode of jettison for the service module is to operate the thrusters for some period of time, until they burn out, et cetera; now, we cannot do that, cause we did have to use fuel cell power for that, so the service module will be are you all able to hear me - I see everybody looking like they can't - as soon as we do the jettison, the service module will be inert, because all the electrical power will be in the command module; there will be no fuel cell power whatsoever, however, the pyrotechnics and all those controls are from the command module and the impulse from those will be sufficient to separate, plus you still have some RCS thruster capabilities, its not designed for that, but there are ways of using it to give you some translation type velccity. Relatively inefficiently, but it can be done. And now you asked me something else that I - okay.

QUERY Can you translate a 100 amp hours of command module battery capacity into activity for us? For instance, would this permit a normal power up platform alinement and an entire reentry procedure and leave you some pad at the end?

SPEAKER The word normal is not - I mean, there is no normal for this case, but I think I understand what you are asking - and yes, we would expect to be able to get all that equipment on the line, based on what we see now, in terms of our capability and what we expect to find as we get our switches configured and so forth. We are thinking that we will have a full up command module essentially.

QUERY What if you have trouble with main bus B? What happens then, and the second question, if there had been a short circuit in the fan or a heater, on the fuel cell, would such a short circuit of shown up in a talley light on the dashboard?

SPEAKER Answer your second question - no. It wouldn't have, unless it really was an unusually high short. Most of those things are protected by circuit breakers — that will trip -

END OF TAPE

SPEAKER No, it wouldn't have unless it really was an unusually high short. Most of the - those things are protected by circuit breakers that will trip off earlier than that and if we cannot get MAIN BUS B on, it's hard to say what the effect will be. The systems people here at MSC have uncanny ways of coming up with alternate routes to power things. The main thing that I would think that we would have trouble doing is using the LM power (the Lunar Module power) because that does go through the MAIN BUS B. All the other functions that we need we can power from MAIN A and I would not be surprised if we couldn't think of - not myself, but the people who are so clever at this, could not think of a way to get that LM power into the parts of the CSM we're interested in, however, I don't really know that they can do that yet.

QUERY I got in late and I may have missed it but my office says one of the wire services is emphasizing a threat to the guidance system from cold that if you're having trouble keeping the guidance system alive for the lack of heat.

SPEAKER Well, Guidance systems don't like to be cold. The people that run guidance systems, however, like to talk in very percise terms. They're talking about very small errors in drift and things like that, and we think that even though it gets cold and we have to heat it up again and bring it back up why, you know, it may have some errors. Like it might, perhaps, put us 25 miles from the landing point and I don't think we would mind that so much but you know a guidance guy that designs hardware likes to get within 1 mile or something like that. So I really don't think, to answer your question, that there is some concern that it's getting too cold but we think that it's a tolerance type thing and that actually it'll be usable to us for what we need it for here.

SPEAKER Thank you.

QUERY Can you get a little more specific about the condition of the crew and their health? Are they getting enough sleep; are they using any medication; are they eating properly; is the air in the modules stuffy or good or is it compared to being down in a coal mine, for example, with medium bad air?

SPEAKER I've never been in a coal mine, I don't know. It must not be, though, because I guess maybe in reverse order for your questions there, the air is fine, the flow is good, the temperatures are good, in fact, they even commented they were a little bit chilly up in the Command Module so as far as the - as the quality of the air that they have it's very good. They've, I don't recall if all of them

SPEAKER have mentioned eating. I know Lovell and Haise talked about they were eating and so I'm sure that they're getting enough food. That's no problem. And, essentially, the situation that we are in allows them to sleep whenever they want to, as you've already probably seen, in fact, someone was asking me about the - about the flight plan and it's kind of difficult to do that because you say well, you sleep this long except you found out that the guy sleeps for half that long and he wakes up and he feels pretty good so he lets somebody else sleep so essentially there's no - we have no constraints in this area to speak of and they're able to take their rest as they need it and I think that their condition is - they've been tired up until we did that midcourse, but since that time they've been getting rest and they will get more rest and I think you'll see a very definite improvement shortly. Oh, I'm sorry they haven't taken any medication, at least they've reported none to us and I don't -

END OF TAPE

WINDLER very definite improvement shortly. Oh, I'm sorry they haven't taken any medication, at least they've reported none to us and I don't know any evidence or reason or think they've taken any.

QUERY The question on that consumable water. Is there any way you could make use of the water that's in the command module, which I understand is not a problem, in your thermal control?

WINDLER Yes.

QUERY And secondly, how much are you losing in telemetry that you would not have lost if it hadn't been for this powered down requirement?

WINDLER Yes, we can get the water from the command module to the lunar module if we need to. We don't now think that we have to, but yes we can do it by putting it into the PLSS, the portable life support system, and them pumping it into the ascent tank on the LM.

QUERY Does that help you any as far as cooling? I'm not talking about drinking water, I'm just talking about -

WINDLER Yes, that's what I'm talking about is cooling water. They've been drinking water from the command module all along. That's no problem.

QUERY Can you circulate it without using more power if you use it from the command module as opposed to the LM?

WINDLER Oh, no, no, you have to take it from the command module tanks and put it in the lunar module tank and yes, you can do that. It's cooling water now I'm referring to.

QUERY So the amount of water is not a problem, it's just a problem of if you have the power to circulate it, is that the water problem?

WINDLER No, no, the amount of water is a concern. However, we are now at a rate that tells us that we'll be able to make it even without using the PLSS water or the command module water. We're okay now on the lunar module tanks.

QUERY The part was how much are you losing because of the power down? Telemetry -

WINDLER Really very little. We're on the low bit rate and one of the things we'd have if it was up is the guidance system, but it's not up anyway, and it turns out that the lunar module has a great many of the parameters on the low bit rate or at least the systems are pretty well spread out, so we really have good visibility into the LM on low bit rate. It's better than the command module in that respect.

QUERY What is the life of one of these canisters?

WINDLER Well, there are 2 different sizes. The

WINDLER larger size that we call the primary canister Is supposed to he around 23 hours. However, as I mentioned, the first one we ran until it got a little bit above the specified partial pressure of the CO2 and it went 27 hours. The smaller ones we think last around 6. However, the one that was in there had lasted longer than that and had not yet gotten up to the normal removal time. I don't have that time, but it must have been close to 6 when I left the Control Center and it still appeared to be still slowly rising. I was surprised because I would have thought they would have to change it before I left.

QUERY What's your projection about the oxygen situation in the command module immediately after separation? How much oxygen will be left after separation in the command module?

WINDLER We have - you recall that we isolated the command module reservoir I supposed you could say, the surge tank plus we have the repress bottles available to us and we have 2 bottles that are fairly hefty amounts of oxygen available from the lunar module, the OPS system, the oxygen pressurization system I guess that stands for. It's designed as emergency supply for the lunar excursion, for the PLSS. So we actually have ample oxygen for the entry.

WARD We have one more right here and then -

WINDLER You recall as a normal course we lose the command and the service module tanks anyway before entry interface

QUERY Will you go into some of the major options you have for separating the LM and the service module? The major options you're considering.

WINDLER No, I really can't do that very well. I think you'd be better to get that later on in the day at the end of all the activities today. I think mostly they're concerned the best time at which to jettison the LM and the service module and perhaps the attitude that's involved, and there must be several of those and I'm sorry, I have not paid much attention to that. I imagine it's being reinterated over and over again anyway.

WARD We'll have one more over here and then we'll need to close it off.

QUERY How many hours of lithium hydroxide or whatever it is have you got for screening off the CO2 left and what is the danger level in percentage of CO2 and what is the margin between the number of hours you've got available for scrubbing it and the time of splashdown?

WINDLER Okay, the time of splashdown, and I'll let you work out your numbers, the time of splashdown is 142 hours. We have 37 hours available on the normal lunar module systems, we have 168 hours of capability in the command module. The danger level is the subject of some debate. We have normally operated at a 7.6 parts per million partial

WINDLER pressure. We had decided we could go in the case we're In up to 15 and I venture to say that you can probably exceed that. But those are the numbers that we're working with. When I left we were at 5.8 and we're waiting till we got to 7.6 to change the canister. We had been up to 15 during the night and we let that one canister go for 27 hours - well, we let -

END OF TAPE

SPEAKER at that point 6 to change the canister. We had been up to 15 during the night when we let that 1 canister go for 27 hours. We let it go until it got to 15. We decided in advance we'd do that. And we switched over to the secondary and almost immediately it went down to - I believe it was down to about 6 and then it gradually dropped down to about 3.

QUERY If you have 168 hours of capability, then there's no problem is there? Or did you say something about 37 hours.

SPEAKER I already did already. Perhaps you missed that, I'm sorry, but what I said was. We can't show on the LM systems yet. We can not show on just the LM module systems that we can get all the way back, however, we're working on a scheme to use the command module lithium hydroxide, but we have yet to demonstrate that, although we're expecting to do that momentarily. If we do demonstrate that, yes we will have no problem, but I'm just trying to tell you that that is our situation. We have yet to demonstrate it. Although we have some other ways of going at it besides the one that I described earlier.

QUERY Thank you very much.

END OF BRIEFING

APOLLO NEWS CENTER
HOUSTON , TEXAS

CHANGE OF SHIFT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 15, 1970
4:40 PM CST

PARTICIPANTS :

Glynn Lunney, Flight Director
Terry White, PAO

APOLLO 13 CHANGE OF SHIFT BRIEFING 4-15-70 CST 4:40P 29A/1

PAO Are we ready to get under way here?

LUNNEY Okay.

WHITE Alrighty, let's review the last eight hours or so of Apollo 13, mission. This is Glynn Lunney, black team Flight Director. Glynn, why don't you sort of hit the high spots and also the outlook for the next mid course correction and so on.

LUNNEY Okay. When we came on duty this morning, about 90 hours, the LMP and the CMP had just gotten up and Commander Jim Lovell in a short time thereafter was ready to go to sleep and went below. Just as I left the control center, I heard that he was up. So he got a good eight hours sleep, the other men also, seemed to have gotten eight hours sleep in Jack's case, six in Fred's, so they seem to reasonably well rested at this point of the flight. The course of the day was fairly quiet. One of the first things we did today, when we had Jack Swigert up, was to fix up some lithium hydroxide cansiters from the CSM. There was one in the control center, I was hoping to get it over here, but it disappeared before I had a chance to grab it. What we were doing was, taking a canister, which is about this square and taping a bag over it, a plastic bag, very securely, plugging up a couple of the bypass holes, and putting a suit hose into it and taping the suit hose to the bag. The purpose of this then with the suit fan behind the fan was to draw the air, the air in the cabin, through the carbon dioxide canister, the lithium hydroxide canister, to take the carbon dioxide out and then to bring the air back into the suit loop and then of course to replenish it with the fresh oxygen and send it back out the outlet hose into the spacecraft. We've done this now on both hoses and we have two of the command module lithium hydroxide cansiters, hooked up. They very quickly brought the carbon dioxide level in the suit loop down to a very comfortable level. We put them on line at about 94 hours and they have been keeping the carbon dioxide down very well. We had been concerned about that in the sense that we didn't have enough canisters in the LM alone to keep the air clean, and, if we had not been able to make this system work, we probably would have had to spend some power through the CSM to run the fan through the canister down in the CSM, which would have been a little inefficient since most of the traffic is in the LM. It is working fine now, as I said. It took about, oh, about an hour today to go through the process. Joe Kerwin, the CAPCOM walked Jack and Fred through the procedure and it seems to be working just fine. The next item we had of some length was the command module switch and circuit breaker checklist. We did this at about 92 hours and just the reading up of the information took about 45 minutes. What we were doing there is effectively

LUNNEY taking power off the main BUSes in the command service module. That is all the systems that are operated with electrical power, were removed either by opening the switch or opening the circuit breakers associated with that equipment. So effectively, we have the command service module in what you might call a zero zero condition, ready for the checklist work and powering the command module up when we go in for entry. After the switches had been configured we wanted to do one more thing in the command service module and we sent Jack back over. We had a couple other things that we found that we could open which we did. And then we did something to close a couple of switches which connects the batteries to the main BUSes. The battery goes through one small BUS and then on to the main BUS. We have some motor switches in this line which have to be closed by the little battery BUS in order to get power from the batteries to the main BUSSes and we need to do that in order to have the command module powered for entry. Now we have had some concern that the spacecraft of course is operating cooler than normal. Normally we have people in there and equipment going and it's warmer than it is. We were concerned that with the cabin probably cooler than normal, that we might just possibly, although we didn't have any test data to say we would, run the possibility that these switches would be sluggish or not work as well as we would like, in the cool environment. So we closed those switches and left them closed then we pulled the circuit breakers. So we have in the process demonstrated that we could put the batteries on main BUS the BUS voltages are proper for the condition of the batteries, that they are in right now, and we did not have any current readings which indicated that in truth the switch checklist that we went through to remove all possible power from the BUSes indeed accomplished that. There are no equipment on the BUSes and there are no shorts. One of the reasons also, that we wanted to check this, you will recall, when we had the loss of cryogenic oxygen, we lost the main BUS, soon after that. We felt at the time, we still feel, that that was connected with the fact that one fuel cell that was supplying the BUS was injured in some fashion in what went on in the sector back in the service module and that caused the BUS to go down, but we demonstrated today that indeed the BUS was good and that it could be used fully for the re-entry work. The other reason for wanting to check it, is if the BUS were not available to us, we would have some different configurations that we would like to set up for entry. So, that helped us also to initialize the work that going on, preparing a checklist and procedures for entry.

About 94 hours, we started to watch the SCH pressure, that is, the super-critical the cyrogenic helium in the descent propulsion stage. It is rising at a pressure of 30 psi per hour. This is completely normal, by the way, after

LUNNEY two firings of the engine. The significance of this rise is that some where out around 105 to 108 GT the small disc is going to op- push this way and re-pressurize the SCHe tank. Now we still have gas trapped at high pressure in the propulsion tanks in the descent engine and we have the capability to burn about 850 feet per second, out of the DPS and right now we are looking at one mid course to get home on the order of 7.7 feet a second, which I'll talk about later. The significance of that is that we are looking forward to timing the mid course and the time when the SCHE pressure gives way in the same time period, give or take an hour. The reason for that is that we're going to have one of the control systems brought up to do the mid course and we want to use the same control system to start the passive thermal control mode again. Now, as you know, the passive thermal control mode, setting it up is kind of delicate in the sense that any vents tend to tip it over, pitch it over or whatever. And, so we wanted to try to see that while we had the machinery up to do the burn, that hopefully we can watch the SCHE vent at the same time, and any disturbance that it would do would be done with and then we could get on with setting up the passive thermal control. Actually, we don't expect a lot of disturbance, because the gas comes through and goes through holes at almost a 360 degree fashion. We really don't expect much of a disturbance but given the difficulty in the LM of setting up the passive thermal control we wanted to make it as easy as we could for tonight. The passive thermal control right now is slid off some and where we started out doing about this it's, probably skewed down and doing something more like that, about now. We still have had good COMM, matter of fact, about two hours ago, I guess, we came in sight of the large dish the 210 foot dish at Goldstone, and the COMM improved noticeably. I'm sure you noticed that. We did have a discussion on the mid course as to, as to whether to include any kind of weather avoidance in the burn itself. That is, when we're making mid-courses, we can do the burn in a different direction with a different velocity and effect the landing point somewhat. However, we have...

END OF TAPE

SPEAKER - To the burn in a different direction with a different velocity and effect the landing point somewhat. However, we have been tracking the wheather in the Pacific and there just isn't enough evidence that says we ought to move the landing point, certainly not at this time. As a matter of fact, the last I heard right before I left the Control Center, was that if anything, the weather was going to move to the West and it was progged to be oh - about 500 miles away from us at landing, so it doesn't appear that we really have to consider that at this time. Now as we get closer to landing, the weather picture may change somewhat, although I don't have any indication that that is so at this time. And we will just continue to watch that as we normally do in all flights. And let me say one more thing about the midcourse. As you know, we did the burn at 79 and 1/2 hours on the LM platform, you recall that we set the LM platform up at about 60 hours or 59 hours when we left the Command Service Module, the platform probably was off very very little, but enough to cause to have to do the midcourse that we are looking at here tonight. We also had a burn that was about 1 foot per second over or under which there was no point in trying to trim it at that time, which also led to the fact that we have to do a midcourse. Now, as soon as we recognized that we had to do a midcourse to get in the corridor, we prepared a set of information, which we call a Pad which is just the word for burn information and radioed it up to the Pilot, so they had onboard a procedure to do a propulsive burn that would put them back in the corridor. This is primarily a precaution in case for some reason they lost COMM and they weren't able to communicate with us they would then have the information required to do the burn for corridor control. That particular Pad by the way would have been down closer to entry. We have been able to maintain COMM, we've had good tracking and we had a continuing firm estimate of what the midcourse is and it looks to be on the order of about 7.7 feet per second, we plan to do this as I said somewhere in the 105 to 108 period, probably 105:30. We plan to do this with the descent stage engine. I should say that we have a large number of engines available to us to do the midcourse there is that. It's possible that we could use the RCS on the LM, we could use the RCS on the Service Module and we could use the ascent engine if we had to, I just say all of those things to give you some assurance that there are a lot of ways to get the propulsion required to do this particular maneuver at this time and the fact that we have to do a midcourse is in no ways of any real concern to us at this point. That's about the midcourse - Let me tell you something about the status of our consumables and let me tell you one more thing about the

LUNNEY - burn. We are not going to bring up the primary guidance system due the burn and therefore, we have had to modify some of the checklist based on the alignment that we will be in for this particular burn. So we worked that out during last night and we have had a number of crews running these procedures in the simulator all day and relative that a procedures - and relative - we have a lot of assurance that the midcourse technique is understood and the Pilots who did it will be standing by if the Flight Crew has any questions about the procedures and we have every indication from the telemetry that all the equipment is ready to do the stuff - is ready to do the midcourse. So, looking ahead oh - about to 105 or to 108 everything looks Okay for the midcourse coming up. About consumables now in the LM, the cannister, the lithium hydroxide cannister connection that we have with using the Command Service Module cartridges is working just fine. Water continues to be the most limiting consumable. Now at the present rate we are using water and assuming that we power up and do 2 midcourses; one coming up and one later we still have a margin to fly until 160 hours. We currently planned to land at about 142 and 1/2 so we have about - oh about an 18 hour Pad on the LM water. We even have a little bit more than that, in that we usually have more available than our instrumentation will allow us to assume which would probably give us another 8 or 10 hours. So, although it is tight, the margins for the water continue to remain and certainly very encouraging and all in our favor. On the power - Well, let me talk about oxygen, oxygen we have a - plenty of oxygen in the Lunar Module, as a matter of fact we could fly out to an elapsed time of 270 something hours so that we are very comfortable on the oxygen available. On the power available we could fly out to landing time of 200 hours including again 2 midcourses which is the same assumption that we made about the water, we have about 50 percent of the RCS left, and again that is a pretty comfortable position to be in the LM RCS. We have had a significant effort going on all day, actually for some time, but - but it has been converging today on the subject of the procedures for entry, the checklist for entry, the exact sequence it is going to go through. Now I have not spent any time at all in that area, we've taken one of the 4 Flight Drill Teams out of the shift schedule and we have put them with all the other people who have been working the entry problem, we've also had the simulator scheduled all week and we have - as soon as we get final checklist we will have people in the simulators Astronauts in the simulators running through the checklist and the procedures that we intend to use for entry. I can't exactly give you a schedule on that, but I expect people to

LUNNEY - be in the simulator tomorrow running reasonably firm checklist to entry sequence. We did ask, because of the number of reports about things venting in the area, we have asked that the Pilots check the Command Service Module optic system and one time when Jack was going through the Command Module, he checked them and they are perfectly clear and he apparently watched them for sometime through a vehicle rotation and we don't have any problem in that area. We're going to be doing one more thing shortly - and I referred to earlier with power off in the Command Module and Service Module, the vehicles will be operating by all odds a little cooler than normal, we're going to turn the telemetry on here in a little while, for a short period of time - oh about 5 minutes or so and take some high bit rate and then correlate the temperature data that we find in the vehicle with the analytical models that we have as to how the temperatures in the vehicle ought to behave in this kind of environment. Compare them with what we see from the telemetry in flight and see exactly what our status is. It's possible that what we find there will affect the sequence of events that we plan for the entry. And possible that it will affect the timing of some of those events. Depending on how cool things are. After the burn, in the time frame I have been talking here 105 to 108, we are scheduled to go back in the passive thermal control and the next midcourse we have scheduled if we were to need it would be down within a couple of hours of the entry interface time and that is again being worked in the over all context of the work going on for the entry checklist procedures. That about summarizes the shifts and our general posture right now and our intention for the next 8 hours or so and from there, I guess I will be glad to answer any questions, if I can.

WHITE Please wait for the miccrophone so we can get it on the transcript. Back there, Gordon Bassham. One row back.

QUERY Glynn, there was something mentioned a bit earlier in the air-to-ground or on the air-to-ground in the Mission Control Commentary there from Terry, about an hour ago, about a 165 hours worth of - check my figures - 165 hours worth of water level, I believe it was.

LUNNEY Water, um huh.

QUERY - Is this figure you gave us a moment ago, was 160 hours - -

LUNNEY Yes, The 165 hour figure does not include time for powering up the midcourses, so it's the way of keeping track of the books right now in the Control Center and we always subtract 5 hours for 2 midcourses -

QUERY - in other words a 165 hours would be for one midcourse and 160 for 2 midcourses.

LUNNEY No, 165 would be for no mldcourses from now on, just staying at the current rate at which we are using water. Okay. The numbers - The reason they are doing it that way, is because it is easy to take current rate and just run it on out. But everytime they run it out, we subtract 5 hours from the water and the power at the end and that would be a margin for two midcourse correction period.

WHITE Carl Abraham.

QUERY Two questions, whose shift has been detached for the - -

END OF TAPE

QUERY Two questions. Whose shift has been detached for the simulation work. Secondly, is it the separation of the LM and the service module that is being simulated or the actual penetration of the atmosphere in the landing.

LUNNEY Okay. First off, Gene Krantz's team has practiced and trained to cover the entry phase of the flight. We have three other teams so we have taken Gene's team off to work with the people who are working on the checklist. Secondly, right now we are not doing in the simulators what we will do for entry. When we get to simulator work, we will probably going to the entire timeline from some number of hours out associated with - once we start going into the command module and bringing it up. I don't know at what time before entry we will do that. That's the work that is going on now, but as soon as that gets done I am sure that the concentration will be on the work prior to the atmosphere because once we hit the atmosphere we will be doing essentially a normal entry. I am sure though while they are at it, they are going to run them down to the ground to see that there is nothing else that they can find. The procedures, once you separate the command module, I think will be almost if not identical to what we have had up to this time. The procedures that need study and work are those associated with separating the LM and the service module or in whatever order you do that and the other system configuration work that has to go on.

WHITE Mark Blume.

QUERY Glynn, I know you've got a lot of engines to make this midcourse, but what would be the effect of going right in now without a midcourse. Would you skip out again?

LUNNEY That would be ill advised, Mark. Presently, we have an 86-nautical mile perigee at the earth which is not a capture condition, but I guess I mentioned the number of engines was to give you the impression that that is not abnormal for the burn that we did to get to these conditions and there has been no alarm or concern about that in our operation. WE have the burn scheduled and and intend to do it.

WHITE Follow up with Blume.

QUERY I understand it is ill advised, but what would be the effect. Would it be a skipout?

LUNNEY Yes, it would. You wouldn't even enter any atmosphere. You'd go by at 86 miles and keep on going.

WHITE John Wilford.

QUERY I take it then that the sequence of events prior to reentry has not been firmly established

QUERY Whether you jettison the LM first or the service module first, that sort of thing.

LUNNEY It is in the process of being established. I'm sure it is a lot more firmly established than I could convey here to you today because I have not been involved in it. I have been on the console all day. The men I talked to, I asked them how it is going and they think it is going pretty well and they are just about at to mark up the checklist with the simulator work, but I can't tell you any details because I just don't know.

QUERY Following that up, can you tell us if you've made any detailed plans for photographing the damage to the service module when it separated or will the astronauts be too busy.

LUNNEY That is under discussion. We have some lenses on the Hasselblad camera which would lend themselves to doing that. Now, whether the pilots can do it or not is another matter and we'll probably - we'll get the first feeling on that from the work that will be done in the simulators. But again, our attitude will be that in no way can we afford to make any undue compromise here in this sequence of the flight where we will be fairly time critical in order to get those photographs. Obviously, if the timeline lends itself to it and it is convenient, we will do so.

QUERY If you are unable to do it, have you any other means of finding out what happened?

LUNNEY The only data we have is the data that we have recorded from the telemetry information. Of course, the service module is separated from the command module before entry and it is not recovered and we will just have to do the studies from the data that we have. Photographs might or might not help. We really have no way of knowing.

QUERY Can you tell us - what are the parameters of the entry corridor. How low or how high.

LUNNEY I didn't bring those numbers over here. For the normal set of conditions we have a flight path angle that we are shooting for of a negative, I think 6.5. The velocity will be about 36 000 some feet per second. It's essentially a normal entry that we deal with when coming back from the moon and the kind of limits we have on it again are the same kind of limits we have on the entry conditions to achieve the safe one as we've had on previous flights. It's a standard entry from that point of view.

QUERY There have been some reports that you have some attitude control problems, do you have any that would effect the reentry?

LUNNEY Let's see. Attitude control problems. We have not had the altitude control system on really all day since we set up thermal control last night. Perhaps what you are meaning is that in the course of rolling around any kind of a vent or any kind of instability in the original setup tends to make the vehicle wobble off even people moving around can make it wobble off, but we don't have an active control system trying to take care of that. We've got it turned down now to save power and water and it's just rolling around. We have absolutely no indication that there is any problem with the control system that we use for entry. That is, the system in the command module. When we turn the instrumentation on, I think we will get some telemetry on the command module RCS system but we have no indication there is any problem with that. Perhaps it is a little cool but that's all.

QUERY What about for your firing tonight. Your midcourse?

LUNNEY We will be using the descent stage engine which looks fine to us. All the telemetry on it is normal and we will be controling that with the RCS thrusters. Again we have 50 percent quantity in that system. All the thrusters are working. Every indication is that the control system is already to be used.

QUERY Why so much effort on simulating your reentry.

LUNNEY Reentry?

QUERY Well, your whole team on it.

LUNNEY The reason for that is this. We have — if we were going to do a regular roll entry, we would get in the command module as early as practicable and we would power up and check everything two, three or four times in a fairly leisurely fashion. The problem that we are tackling is that with the limited power available to us in the command module, now we don't have the fuel cells anymore, we only have the three entry batteries and with those available, that limits the amount of power, or if you want to look at it the other way - it limits the amount of time you can be in the command module with the equipment powered up so that you have to compress some areas perhaps and get the optimum arrangement of your systems, the best arrangement of your systems for the amount of power that you can spend out of the entry batteries. Your also have a couple of new problems, in that, we have to jettison the service module and it doesn't have active any more. Those little thrusters that pull it away. Those used to be run by the fuel cells on buses down in the service

LUNNEY module. So we have to figure out how to get rid of that and out of the way. We also have to get rid of the lunar module again in a fashion that does not bring it back into the vicinity of the command module and we have to do all this against the background of limited power in the command module but we have an ability to transfer power from the LM to the CSM but only up to 15 amps. So we have to just work out what's the best way to use all that. We have an ability to align a platform in the lunar module and then through a series of procedures transfer that intelligence to the platform in the command module so that it knows where it is. Then we can do something with it and that again is something that we normally don't have to do for entry. So against that kind of background they may have to go through and carefully think out minute by minute what has to be done, what's the best use of the power and the water available and etc.

QUERY Glynn two questions. Have you taken a reading yet on the consumables on board the command ship so that you in what time out in space that, if you lost the LM that the crew could reboard the command module and come on in?

LUNNEY Let's see, how shall I go about answering that. With the power that we have in the batteries if we had to go into the command module, we would have to just turn it all off and turn the radio up every 10 hours to say hello. That's about what we'd be able to do. It would probably be very cool. There wouldn't be any navigation systems up or communication systems. We just would not be able to spend any electrical power in other words. As far as the rest of the systems go, we would have enough of what we need to get back on under those conditions. The only other things we would be concerned about is water and we can arrange drinking water. Without any equipment on you don't need to cool anything.

END OF TAPE

LUNNEY and we have the command module RCS system for entry and as far as we know, it's in perfect condition, both systems.

QUERY We have been given the thumb rule figure of about 15 hours. Are you saying that if they lose the LM after this descent burn tonight and they're on the proper course, that you could conceivably as far out as they are now, power down and bring them in safely?

LUNNEY Yes, I think that's concieveable. Again I say it would have to be done with essentially lights out in the command module and no equipment on. We really don't know how cold it would get. We really don't know how much difficulty we would have powering it back up once it got that cold, it would probably get colder than it is getting now. But that is the mode we would have to fly in. Again, we don't have any indications that we would have any problems with the LM.

QUERY My second question is, and I'll be right brief is have you given any thought to future Apollo mission making such things as canisters interchangeable between the two spacecraft after this emergency?

LUNNEY Well I'll answer that question, your two questions in two parts. One. We haven't had time to think too much about future missions, certainly I haven't. Secondly, I don't know the problems associated with that, in that right now the thing is built and ones square and ones round. However, even with those circumstances, we've been able to use the canisters and successfully clense the air in both ships for use by the pilots. So, if that's an answer.

QUERY Glynn, on previous moon missions, if you had had no mid course corrections after TEI would any of those missions have been as far outside the corridor as this one?

LUNNEY I don't recall, I don't recall doing an 8 foot per second mid course out here. I just don't recall. I think probably this one is as far out as any of them. Perhaps, more than any of them. I just don't have that information.

QUERY Glynn, if you went over to a lights out command module, say tonight, what would be your oxygen supply?

LUNNEY Well, there would be very little in the command module.

QUERY Would they have enough?

LUNNEY I don't know for sure how much is in one tank. 3 pounds? No, there's not enough in the command module.

QUERY So if, with the mid course correction if there was need to transfer, you'd have all consumables available but oxygen?

LUNNEY Yes.

QUERY Glynn, you referred several times to the lunar module becoming cold and the command module becoming cold. Are you talking in terms of physical cold to the individual or are you talking about cold in terms of the equipment aboard, the guidance, and so forth.

LUNNEY To the equipment.

QUERY Glynn, after they move into the command module, the critical priority shifts from water now to power then.

LUNNEY Yes.

QUERY What is the flight plan for tomorrow, Glynn? What do you plan to do?

LUNNEY We'll probably spend most of the time talking about what we're, going to do the next day.

PAO SECOND row back here.

QUERY Could you tell us a little about the condition of the astronauts. You were worried earlier about Lovell not getting enough sleep.

LUNNEY I was off the control center when Jim Lovell woke up. I heard, I asked Jerry when I was leaving how he sounded and he said that Jim reported in that he slept well and was feeling fine. If you've heard the air to ground in the last hour or so, you probably know better than I, but that was what I heard.

query Glynn, could you tell us anything generally about the medical state of the crew?

LUNNEY Well I don't know how to differentiate medical from the remark I just made. As far as we can tell they are feeling fine. No report of measles if that's what you had in mind. I guess I can't say any more than that.

QUERY If a second mid course is necessary, could you tell us what's the last possible time it can be made?

LUNNEY I guess it could be made as late as we can still do it. However, after about two hours, by that I mean the time line for the crew. But after that about two hours it doesn't do too much good to try and do them because you are so close to the conditions that burning the little bitty thrusters that you would be employing at that time really doesn't change the velocity of the flight path angle very much.

QUERY You talked about the conditions of the men. What about their discomfort? Has that increased at all during the past few hours?

LUNNEY I guess I haven't noticed anything to say that discomfort has increased. But I kind of get the general impression that they are kind of getting use to operating like they are and they seem to be becoming more comfortable with the condition they're in and what they

LUNNEY that is, normally they plan to sleep all three men at the same time, but in this case we have a watch set up and that seems to be working all right.

QUERY Glynn, what are the temperature and humidity in the spacecraft.

LUNNEY In the command module, Jim? Is that what you mean?

QUERY Well, in both parts, LM and command module.

LUNNEY Near as I can tell, the ca-I haven't read the cabin temp lately in the LM but I guess it's about 70 degrees and I don't know what the humidity is but it's average and we really don't know what the cabin temp is in the command module. It's probably cooler than that. The last guy, I think Jack Swigert went down, the last pilot went down, reported it was pretty chilly down there. So it's probably 60 or maybe 55 down in the command module.

Query In trying to determine just how comfortable the astronauts are, could you be a little more specific as to what discomforts or what things do seem to be bothering them at all as they go through this operation, and also, could you be a little more specific as to what they're eating, for example, what kinds of foods and their schedule of eating, and so on?

LUNNEY I guess I don't mean to imply that they're uncomfortable about anything. The only judgment that I can make about how they're feeling is from their tone of voices and my impression is that that seems to be getting better all the time. I assume they're eating the regular food on the regular schedule and I assume Jack Swigert is eating Ken Mattingly's food. They hadn't said much about it, I take that back. A little while ago Fred had a few remarks to make about cubes that seemed to be stuck together with glue and the comment at the time was that when they start complaining about the food you know they are feeling a lot better.

QUERY I guess this is a dumb question, but what will happen to the LM when they jettison it? Where will it go?

LUNNEY It will probably land, I don't really know, but within several hundred miles somewhere out in the Atlantic or in the Pacific, in very, very deep water.

QUERY Are you still doing the manual yaw for the PTC?

LUNNEY Yes, with the assistance of the guidance control system and every time we try a new one of those, it usually takes a little while to get it stable and to get it going the way we want it. And that's the way we're going to be doing it tonight, unless it just simply doesn't work in which case, we might be compelled to do something else.

QUERY Everything is off in the command module except the warning lights. Right?

LUNNEY No, there aren't even warning lights on the command module.

QUERY No warning lights on? When, do you have any time of time lifie when you plan to power it up?

LUNNEY No that's really in the general area of the entry check list and when we would begin and when we would start working with it. The only thing we're going to do that I referred to earlier, and perheps they're doing it now, is to turn on telemetry for about five minutes, but other than that, when we climb in the command module and start using it for entry, is probably in the final stages of being firmed up and I'm sure you'll hear some more about that tomorrow.

QUERY I don't quite understand about the position of the trajectory. Did I understand you to say that they are further off in this respect than any other flight has been, and if so, what caused that, and are they still on a free return trajectory?

LUNNEY I believe...

END OF TAPE

QUERY - lunar free return trajectory.

LUNNEY I believe that at this point in the flight they are further off than some - the other returning lunar flights. They are not on a free return trajectory in that by free return it means that they are reentering within the corridor without any further midcourses. We are going to perform a 7.7 foot per second midcourse here in a few hours which will put them in the middle of that corridor then you can call it free return. That meaning that you don't have to do anymore maneuvering to enter safely.

QUERY What caused this?

LUNNEY Okay. Probably the reason that we are of this little bit. You recall when we normally do a TEI to lunar orbit. We usually spend the last couple of revolutions before that burn doing what we call program 52's, realignments of the platform so that it is a very accurately aligned and that we know exactly where it is. We also watch the accelerometers very carefully and if they are the least little bit off, we send up a command to the guidance computer to tell how far off they are so that it can compensate for those accelerometers during the burn. Now in the burn that we did, we established a reference for the platform at about 59 or 60 hours when we got out of the command module. We then used the platform about 20 hours later without any updating of that platform. We also did not update the accelerometers in that platform because we were very sparse with using any of the stuff and that would have called for turning some more on. So in all respects the platform or the guidance system has performed admirably well. We haven't had to do anything with it for an entire day and it did the burn for us such that we have what is in effect a very, very small midcourse under the conditions that the guidance system had to operate in.

QUERY Glynn, you mentioned that you had about 3 pounds of oxygen, I guess compressed gas, in the command module. Would that be enough for 3 men for about 12 hours? Figuring 2 pounds per man per day? Is that the rate?

LUNNEY I think it is about 2 pounds. I don't recall those numbers. That 3 pounds is only going to last so long. There is another 3 pounds, by the way, in the repress pack. I guess we can get, if you are interested in that kind of thing, how long people can get along on 6 pounds of oxygen. It is a matter of hours for 3 people.

QUERY Glynn, I was curious if you attended the meeting of this flight review advisory board after your shift and, if so, what happened, whether they offered any advice?

LUNNEY I think primarily the meeting we had this afternoon was one of being sure that everybody was aware of the status. We did talk some in general about the arrangements that were being made for the entry checklist as I have described here, that is, the various groups that we have had working on them. We did have a number of problems suggested to look at and to consider and near as I can tell the people who are doing the work were looking at all those problems. So I think it was useful in that we informed people in more detail what was going on although they have been hearing that most of the time and I think also we had the benefit of another group of people individuals thinking about the problems we have, mentioning areas that have to be covered and in that process getting assurance that they indeed are being covered. So it was pretty useful.

QUERY How would you characterize the situation at this point in time, serious but not critical. You phrase it. How would you put it?

LUNNEY I am still calling it stabilized and that's the way we want to keep it.

QUERY This may sound completely ridiculous, but believe it or not it has been published somewhere.

LUNNEY I believe it.

QUERY Providing the burn goes all right, is there any possibility of one of the men going outside to inspect any possible damage?

LUNNEY No, Sir. None that I can imagine.

QUERY During the afternoon on the air-to-ground, I think it was Fred Haise mentioned venting around the descent stage, can you tell us what that means?

LUNNEY Yes. Actually, I can't. He reported that. We are able to look at all the systems down there that might vent except one. None of those we can look at were venting. The only one we can't look at is a small bottle of helium which is used in helping the engine start process. We weren't able to look at that because we were on the low-bit rate telemetry. We just don't have that parameter on there. So we don't quite know what to make of that at all, to tell you the truth. All the systems that we can see look all right. The engine will burn fine without that start tank that I referred to and one of these days when we get in a little closer and we get high-bit rate, we'll be able to verify the debt tank as either okay or not, in which case it might have been that or it might have been something else or maybe the stuff really came from somewhere else and just appeared to come from descent stage. I should say one other thing. At this point in the flight the calculations that we have run indicate that hydrogen in the cryogenic tanks in the

LUNNEY service module may be venting. So he may be seeing some particles that might look like they are coming from that end but may be in truth hydrogen ice particles from the command service module.

QUERY Is there any lingering concern over that thud in the "snowflakes" that Fred Haise saw at the same time that he saw that venting?

LUNNEY Yes, we continue to watch to see if there is anything that might be an indication that thump amounted to something. We had talked, of course, to a number of the pilots. Tom Stafford's characterization of the sounds you hear when you are going to the moon or that it is creaking or groaning, it sounds a little bit like my old sailboat sometimes, from what he has to say about it. It's also possible that the sheet metal, the skin of the vehicle or a web down in the structure of the vehicle is expounding or contracting that lets off a thump sound if something moves in. And it is probably, if I had to guess, something of that nature rather than anything else.

QUERY In stating the reason as to why the craft is not now in the proper corridor, can you eliminate as one of those reasons the fact that all three astronauts were in the LM during the burn coming out of the lunar orbit or is that still a factor?

LUNNEY No, that's not a factor. The guidance system during the course of that burn had all the rates damped very, very low, hundreds of a degree per second which indicates that the vehicle was controling the thrust vector right through the center of gravity of the entire stack where-ever people or equipment were distributed and that that was not a factor. I think it was just due to the fact that we had a system that had not had an alignment for approximately a day and I would think that you should consider that actually a very accurate performance for those conditions rather than inaccurate one.

QUERY Yet, why all 3 of them were together?

LUNNEY Well, I don't know. I heard Gene Kranz say that he felt Jack was interested and perhaps that's the best answer at this time.

QUERY Glynn, do you think this unexplained venting has any effect on the accuracy of the trajectory?

LUNNEY We have been continuing to watch to see whether we can see any effects of venting in the tracking. Now, normally on the way to the moon we do water dumps and waste dumps and we can see that in the tracking. The venting that is being reported is of such a low level that it does

LUNNEY not appear in the tracking like those other events do so it's something even less than that kind of thing. Okay.

QUERY When you turn the guidance platform on the command module, will it automatically know where it is?

LUNNEY Not unless we first tell it something. Now it can find out where it is by going through a certain program called P-51. You look at the stars and you can tell from the stars where you are and then you go and align it to where you want it. The question in my mind and I don't know what has come out of the deliberations is whether we have enough time to go through both of those kind of programs or whether we would even want to. We are proably going to try to transfer enough information to

END OF TAPE

LUNNEY - enough information to the Command Module computer so that we can align that platform from one in the Lunar Module that we will align several hours ahead of time and least we will know where we are starting from. Very similarly to what we did when we were getting out of the Command Module into the LM, okay.

QUERY You say that there's probably - that it's probably off - the alinement of the lunar module is probably off or at least it was

LUNNEY Yes.

QUERY - so anything you would transfer to the command module will probably be off.

LUNNEY Yes. Okay. Now the problem with aligning the command module platform is considerably more difficult if you have no idea where you are. If you approximately know where you are, you can ask the computer, "I know where I am. Go pick me a couple of stars." And it will go and point the sextant to where the stars ought to be and you look in the sextant and the star isn't quite there. It's down a couple of degrees from where it ought to be, so that you have the automatic system to get you in the right ball park and then you just bring it in a little bit - a couple more degrees and you have it.

QUERY Glynn, from this point in is there any single item that, to you, was the most critical during the rest of the flight? Realizing everything's important.

LUNNEY No. I'm not going to identify - I couldn't, Roy, anything single, I think, we want to keep everything we have in the LM working right now. We want to keep that equipment working.

SPEAKER Okay. One more over here and then we'll wrap it up.

QUERY I'm just wondering, in all the simulation exercises, whether you've ever chilled a guidance system to the extent that the command module will be chilled because of it being turned off so long and whether, if not, this is any kind of a risk to worry about or whether this is fairly routine.

LUNNEY As a matter of fact, they have. They have chilled the components of the platform. I don't really recall the numbers. As I recall, it was something down around minus 20 degrees and the platform was then brought up and used, not in flight, but in a sense it was used to see how well it did. The airs that existed in the platform after that kind of treatment, resulted in misdistances on the order of, you know, 10 miles, or something like that, which is, in effect, kind of trivial. So we feel pretty good

This page of transcript missing

APOLLO NEWS CENTER
HOUSTON, TEXAS

CHANGE OF SHIFT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 16, 1970
12:07 A.M. CST

PARTICIPANTS:

Gerald Griffin	Flight Director
Jack Riley	PAO

RILEY Okay. We'll get started now. Gerry Griffin, Flight Director of the Gold Team. Gerry.

GRIFFIN Okay. We didn't have anything out of the ordinary, I guess, happen on this shift. We - when we came on the planning was pretty well under way, although it had not been completed for MCC 5, which we made with the DPS. We got that burn in. You may have noticed that it went just a little bit earlier than we had scheduled it. We had scheduled it 105:30, and the crew got into position and got ready to make the maneuver. It so happens that mid-courses of this type are not time critical, so rather than have them wait, we told them to go ahead and press on in the time line. They actually pulled the burn off somewhere between 10 and 15 minutes early. I didn't time it exactly. Some of you might have a question wondering what kind of a factor can you slip that by. Plus or minus 30 minutes on one of those burns makes a difference in flight path angle at the Earth of like 1/10 of a degree. It's almost in the noise. We expect the results of that burn to be very good. The - we'll have a very gross update in the order of 2 to 3 hours after the burn, and it will probably be on the order of 5 - between 5 and 10 hours until we have a real good number or a good entry conditions after that burn. The - I guess we did this burn in a blow down mode. That is, we did not actually have the super critical helium in the loop. We did the burn with just the trapped ullage pressure in the DPS engine, and that is one of the reasons that the rise rate on the super critical helium was not quite as rapid after the burn as it is on a normal one due to the heat soak back. However, even without that burst disk on the super critical helium, should vent the helium somewhere between 107 hours and 110 hours elapsed time. That burst disk has the range of pressure there that it will burst in and it will reach the low limit somewhere around 107 hours. This is a very low venting item for a couple of reasons. One is the vent has a cancelling type end on it. It's got 2 holes that sends the stuff out in opposite directions. Since it is helium, you know how light it is. It's almost no mass, so the disturbing torques that we get as a result of that venting should be very low. That's why we went ahead and started PTC, and we're just going to let it vent when it vents. The consumables picture has not changed any enough to talk about since the last time you were briefed. The water continues to be the pacing item. Right now, based on the predictions, it's good out to around 160 hours and that's got probably a plus 10 and a minus 5 band around it. One of the things that will effect that will be when and if, and it's pretty sure that we will, but we don't know quite when

GRIFFIN - yet. We probably will supply some power over to the CSM somewhere in the time frame of 111 115 hours in order to do 2 things. One to heat the Command Module up some just in general, and while we're doing that, we'll also charge the Battery A, which is our Battery that is down the most, and we'll try to get as much power back into those Command Module Batteries as we can get in. Of course, when we do that, we'll watch the water usage in the LM, and if it were to get significantly high - or high enough to start putting our water critical for us again, then we would terminate that. We don't expect that to happen. Incidentally, the number I gave you there on the water does not include using any supplemental water again out the PLSS or out of the Command Module. We just about have gotten the entry procedures worked up. That's been a day long task that Gene Kranz has headed up with his team and others. We've just about got those to the point now where they're being finalized and those procedures will actually be run through a trainer probably here at Houston, tomorrow, and somewhere around mid-day tomorrow I would suspect we'll start reading these procedures from entry up to the crew. That'll be a very length update. We'll want to start plenty early, and make sure that we have a lot of time to get it right. The weather in the recovery area is - continues to hold about where it has been 2 000 broken is the last time I heard. 10 miles visibility, 4 foot seas. So, that's looking good. That's - oh, one problem that we did have. It turned out not to be a problem, was the Battery mal. We had a malfunction indication on Battery number 2 in the LM. At the time the Battery looked good. We immediately thought that it might be a sensor problem. Just to be safe we pulled the Battery off the line and let it cool for awhile. The only possilbe thing that it could have been was an over temperature condition because the currents were normal so we knew that it wasn't an overcurrent or a reverse current which is the other two parameters that would light this light. We let it cool for an hour. When we put it back on the line, the light came back on again indicating that it was indeed a temperature sensor failure. So we put the Battery back on, and left it on. The Battery is okay, but the caution warning sensor has failed - failed on. That's about all we got.

RILEY Okay. Questions?

QUERY Gerry, I understand that you don't really have the burn data yet. Do you anticipate any possibility of another mid-course?

GRIFFIN That depends on how well this burn does turn out. If the burn turns out as well as it appears to

GRIFFIN - we would not have to do another mid-course. Of course, that's why the mid-course was targeted like it was. So, we'll just have to wait for awhile yet. I think that the probability of another mid-course is low, but it's certainly not impossible, and we'll do it if we have to. I've got some - the flight path angle GAMMA that we were shooting for was 6.51 degrees, and after the burn - this is just confirming the burn, by adding the burn on to the vector that we had, the GAMMA was 6.52. That in itself doesn't mean a whole lot. It's still going to have to have some tracking to confirm that, but it looks good first look.

RILEY Right next to you.

QUERY Even though you're still working on the procedures for reentry, could you say at this time or do you know at this time which one of the Modules you jettison first?

GRIFFIN Yes, that'll be the Service Module. It's on the order of 3 1/2 hours now prior to entry interface. The LM jettison will occur about 1 hour to entry interface. So, those 2 are holding about where I told you last night except the Service Module jettison has moved up a little bit. It's a little earlier.

RILEY Over here.

QUERY On your -

END OF TAPE

GRIFFIN - these two are holding about where I told you last night, except the service module jetison is moved up a little bit, a little earlier.

PAO Over here.

QUERY Pointing that out, what would be a feasible time for entering the command module, the outside or inside limits?

GRIFFIN Okay, the, that time would be on the order of 6 hours, and I haven't been working in this procedures today but I've seen enough of a summary that on - around 5 1/2 hours is the first time that any power at all is brought up on the command module. So, entry into the command module, I assume, would take place 15 or 30 minutes prior to that. So, on the order of 5 1/2 to 6 hours is the number you're talking about.

PAO Over here. Paul Rieser.

Rieser I guess we're kind of going at this piecemeal but, when would they seal away the LM and cut off the 02 flow from that during the entry procedures?

GRIFFIN I'm not real sure of that one, because I don't know enough about the procedures just yet, but if we jetison the LM in an hour, I would think that we would probably have to have it sealed off approximately an hour prior to that. Something like that, an hour and a half to two hours prior to entry.

PAO Back up here.

QUERY Gerry, are you satisfied the RCS, the CM RCS is okay from a temperature standpoint?

GRIFFIN Yes. That's another thing I forgot to mention, and I guess that most of you are aware that we went into the command module and powered up the telemetry for about 7 or 8 minutes. The temperatures in the whole CSM were very good. They were higher than we really expected, and they were very even, as even as we - more than we expected, because we needed the PTC that we had done yesterday was pretty sloppy, but evidently it was good enough. The command module RCS pressures and temperatures in the plumbing system looked fine. The thrusters themselves also are okay, however, two of them are low enough that is we had these same conditions at entry we would have to heat them prior to pressurizing the system which is a normal thing that we do, even in a normal entry, but I suspect that all of those temperatures are going to rise when we apply some power to the command module and just get the ambient temperature and all those temperatures are going to come up some, and they look very good. The whole command module does. It appears that the ambient temperature in there is somewhere around 50 degrees, incedently.

PAO Back up there.

QUERY In this plan maneuver to pressurize the

QUERY docking tunnel and use that to push the two vehicles apart, would you describe what's going to be done to the valves that are in the hatches, especially the valve that's on the side of the lunar module. Is it possible to build up a pressure in the tunnel in excess of the lunar module and conversely could you install the hatches and the Drogue and everything else and let the pressure build up in the lunar module and continue to let oxygen bleed off into the command module until just before you are ready to separate?

GRIFFIN You could do that. You could build the pressure up high in the lunar module, but as soon as you put the hatch in and closed it, if you opened the dump valve say in the hatch, the pressures would equalize, so you wouldn't really be gaining anything. Now, the procedure, and I haven't seen the details, but the procedures are, I understand, it will be much like we did, had to do on Apollo 10, that is, the tunnel itself will be the only pressure that will actually push us apart, and it will give us about 3 feet a second, and as far as I know, there's going to be no attempt to try to bump the cabin pressure up too much. We'll probably get on the high side, but I don't think we're going to get it up to anything near the relief pressure.

QUERY Pressure - The source of that pressure then will be from the command module into the tunnel and the lunar module hatch will be sealed completely.

GRIFFIN The lunar module hatch, I think, will be closed, will be sealed, if (Garbled) that way. The command module hatch will be closed and sealed and there will be pressure trapped in the tunnel, and when they separate, that pressure that's trapped in the tunnel will push them apart.

QUERY You said that the temperature in the command module was 50 degrees. Could you give us the temperature in the LM, and also could you tell us what kind of temperatures you expect, especially in the light of the wire service story, that is could fall down to freezing point. Is this correct?

GRIFFIN I'll have to look at the LM cabin temp, it's something higher. I don't know if you look at it Jack - it's higher than the command module. It's probably in the low 60's. I can find that out for you after our meeting here. What was the last part of your question Emmitte? I didn't understand it.

QUERY The last part was, what temperatures do you expect especially in the light of news storiy, that the temperatures could fall down to freezing? Is this correct?

GRIFFIN I think we expect toward the end of the mission to see some temperatures down around freezing, back in the decent stage of the LM. We may have some temperatures that low back in the service module. However, the temperature

GRIFFIN in the command module will certainly be higher than that. I don't suspect it will go any lower than it is right now. It may go a little lower but not significantly lower. It may get around 40 in the 40's, and as soon as we start applying power to the command module, of course, that temperature is going to come right back up. So, I don't expect any temperatures close to freezing in the command module.

PAO Did you have a question here?

QUERY (Garbled) go

GRIFFIN I'm sorry.

QUERY Where does the lunar module go, what happens to it?

GRIFFIN It will reenter into the Pacific some 5 to 6 humdred miles behind the command module. It will be very close to where the service impacts, I imagine.

QUERY (Garbled)

GRIFFIN Negative. It will be in deep water and sink.

PAO Mary Bavel.

QUERY Gerry, what is the situation on the power in the LM now that you've conducted this firing in the various systems? And secondly, have you seen any medical data at all on the astronauts?

GRIFFIN Let me answer your second question first, because it - Yes we have. In fact, we had high bit rate data for a while there, right around the burn so, and you've got to have high bit rate data to get biomed, and we did have biomed and I can't tell you which crewman it was on. I think is was Fred Haise. Also, just as we were leaving, we did get a medical report, a crew status report, and the only thing I got - I heard just parts of it, but it sounded like the only thing they said was that they weren't any more tired than usual. They said tireder than usual, and as far as power situation, the burn of course, was calculated into that and power, as it turns out, is probably is our, well besides lithium hydroxide, now that we've got the cluge working that's probably our fattest consumable. In fact, we've got enough power now from where we are we could get all the way through the rest of the mission with the ascent batteries. If all 4 descent batteries were off the line, we could make it with the ascent batteries. So, we're in good shape, power wise.

QUERY (Garbled) around the flight directors console?

GRIFFIN Right.

QUERY (Garbled)

PAO Back to second row, back.

QUERY Did the quick test tonight remove all concern about any deterioration in the command module since it's been an active 3 days?

GRIFFIN It certainly gives us a good feeling about it. Of course, any mission I guess you have always had, when things are in front of you to do that are very difficult, you want to make sure those systems work right and you can't really tell that until you get there, but I think we all got confidence in the command module now - I had confidence in it before, but to look at the data tonight really made us all feel, if I can say it, warmer, because they - the most part the command module was warmer. I feel pretty good about it, and in fact, I feel real good about it. I think we can press right on into a normal entry now.

PAO Thank you very much.

END OF TAPE

APOLLO NEWS CENTER
Houston, Texas

CHANGE OF SHIFT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 16, 1970
7:05 AM CST

PARTICIPANTS:

Milton Windler - Flight Director
Doug Ward - PAO

WARD Are we ready to start? Flight Director on this shift is Milton Windler.

WINDLER Okay, things were pretty quiet last night, if you are on Houston time anyway. The status of the trajectory probably you have already heard over the air to ground but we are back in the corridor now; the best vector that we have indicates Okay, they need more volume or what? I'll get closer to the mike. How's that, better? After the midcourse maneuver our best tracking shows us to be minus 6.24 degrees inclination angle and - or entry angle rather - which is within the corridor, and we were looking for 6 and a half, but if it continues like it is now, we'd be very satisfactory. And we'll continue to track that for the next several hours to build a real solid vector so we'll know exactly what we have to do in case - for the next midcourse - which is scheduled for entry innerface minus 5 hours. The status of the crew is good; you probably heard that over the air to ground; the LMP and the CMP had both just gotten up from around a 6 hour rest, and Lovell has gone off to take another rest period himself now, so he is presently asleep. The consumables continue to be doing well; we are actually now on the ascent, stage or within the ascent stage capability of the LM, so we are looking at oh, the minimum consumable I guess you would call it, would be the water is around 163 hours, or so, and this is not counting on some backup methods that we have available to us.

QUERY (garble)

WINDLER In just a minute, I'll let you ask me a question, how will that be?

QUERY What do you mean now 163 hours (garble)

WINDLER I'm speaking interms of ground elapsed time, isn't it? I am speaking in terms of ground elapsed time. The landing is at 142 as you probably are aware. The things that are happening also - another point that occurred during last night's operation was that we powered up the command module from the lunar module, and started charging one of the entry batteries. You recall we have been talking about the fact that that is a relatively inefficient operation, in fact, it's going to take around 120 amp hour to get 20 amp hours into the entry batteries, but we've spent the last day or so, looking at the entry time line and thinking about the things that we have to accomplish and we felt like we would be somewhat close to our margins if we did not do that, so this is around a 15 hour operation, and we plan to put about 20 amp hours back into that particular battery which will bring them all up to around their normal maximum; the maximum that we could expect on any occasion then for entry. So that's what happening right now; on the spacecraft anyway. Back here in Houston, people have been working all night on the details of the entry timeline - on the stowage requirements, a lot of work has been done on verifying procedures in the simulators here. They are going to come in this morning - oh probably in the next hour or so, and work with the integrated lunar module's simulator, and command module simulator and go over the present version of

WINDLER the procedures, which of course through the night have been tweeked on a little bit; we are thinking now that we may even be able to run an integrated simulation this afternoon with the mission control center with the team that is going to be conducting the entry tomorrow morning. You will recall that I said we had pulled that team out of the normal control center operation and have them free to prepare for this; so it may work out that we will be able to do that, although it has not yet been completely established. The rough sequence of events that we are looking at - I guess that has already been released - because I noticed as I passed through, it was being telecast by some channel or other, in any event, we are looking at starting the activities formally I guess you might call it, around 6 and a half hours prior to entry innerface, doing the midcourse at 5 hours, if it is necessary, and of course, if we can avoid that, well, we would like to, but if it is necessary that's when we'll try to do it, followed fairly shortly thereafter with a jettison of the service module, perhaps probably say 30 minutes later, we would if as indicated yesterday, if we think it is safe, and have the opportunity there, we'll try to take pictures of the service module after the jettison -

END OF TAPE

WINDLER thereafter with a jettison of service module. Perhaps, say 30 minutes later. We would, if as indicated yesterday, if we think it's safe, and I have the opportunity there, we'll try to take pictures of the service module after the jettison. We'll be bringing up the command module guidance and navigation system in this period and getting an alinement. We plan to hang on to the Lunar Module until approximately and hour before entry interface, at which time we'll jettison that as we - in the way that we've done in the past. And proceed on then with our relatively normal command module entry procedures. So that's the situation that we find ourselves in and unless there is anything else, Doug, we'll be open to questions.

WARD John Chancellor.

QUERY Can you tell us if there are any changes in the entry procedure at this time that wouldn't have occurred once you got rid of the LM.

WINDLER You must be speaking of late in the - just prior to the entry.

QUERY Relatively normal?

WINDLER Yes

QUERY I'm talking about the word relatively.

WINDLER Well, I'm talking about the fact that in these details, they're still being worked on so it's hard to say yet exactly how they'll turn out, but you know, ultimately we'll come to the point at which we would expect to be on the command module by itself and an ordinary high speed entry is the type we'll be having here so, presumably, we'll meet what I would call the normal procedures and then it would be the same from then on. As best we can tell now, we'll be able to get the command module fully up - the guidance systems and so forth so we would presume that we will be able to do all the standard procedures that we've already been practicing.

QUERY It's my fault, Milt. I broke in on your train of thought when you were starting to work the consumables out for us and you didn't give us the rest of them, the electricity and so forth.

WINDLER How about that. Okay. The oxygen, we have plenty of oxygen, out to 200 some hours ground elapsed time, the batteries at the present time, well at the minimum power, 167 hours and even with the charging operation we have going, should be good up to past 158 or there about. The lithium hydroxide, we have plenty of that. We have enough now in the normal LM system, which is about 37 hours worth should we decide to do that, we can continue on from where we are now, and land on just the lunar module systems. However, we did change recently, as you probably heard, and put on a new command module type canister onto our [redacted] jury rig and it brought the CO2 down and I think I made a mistake

WINDLER yesterday. I referred in parts per million and I meant partial pressure. So anyway, the sum total of all that is that we're in good shape on consumables and that we actually, in fact, could operate from here on in on the ascent stage, as I indicated, with a minor exception, on the oxygen, we don't have quite enough in the ascent tanks to support that, but we have the OPS bottles onboard which would supplement that.

PAO This one right back here.

QUERY Milt, would you address yourself to the non propulsive she tank venting and particularly with regard to - is this a predictable sort of thing or could the venting have done a whole lot more damage then it did.

WINDLER I can't address myself to the non propulsive vent. Cause there wasn't any. We always - not always, but most all of the vents on a spacecraft are designed to be non propulsive, and this usually means that it is kind of a T-operation where the gas goes out in 2 directions, which theoretically cancel each other etc. And almost always we find that when we get into a case of actually observing them in a zero g condition that they do have some slight effect on the spacecraft motions. I guess I was a little bit surprised that the helium which I thought anyway, was a relatively small amount of weight, and coming out at perhaps a relatively low velocity, could have enough effect to stop the rotation and start it in the opposite direction. If you think about it a little bit more though, perhaps that's not so surprising since it did operate over a long period of time and I guess it can be expected, in fact, I think you could explain it with as little as about two-tenths of a foot a second of velocity so, but as far as any danger to the spacecraft, there was no danger from it

END OF TAPE

WINDLER long period of time and I guess and it can be expected. In fact, I think you could explain it with as little as about 2/10th of a foot a second of velocity, but as far as any danger to the spacecraft there was no danger from it at all. It was just that it changed the motion in a different way than we had expected.

QUERY On that, is there any possibility with the vents arranged as they are that a DELTA-V could have been imparted that would have affected the trajectory. All it did was affect the rates a little bit, but could it have affected the trajectory any?

WINDLER No.

WARD Let's get this one right back here.

QUERY Mr. Windler, could you give us a little detail about the plans for the crew, what time they are going to eat and any final preparations that they'll have to make.

WINDLER No, I really couldn't do that. I think we talked yesterday and you probably observed during the day that the crew has generally been sleeping when they felt like it and getting up when they felt like it and eating when they felt like it, and it's very hard for anybody to tell exactly what they're going to do. They are getting more rested, of course, as they continue their cycle, and they're of course now trying to come up to the entry interface time in a good physical condition and I'm sure they'll do that, so other than that I really can't say very much about their detailed scheduled.

QUERY On the charging up, that process began sometime ago?

WINDLER Yes, it did.

QUERY Yes, and you just spoke of getting it up to the normal maximum. We were given earlier this figure of about 100 ampre hours in the batteries in the command module, you are now going up to 120?

WINDLER Yes.

QUERY Could you give us some idea how long it will take to get things warmed up again in the command module and will the cabin atmosphere get up to a comfortable level in time to do the crew any good when you start to bring up the electronics and guidance system, etc.?

WINDLER Well, I've lost track of all your questions there. I'm sorry. First of all, the comfort level will come up and will keep the crew - will be satis-factory for the crew I'm sure. There's only - we're not really worried about the command module temperatures very much. We were interested in seeing what they were and I guess from the standpoint that we had not had any instrumentaion data from them in a long time we were concerned from that point of view, but the data that we have fits in very well with the

WINDLER expected temperatures. We were interested in determining whether or not we had to heat the command module RCS system and I think I indicated to you before that we probably would have to do that and the temperatures indicate that we will and we were interested because it requires power to do that and we needed to put that into our considerations for the entry profile, but that is an expected operation. Sometimes we have to do that and sometimes we don't. It just depends on thermal characteristics. In this case we now plan on doing that, but other than that we're not really concerned about the coolness of the command module as such.

QUERY What I was looking toward was the time yesterday you had about a 500 amp hour pad in the LM batteries at landing. This was the estimate. You're going to expend 120 of that charging the reentry battery, how much of the rest are you going to expend in bringing things up in the command module and how much are your heaters going to use, etc. How does your budget look for those last few hours?

WINDLER Well, I think in summary, we are limited in the amount of power that we can send to the command module by the wires and the circuit breakers to 15 amps, and that's right now I'd guess you'd say the limiting factor. We actually - well, in fact, have probably more amp hours, I'm sure we will, have more amp hours available in the LM than we can transfer or use in the CSM, so it kind of becomes now a look at some of the things you can do in the command module versus the power that they take and the time at which you need to use them, etc. So probably we won't - there will be a few things that, yes, that we can do with it, but other than charging this battery and perhaps doing a little bit of that preheating I mentioned, although it looks like that will take more power than we can get through the line.

END OF TAPE

QUERY Yes, would you discuss the probability of this last mid-course correction and can you still use the DPS engine? Is there enough pressure in the fuel tanks?

WINDLER Well, we can use the DPS engine if we should choose to, yes, although I think the DELTA-V would be very low if we had to make the mid-course and probably we wouldn't - we'd probably use RCS. However, that's a decision yet to be made. And right now it looks like we won't need that mid-course, but we have a lot of tracking time ahead of us before we can really say that.

QUERY Thank you. The last shift, they had a power up of the CSM and they had some transfer of telemetry data. In all these samples that you received, could you tell if the shield of the CSM might have been in any way damaged by the explosion or whatever happened?

WINDLER We don't have that kind of instrumentation available to us really, so we don't have any better insight. The only thing is that the command - the deductions, and I mentioned this yesterday and we've seen nothing to change this, the more things that we look at the more things we find that are all right, and that to me is a positive indication that essentially the problem that we had with the fuel cells was localized to the cryo tank and had a limited effect on the rest of the machine, the rest of the command and service module. So I think it all tells us that the heat shield is okay.

WARD Any other questions? Thank you very much.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

CHANGE OF SHIFT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 16, 1970
2:10 PM CST

PARTICIPANTS:

Glynn Lunney, Flight Director

Terry White, PAO

WHITE This is Apollo Control, the Change of Shift News Conference will begin momentarily.

CAPCOM Aquarius, Houston, go ahead.

LUNNEY Those lights get brighter every day.

WHITE Yeah, I need those eye shades like a Faro dealer wears. All righty, lets get started; black team change of shift briefing. Glynn Lunney, Flight Director. And, Glynn, let's just hit the high spots as usual of the last 8 hours.

LUNNEY Okay, when we came on this morning, we had already performed the midcourse from last night that I am sure you have already been briefed on, and the vehicle was in passive thermal control mode, satisfactory comm, and we went around and briefed in the room. We were then and still are on a comfortable trajectory and we are well within the corridor; flight path angle of about a quarter of a degree away from what we aimed for. During the night before we came on, they had a battery 2 malfunction which was reported to me at the last press conference I was at by the way, we had that blinking still due a number of time off and on, intermitently, but we have pretty firmly concluded that it is only instrumentation problem, we are continuing to use the battery, and the battery is performing fine. That battery is one of the descent batteries, battery number 2. We had turned on the telemetry last night, the thermal data - that we were interested in getting - the temperature data that we were interested in getting from the vehicle gives us a lot of confidence that the vehicle was in good shape, I am speaking now mostly about the command module for entry. We had been on the LM power; we had hooked up the umbilical from the LM to the CSM to enable us to transfer power to the command module, this connection is capable of transferring up to 15 amps only, and when we came on duty we were just starting, or had just started to charge battery A. Battery A you recall the one we used some while ago when we were powering the CSM, when we were leaving it, when the fuel cells were going down, and that was down bout 22 amp hours, so for the last few hours, we have been in the process of replensihing that battery and we expect to have it fully back up to charge oh, some time around 127 or 128 hours elapse. We had been on, you recall, I discussed yesterday, the fact that we hooked up a couple of the CSM lithium hydroxide canisters through which the cabin air was being drawn, the canister were hooked up on the end of the hoses to cleanse the air of the carbon dioxide, we were on those systems for 20 hours, and we just began to see a very very slight rise in carbon dioxide measurements;we were up to about 1 millimeter - one and one half millimeters of mercury - at which time we decided that we 'would put another canister on the one that we had already had rigged up, so that we now have two canisters in series, taped together, so that there is no leakage between them, feeding into the hose, through which the air is being drawn into this suit loop. So we are continuing to get good scrubbing or cleansing of the carbon

LUNNEY dioxide in the vehicle and we feel that the present arrangement of removing the carbon dioxide will last just fine into the 130 hours sometime, perhaps 135 hours, thereabouts, and by that time, if we see the carbon dioxide level going up a little bit, we will probably go back and select the primary cartridge which we still have available in the LM which will be good for about a day, so at the present time, that is our plan relative to the carbon dioxide. At about 133 and a half hours, Jack and Fred, Jack Swigert and Fred Haise went on duty, and Jim Lovell went below to take a nap as best he could; Fred reported that he had 5 or 6 hours sleep; we have since that time, not really been doing much with the vehicle; we have had the pilots going back and forth as ever on duty down into the command module to look at the charge occurrence, this is to keep track of exactly what we are putting into the battery so that we will know what we have in there and will know when to terminate the charge. We also want them to get down there and look at that gage regularly because we don't have any telemetry on the vehicle and we didn't want anything going on down there that we didn't know about. I discussed the battery malfunction we had, another one visible to the crew for awhile, at 115 and a half hours I think, about, and we discussed it again, the fact that we had concluded that it was a sensor and as I said before, we continued to use that battery just fine. We radioed up some information on the trajectory, as I said earlier, we are comfortably within the corridor, at a flight path angle of about negative 6.25; a midcourse of approximately 2 feet per second a few hours before entry will put us right back in the middle of the corridor, however, it may not even be required, at last measurement, the midcourse was down to one and a half feet per second, and for all we know, by tomorrow, the midcourse will be closer to zero, although it may also still remain at the present level. The one report relative to crew comfort is that it is getting fairly difficult to sleep in the command module in that it is getting fairly cool in there. Jim Lovell reported that he has been using the lunar boots to keep his feet warm, and yesterday we were involved in a discussion as to one of the pilots, I have forgotten which one it was, sleeping in the tunnel up with his head probably pointing into the lunar module, or perhaps his head pointing away from it. There is not much we can do about that problem right now, so they are going to have to sleep the best they can - either in the LM or in the tunnel and stay dressed as warmly as they can onboard. So that was the shift items - let me give you an idea of the consumables and I know you are always interested in those.

LUNNEY We discussed the water yesterday, well, I should say consistently, the water has been running at about

LUNNEY the same rate; it is running at just about the same rate now as it was before, you know, we are drawing a little more current out of the LM batteries now in order to charge the command module battery, but the water profile is staying just about the same, so consistent with the kind of information I was giving you yesterday, assuming that we have to power up for one more midcourse, we are predicting a life time on the water of 160 hours, 159 hours. The oxygen is very comfortable, we have a depletion in the LM of 271 hours, so that is well past the splash time, the depletion of the power at the same rate, except for about 2 hours - if we assume that we continue to use power at the same rate - and add in couple hours for a midcourse - we would have 170 hours of depletion, now it is probable that we will use more power tomorrow than the numbers I am quoting here and get as much useful work out of the LM in terms of transferring its power over to the CSM as we can. The details of exactly how we are going to accomplish some of the functions tomorrow are not all completely resolved yet. We had a briefing just as I left the control center with the crew as to the time line - the major events - I assume that everyone heard those - as to the sequence of events we would be going through in preparation for any actual entry. Some of those details within those events are still being worked out, we had crews in simulators all day, there will be another meeting this afternoon on exactly what the checklist ought to be, and as the Cap Comm Joe Kerwin was saying, we will spend some time later on this afternoon and evening reading up a lot of the check list that the pilots will need for tomorrow. We are basically going to be modifying the checklist that they had onboard and the number of the parts of this activity tomorrow had already been exercised. There was one more thing I wanted to tell you; the weather is very good in the recovery area; oh, I know what I wanted to tell you -

END OF TAPE

LUNNEY - there was one more thing I wanted to tell you. The weather is very good in the recovery area. Oh, I know what I wanted to tell you. I have asked that somebody plan, either in conjunction with the next press conference, or separately, to perhaps lay out as well as we can, the timeline and the activity that will be going on tomorrow so that you'll be as informed as we can have you at this time. I'm sure there will be a lot of questions; some of them I won't be able to answer in the next hour and I hope that sometime this evening, we can satisfy most of your questions on the details of what's going to happen tomorrow. The weather is good in the recovery area, as a matter of fact, it's very good. And I think that's about all I have to say and perhaps we can find what you're interested in by going to questions.

SPEAKER Okay. Front row down here. Wait for the mike, please.

QUERY A two-part question. Do you have an estimate of how cold it is in the command module and number 2, if, as I assume, the lunar module is reasonably warm and the command module is cold, why don't the temperatures sort of even out going through the tunnel between them?

LUNNEY I don't have the temperature in the command module. I think it's running about 40 or 45.

SPEAKER It was 52 at 102 hours, but it's probably cooler than that now.

LUNNEY So it's probably cooled down. We will be turning the telemetry on here in about another hour, so we'll get another idea of what's in there. I guess the reason that it doesn't mix too well is because the tunnel is fairly narrow compared to the two volumes on either end and there is not a lot of flow out of the hose that would force circulation. There's enough circulation in that there's no problem with the carbon dioxide level in the command module, but there's nothing working that forces the flow between the two ships.

QUERY (Too low)

LUNNEY It's about 3 feet.

WHITE Mark Bloom.

QUERY Glynn, if you do MCC-7 and assuming it's a foot and a half - feet per second, how will this move the ground track from which - what's it for? What would it be for?

LUNNEY It would be simply for what is called corridor control. The flight path angle or the angle at which the velocity of the spacecraft - the velocity vector is coming back in, is currently at a negative 6.25. Now, if we do a midcourse tomorrow, the purpose of it will be to put that flight path angle at a negative 6.5, which is the nominal

LUNNEY entry angle. The current angle is very comfortable. We could fly the same - without a midcourse at all, we could fly the projectory right on down. We could fly the same range and probably land in the same place. The reason for wanting to put it in the middle of the corridor is just to give it the most room for dispersions on either side plus the most familiar set of conditions for the pilots in that they've seen more nominals than they have dispersed projectories to an entry. Okay.

SPEAKER Fourth row back here.

QUERY Could you tell us please, the astronauts who are taking part in the simulation other than the Apollo 14 crew?

LUNNEY That would be a long list and I haven't kept up with them. The 14, the backup to Apollo 13, I've seen the Apollo 15 crewmembers around. Deke and Tom Stafford are helping all they can. And there are probably a dozen more, but I can't recall who they are right now.

SPEAKER Front row over here.

QUERY Have you seen any signs of anything you might describe as fatigue in the crew so far?

LUNNEY No, I don't think so. I think they've been - I think they've proved, through yesterday and today, they seem to me to be at the same level of operation, and I think tomorrow that they will go through their own process of bringing themselves completely up for the entry as much as anybody has to do to prepare themselves for an event like that. And I think the best indicator is the tone of voice of the pilots. It's been very good.

QUERY Were they fatigued earlier, or did you get that impression?

LUNNEY I didn't really get the impression that they were tired. We've asked - somebody asked awhile back - I recall Fred Haise, I believe, answering that they really felt pretty good and they really didn't feel tired or fatigued.

SPEAKER Back here.

QUERY If it's so cold inside the command module, why aren't they wearing spacesuits? (garble)

LUNNEY The primary disadvantage to putting a suit on is that it is bulky and it limits what the people can do; it's cumbersome to try to squeeze around in either the LM or the command module, especially if you're trying to squeeze through the tunnel and we've kind of had - with one man on watch, we've kind of had them busy moving back and forth so that they just haven't felt the need to put the suits on. Now that's entirely up to them, if they feel that it is just so cold that want to do that, they can certainly go ahead and do it.

SPEAKER John Wilford.

QUERY Under the plan for the separations that you have now, where will the lunar module re-enter and

QUERY where will the service model re-enter in relation to the command module?

LUNNEY Well, I hope that the men who come over this afternoon, this evening, can tell you some more about that. I don't know off hand. Of course, we fully expect both of them to splash down in the Atlantic and the separation sequences that we have are primarily designed to be sure that they are away from the command module during the coast above the atmosphere and during the re-entry portion. So I'm not answering your question, but I hope that they can help you better with that than I.

QUERY Why aren't you going to be using the normal technique for jettison the LM rather than letting it be pushed away by that pressure, pressurized tunnel?

LUNNEY Well, the reason for that is that we don't have the service module - we would not have the service module with us, the normal procedure for separating from the LM. It's undocked from it and then translate away with the service module thrusters. At the point of the flight that we'll be at we will have already detached the service module, the command module does not have a thruster configuration that allows it to translate. It can just rotate, pitch or yaw. Okay?

QUERY There was some discussion about the possibility of the astronauts getting into their spacesuits just prior, I believe to jettisoning the LM after they put the tunnel hatch in place. What was the final decision on that score?

LUNNEY Well, to clarify your question, the question really is whether they ought to put their suits on before we go into all the entry preps for tomorrow or not. As Joe Kerwin, the capsule communicator discussed on the loop, the advantages of having the suit on is if there's any problem with a leak in the command module hatch. We have not experienced any problems like that and we are able to exercise closing the hatch now and as Jim pointed out they will do that a number of times. The disadvantage with putting the suit on is the same one I discussed earlier that the suit is indeed a cumbersome thing to wear and in the sense that it is cumbersome it actually becomes a limitation or a compromise in getting this job done that you have to get done to accomplish the entry. So it's a question of trading off inhibiting or making more difficult the task which is already difficult that they have to do tomorrow versus your confidence in the hatch.

QUERY Just about the time you were getting started in here the recommendation was made that - from the ground that they not wear the suits during the separation of the LM. And the reason that was given was that the wearing

QUERY - of the suits would cause the astronauts to generate more heat and the heat would have to be dissipated and there would be comensurate power drain with that function. And water requirement - and I'm wondering whether or not the numbers that you have been giving us on the water and on the power really indicate as large a margin as one might think. If you don't have enough to be able to handle suited - the heat generator by suited activity. That's a metabolic heater. There's - it can't be all that much in a calors and yet you don't want to expend those consumables for that function and pick up the protection of the suits. Now, I'd like you to review that again.

LUNNEY You'd like me to what?

QUERY I'd - I'd - I question - I question the - You give us some numbers which would seem to imply that there is a large buffer in some of these consumables. Or at least adequate for doing the mission without any sweat. But it seems now that the decision on the suit doesn't reflect that. Whatever little amount would be needed to dissipate the body heat, they're not willing to expend it for a period of several hours -

LUNNEY Okay

QUERY That they might otherwise do so.

QUERY Each time that, at least I've quoted the numbers to you, that is I have tried to carefully explain that they are based on the current rate of expenditures allowing for two midcourses 2 days ago and allowing for, from this period forward, a couple of hours for one midcourse. The numbers that we have been quoting are consistent with that. Putting the suit on is an additional load. I don't think it's an overriding factor in determining that the water availability would be much more marginal than what it is right now. I think the primary reason - -

END OF TAPE

LUNNEY I don't think it's an overriding factor in determining that the water availability would be much more marginal than it is right now. I think the primary reason for not wanting to put the suit on is that it definitely encumbers the operation of the astronauts in getting the ships ready to do the tasks they have to do. An additional argument for not putting them on is that they'll get warmer and will have to dissipate the heat, but I personally don't consider that an overriding reason for not wanting to put the suit on.

QUERY Glynn, I have several questions on the crew and how they've been living in space. You mentioned that they're having difficulties sleeping in the command module. Where have they been sleeping, first of all, and wouldn't those beta sleeping bags provide some warmth?

LUNNEY Well, I assume that they have continued to go down into the command module to sleep. I don't know what all they're doing to stay warm while they're down there. Jim talked about putting the lunar boots on for his feet, he talked about wearing a couple of sets of underwear. I don't know whether - how much good they're getting out of the sleeping bags, but they generally seem to be getting cooler and cooler as they sleep in the command module. In other words, they definitely seem to be noticing it at this time of the flight. Somebody remarked that they were rubbing their hands when they came up from the last sleep shift down in the command module.

QUERY Then secondly, on the food. In the hurry, you know, to transfer into the LM and what have you, they seem to be - they were sort of snacking there for a little while. Do you know what kind of stuff they've eaten and have they been able to use any hot water or have they been eating cold stuff, do you have any comment on that? I mean, have you heard any comment?

LUNNEY I don't know. I really don't know -

WHITE - hot water in the LM.

LUNNEY There's no hot water in the LM, no, but I really don't know what they have been eating. I just assume they've been working about through their regular menus or deviating as they see fit.

WHITE And reading the telemetry.

QUERY And the other one was outside of the comment that Lovell made that there would be a long time before another moon mission, which he made several days ago, I haven't seen any comments from the men particularly on their plight in space. Have you heard any?

LUNNEY On their plight?

QUERY Yes, you know, how they (garbled)

LUNNEY No, I haven't heard any handringing or anything like that. I think their primary interest, as ours is, is to keep the ship working like it is now and get thought

LUNNEY out what they have to do tomorrow. I wouldn't expect to hear that kind of thing from them either.

QUERY Realizing you'll be able to fill in more details later, could you still give us the outline of this pre-entry sequence and a rough estimate what time each step will happen and perhaps what altitudes?

LUNNEY No, I'm not going to give you altitude, but I'll give you the same times that Joe Kerwin read up to them a little while ago on the air to ground. They're to start the IMU heater in the RCS preheat checks in the command module at 136:10. They're to start powering up the LM AGS and getting it alined at about 136:40. They're to do mid-course 7 at about 137:40. Service module jettison - am I going too fast? 136:10 for IMU and command module RCS; 136:40 for powering up the LM AGS; 137:40 for the mid-course, which by the way would be done with the LM RCS at the present size which we don't expect to change. At 138:10 service module jettison, at 141:40 it would be the LM jettison, the time period in between the service module and the LM jettison, of course, is all devoted to the systems operations within the command module, getting it ready for entry including the alining the platform, and then at 142:40 is the 400 000 foot point, and there's a landing about 14 minutes later at 142:54 and that's all to the nearest minute. I would hope - service module jet 138:10.

QUERY (garbled) talked about earlier?

LUNNEY Is it still the what?

QUERY Is it still going to be a push and pull exercise?

LUNNEY It will with the service module. Okay?

QUERY (garbled)

LUNNEY Yes. The service module jettison will occur in plane. I haven't looked at the pictures or the drawings, but I think what they will do is as they are coming down they will point the service module behind them, service module will be trailing, and they will be inplane. I don't know what pitch attitude they will be at, and what they'll do is translate that way a half a foot per second or foot per second and then they'll separate the service module and then they'll translate with the LM thrusters in both cases back to half a foot or foot a second that they put in with the push. This in effect starts the service module on a path 1 foot per second different, and of course over 4-$^{1}/_{2}$ hours it becomes a considerable distance in miles that the 2 vehicles would be separated by. Yes. You push with the thrusters, okay? One foot per second, you get rid of it, then you thrust back 1 foot per second and you get back on the same trajectory you were on. You put the other part of the vehicle on a different trajectory by that much. Okay? You asked about the other procedure. We're going to separate the LM much as we did on Apollo 10.

LUNNEY The tunnel will he pressurized. Again we don't have any translation thrusters in the command module which is what the pilots will be in at this time not the command service module. And by leaving the tunnel pressurized you in effect have the same principle going for you when you release the balloon and it will move on away from the command module. That will be done, oh, about 45 degrees out of plane so that it will go off to the side as we get close to entry.

QUERY The LM and the command module will be considerably lighter, I believe, have less weight after they release the service module. Now, will that half-a-foot per second effect the trajectory in any way. The pull part of it.

LUNNEY The point of talking about doing it in feet per second is that, yes, the weights will be different and when you push, you've got to push the whole stack and then when you back you won't have to burn as long in order to get the foot per second back because you're lot lighter with the service module jetisoned. So putting a foot per second in and taking it out essentially puts you back on the same trajectory. It will be a longer duration burn when you are pushing with the service module on than when you are backing off without it. If that answers your question.

QUERY Excuse me if you have already answered this, Glynn,

LUNNEY Where are you?

QUERY Over on your right and way back.

LUNNEY Okay.

QUERY Will you leave the LM systems up and the AGS in attitude hold when you do that pop-bottle thing?

LUNNEY Yes. The idea being to control the attitude of the LM with the control systems so that the effect of the pressurized tunnel will be to continue to thrust the vehicle away from the command module.

QUERY Glynn, did you say what the separation rate will be for the LM with it's tunnel -

LUNNEY I don't really recall. It's on the order of a couple feet per second. Maybe it's one and a half. Something like that.

QUERY I've got 3 questions first of all. Are there any real possibilities to make pictures of the service module after jettisoning it and, second, can the crew keep up with what they have to do or have they time which they can use to do nothing and the third questions is, after jettisoning the LM could it start rolling over a time and then -

APOLLO 13 CHANGE OF SHIFT BRIEFING, 4-16-70 CST 1428 34C/4

LUNNEY We have planned a PITCH maneuver with the LM to take pictures of the service module; however, as we briefed the crew, we consider that, at this stage of the mission the low priority item. We would not want to interfere with the conduct of the operations that has to go on to get the vehicle ready for entry. There are people working on what kind of cameras and what kind of lenses do but we have tried to convey and will continue to convey to the flight crew that we don't want they to spend too much time or jeopardize any of their sequence getting those pictures. As far as the timeline for the crew goes I think there are going to be -

END OF TAPE

SPEAKER flight crew that we don't want them to spend too much time or jeopardize any of the sequence getting those pictures. As far as the timeline for the crew goes, I think there are going to be tight parts to the work tomorrow and I think there will probably be some periods in there when you'll be able to tell that we're just waiting for something to occur. I have not heard yet, completely, the results of the simulator work today. As a matter of fact, the astronauts were still in the simulator when I left. No, we don't expect the LM to go tumbling all over when we fire it away with the tunnel pressurized because we have left the control system on in that you continue to maintain the attitude of the lunar module.

PAO Front row down here.

QUERY Is the midcourse a final decision?

SPEAKER No sir. As always, we kind of delay that probably to your consternation, as long as we can, and while we get as much tracking as we can in order to be sure that we have to lo, and sort of in the past, as I recall, we always think we have a midcourse at this time in the flight then we rally end up having to make, and it may well be small enough tomorrow not to have to bother with.

QUERY mother thing was you said the LM and the service module might splash down in the Atlantic.

SPEAKER No, I'm sorry I said that, the Pacific.

QUERY Oh, I thought you said Atlantic.

SPEAKER If I did, I was wrong.

QUERY In what shape might they be when they got there?

SPEAKER The service module?

QUERY And the LM? After reentry?

SPEAKER Well, we're never going to use them again, I expect they will be broken up, especially the LM. I expect it to break up.

PAO Art Schneider.

QUERY Glen, you've often said in the past few days that your goal is to maintain the stability of the stack. But what in the back of your mind is the major real practical problem that concerns you in achieving that goal.

LUNNEY Well, I don't pick on any one thing. We've been careful about the power. We've tried to be careful about the water. We have been comfortable on the oxygen. We've tried to maintain a passive thermal control, as difficult as that has been, I think for the pilots to perform, we've tried to maintain that to assure that, to the best of our ability to study these kind of problems, that the vehicles are still safe. We did not want to find ourselves with hot spots on the vehicle or cold spots on the vehicle. So all in all, it's just been a continuing process of watching all these variables

LUNNEY and watching the performance of the systems and being sure that they are continuing to do the job and I guess in summary just plan - just being plan careful about what is going on and what we are supposed to do and also being careful on the subject of the preparations for tomorrow. There has been an awful lot of hard work going in getting the procedures and we made quite a point out of that and maybe it is difficult to appreciate, but flying these vehicles as complicated as they are as complicated as they are by the fact that they are on a trajectory with all the constraints that that imposes is just - It's just a big job of intergrating what you want to do first and how you want to do it. How you want to power from the LM to the CSM. We just try to be very very deliberate about all of these things and I just have not had any one thing on my mind that has concerned me, I think all of us feel that the entire situation needed to be watched at all times in this entirity. Because if you get to concentrating on any one thing you usually end up missing what you ought to see.

WHITE Third row back here.

QUERY I was wondering if you have any kind of control over the LM once you allow the air pressure in the tunnel to cast it off so to speak, if you should want to activate some kind of a thrust mechanism within the LM, after it is separated, is there anything you can do or is there anything the crew can do, or once that tunnel cast it off, that's the last you can tinker with the LM?

LUNNEY Once, - actually, once we close the hatch we will not be tinkering with the LM anymore, now there is an active -

QUERY If something went wrong -

LUNNEY I am getting to that, sir.

QUERY Sorry.

LUNNEY There is an active control system an automatic control system working in the Lunar Module when we jettison to hold attitude. It is possible, if we wanted to and we have no reason to do this, that we could send numbers to this computer, just as we do in flights, sending it state vectors and updates to the platform, but there is absolutely no point in doing that, in no way could we fire an engine nor turn something on or off, by that processs. So, in fact the answer to your question no, we are not going to do anything to it, nor could we really do anything to it.

WHITE Thank you.

QUERY Are you satisfied with the results of todays checks that you now know the full extent of the damage caused by the original explosion? If so, what is that? And in particular is it true that the PYRO technic

QUERY devices leads go down into the Service Module and is there any doubts in your mind that they may have been damaged and may give you trouble when separation comes?

LUNNEY Well, we haven't done anything particular today to satisfy ourselves on that anymore than we have all along, we have had the telemetry on the - on the Command Module we have verified the integrity of all the equipment other than the cryogenics in the fuel cells that we can on telemetry. We have looked at the batteries which supply PYRO technic voltage to fire the circuits, there are circuits down to the Service Module, but the only one that we are concerned about tomorrow is the one right up by the Command Module which cuts what are called the tension ties, these being strapped with stainless steel hold the Command Module and Service Module together in three places, we have to cut these tomorrow with PYRO technics, but that is in the area that is enclosed and above the area where the cryogenic problem occurred, there's really not anything that you can tell from telemetry about that area, other than about temperatures in that area seem to be normal.

WHITE Mary Bub.

QUERY - before reentry will the men actually get in the Command Module and start getting ready and how does this period of time of X number of hours compare to the X number of hours that they would normally use in - you know the same checklist, well I know they are different, but I mean in getting ready for reentry. And usually the men have always had a stowage problem to getting everything put away and that kind of thing and I was just wondering.

LUNNEY Well -

QUERY How they would compare.

LUNNEY In reverse order, the stowage problem as strangely enough is little bit easier, because we haven't had time to take much out where it has been stowed and what we are going to do is really not worry about any stowage at all, much in the way of moving things around, our main concern is what it is in the LM that we would want to bring back to the Command Module to bring home. And there are really not very many items in that class. Now as to the time the hatch will be closed at about an hour and a half to go between the Command Module and the LM at which time the 3 men will be in the Command Module, up until that time I think there will be some traffic back and forth, but primarily the CMP will spend the last 6 or so hours in the Command Module actively doing something. That is in the sense of getting the ship ready to fly although he won't be doing something every minute. In

LUNNEY - that sense the amount of time that we have somebody in the Command Module will be about the kind of time that we usually prepare for this kind of entry, however, most of the time we will only have one man in there rather than 3. Secondly, we have a lot more to do in that most of the equipment is usually up when we come back from the Moon, at this stage of the flight, for example the guidance system, the cooling system, the batteries, the fuel cells, in this case, none of that equipment is up and it all has to be brought on line slowly, to be sure that the batteries warm up to support the increased load. So, tomorrow, I think you're going to see primarily - and the other new thing that the pilots will have to worry about as we will in the Control Center will be the fact that the LM is really the thing that is doing all of the steering until we separate with the Command Module alone. So that we will have effectively 2 vehicles to fly most of the time that we normally have only 1 vehicle to fly and normally, that 1 vehicle is 95 percent ready for entry and there is just a few things that you have to do, and in this case we have to power it up from the beginning, so there is quite a bit of work to do tomorrow. And the pilots will have a fairly busy task, now the effort that has been going on here for the last few days is to be sure that the way in which this is laid out is a reasonable thing for the crew to do in that order. Two men in the LM and 1 man in the Command Module and we think we have that but there will be I think a fair bit busier than usual preparing for this entry.

WHITE Any further questions? Front row down here, let's take one or two more and then close it up.

QUERY Glynn, despite the fact that Dr. Paine has called the mission a qualified failure, you must have learned a lot of new emergency procedures, new ideas on the capabilities of the spacecraft and the men can you comment on that for us?

LUNNEY Well, I guess we have learned a number of things certainly in operating the LM like this, now we had in the past considered how we would do some of these things if we had to go in and use the LM in the present fashion as being used. I don't know as I can come up with some specific examples of anything that we have really learned. Some things are difficult, you learn those, the control task from the LM with the entire stack are difficult we kind of knew that but - which appears that they can be difficult for the pilots, I guess all in all I'm just going to wait until tomorrow before I start thinking about what we have to do for the next one and what we learned from this flight.

WHITE Back here.

QUERY Realizing that they were awfully busy when the trouble first broke out, is going through tomorrows new checklist and dispatch going to be the most hectic hour or two that the astronauts have experienced so far in the flight? How would you compare it with the Monday night activity?

LUNNEY Well, we will have an advantage on what we had to do Monday night, in the sense we've had several days to think about it and some time to run a lot of this work in the simulators. We have - we will have a well briefed crew on exactly what we want to accomplish tomorrow - you know an almost minute by minute basis, but it really isn't that detailed. Monday night problem was different in that in the first place one wasn't sure what the problem was, for a while and that always makes it quite a bit more difficult to handle plus you just didn't have all of your procedures written out for the particular problem you were dealing with. One you weren't sure what the extent of the problem was and two procedures might or might not have worked. So, -

END OF TAPE

PRESS BRIEFING $-16-70 CST 14:48 34E/1

LUNNEY You just didn't have all your procedures written out the particular problem you were dealing with. One you weren't sure what the extent of the problem was and two procedures might or might not have worked so they had a more difficult time, I think, the other night and we have a lot going for us in the preparation for tomorrow. I've talked some about the procedures here. I think my purpose has been to explain, one, why you've heard so much air-to-ground traffic on the subject and will today because it is - it's different and it takes a fair amount of thought and planning and two, just to acquaint you with the problem that the pilots will have in getting the vehicle ready for entry tomorrow. I - I don't mean to overdo that in the sense that we've given them an impossible task. I think we've tried to make the task a reasonable one with the power that we have available and with the systems help that we can get from the LM tomorrow.

WHITE Any further questions? I understand Neil Armstrong will make some sort of briefing in here, a presentation at about 3:00. Glynn, if you want to run for the back door I'll try to hold them off. Thank you very much.

END OF TAPE

APOLLO NEWS CENTER
HOUSTON, TEXAS

CHANGE OF SHIFT BRIEFING
MANNED SPACECRAFT CENTER
APRIL 16, 1970
9:05 PM CST

PARTICIPANTS:

Gerald Griffin, Flight Director
William Stoval, Flight Dynamics Officer
Jack Riley, PAO

APOLLO 13 CHANGE OF SHIFT BRIEFING, 4-16-70, CST 9:05P 36A/1

RILEY Okay. Let's get started. This evening we have Flight Director, Jerry Griffin and his Flight Dynamics Officer, Bill Stoval. Jerry.

GRIFFIN I think you probably followed most of the air-ground. Here recently, we have been doing this check-list updating for the entry phase. We're just about to wind up the CSM portion of that and as soon as we finish that, we will switch over and do the LM closeout portion. It so happens, that will be a whole lot shorter than the CSM and this other thing is kind of like reading War and Peace or something over the air. I think we've been at it for about an hour now. Of course, that task has been in more, I guess here at MSC and other places about three days now developing those procedures and running them on the simulators. It just took a long time to pull it together and we finally kind of got in right under the wire in time to read it in. We didn't do a whole lot less on our shift. We did do some updating of our midcourse correction stuff and Bill can talk about that. He can tell you where that stands right now. And we have virtually the same consumables status that I gave you last night and I'm not sure what Glynn told you this afternoon, but we're in about the same position. We have finally emptied the portable water tank in the Command Module and you may have heard just now, we told them to go ahead and drink all the LM water they felt like they needed because we've got a pretty good pad left over there, and besides that two of them will be going to sleep here pretty soon. There will only be one of them up. So we're in good shape there, good shape powerwise, oxygen, lithium hydroxide - all looks good. In fact, we've made our last kluge. If the CO2 level gets up high again to switch, we're just going to switch back again to the alternate LM primary cannister and end out the mission on that. We've updated the crew on the stowage and they've transferred stuff back and forth except for a couple of exceptions that they just can't do until later. The probe and drogue get stowed on the LM and they have to wait to do that and there are a couple of cameras that are left back over on the LM and they'll have to go to the CSM. But they are in real good shape, I think, housekeepingwise in the spacecraft, both of them and as soon as we get ready to start this whole entry, what I call an entry phase, I think they will be in real good shape to start it. Bill, why don't you say something about how the midcourse stands right non, what size it is and what time and all.

STOVAL Okay. We've been watching this trajectory now for about 12 to 14 hours since we had the

STOVAL sch-burst disc last night, and It seems to be settling down moderately well. We're looking at the midcourse anywhere from 2.7 to 3.4 feet per second and it's sort of bouncing around in that region. That would be at a GET of about 13740, so I fully anticipate a midcourse of somewhere in that vicinity.

RILEY Bill, why don't you go ahead and tell them what kind of a burn and the duration and DELTA V if you've got all that.

STOVAL Okay. We're tentatively planning to stage down at this level to do an RCS maneuver here and it would be on the order of 20 to 25 seconds long or somewhere in that range, depending on the DELTA V we need. And it would be done essentially just like the midcourse last night where they align the AGS system using some sightings on some planets, this type of thing. It worked out very well last night and it just may work out very well again. The attitude of the maneuver is certainly not critical, but we are trying to adjust the entry conditions so that they will be just perfect.

GRIFFIN You might mention, too, the entry angle based on, I think your last update was what, minus 6.05.

STOVAL Minus 6.05 which is about 46/100 of a degree shallow. We'd like to get it about 6.50 which is what we would target the midcourse to do.

GRIFFIN Okay, now, let me give you a little bit because I know you are going to ask that. I'll give you a little bit now and the major sequences that we are going to go through. At 6 hours and 30 minutes prior to entry is where this entry phase is really going to start. At that time we'll power the Main Bus A with the command module Battery C and we will still have power from the LM supplying power to Main Bus B so at 6 hours and 30 minutes, we'll have both buses in the command module powered and that's when we start a partial power up for the command module. We'll come along and do midcourse 7 at Entry Interface (EI) minus 5 hours and shortly after that, at EI minus 430, we'll jetison the service module And we are going to PITCH right after that maneuver we are going to PITCH about about 90 degrees and attempt to take any picture that we can get of the service module as it moves away and we are using this push-pull thing that I have talked about before to get the service module away from us but it will be at a very slow rate. We're going to be taking pictures out of the LM window or windows as well as window number 5 in the command module. So we are going to have a lot of cameras looking at it and, hopefully, it will

GRIFFIN come off and turn in the right direction for us to see something if it is there to see. It will be on control, of course. We'll finally transfer total power, we'll terminate LM power at approximately EI minus 2 hours and 30 minutes and from that time on we'll be completely on the CSM batteries. We'll jettison the LM at EI minus 1 hour, and the technique for doing that is now zeroed on in - we'll put both, of course the CSM hatch will be in, we'll close the LM hatch with its vent valve closed, we will vent the tunnel down to about 2 psi and when we separate the lunar module off the pressure in the tunnel will push us off - push us apart. From there on, it is almost a normal, from EI minus 1 hour on, it's almost a normal entry, even as far as the checklist goes, it's almost a normal entry. So from there on, we wouldn't see much difference. This profile, the last time I checked - oh, incidentally, we have been charging the batteries, we charged Bat A, it's fully charged now and we are now charging Battery B and we're going to top it off all the way so that we should have approximately 118 amp hours when we start this entry phase. That's in the command module. This profile runs around - 106 is the last number I heard and that may change a little bit because they are doing things a little differently, but that's ball park.giving us a pad on the water of somewhere around 12 amp hours and if you want to convert that recovery time, it takes about an amp and a half an hour in a fullup condition. You can get it longer if you turn off the S-band and go VHF only there are some other tricks you can play in there to extend that lifetime. Also, that's kind of a 3 sigma low battery amp hour assumption there, too. There is probably nearer to 50 amp hours in those batteries than 40, but we play it kind of conservatively there and put those other 10 hours in our pocket. So, it looks like things are going real well. We got this checklist business, I think is kind of a space first. That's an awful lot of reading and I am glad we had good COMM to do it with. We finally had to turn the power amplifier on to make sure we could hear him well and we finally got it up there. I think that's all I got.

RILEY You want to give them those entry numbers?

GRIFFIN Oh, I can give you some - Entry Interface will be at 142:40:40, and that's 400 000 feet. Drogue time will be 142:48:55, Main shoots 142:49:43, landing at 142:54:40. And that assumes a midcourse correction. The splash point for the command module will be 2140 south, that degrees and minutes, 21 degrees, 40 minutes south,

APOLLO 13 CHANGE OF SHIFT BRIEFING, 4-16-70, CST 9:05P 36A/4

GRIFFIN 16523 minutes west. The service module whatever makes it through the atmosphere should splash somewhere around 25 degrees 21 minutes south, 17456 west and likewise with the LM, whatever makes it through will be at around 2523 south, 17530 west. They can see the service module in the LM

END OF TAPE

GRIFFIN Makes it 3 will be around 23 south, 175 30 west. You can see, the service module and the LM are very close together. Somebody asked Glynn Lunney and I'll throw it out now in case it can answer the question, the service module seperation takes place 34 888 nautical miles above the earth and the LM jettison takes place 9 729 miles above the earth. Naut-Those are nautical miles. On the out skids, the last ones? Service module SEP 34 888, LM jet 9729.

RILEY We'll take questions now. Let's get this one here then come over here and get these guys.

QUERY You said something after you mentioned the length, or at least the amount of amp hours you had left on the water, that works out to 12, to 8 hours at one point five an hour, but you mentioned something else, you have other batteries.

GRIFFIN No, these batteries are rated at 40 amp hours each. However, the batteries we know have some additional, we always can't count, you can't measure for one thing. But there's five to ten additional amp hours in any of these 40 amp hour batteries.

QUERY What drain do you expect from the equipment?

GRIFFIN You mean, drain on the water? On the water? An amp and a half continuous.

QUERY Jerry, I gather you're happy with the way things are going. Step by step just subjectively where's your personal confidence level, right now?

GRIFFIN It's good. I'm glad to see us get this checklist stuff up, that was the last big thing to do and from here on in, it's merely the equipment performing and so I feel confident that we'll make it.

QUERY Mr. Stoval spoke as if the mid course definitely will be made. Is that correct?

GRIFFIN I'd say it's a pretty fair approximation. It's hard to tell with this trajectory moving as it is but it would have to have taken pretty significant deviations for us not to take the mid course at the moment.

STOVAL I'd add to that that as long as it stays in this range we will make it. If it did show some decrease that we didn't have to do it, we wouldn't.

QUERY Mr. Lunney spoke this afternoon of the spacecraft still being comfortably within the re-entry corridor and I take it that is still true.

GRIFFIN Do you want to talk about that? It's in the corridor. It's shallow but it is entering.

QUERY So the mid course that you're going o make then is desirable, but not mandatory? Is that correct?

GRIFFIN Well it's really hard to pin down. We, it depends on what Glynn thought comfortable was.

GRIFFIN It's 6.05 is pretty shallow. Okay 5.9 really defines the lower part of the corridor if you will. And you're bumping it. I don't know what his definition of comfortable was, but I'd say anything within plus or minus 2.5, .25 degrees 6.5 would be comfortable. Anything other than that starts to get a little uncomfortable, but certainly flyable

QUERY Did the one Al just ask, did you give us a time on this mid course correction.

GRIFFIN That would be a GET, at least current planning, would show 137:40. And again the time's not critical. It will be the kind of thing like last night where they do it when they feel good about their alignment and everything else.

QUERY How many feet are, is there any way to measure that, how do we express that correction?

GRIFFIN Feet per second? Delta V would be 2., 2.73, 3.4 these are the kind of numbers we've been looking at all night, but it's in that range.

QUERY (garbled) on times, save us all some arithmetic, did you happen to translate these mission elaspe hours into eastern standard or central standard?

GRIFFIN I haven't.

QUERY Splash down is still the same?

GRIFFIN It must be about shortly after noon, a few minutes.

RILEY It's within a minute or two from what I think they said earlier.

GRIFFIN We launched at 1:13

RILEY Back up on the end of the front row there.

GRIFFIN (garbled)

QUERY What would happen if you did not make the mid course correction, that's one, two, how many people are going to be taking the pictures, and three, what are the chances of the LM burning up before it hits the face of the earth.

GRIFFIN Well let me start from the back. The chances are that pieces of the LM will make it in. I can't tell you exactly what pieces. Kind of like the service module. Chunks of that usually make it in and a lot depends on the orientation that it gets captured in the atmosphere at, and so forth. So, pieces of it undoubtedly will probably make it in. It's all out in the deep water, out in that area. Now let me go back and answer the question. If we didn't perform the mid course it would mean that we would have to fly, and Bill correct me if I'm wrong, the entry would be a little bit hotter as far as temperatures go, it would be actually a lower G entry than nominal and it would mean that we would have to probably fly with some reflectors down, more than really on a normal entry. That about...

STOVAL The G level, I'm not sure about, but the rest of it is right. It would definitely lift vector down and like I said it's flyable and I don't the retro-fire officer would have to tell you which programs you get into I'm not..

GRIFFIN It's not that much different, it would just be a, that's why we define this corridor that way. It's acceptable in between those ranges. Slightly different orientation in the spacecraft as you modulate the roll to affect the lift.

QUERY Who will be taking pictures?

GRIFFIN Actually all three of them, although one of the cameras is sequence camera, that you just turn on and it runs. Then you have Hasselblads that you actually have to activate, but all three of them will be involved in that.

QUERY (garbled) priority.

GRIFFIN They're low priority. We've put some priorities on the three sets of cameras but it's only for our own purpose of, we'd rather have the pictures out of the LM because we feel the windows are going to be better and, but all of it is low priority, if they don't want to take them.

STOVAL Yes, in just a minute when he's through over here. Okay, fire away.

QUERY I've got a couple. First of all, how come the trajectory changes, secondly, could you give us the heat of the, the peak point of the entry, please?

GRIFFIN Bill why don't you answer..

STOVAL It's not so much that the trajectory itself changes, but the way we measure this trajectory, we all the radars across the country are using this dop, what we call the doppler shift to determine velocity, and we only determine the line of sight velocity and it takes a very long time with them coming straight down at us to really get a good feel for where this spacecraft is. Any place else toher than along the line of sight and how fast it's going. And last that perturbation well when the SCH-tank blew. Okay, that bothers our data, that takes maybe eight to ten hours to recover from something like that. So it's now really the trajectory itself as much as it is our ability to determine the trajectory.

GRIFFIN Then it's a geometry problem and if the geometry is not real good so there's noise in your solution.

STOVAL And we're having the comm situation is not the best for tracking, of course the LM is in a little higher PTC rate than we're use to and the data doesn't quite fit as well and the people are just having a lot more trouble fitting it than they normally do.

GRIFFIN That's one we can get for you and the

GRIFFIN retrofire officer will have that. We will have to get it for you afterwards and have him call it over. He can give you the peak temperatures.

QUERY Jerry, what pictures do, what do you expect to see in these pictures of the service module. Will they be trying to take pictures of the general area where the trouble developed, on Tuesday night?

GRIFFIN Well, we kind of just have to take what we get. Understand that the service module as it comes off is uncontrolled. It will probably not be perfectly stable because of the disturbance torques put to it when you blow the pyro ring, so hopefully it will come off and turn one way or the other and before it gets too far away if there is anything of interest to see on it, which I suspect there probably is, hopefully we can get a picture of it.

QUERY Just one more question. Will you be trying to take any pictures of the LM after you jettison?

GRIFFIN No. No, at time, see you're one hour prior to entry interface you've got all the cameras stowed.

QUERY Again, to save us a little work. If you've got the answer already. Those figures that you gave us for re-entry time-procedure time. Have they differed from the earlier ones that we got.

GRIFFIN No...

end of tape

QUERY - figures that you gave us for - for reentry time - procedure times. Have they differed from the earlier ones that we got?

GRIFFIN No, not significantly, they're about like the ones I gave you last night, I think. They - they're almost the same.

STOVAL (Garble) on the front row and then move over to Harry, please.

STOVAL Right, well - Ladies first here,

QUERY Jerry, in the need to conserve power on the limits - first of all, what have you lost or sacrificed in the way of data. Secondly, because you haven't had things turned on in the Apollo, what have you lost there that maybe perhaps you would have liked to have had?

GRIFFIN Okay, the LM data we've lost almost nothing, we've - we've operated a little more in low bit rate than we would have in a normal mission, we'd of had a little bit more high bit rate data. But since we didn't - most of the high bit rate data on the LM is associated with the PNGS, the primary guidance and navigation system, since we didn't have the PNGS powered up we really haven't missed much by not having high bit data. We've missed a few, you know, odd temperatures and so forth like that. But we really haven't lost very much data from the standpoint of the problem, because we powered - had to power the PNGS down anyway. As far as the normal spacecrafts life support system and all, we've lost nothing. Now, in the command module side, we have lost our ability to - since it is powered down to continually monitor the temperature trends, and that's why now three times we've taken - well, we've twice gone in - we had the conditions at shutdown, and then we have twice gone in and taken kind of a snap shot of the whole vehicle for about 5 minutes and determine what all the temperatures were, and you can see that the slopes of all of them plot out pretty nicely. The vehicle has cooled down. So we did lose the ability to continuously monitor those temperatures, but we've been able to get enough data to put the picture back together.

QUERY What are the temperatures?

GRIFFIN It looked like the cabin temperature in the command module was 45 degrees this last look we had; the general structure of most of the spacecraft was around that same level 45 to some as high as 50. And it looked like the whole thing had cooled down about 5 degrees from where it was the last time we looked.

QUERY Will reentry be controlled by the primary - the command module primary guidance and nav system -

GRIFFIN Yes.

QUERY - and if so, when will you fire it up and how will you tell it where it is and what's going on after it's been sleeping so long?

GRIFFIN Okay, we're going to do a - a cold startup we're actually going to turn the power on at about 2 - minus 2 hours and 20 minutes right after we terminate LM power. We've read up a procedure where he can use the sextant to do an Earth-Sun aline - let me take that back, the Moon-Sun alinement. And, however, we told him to - when he was looking for the - as he was looking through the optics if he could see stars, to go ahead and just do a normal P51 and P52 in the PNGS, it's just normal startup, and do his alinement that way. The only reason we gave him the - the other technique was to cover all bets, just in case he could see stars we wanted to make sure he had thought about how to use the - the Sun and the Moon to make that alinement. So, he'll - he'll just be bringing up a platform just like we did it on Apollo 7, you know we - we kept turning down the platform every time we got through with it, and he - he'll do the same thing.

STOVAL Go ahead, Mark.

QUERY Jerry, a couple of questions, one: you said that - that the reentry from min - 1 hour minus EI on now would be just about normal. What are the differences?

GRIFFIN Well, there's some - in order to conserve power for instance, we - we've waited late say for instance to power up the back up control system. There's, you know, usually in the normal entry we - we turn on both evaporators very early to precool the spacecraft, well, that's a problem we don't have this time. We're plenty cool enough already. So, we'll be turning on the coolant loops rather late. There's a few other things like that - the EMS, the entry monitor system, we're bringing on a little later than normal. And that's in - once again an attempt to save a little power. But, the things that we are doing are normal, the timing is a little bit different.

QUERY For the - At EI, what would be completely normal?

GRIFFIN Yes.

QUERY Okay. And the other is, you - Wonder if you'd go into the water situation a little bit more? I thought I understood that they were carrying water from the LM to the CM in water bags, and I was just wondering if they - if they're going to have any water in the CM for splashdown in case it takes awhile to get a ship there?

GRIFFIN Yes, they - they will. We haven't - they haven't done that yet, Mark, but they're - they undoubtedly will. Right now there is no bags, and we asked them a question if they had any water stowed in bags anywhere, and their answer was: No. So - but prior to the closing out the LM and getting back into the command module, they will take some water in those 8 ounce drinking bags and take it back over to the command module with them. But there's no sense

GRIFFIN in doing that now. We - once we take that water out of the system you can't get it back in and just in case we needed it for cooling we'd have it to cover some other contingency. But they will take some water over there with them. Of course, in their survivor kits, too, they've got three five pound cans, 15 pounds of water. There is 5 pounds in each survivor kit.

QUERY Are they going to suit up? And secondly, how much power drain is to cool off the suits if they were suiting up?

GRIFFIN The answer to your question is they aren't going to suit up. That's the plan. And I don't know what the power drain is to run the suit circuit. It is probably on the order of 5 amps I think, something around there. And just to run a fan in the gycol pump and all.

QUERY May not have figured this, but in terms of your total plan, in terms of reading it up, can you give us an approximate on the time that it will take from beginning to end to have read this total plan?

GRIFFIN I think probably by the time we've done it all it will be close to 2 hours.

QUERY What did the MCC or the lack of it effect the splashdown point? And second what is your latest weather report?

GRIFFIN I didn't hear the second part, but the first part, you'll correct me if I'm wrong, I think we've got enough capabilities to stir back to the target point, as long as you're in the corridor.

STOUAL I believe so, but I'm getting out of my area there.

GRIFFIN We'll still target for the same point. Now, some place if you're very shallow or very long, you obviously don't have enough lift to get up in the end, or you don't have enough negative - or enough to turn you in shorter. But I think within the constraints of the corridors we've defined it, it could get back to the target point. Let me take that — that's another question off. I'll find an answer for you. Now what was your second question? I didn't hear it.

QUERY The weather.

GRIFFIN The weather, oh the weather is good. 2000 scattered clouds, 4 foot seas, winds about 15 miles an hour, 10 to 15 miles an hour, and they do expect widely scattered when they say widely they mean 10 percent or less - showers, and in those showers you can expect 2000 foot broken conditions, which is an overcast as opposed to a scattered cloud. But it's a broken overcast, but that would only be in the showers and those are 10 percent of the area or less. It looks real good.

SPEAKER Ed, did you have a question a while ago, or did someone answer it?

QUERY If you answered this, I didn't hear. Why did you say they are not wearing their suits tomorrow, Jerry?

GRIFFIN That's the normal entry. We don't do entries suited anymore, unless we have reason to suspect that the cabin's leaking or going to leak, or is leaking. So that's just the normal configuration. Now the reason we discussed it some today, and you may have heard some commentary on air-to-ground, was since we're putting the hatch in kind of late in this case because we're dumping the LM. Normally, we got rid of it back at the Moon and then we've flown all the way back being able to monitor the cabin very closely. In this case we're putting in the hatch pretty late and we won't have hours of data, hours and hours of data, to see if the hatch made a good seal. But conversely, we also have a lot of confidence in the hatch. Jim said he was going to try a couple of times practice putting it in, and make sure it goes in smoothly and make sure he's squared away on putting it in. And if there was a gross leak we could detect that in the time it would be there. Really that's all we'd be worried about. So in that case if they did we would have to have them get in the suit very quickly, but I'm not expecting that the hatch is a very simple device with a seal around the edge and you put it in and you close it. Unsuited entry, though, is normal.

QUERY About how many miles from the splashdown point of the command module is the splashdown point for the SM and the LM?

GRIFFIN Gee, that's - I think it's on the order of 500 miles, but I'm - it's on the order of 500 miles. Uprange.

QUERY Will you be able to recover any of the pieces of the SM that you were talking about? If so will they be able to give you any kind of a clue as to what happened Monday night?

GRIFFIN No, like I say, we don't have forces in that area -

END OF TAPE

QUERY - monday night.

GRIFFIN No, like I say, we don't have forces in that area. This is just hunks of metal and where it hits it's going to sink so the likelihood of doing that would be nill. In fact, you just couldn't do it. Even if you did, I doubt that after going through entry, you couldn't tell anything about it. It will be all burned up mostly.

QUERY How close to the target area will the rescue ships be when it hits? In other words, if it hits exactly where you want, are the rescue ships going to be able to be in the area?

GRIFFIN You talking about the command module?

QUERY When the command module hits, yes.

GRIFFIN Yes. We'll have forces on station. Aircraft carriers, helicopters and all kinds of boats.

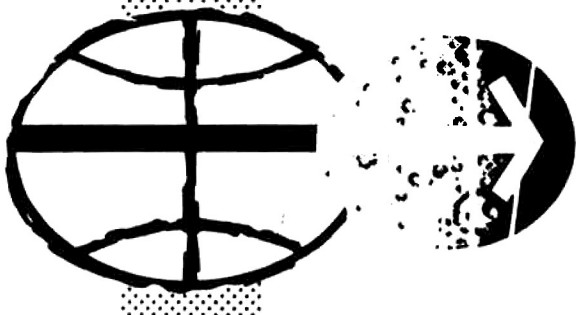
RILEY Okay. Thank you very much.

END OF BRIEFING

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 13 MISSION

MOCR POOL



MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

MOCR POOL

Hatch, UP---Williams,AP

take fifteen

4/14---7:35 a.m.

The flight dynamics officer estimated the earth would lose contact with Apollo 13 when it goes behind the moon at 77:10 GET. He estimated the signal would be reaquired ~~again~~ at 77:30 GET when the craft emerges on the other side.

0-0-0-0-

Mission control postponed a decision on Charles Duke's proposal to line up the spacecraft using the sun as a reference point. The Apollo crew will attempt to orient the ship using stars as reference during the trip around the dark side of the moon.

If this proves unsuccessful, mission control could still fall back on Duke's plan when the spacecraft ~~it~~ is back in the sunshine.

30-30-30-30-

MOCR POOL

Hatch, UP---Williams, AP

take sixteen

4/14---7:45 a,m,

Thomas Paine, NASA administrator, arrived at mission control about the same time "gold" shift replaced "black" shift. Paine flew in from Washington during the night. With him was George M. Low, deputy administrator.

Jerry Griffin, the "gold" team flight director, arrived about 7 a.m. looking fresh and alert. The first thing he did was make himself a cup of coffee. . .then he sat down with Lunney to discuss the switchover.

Astronaut Joe Kerwin replaced Jack Lousma as capsule communicator.

30-30-30330-

MOCR POOL

Hatch, UP---Williams, AP

Take seventeen

4/14---8:15 a.m.

The two most mobile men in mission control were astronauts Ken Mattingly and Charles Duke. The two roamed around mission control constantly conferring here and there. Both wore knit polo shirts, Mattingly's ~~xx~~ blue and Duke's white.

By contrast, chief astronaut Deke Slayton was sedentary. Slayton sat for hours in the back row of mission control leaning against the wall, apparently in a comtemplative mood.

Later he walked to the flight director's console, put on a pair of headphones and, once there, remained almost motionless, leaning against the cabinets.

30-30-30-30-

MOCR POOL — take 18

4/14 9 a.m.

art hill

Tight knots of flight controllers gathered around their consoles for a long and thorough debriefing this morning following the most hectic night in U.S. space history.

The gold team, led by flight director Gerry Griffin, came into the control center about 7 a.m. to relieve the black team of Glynn Lunney.

The normal handover takes about an hour, but in the emergency situation it was nearly double that period before Griffin's team was alone in the control center.

Griffin left no doubt that he was favoring a total mission time of 142 hours, with splashdown in the prime recovery area of the Pacific Ocean.

"I want everybody to lean toward this 142-hour return time," he said.

The strain of the long time was clearly visible in the haggard, worn expressions (shown by) many of the controllers on Lunney's shift.

"We probably ought to get this room around to some kind of normal configuration. Some of you guys go get some sleep," Griffin said.

MOCR POOL -- take 19

4/14 10:10 a.m.

art hill

It was a very quiet hour in mission control. Flight director Gerry Griffin advised (the) capsule communicator to remind the crew to move the lithium hydroxide cannisters that absorb carbon dioxide out of the command module and into the lunar module before they swell up too much.

Griffin said "I wouldn't wake up Fred (Haise) for that, but it is something you should do."

MOCR POOL — take 20

4/14 11 a.m.

art hill

White House interest in the flight of Apollo 13 manifested itself today in several ways in mission control.

First, Dr. Thomas O. Paine, head of the National Aeronautics and Space Administration, talked directly to President Nixon from the viewing room behind the control center.

Then, one of the President's principal advisors, Dr. Henry Kissinger put in a call for Frank Borman, the astronaut who commanded Apollo 8, the first Apollo flight to the vicinity of the moon at Christmas, 1968.

Borman, who is now field manager for the space station study task group, and who plans to resign on July 31, was not in the control room at the time of the call, although he came in later.

Among the other observers were Dr. Robert Gilruth, director of the Manned Spacecraft Center, and Dr. George Low, deputy administrator of NASA.

To further clarify a reference to the lithium hydroxide cannisters earlier, the reason for wanting to move the cannisters into the lunar module from the command module is that the environmental control system is turned off in the command module, which will cause an increase in the humidity and the carbon dioxide-absorbing cartridges will swell unless they are moved.

(MORE)

Among the visitors in the control room was the man who precipitated the placement of Thomas K. Mattingly II by John L. Swigert Jr., astronaut Charles Duke.

Duke was wearing a white polo shirt with a Scottish caricature of a golfer on it. There was no visible sign that he had or has German measles.

He spent nearly an hour talking with Rocco Petrone, Apollo program director.

Under the original conditions, pool reporters were to be allowed to have interviews with persons in the control room area at their convenience.

However, with the emergency, no interview requests are being granted, a NASA spokesman said.

MOCK POOL — take 21

4/14 12 noon

art hill

After the decision to let Apollo 13 aim for a mid-Pacific splashdown in the prime recovery area, the main concern of the mission officials was to make sure that the spacecraft would be properly aligned for the upcoming burn at 79:25.26 GET.

The alignment is of some concern, since flight controllers are dealing with an abnormal situation in which the lunar module systems are driving both it and the command service module.

"The big thing we've got to do now is that we want to do a check with the sun with the AOT (Alignment Optical Telescope) to get a check on our alignment," said Gerry Griffin, flight director now on duty.

"If that alignment looks good, then we are going to go with the platform as it is now. If we are outside plus or minus one degree, then we will do an earth-sun alignment before we go into darkness," Griffin explained. to the controllers.

"The only problem is that we have got to start the crew thinking about this procedure," he added.

To make sure that the crew understands what will be required of them, Griffin went over the explanation step by step with capsule communicator Joseph P. Kerwin and astronaut Charles Duke.

There was some discussion as to whether Duke might not be the

(MORE)

one to read the alignment [redacted] procedure to the crew.

Otherwise, it was a quiet hour in mission control. [redacted]

[redacted]

In order to make sure the explanation is understood by the crew, it was decided to use some of the spacecraft's precious electrical power to [redacted] assure a clear transmission of the message.

The power will be used to drive an amplifier so that normal voice transmission can be used.

Among the observers in the past hour in the viewing room was a party of Germans led by Dr. A.F. Staaps, president of the Hermann Oberth Society, Hanover, Germany.

The group were the guests of Dr. Thomas O. Paine, administrator of the National Aeronautics and Space Administration.

MOCR POOL -- take 22

4/14 ; p.m.

Hill-Boland
Houston Chronicle

The Apollo 13 crew called today on the advice of the first man on the moon to help them check the alignment attitude of their spacecraft.

Apollo 13 commander James A. Lovell, Jr., wanted to know if he had to have sunlight in a device known as the alignment optical telescope in order to do a sun check to verify the spacecraft's alignment.

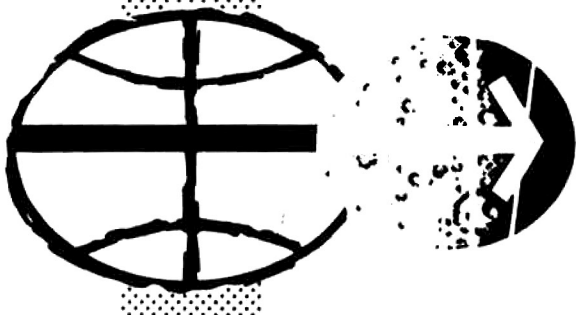
He requested the information from Neil Armstrong, who commanded the first mission to land on the Moon, Apollo 11, on July 20, 1969.

Armstrong, who has been observing the flight controllers most of the day from the viewing room in the back of the control center, stood up in his seat, waved his arms and grinned, and then turned his thumb down, signifying "no."

Then he went down to the floor of the control center to explain that sunlight would be needed for an Earth check with the alignment optical telescope.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 13 MISSION
WHITE HOUSE STATEMENTS



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

LLOYD E. CLARK of Memphis, Tenn. Clark, 40, is president of the Alodex Corporation of Memphis. He has been a national director of the National Association of Home Builders since 1958, and he served as president of the Association during 1968. Clarke is a graduate of Kansas State University.

JULIAN H. ZIMMERMAN of Austin, Tex. Zimmerman, 53, is president of the Lumbermen's Investment Corporation. He is a graduate of the University of Kansas.

CHARLES P. LANDT of Raleigh, N.C. Landt, 50, is president of Cameron-Brown Company, a Raleigh real estate firm.

Under the provisions of Public Law 90–448 of August 1, 1968, the Federal National Mortgage Association is being transferred from Government to private control. The former Board of Directors consisted of nine members—seven appointed by the Secretary of Housing and Urban Development and two elected by the stockholders of the FNMA. Beginning in May 1970 the Board will have 15 members—five Presidential appointees and 10 elected directors. By law, one of the appointive seats must go to a representative of the homebuilding industry, one to a representative of the mortgage lending industry, and one to a representative from the real estate industry. These seats will be filled, respectively, by Clarke, Zimmerman, and Landt.

The 10 elected directors will be chosen at the annual meeting of the FNMA on May 21, 1970. All 15 members of the new Board serve terms of one year and may be removed by the President for good cause.

Paul Volcker, Sherman Unger, and Lloyd Clarke are present members of the FNMA Board of Directors.

APOLLO 13

Statement by the President Following the Safe Return and Splashdown of the Astronauts. April 17, 1970

For much of mankind, the reaches of space had never seemed so infinitely remote as they did when Apollo 13 was crippled nearly a quarter of a million miles from earth, headed toward the moon.

With Astronauts Lovell, Haise, and Swigert safely back on earth, a surpassing human drama that gripped the world for 3½ days at last has a happy ending. Their safe return is a tribute to their own courage, and also to the ingenuity and resourcefulness of those on the ground who helped transform potential tragedy into a heart-stopping rescue.

From the beginning, man's ventures into space have been accompanied by danger. Apollo 13 reminds us how real those dangers are. It reminds us of the special qualities of the men who dare to brave the perils of space. It testifies, also, to the extraordinary concert of skills, in space and on the ground, that goes into a moon mission.

To the astronauts, a relieved Nation says "Welcome home."

To them and to those on the ground who did so magnificent a job of guiding Apollo 13 safely back from the edge of eternity, a grateful Nation says "Well done."

NOTE: In the week following the explosion which damaged the service module of the Apollo 13 on its way to the moon, Press Secretary Ronald Ziegler reported on the continuing expressions of concern on the part of the President. The President was informed of the problem when it occurred on Monday night, April 13, and followed the progress of the return flight daily, with special briefings from former Astronauts Michael Collins, now Assistant Secretary of State for Public Affairs, and William A. Anders, now Executive Secretary of the National Aeronautics and Space Council. On Tuesday, April 14, the President went to the Goddard Space Flight Center at Greenbelt, Md., for briefings. He spoke with members of the families of the Apollo 13 crew during the week and immediately following splashdown. Mr. Ziegler also reported that offers of assistance from many countries of the world were received by the President.

The President also proclaimed a National Day of Prayer and Thanksgiving and announced plans to present the Presidential Medal of Freedom to the astronauts and the ground crew of Apollo 13 (see the following two items).

APOLLO 13

Proclamation 3979, Designating a National Day of Prayer and Thanksgiving. April 17, 1970

NATIONAL DAY OF PRAYER AND THANKSGIVING

By the President of the United States of America
a Proclamation

The imperiled flight and safe return of the crew of Apollo 13 were events that humbled and inspired people all over the world. We were humbled by the knowledge that in this stage of man's exploration of space, a safe splashdown of an imperiled mission is in its way as successful as a landing on and safe return from the Moon. We were inspired by the courage of the crew, the devotion and skill of the members of the NASA team on the ground and by the offers of assistance from nations around the world.

Particularly inspiring was the spontaneous outpouring of prayer, from every corner of the world, from members of every faith, calling upon God in His infinite mercy to bring home in safety to our small planet three fellow human beings.

Now James A. Lovell, Jr., Fred W. Haise, Jr., and John L. Swigert, Jr. are home again. The prayers of millions all over the world helped to bring them home safely. I urge my fellow Americans and all the peoples of the world to join with me in offering another prayer, one of deep thanks, for the safe return of the crew of Apollo 13.

NOW, THEREFORE, I, RICHARD NIXON, President of the United States of America, do hereby designate Sunday, April 19, 1970, as a National Day of Prayer and Thanksgiving.

IN WITNESS WHEREOF, I have hereunto set my hand this 17th day of April, in the year of our Lord nineteen hundred seventy, and of the Independence of the United States of America the one hundred ninety-fourth.

RICHARD NIXON

[Filed with the Office of the Federal Register, 2: 02 p.m., April 17, 1970]

NOTE: For a statement by the President following the splashdown of Apollo 13, see the preceding item.

APOLLO 13

The President's Remarks Announcing His Plans To Present the Presidential Medal of Freedom to the Astronauts in Hawaii and the Ground Crew in Houston. April 17, 1970

Ladies and gentlemen, I have just talked on the phone with the three astronauts on the ship. I have told them that I would like to present the Medal of Freedom to them in Hawaii tomorrow.

We will leave here in the morning, going first to Houston, where we will pick up the two wives, and then go on to Hawaii where the Medal of Freedom will be presented in a ceremony tomorrow at approximately 5:00.

I also want to say at this time that reactions, of course, to what has happened have been pouring into the White House. I have talked to the leaders of both the House and the Senate, Republican and Democrat, and to several leaders in the country that have been calling in.

There are no adjectives that can be added at this time. I will put it in personal terms. I thought the most exciting day of my life was the day I was elected President of the United States. I thought perhaps next to that was the day that Apollo 11 completed its flight and I met it when it came down to sea in the Pacific. But there is no question in my mind that for me, personally, this is the most exciting, the most meaningful day that I have ever experienced.

I feel that what these men have done has been a great inspiration to all of us. I think also what the men on the ground have done is an inspiration to us. How men react in adversity determines their true greatness, and these men have demonstrated that the American character is sound and strong and capable of taking a very difficult situation and turning it into really a very successful venture.

Finally, in recognition, also, of the men on the ground, I am going to present the Medal of Freedom tomorrow in Houston when we stop there, to the Apollo 13 crew on the ground who have made these very difficult decisions on the spot, decisions that had to be right. They couldn't miss even a little bit without risking the lives of these men.

This is a superb achievement. It is one the whole Nation is proud of and I am very proud to represent the American people in presenting the Medal of Freedom to those who participated, the hundreds, the thousands, in making this possible, and also to the three men who have now returned safely to earth.

NOTE: The President spoke to reporters at 3:25 p.m. in the Briefing Room at the White House. Prior to his remarks, he had issued a statement on the return of Apollo 13 and proclaimed a National Day of Prayer and Thanksgiving (see the two preceding items).

Digest of Other White House Announcements

Following is a listing of items of general interest which were announced to the press during the period covered by this issue but which are not carried elsewhere in the issue. Appointments requiring Senate approval are not included since they appear in the list of nominations submitted to the Senate, below.

April 13

The President lunched at the Pentagon with Secretary of Defense Melvin R. Laird, Deputy Secretary David Packard, and the Joint Chiefs of Staff.

April 15

The President has invited President Suharto of the Republic of Indonesia to visit the United States on May 26 and 27. The Indonesian President will be accompanied by his wife.

The President will host a dinner for Vice Premier Chiang Ching-kuo of the Republic of China on April 21.

April 16

President Rafael Caldera of Venezuela has accepted an invitation from the President to make a state visit to Washington on June 2 and 3. He will be accompanied by his wife.

April 17

A letter from the President was read at memorial services for Merriman Smith, White House Correspondent for United Press International and dean of the White House press corps, who died on Monday, April 13, 1970.

The President addressed the closing session of the 1970 Republican National Leadership Conference at the Washington Hilton Hotel.

In the fourth of a series of "Evenings at the White House," singers Johnny Cash and his wife, the former June Carter, entertained the President and the First Lady and their guests.