the inspiration of discovery and the longing to understand. Our journey into space will go on."

Mr. Chairman, I'm prepared to answer any questions that you or the Board may have.

CHAIRMAN CONWAY: General, I thank you very, very much for a very, very excellent presentation here. And your report itself is an indication of a very good hard work by a lot of very experienced and very capable people.

I will say I'm hopeful that the Department of Energy and the work that it does for the safety of the nuclear weapons program will have learned from this because we see right today the Department of Energy has undertaken what we believe to be some major changes in the way they've operated in the past, and as they're proposing to upgrade in the future, that have this Board somewhat concerned.

I think there's a lot of lessons to be learned here. And we hope that the DOE will have learned from these studies that you and your associates have put together, and to keep them from making some major mistakes.

VICE CHAIRMAN EGGENBERGER: I'd like to discuss a little bit with you the engineering organization as you believe it should be. Let me talk

here a little bit, and then we'll get to the bottom line.

Within the project organization, our Board here believes that there's no substitute for a strong and capable engineering organization. And this organization generally is viewed as in charge of the project from a technical point of view, and is capable of making all analyses, or whatever is required to make the project go.

And in fact, it is in the line organization. And what it has done is also responsible for safety. Safety is the responsibility of the line, and it starts at the top and goes to the bottom, and goes from the bottom to the top.

Now, you have suggested, or recommended, that NASA establish an organization off to the side that whenever a waiver or a change is required or asked for by the project organization that affects, can I say safety, that it must be approved by this organization off to the side.

Now, I don't quite understand that from my following thoughts. Do you believe there would be a tendency for the project organization to begin throwing everything up to this approval board that's out on the side, and then hence be shirking their

responsibilities of conducting the proper engineering that's required for the conduct of the project, and hence the safety of the project.? That I don't understand.

And then there's always, and this bothers me, and has bothered me for a long time, and especially in the nuclear weapons program. Eventually whatever is being asked to be done, to be waivered, has to come to the top somewhere. There's always a top. And that person needs to be able to say yes or no. Otherwise, he is not in charge.

So now that I've attempted to talk about this a little bit, could you maybe talk about how you would envision this organization in NASA that's set off to the side, how it actually should operate? Do you see what I'm pushing at here?

MAJ. GEN. BARRY: Yes, sir, I do, and it's actually the struggle that I know NASA's going through right now. What we did do was tell them what to do and not how to do it.

VICE CHAIRMAN EGGENBERGER: Yes.

MAJ. GEN. BARRY: And that puts, of course, the implementer, because I've been on the receiving end of those kinds of things in my career, too. And here's some thoughts that I might share with

you, if I may.

First of all, we did some analysis of theory. And one of the theories that we looked at was Perrow. And this is an author that talks about tightly coupled organizations. My words. A truck or a tank driving, goes off the road. Not a big deal, you're not going to hurt anybody, you can probably get it back on the road, a lot of options. If you fly an airplane, like an airliner, it's more tightly coupled. Something goes wrong, you don't have a whole lot of options in a lot of cases, but you do have some. You go into space, you're even more tightly coupled. So the bottom line is small technical failures can result in catastrophic outcomes in a very tightly coupled organization. NASA we determined to be a complex organization that was very tightly coupled.

So with that understanding, we looked at some benchmarking elements. And we turned to SUBSAFE in the Navy. And that is where we became more familiar with the issue that they do not allow kind of the operator or the program manager to waive technical issues without a substantive analysis. The reason we arrived at that sensitivity was we found in some cases that NASA was, and I'll use the term PowerPoint, were not doing technical analysis of specifications or

waivers. They were doing analysis, but it wasn't as technical with a report, we thought, in a lot of cases, particularly with the foam coming off on the left bipod. Had they done that more detailed analysis, they might have been able to conclude that they had a more serious problem than they really did.

By separating this from the program, and having a technical assessment of authority that has to be -- they have to go to them to get approval to waive any kind of specifications, then it builds in a balance of power and a check and balance element that we saw in the Navy that worked pretty well, particularly with their SUBSAFE issues.

We also looked at aerospace, and the Air Force, and how while the relationship is different than SUBSAFE, it does provide an independent review as they work up, get ready for launch. As opposed to NASA, where they've out-sourced quite a bit to the contractor, but it still was internal to them, and it wasn't an out-sourced review to verify how they wanted to be able to arrive at the conclusion that it was safe for flight.

I'll also share with you some other things that we thought that were important, that you'll see in the report, particularly in Chapter VII, on things

that we thought were important for a high reliable organization.

First of all, here are the management failures that I alluded to, but I'll go into a little more detail. The space shuttle is not operational. It is not correct to have cost, and schedule, and safety, and waiver in one organization. It is not correct to have normalization of deviance. You have to be sensitive to that. It is not correct to have an integration office that is not truly an integration office, and it is not correct to ignore specifications that are on paper that are not being realized in reality.

If you take that, what can this second independent technical assessment group do? It can allow for what we concluded to be the valuable elements of a high reliable organization. Constant learning. You're going to require those people to do the technical analysis, not PowerPoint. Checks and balances. You're going to have that additional although bureaucratic element that is going to just say, okay, here's another set of eyes. Redundancy. A preoccupation with failure. Resilience. Have trend analysis done much more readily than was done before. The program was not doing it.

They had a tracking system for NASA called PRACA, Program Reliability Action Control System. It was very problematic, and very non-user friendly, and very hard even for the Board to go in there and find information after we asked NASA for it. Integration, and finally communications.

All of those elements I think we concluded to the Board that could be applied to this separate organization that would help enhance and strengthen the NASA organization. So, yes, safety is responsibility for all people. It is not just to be put in this separate organization now, nor can the program manager relegate all that responsibility and say, well, it's up to you. If you say it's okay, it's okay. Remember he's responsible for the day-to-day operational launch. Not all of those are going to be requiring waiver on any specifications. And it does require leadership from the top. But it takes a cultural adjustment.

And here's what we determined. We had a long conversation to say, okay, what is this culture. But if you're going to change the culture, it requires two things in a formula. This is very simplistic, and probably not exactly the answer, but it's an answer. We determined that we can help NASA by making

organizational changes. Separate technical assessment, better safety, and better integration as a case in point. But it required leadership from the top in order to change culture. And that's why it takes time. You will not see our recommendation saying that's a return-to-flight. Because it can't be done before now and then. It's going to take years to work this in a cultural element.

But it was a general recognition that, yes, we have confidence that they will be able to get flying in a safe manner in the short term, but we had less confidence in the long term. That's why we wanted to put this bureaucratic recommendations on organizational changes to help change the culture. But we give them the tools. It's still going to require major leadership from the top.

VICE CHAIRMAN EGGENBERGER: Thank you. I'd like to also say that this was a very important presentation to this Board. And it's a job well done.

MAJ. GEN. BARRY: Thank you, sir.

DR. MANSFIELD: Thank you, Mr. Chairman. Yes, I commend you for the effort, excellent effort put together by the Board. We're going to be learning from this. Many organizations are going to learn from this for a long time. And we hope to reinforce some

of these conclusions in our discussions with DOE.

I would like to point out one thing that's in the report in NASA's favor, but not in the manned space flight program. You mentioned that Aerospace Corporations serving as an independent engineering organization has delivered a performance for the Air Force much better than in launch failures, much better than commercial rate, 2.9 percent I suppose.

I point out that NASA's expendable launch vehicle program has even better performance. It achieves that performance by having an independent NASA technical organization. Now, in fact, because of the organizational pressures and budget pressures, it has to steal it from the rest of NASA. It arm-twists. The scientific organizations, principally at Goddard, sat as the payload people to provide engineers to oversee the launch vehicle manufacturers. They've had to hide this because budget-cutters are always after it. In other words, some people at NASA, by hook or by crook or by stealth created their own independent engineering organizations, and it's shown paid off.

But it shouldn't be necessary. It shouldn't be necessary in any organization. That's one point to make. I think that by and large your list of characteristics of healthy and unhealthy

organizations in this regard are almost entirely transferable to the Department of Energy's nuclear programs, in different ways and different places.

But in particular, the similarities are this. SUBSAFE, for instance, is a central organization because it's got a fleet that operates these things, and it's got fleet commanders that want their ships to be in certain places at certain times. Sometimes they can't do it because the engineering organization tells them they have to fix something. The analog here to the Fleet is the Department of Energy sites, and I suppose the analog at NASA, is Johnson, and the space shuttle program itself.

DOE does not have a central organization that can blow the whistle and direct the sites. In fact, they don't want one. And that's one of our difficulties. We believe that DOE is making choices, or has made choices that will have to be reversed. It isn't that they neglected to do something that they always knew was right. They decided they didn't want to do some of these things. And that's why we have to question those things. The study of aberrant organizations is going to be a necessary part of DOE healing itself. Thank you.

CHAIRMAN CONWAY: Bruce.

DR. MATTHEWS: Yes, again let me compliment you on this very thorough and compelling presentation.

I have a question relative to where the Department of Energy seems to be going. They basically have embarked on some organizational changes that sound somewhat similar to the history that NASA went through. And their goals are good. Their goals are to increase productivity without compromising safety. And there's nothing wrong with that.

Simply put, though, they seem to be sort of decentralizing authority. They're putting more authority and responsibility at Field Offices, and on the contractors. And as you know, the Department operates very complex, tightly coupled systems, maybe not -- well, maybe as tightly coupled as the shuttle. Certainly the consequences of a failure could be much more catastrophic.

And one of the objectives is to reduce redundancy in oversight, and give more responsibility to the field, and not have redundant oversight. Okay, so that's a key word. And so given that, two questions.

One is what's your sense on effectiveness of redundant oversight in finding, uncovering

potential failure modes? And the second question, and if you don't want to answer this it's okay with me, is what would you advise the Department of Energy based on what you've learned in the new way of doing business that they're moving toward?

MAJ. GEN. BARRY: Yes, sir. Those are excellent questions. Let me concentrate first on this issue of decentralization and centralization.

My philosophy, I personally am a decentralist. But in understanding the complexity of research and development, I make a distinction between the operational world where you can be more mature, and the developing world where it's a little more risky, particularly when you're dealing with enabling technologies. Even though the shuttle has been around for a while, it's still a lot of enabling technologies.

What we found out was it's kind of like centralized control/decentralized execution if you know anything about the Air Force philosophy. But the centralized control by management is stability in chaos. That's what it does when you centralize things. And that's good. Norms, procedures, standards, you need that in order to communicate through any large, complex organization. The

decentralized element that you have to have is execution by line operators. The innovation, that's where you find these amazing people that can come up with, like Apollo 13, as a case in point. That is where the American ingenuity and innovation is at its best is when we can do that. So you never want to stifle that to the point.

The problem is switching from one to the other, and where the balance is. I use the example of the out-sourcing element. Great idea, core competencies is an issue. In the military we have the same problem, but also I think in DOE and certainly in NASA. What are the core competencies that you don't give up and out-source over to a contractor? And did they move too far in one direction?

We have a great propensity, mankind does, you know we swing from one pendulum to the other, and then finally we kind of come to a magic middle point. Maybe we went too far. If 40,000-plus government mandatory inspection points [GMIP] was too many, okay.

So you do have things like you said where you reduce redundancy in oversight, because I'll give you a case in point. NASA was in the early `90s, after a shuttle would land at Kennedy, they had like

five photographers filming all underneath the orbiter. And say, well, what are you doing? Well, we're trying to monitor the debris that comes off from landing in the lake bed. And you say well wait a minute, this is Kennedy. You're landing on a hard surface. Well, we do it there.

So there's good, prudent managerial decisions that you need to make. So you don't do stuff that's excessive. But going from 40,000-plus GMIPs to 8,500 may be too much in one direction. Hard for us to analyze that as a board and say no, we think you needed 12,000. You know, we couldn't do that.

So this balancing between centralization and decentralization I think is a very key element. But certainly in a tightly coupled organization, centralization is needed in a very enabling, risk-oriented, highly complex organization. When you move more toward an airliner, maybe you can move more to the issue of being even more decentralized in some cases.

Let me talk about another term that was used, and you mentioned oversight. NASA chose to use, again it's very important to understand the language of any organization. They use words like "oversight" and "insight." I mentioned to the Board earlier when

we were discussing this morning we found that to be very problematic because nobody could define to use what "insight" and "oversight" was, and what the differences were. It was meant to explain, as they moved to out-source, and they moved more to the contractor. The contractor took over more oversight responsibilities, and NASA took over more insight responsibilities, primarily meaning that they were going to look at metrics and occasionally do spot checks, reduce government mandatory inspection points, things like that, to be able to get a sense of it, but most of it was being moved over to the contractor.

But you ask one person one definition, they would give you another opinion. So it was important for us to try to understand how that was. And the basic conclusion that we arrived at, while not causal, the movement to out-source was ridden with unintended consequences.

And the unintended consequence was primarily that the technical expertise for the government civilians went down. And when that happened, their ability for situational awareness went down. And situational awareness in fighter pilot terms is used in my culture, but it is being able to look at all things around you and being able to make

an assessment. When your technical expertise goes down, you may not hear that hidden echo that comes in at a very low level, like foam coming off, an O-ring not working right, and being able to identify it as really something significant that you've got to pay attention to. When your situation goes down, you're not going to be able to have that key ear to be able to do it.

Final point you made about DOE on the advice. The thing that we were excited about as a Board was clearly when we arrived at the conclusion, that the technical cause and the organizational cause were equal. I mean, you couldn't separate the two. It wasn't like this, and it wasn't. [The speaker held both hands out to simulate a balance.] We treated them as equal. I don't know of too many organizational investigations that really arrived at that kind of conclusion myself. Maybe there are.

But we found that a lot of what I've just gone through in much more detail in the report can be applied to the private and the public sector. So, again I go back to one of my opening comments. I think if you look at the organizational culture and managerial aspects of this investigation, there can be a lot of great insights that can be applied to DOE.

So I offer that as an answer to your question.

DR. MATTHEWS: Thank you.

CHAIRMAN CONWAY: I think we're seeing there's also pressure for more out-sourcing. So it's coming up from the White House, it's also coming from others. And obviously industry would like to see more of this.

And I think the point you make in your report of the lack of technical competency within the government, the adverse effects that has as we proceed, and we don't want to lose that if we have not already lost it. So I think there's a lesson to be learned there.

And you mentioned also the pressures and budgetary pressures of cutting back personnel. And we're seeing that also in the Department of Energy. Eliminating personnel, and unfortunately when you try to eliminate personnel, it usually is the best ones that tend to go. And then it gets, as you made a point here, the same amount of work has to be done, and fewer people to do it. And, therefore, they lose their capability of being able to do all the work that previously had been done by other individuals. And then the point where you can't oversee your own work if you have to take on the oversight work also within

your organization.

There's a lot of lessons here to be learned. You made reference also to the fact -- I think you used the term two-star or three-star general and someone of lower rank trying to stop on a technical basis. I think we learned the lesson from Rickover. He wouldn't let his officers wear their uniforms. They were all in civilian clothing because he said he didn't want the decisions made by the sleeves on the table, the amount of stripes you had.

So technical matters have to be determined, and conclusions based on technical competence. And it may be someone down at a second lieutenant level as opposed to an expert in the technical area. There's a lot of lessons to be learned here, definitely, that should be and can be carried over into the Department of Energy.

Kent, do you have any questions?

MR. FORTENBERRY: Yes, a few questions. First, allow me to belabor the point of central versus decentral control. And I think when you talk about that, clearly the function has to be referred to because it depends on that.

If I look at the specific recommendation for this organization, and we refer to it as sort of

an organization on the side, that's not at all what I see. I see functions developing the technical standards, conducting trend and risk analysis for both subsystem, system, and enterprise levels, owning the failure modes and effect analysis, conducting the integrated hazards analysis, deciding what is and is not an anomalous event.

Those functions, if I refer to those -- was there some insight as to whether those should be or could be centralized, or for example, is there a thought, and I think when we look at the Department's approach, we see a tendency for those functions to be very decentralized. What's your response to that?

MAJ. GEN. BARRY: Again, we got to the point where we didn't tell NASA how to do it, we told them what we wanted to do.

MR. FORTENBERRY: Sure.

MAJ. GEN. BARRY: But let me just comment on, I think, a recent paper that I reviewed. And it had to do with the way they're trying to organize to work their way through this.

One of the ideas, and this isn't fully approved yet, as far as I understand, is that they will have decentralized representatives of this independent technical assessment assigned to each

center. So there will be a decentralized element there that will work their day-to-day routine kind of concerns, trend analysis, problem review, certainly looking at any incidents that could be, again, listening for those low signals. And all the elements that you just cited. And then to be supervised by a central safety authority up at NASA, and to try to look at these and see if we've gotten anything.

It's interesting.

DR. MANSFIELD: Excuse me, can I interrupt. There will be a tenant at the site.

MAJ. GEN. BARRY: Right. Exactly.

DR. MANSFIELD: Because that's important. Any way that the site director or his manager --

MAJ. GEN. BARRY: Well, I think there will be a dotted line.

DR. MANSFIELD: Well, they'll tell them what's going on.

MAJ. GEN. BARRY: Sure. Keep the information flow.

DR. MANSFIELD: But he would answer only to and report to headquarters.

MAJ. GEN. BARRY: Yes. Again, it's hard for me to be put in a position where, you know, this is what they're going to do, because they're still

working it out, and that certainly was not our responsibility.

DR. MANSFIELD: Well, I'm trying to understand what the necessary characteristics of this are.

MAJ. GEN. BARRY: Yes, I think that's definitely true. And this balancing between centralized and decentralization has got to be worked. You've got to be able to work both sides of the fence. You have to know when to go from one to the other.

But I think overall, you know, you set the basic procedures, and establish the standards and what it wants. You can decentralize down to a lower level, my view, my personal view, not the Board's.

And I agree with you. You've got to work the functions and make sure that's done.

MR. FORTENBERRY: For example, actually establishing the standards -- I would think that would be very difficult to decentralize that.

MAJ. GEN. BARRY: Yes.

MR. FORTENBERRY: That would have to be …

MAJ. GEN. BARRY: That would have to be from the central area. And that's good because people can now know how to communicate with each other using the same terms. They establish procedures and all.

But then, you know, how you work specific elements. I mean, I'm using a fighter pilot term, but I will, you know. The central operational command will tell you where you need to go to attack a target. It won't tell you how to attack the target, what weapon to use, what axis to come in on, what airspeed to fly, and how many airplanes you necessarily need in some cases. But they're telling you, "We need to take that target out at such and such a time."

So when you establish centralized control you say, okay, here are the procedures, here's how we're going to communicate, here's the standards that I will not accept to be violated. Okay, now you go make the day-to-day work within that framework.

MR. FORTENBERRY: And the trick is deciding what are operational decisions that you could make at that level, and what are not.

Another point. You certainly talked about it in terms of the pressure, and the checks and balances. But there was a little discussion, and actually it came from a previous assessment, in the report. And I'll just read this.

"The workforce has received a conflicting message due to the emphasis on achieving costs and staff reductions and the pressures placed on the

flight schedules." And you had a picture of the clock that was ticking down. And that was also discussed in the report. How do you eliminate the inappropriate pressure and still have a motivated schedule-driven operation? Is that even possible, or is the Board just simply making an observation that that's a reality that has to be dealt with?

MAJ. GEN. BARRY: That's an excellent question. And schedules are good management tools. And this pressure that we showed with the clock, that was to get to this node 2 for the space station. By February, '04, they wanted a node 2, so they were kind of driving to that.

That in itself is not bad. What we found to be bad, if I can use that word, was that the understanding of the pressure at the headquarters level was different than the understanding of pressure down at the floor level. When we did our interviews of the people on the floor, they were highly convinced that there was pressure. I mean they're looking at clocks that people are talking about. They said they felt like they were being pressured. The headquarters level, they were seeing that as just a management tool to say this is where we want to guide them, which is prudent.

The problem was the communication between the two levels. That's when you have a disharmony. That's when you have a disconnect. That's when you have a problematic element with pressure and schedule.

So if both were communicating, both understood, maybe headquarters, maybe they would have been more aware of these incestuous elements that they could have been putting out messages they didn't really intend. And then the lower level could have been communicating back up and saying, well, here's what we're really having to deal with.

So I'd say scheduling and pressure are good prudent managerial concepts. The problem is when the senior level management and the shop level are not communicating, and they see it differently.

MR. FORTENBERRY: And one other point. A lot of what I read in the report, and what you talked about today, has to do with what I'll call decision-making under uncertainty. And some cases, it's a vast amount of uncertainty.

And depending on how that's done, and I think that's one of your points about the technical authority, some people can make those decisions quite easily. And I think the phrase, "Fools rush in where angels fear to tread," is maybe appropriate.

And you were referring to the impact effects. And you talked about the testing that your Board conducted. Did you get a sense for what sort of test data had been collected, and I guess, ordered or desired prior to the event in terms of looking at impact? I know there's certainly a lot of focus on impact. And you talked about photographers collecting data. Was that a decision that was made really with the absence of the R&D needed to show the effect of the impact that basically your Board finally did after the unfortunate incident. Is that what we were dealing with there?

MAJ. GEN. BARRY: Well, of course hindsight is perfect in retrospect. So we tried to always stay away from that, and tried to put ourselves in the position of what they knew at the time when they were making decisions.

Let me just, you're leading me to a comment that I think I'd like to make, and that is if safety were paramount, we'd never fly an airplane, we'd never fly a shuttle. You have to manage risk, similar to what you have to do with the nuclear industry.

What's problematic if safety is not paramount in this sense, and that's a hard thing to

say, you have to manage risk. What's problematic is when you're seeing trends -- I'm going to use the word "rhythm" -- that is going bad, and not hearing it, and not seeing it. It's one thing to say, if you have a problem with developing a new fighter, or working with the shuttle, and something completely new starts, and you've never seen it before, and God forbid it results in some major catastrophe, that's one thing. When you're getting signals a number of times, and our failure not to see those signals, that's problematic. That's where I think we would make a distinction between decision under uncertainty.

There was information available, and the system was not able to pull its tools together to be able to rise to the occasion.

MR. FORTENBERRY: Well, let me augment --

MAJ. GEN. BARRY: Let me just make a comment. It's like when you have a flight schedule. When you're flying, and using my culture. But I look at a schedule for flying. There's going to be young people flying with old, experienced people. What you don't want is two inexperienced people flying together. What is the most risk-averse? What is that one dot that stands out over the rest that you have to train yourself to be able to see? And it's gauging

rhythm.

When you change leadership, your rhythm changes because everybody's trying to figure out what the boss is doing. When you do something entirely different the rhythm changes. You move to a new location, rhythm changes. And that's all part of normal risk management.

The problem is your ability to recognize when things are in a risk state. And that's where you've got to do trend analysis, you've got to listen to those little things, and you've got to have a really tuned-in ear. I'm sorry, I didn't --

MR. FORTENBERRY: Well, I was going to augment my question by saying that my interest is I didn't see recommendations that addressed deficient R&D emphasis. And I think what you're saying is that that wasn't the conclusion you made.

But I'm interested in that, and whether or not there was a driver or a motivation to pick up on areas where known uncertainty existed, and areas where the decisions were perhaps not fully supported, and identify those for current or future R&D activities.

So just kind of explore that area a little bit, because I didn't see that in the recommendations.

MAJ. GEN. BARRY: The recommendations had to be agreed to by all 13 members, and of course, that has challenges in its own as you well know. But one of the things I would draw your attention to is the discussion in Chapter VII. And this is: we really took some hard hits against NASA on the issue of technical analysis, and not just do PowerPoint briefings.

We found a lot of times, you know, you would ask people, and this is symptomatic of our culture, by the way, and I mean the whole United States in a lot of areas. There are two phenomena going on that are pretty unique, and we don't quite fully understand, and that is e-mail and the impact of PowerPoint briefings. I gave you a PowerPoint briefing today, but I also brought a technical report with me. You know, it's backed up to support all that.

A lot of times we find, and the Air Force is as guilty about this as anybody, we conceptualize with PowerPoint, and we don't do it with technical analysis, and review, and writing anymore. Particularly in the R&D world when you're developing either basic research, developmental research, or applied research, you have to have technical documents

to back it up. And we found that to be true in a lot of places like SUBSAFE, and the EOB [earth observatory], even in NASA with the EOBs. But not in the shuttle. In a lot of cases they were doing it.

E-mail is a phenomenon I'm trying to understand when you say, "Is it directive, is it water cooler conversation, is it both, is it a mix?" So and it flattens an organization out tremendously, but at the same time does it ever rise to the level of getting people's attention. Because there's so much to absorb.

So those two phenomena we didn't have a real good answer for, but I would offer them to you for further study, and even in the aspects of DOE. Look at how they're doing technical reports versus PowerPoint presentations, and then look at how this e-mail conversation is going on in any organization, and try to figure out how it's impacting how it operates.

CHAIRMAN CONWAY: If I may, on that e-mail, we saw a specific example of that as the Vice Chairman just called to my attention. We had an incident where we had counterfeit parts picked up in the DoD [Department of Defense], in the military. And the information was made available to DOE. And it went out on e-mail, went out to practically all of the

top officials at headquarters. Not one of them picked it up. Not one of them did anything on it. The Board picked it up, and started to ask questions. And nobody within -- my recollection is about 20 top officials with responsibility for safety matters at DOE headquarters -- none of them felt or took any action on that.

And so finally we brought it to the attention of one of the key oversight groups within DOE, and then some action took place. But that's a perfect example of an e-mail being used to get out some very important information, and it was lost.

MR. FORTENBERRY: Can I ask you for a reference on the two brothers story?

(Laughter.)

MAJ. GEN. BARRY: I don't have it off the top of my head.

MR. FORTENBERRY: And I would like to thank you for an extremely thorough briefing.

MAJ. GEN. BARRY: Thank you.

CHAIRMAN CONWAY: Jack.

DR. MANSFIELD: Just one or two more. The notion of a central engineering organization that serves as the design authority and technical authority. You mentioned either in the brief or in

the report, I can't remember where, that such an organization should own the FMEA [failure mode and effects analysis] and hazard analysis and that sort of thing. This is one that we need to think over carefully at DOE because we've insisted from the beginning that it's the responsibility of the contractor doing the job to define the work, identify the hazards, identify and put in place controls for the hazards, perform the work under the controls, and analyze the results. We hesitate to make that anybody's duty but the line management.

Do you have any comments on that?

MAJ. GEN. BARRY: Well, yes. Metric review, trend analysis, whatever tools you want to use. In fact, Diane Vaughan's got a good term, if I can remember where I put it. But it's technologies of control. You have to make an analysis of what technologies of control you have to be able to tell you what you need to know to run your company, your business, your organization, your agency. And if those tools are not doing what you need to get out of them, then you obviously have to fix it. NASA needs to fix this, trend analysis, PRACA [problem reporting and corrective action], FMEA, because they are not giving them exactly what they need. And they're in

the process of going through those reviews as I understand it to use their tools.

But I would encourage any organization to examine what those tools are and figure out if in fact they're giving you the control that you need. That would be one thing.

The other thing is if you train your people to be able to read the bloody thing. You know, it's one thing to have the tools available, but if it comes across in a format that nobody understands the hieroglyphics, it's not going to do you any good. And you need to be able to develop something that spikes, and say, okay, there's something I need to pay attention to and go for it.

Let me give you an example. NASA was absolutely stupendous on their ability to work flow-liner cracks and BSTRA [Ball Strut Tie Rod Assembly] balls. Now what that means is the flow-liner is the flow of the liquid fuel from the external tank into the orbiter. They found a flow-liner crack, they fixed it, they jumped on it. I mean, it was a marvelous example of team effort and success. And then they had a BSTRA ball, which is again in the flow line. It's kind of a valve and moves in all directions, and they found a crack in one of them in

one of their reviews. And they did a marvelous job.

But those are big things. You've got to find the little things. And if your technologies of control can't get down to that lower level if there's a little whisper that might be indicative. And certainly if it's repeated. You ought to be able to get it to flag, and say okay, is that something we need to concentrate.

You need to review your assumptions. It's like if you come to work every day and your assumption's on the wall on what you need to work about, and then your trend analysis or your tools of control tell you something different, then you need to revise those assumptions. And it may not be number 10 anymore, it may be number 1.

And those are the things that need to be going on in any high complex organization. And I offer that as just …

DR. MANSFIELD: One or two more to follow up. Tell me if I'm correct here. It seems to me that the central organization, the lack of which at NASA you took note of in your report, would need to have the power to dictate research, that that research be done, to resolve issues. What I mean is that somebody

at headquarters should have said solve the foam problem, give me a plan to solve it, years ago.

Am I reading that correctly? Should that be a function of the central engineering authority, to dictate research to resolve issues?

MAJ. GEN. BARRY: Well, they certainly have to have resources to be able to do that.

DR. MANSFIELD: Yes.

MAJ. GEN. BARRY: And safety, too, you know, has to have independent monies to be able to say, okay, we need to concentrate on examining this. Hire somebody to do some research, or do it within your own, internal.

So I do say they have to have the resources to be able to apply to a specific problem.

DR. MANSFIELD: Yes, I'm assuming the resources would be there. But the authority to say this research has to be done before you go on, I'm assuming that should be in the central engineering authority.

The third one is the people have to [be there.] You say NASA cut back, and so has DOE. If one were to establish such an organization in DOE, and NASA were to establish one, they would probably take people from existing NASA billets, and hire people

from the outside, and try to constitute such an organization. My concern is in both organizations people tend to own their jobs. And it's hard to get someone to say to somebody, okay, you've been doing this as part of the NASA oversight at Johnson. Now I want you to come to Washington. Not just want you to come to Washington, I tell you to come to Washington. Well, moving civil servants is not like PCS [permanent change of station] in the Air Force, as you know. Do you think that there would have to be special agreements made with employees so that they could be flexibly moved to different parts of the complex?

MAJ. GEN. BARRY: Well, two comments. One is you're right. I use the term tribal mentality. They say, well, we do this, it's our responsibility, we're not going to change, and we need to just stay where we are. So there is some of that in any organization that has to be fought.

The second thing is moving civil servants. The only example that I could offer to you is that the Senior Executive Service and the Defense Department, those people are clearly under agreement that they will be moved.

CHAIRMAN CONWAY: And in the DOE, but it's not being enforced.

DR. MANSFIELD: But I've heard it's a personal belief, and I can't back it up with analysis, but I don't think such a central engineering organization would ultimately be healthy if people didn't move around.

Thank you, Mr. Chairman.

CHAIRMAN CONWAY: Thank you.

VICE CHAIRMAN EGGENBERGER: I have some very strong views on this independent technical engineering authority, and I want to go a little bit more with this. You have listed a list of things that you believe this authority should do as a minimum. It's also my view that the project should do those things. The project should develop and maintain the standards, should they not? They should do the trending analysis. They should do the integrative hazard analysis. And so on. That's part of the job.

Now, to leave that to not imply that the project is supposed to do that, I believe, is a problem. And as I said before, I would hate to depend on or require that this independent organization receive everything thrown back at it such that we do not have the project being responsible for everything. Of course things should be overseen, and at the top where everything comes together, the Director should

depend on various sources of information to make the final decision.

Do you want to comment any more on what I just said? Tell me something?

MAJ. GEN. BARRY: You know, as a commander in the field, I can empathize with what your points are. And again, we tried to tell NASA what to do and not how to do it. And we're as anxious to see what they're going to come up with as anybody.

VICE CHAIRMAN EGGENBERGER: All right.

MAJ. GEN. BARRY: Let me just make a point. I agree with you that the standards in trend analysis and integrated hazard analysis. But it's interesting to watch the benchmarking that is done by aerospace. The Air Force does that. And aerospace does that. And they get confirmation on it.

Now, if that's the way that NASA chooses to go, you know, fine. I don't think it was the Board' intent to relegate full responsibility in all those areas over to this independent technical assessment. That's my opinion of what the Board meant. And everybody's responsible for safety. You have to be focused on that.

But it is using independent tools and people who are not owing their existence to schedule

and cost, to be able to sit there and say I'm not influenced by any of that, and here's my opinion. And that way I think you get that balance of power and checks and balances.

So I'm not sure I quite agree with your premise that we intended for all that responsibility to put in there.

VICE CHAIRMAN EGGENBERGER: I'd hope not.

MAJ. GEN. BARRY: Certainly in there. It needed to be done. But as a secondary check, and a redundant effort.

VICE CHAIRMAN EGGENBERGER: And as I think about this, I look at this Defense Board. Now at the Defense Board, we do all of those things except we do not grant the waivers, and we are not responsible for the project. That's the project's problem.

And so we do provide oversight to various people, and we do have various tools to require that things like this get done. But we do not have the authority to stop something.

I'll stop at that.

DR. MATTHEWS: Yes, I have another question. As you were giving your talk, there were three things that stood out in my mind as significant. One is the lessons learned from Challenger somehow

atrophied over the years. Two is that they ignored the sort of indicators of previous flights where the foam came off. They ignored what seemed like a pretty important analysis of the effect of that on the underside of the wing, as you described. And they didn't do any comprehensive testing like the panel did, which was very dramatic to show that. And then the third piece was they waived the criteria on impact.

And so you talked a little bit about normal accident theory, and high reliability organizational theory. And I'm trying to weave them together. I think the normal accident guys would say I told you so, this was going to happen, it just happens. And the high reliability guys would say well if you'd only done this to your organization you would have avoided that.

So my question is in your recommendations, and I think I know the answer to this, but I want to hear it and a little bit of discussion from you, is what sort of addresses this long-term look so it's not going to happen eight years from now when the adrenaline, as you said, is taken out of the system?

MAJ. GEN. BARRY: Well, again, our answer to that last point was that we stated that NASA's

culture needed to change. Now it's hard to define culture, but the two things I mentioned earlier was if you change an organization with some of the recommendations that we gave. We said NASA we can help you on that. We can help you with some organizational recommendations. But you've got to have leadership from the top to be able to do that. You've got to talk about it and work it.

And everything we've seen so far has indications that's going to happen. But it's got to pass the test of time. Because this is not something -- we call it "iron majors" in the Air Force, you know, or military. It's that middle group you've got to convince too, and it takes time to do that. You've got to grow them, and educate them, and train them. And then when they finally do get to senior leadership, then they're supporting the solution and not part of the problem.

So there were echoes. There were indications that problems weren't done with the analysis. There were not enough comprehensive testing as indicated. And they did make too many waivers in a lot of areas.

So as I said earlier, we have pretty good confidence that the short term's going to be good. The

long term, the culture has got to change. And if that doesn't happen, then they're going to gravitate back to what happened after Challenger, and hopefully not after Columbia.

One other point, Mr. Chairman, if I may. I know you're running out of time. But it goes back to a point that you made a little bit earlier that I just want to respond to. And it had to do with the issue of the future.

One of the things that we make a mistake at, and I think this would apply to DOE also, is that we are too -- I'm going to use the word platform-centric -- too system-centric. If something is old, then you're going to replace it in the same kind of system. Fighter gets old, we replace it with a fighter. Ship gets old, you're going to replace it with a ship. Shuttle gets old, you're going to replace it with a shuttle.

That's the wrong manner of approaching the next step. What we recommended in the report was not to do it ass-backwards; to do it the other way. And the other way is to go from a vision and a strategic plan, establish a concept of operations, what you want to do. Establish the requirements and the capabilities, and then and only then do you define

what this thing's going to look like.

Now the Board took a very serious issue. There's two pictures in the end of Chapter XI. You complimented on Chapter XI, which we're very proud of. One picture has a picture of a winged vehicle as a replacement orbiter. The other one has a capsule. Okay, now we didn't recommend one or the other. It's not in our purview or our expertise to be able to do that. But if you arrive from the position of a vision of strategic plan, a concept of operation requirements, a capability discussion, then you can get to a more educated discussion on what that solution ought to be. Don't immediately go to the fact, well, it's got to be a winged vehicle, it's got to be a capsule, it's got to be, you know, who knows.

So I offer that as maybe something for DOE to look at. You know, you need to go to that vision of strategic plan. What is the concept of operations for how you're going to operate nuclear power in the future. What requirements do you need, and then figure out what it is you need to build to be able to get there. And not just say, "Okay, we have a system that's getting old. Let's replace it."

CHAIRMAN CONWAY: Good point. Jim?

MR. McCONNELL: Yes, thank you. I have

two areas where it seems to me there are competing objectives that I'd like to describe and ask you, General, to comment on.

The first. In the conclusion section of your report that talks about the independent technical authority, you talk about the need or the value of redundant technical authorities pulling from the high reliability theory. And that seems to be somewhat at odds with the obvious benefits of clarity and accountability that come from a very linear chain of command, where decision-making is vested in one central element.

What I'd like to ask you to comment on is that it seems to me I read in your discussions here that this entity would be vested with a veto authority, not with a directive authority. Where this independent element wouldn't direct a solution to a problem, but would hold a judgment on whether to grant a veto in any particular case to a standard, or to an expectation. Could you comment on that?

MAJ. GEN. BARRY: Redundancy I think is important. It is problematic in a bureaucracy because if you have too much redundancy, its stop-gaps can prevent you from accomplishing your mission. So that has to be balanced with a linear chain of command, I

agree.

But at the same time, when you're dealing with non-operational research and development testing in a high-risk environment, I think it's prudent to have redundance. We see that in fighter aircraft with quad redundancy. We see that in the nuclear industry with multiple redundancies in systems under nuclear power.

This separate independent technical assessment authority is not necessarily meant to be a veto authority, although it probably could exercise that. Again, if you leave NASA to figure out how to do it, not what to do. But certainly it is the authority to approve waiver changes. Now you could view that as a stop-gap or a veto. If somebody says I can't do this, I can't launch this shuttle unless you waiver this thing, or else we're just going to have to cancel. Well, maybe that's a veto I suppose.

But at the same time, I would be much -- I think the Board concluded that they would be much more satisfied with, instead of allowing that problem that I told you the night before the launch the solid rocket booster connecting points, besides just having the operator more or less, the program manager has authority to say, well we'll just waive that. Launch

anyway because we're pretty convinced it's safe. You go to somebody and say, "Okay, now we have to stop, we have to take some time out here." We have to do some detailed analysis, and do we really have a problem. And then if we do have a problem, we fix it.

So don't go from the attitude of if this organization can help move NASA from the cultural attitude of prove to me there is no problem versus prove to me there is a problem, then I think we've accomplished something. But it's a bureaucratic stop-gap that is cumbersome.

But our government's not pretty either. You know, we have Congress that can trump the President, the President can trump Congress, and the Supreme Court. It's cumbersome, but it does in the long run, I think, work. Can we apply some of those lessons learned in balance of power and checks and balances to the R&D world? I think we can.

MR. McCONNELL: The second competing objectives I wanted to talk to was innovation versus standardization. You talk about an undesirable characteristic of an organization is when the organization normalizes deviations. And again, getting back to this event, technical authority would be good to have, an authority that could evaluate the

desirability of granting a waiver.

But I note that a deviation is a relative term. You have to have an expectation before you can deviate from it. And if you don't have a requirement, then you don't need a waiver.

So my question is you also talked about 49,000 inspection points going down to 8,500. Did your investigation identify any changes in the overall level of expectations, or the specificity, or the way that the federal government defined its expectations for its contractors during this out-sourcing that contributed to some of this problem that would have shown up as a deviation, or would have shown up as a waiver, but was masked by the fact that the expectation no longer existed?

MAJ. GEN. BARRY: Well, I think the short answer is yes. The bottom line on contractors: they are motivated by profit. Although they're great American citizens. I'll tell you, we didn't walk the line that we didn't find a contractor that wasn't either former NASA or former military or someone who'd been in the civil service for years and years. These are dedicated Americans that want to do the right thing.

The problem is when you're making

decisions at the high managerial level that when you got competition. Like you said, competition between standards and innovation that maybe we'll make a decision because this is an operational vehicle, tried, true, and tested. And we can accept this risk.

It's really a way of approaching risk. If you approach the basic focus that your organization, your system of systems is mature, and tried and true, then you're going to be able to make some very conscious risk decisions that are prudent in some cases. If you're of the consciousness that you're still in an enabling technology with high risk, with R&D and testing, then I think your focus is going to be different. I think NASA was over here, which caused them to jump from 40,000-plus to 8,500 GMIPs. Because we can do that. We've got a tried and true system here.

Our overall expectation of the contractor is they can handle it. Let them handle it. We don't need to monitor everything. I don't know where the balance is. And I don't know if it's 12,000 GMIPs or 20,000. But I think it's pretty clear that we went too far in reducing the technical expertise for the situation awareness. If you don't have the situation awareness, listening to little things and being able

to identify them to be problematic, then you're overall expectations, I think, are going to go down. And I think that's what happened when they moved too much to the contractors.

CHAIRMAN CONWAY: General, we've taken more than two hours of your valuable time. We thank you for giving us the opportunity to meet with you, and to ask you questions.

The record here is going to be kept open until November 23 if you decide you want to add anything else to it. You were very, very thorough in your comments.

MAJ. GEN. BARRY: Well, we only have, let's see, there's 2,200 pages in Volumes II through VI, so you're welcome to have that.

(Laughter.)

CHAIRMAN CONWAY: Well, you sure condensed it. You sure condensed it down in a very, very excellent manner. And I thank you very, very much for the time you've given.

MAJ. GEN. BARRY: It was an honor to be here.

CHAIRMAN CONWAY: Is there anybody in the audience that wishes to speak today? If so, come forth. Again, the record will be kept open till