

**United States Election Assistance Commission**

**Public Meeting**

**EAC Voting System Test Laboratory Discussion of TGDC  
Draft VVSG Roundtable Discussion**

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VERBATIM TRANSCRIPT

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## PUBLIC MEETING

### VOTING SYSTEM TEST LABORATORY DISCUSSION OF TGDC DRAFT VVSG DISCUSSION

DR. KING:

Good morning everybody and welcome to this third in the series of roundtable discussion on the 2007 draft of the VVSG.

Today's discussion will be amongst organizations that we call VSTL's, the Voting System Test Labs, as well as, other stakeholders in the new VVSG that includes people who certify the labs, people who have a vested interested in how the testing occurs against the VVSG standard. What we hope to do in today's discussion is to illuminate some of the important issues associated with the 2007 draft and identify ways in which the draft can be augmented or improved that will move all of us towards the common goal of accurate, secure, accessible, and affordable voting systems.

Before we get started today with the introductions, one thing I have asked everybody to do is turn off cell phones or put them on silent and I'm demonstrating that. And turn off PDA's, if appropriate, or at least show the good manners not to Blackberry when somebody's talking directly to you. And then I have a new request which is to put your laptops on mute so that if it starts to make noises while it goes to sleep or wakes up. So if we could do those three things, that would be greatly appreciated and it will help.

So what I would like to do is to first begin by asking each person -- you know, is that perfect timing or what? I'm sorry. I

thought I turned it off. Well that was to demonstrate what a bad plan it is to leave the phones on.

Okay, if we could, I'm going to start if I can with Mark and then work our way around the table and please introduce yourself.

MR. SKALL:

Good morning. I'm Mark Skall. I'm very happy to be at this roundtable and I'm sure that Larry King, I mean, Merle King will do a great job of moderating. Glad to be here.

MS. MEHLHAFF:

I'm Dawn Mehlhaff. I'm an EAC technical reviewer.

MR. CRICKENBERGER:

I am John Crickenberger. I'm the NVLAP Program Manager for the accreditation.

MR. CADDY:

I'm Tom Caddy. I represent InfoGard Laboratory.

MS. AUDETTE:

Gail Audette representing iBeta Quality Assurance.

MR. PHILLIPS:

Brian Phillips representing SysTest Labs.

MR. PADILLA:

Frank Padilla representing Wyle Laboratories.

MR. BERGER:

Steve Berger, I'm an EAC technical reviewer and also a state reviewer for Texas, North Carolina, and Virginia.

DR. KING:

Okay.

MR. HANCOCK:

And Brian Hancock with the U.S. Election Assistance Commission.

DR. KING:

Okay. And I'm Merle King. I'm with Kennesaw State University.

And Brian, if you'd like to give some remarks regarding EAC?

MR. HANCOCK:

Thank you, Merle. Welcome everyone. I think by looking at the audience, this is the biggest participation in our roundtable so far and so we welcome you all to Denver, although I suspect perhaps it's the location more than the subject matter that is bringing you here. But in any case, welcome and we appreciate your presence today.

I also want to thank you on behalf of our four commissioners and our executive director. Our Executive Director, Tom Wilke is here. I suspect our commissioners will be showing up at various times later on this morning and I think perhaps if Merle is at the mike and he recognizes them, we'll introduce them as they walk in later so we'll do that.

As many of you know, this is the third in our series of roundtable discussions on the TGDC's draft version of the VVSG. We're pleased with the first two roundtables that we had with the academics in the set last December and very recently with the voting system manufacturers. We are planning additional roundtables and I'll go over those briefly with you so you'll see what we have in mind. On March 27 in Washington, D.C., we're going to have a roundtable at Gallaudet University devoted to usability and accessibility. On April 24 at the EAC Offices in Washington, D.C., we will have a meeting with members of advocacy groups. The

very next day on April 25, we will meet in a roundtable forum with election officials. And then finally, we're going to have interdisciplinary roundtable again at the EAC Offices on May 5. And that will encompass members from all of the roundtables that we've had so far so we could have everyone sit down at the table and get all of the views and opinions expressed from all of the roundtables we've had so far. So that's our plan for the future.

In order to accommodate the discussions and to receive public comment on the discussions that we're having over these next several weeks, as you know, the EAC has extended our public comment period an additional 60 days. The new time frame requires that all public comment for this document be submitted to us by May 5, 2008 so just keep that in mind as well.

Roundtable discussions certainly are a lot of work and they wouldn't be possible without the assistance of Matt Masterson and Laiza Otero over there so if this is a success, they are a very large part in that success and I just wanted to -- and if they're not then we can blame them too.

In any case, before I give it back to Merle to start the discussions, I just wanted to reiterate what I've said in the previous discussions as to why we're holding these roundtables. We certainly want input on the draft VVSG, but that's certainly not the only reason we're having these. You know, we intend to implement the most robust set of standards possible in order to make voting systems more secure, reliable, accurate, and accessible. That's where we're headed and that's where we want to be. You know, these are pretty simple kind of mom, pop, apple pie concepts when

we talk about them but they're very difficult to put into practice and I think we all know that.

By undertaking the development and adoption of this next iteration of the VVSG, the EAC and its partners are certainly charting the course for the development of voting systems in the foreseeable future. It's certainly an awesome responsibility and one in which we are undertaking with full commitment and proper due diligence.

Given the scrutiny that our electoral process is under, we certainly know failure is not an option in this endeavor. That's why we've invited you here today and why we're going to be holding the other roundtable discussions that I mentioned. The excellent work by NIST and the TGDC in putting this document together is really only the beginning of a process of development review and adoption by our commission. The real work for the EAC, for all of our partners in this effort and really for the American public begins now. The questions we're proposing to the panelists as conversation starters today relate to some of the very fundamental aspects of the TGDC recommendations. The questions are asked so that we can continue an open and reasoned discussion which we began in Austin last December on the direction that we're charting for the future of our voting systems.

With that, I'll thank you once again for coming this morning and I'll turn it back over to our moderator, Merle?

DR. KING:

Thank you, Brian. Thank you for your welcoming comments. And right on cue, Commissioner Davidson has entered the room and we would like to acknowledge Commissioner Davidson.

If I can go quickly over some of the ground rules that we've used in the past, it will help move us towards the finish line that we want to get to by 2:00 today. One is when you wish to be recognized, if you would put your tent card upright that will help me see the order in which people would like to speak. And for each question that we discuss today, the question will be displayed on the board behind us, but each question, we'll ask for some introductory comments and I think there are some members of the panel that have volunteered to kind of help put that question into context for this discussion group.

At the introduction of a question, each member of the panel will be given an opportunity and really there's an expectation that everybody here will participate and share their viewpoint on the issues that are imbedded into the question. And we will work through each of the questions. That's our goal to get through these today. But when we come back from our lunch break, each member of the panel will be given an opportunity to make a summarizing statement and at that time we can pull together some of the things that you heard during the day or you can reemphasize points that you think were important for other members of the panel and the EAC to hear and everybody will be given an opportunity at the end to make a concluding statement.

In the interest of moving things along, if you have submitted testimony prior to coming here today that is already in the record



and if you would make your comments more conversational. I think it will help facilitate things and certainly we don't want to listen to somebody read from a prepared statement if that's not necessary.

One of the things that we did with the vendor manufacturer's roundtable last month was we asked for really some background on the company. And it was helpful because there are some new players in the manufacturing environment. There are some new business models in the manufacturing environment, that it was helpful to set that tone for the discussion.

And today we would like to do the same thing. What we have asked each member of the panel to do is to briefly talk about their organization and how it supports testing in general, what portion of the business is voting system testing, is it a new line of business, is it an established line of business, and how it kind of integrates into the overall business model. I think that will be helpful not only for other members of the panel but for members of the audience to get kind of a contextual understanding of what your individual role is and your organization's role is in the testing of the voting systems.

And to that end, I want to start with Mark and ask each member of the panel to make a brief introductory comment in that regard.

MR. SKALL:

Thank you, Merle. The National Institute of Standards and Testing, so testing is actually in our name. But what NIST does is work with both private sector, government agencies, the academic community to develop standards, metrics, measurements to enable IT to be

more successful and companies to compete better in the marketplace. We have always stated that standards are very, very important, however, standards by themselves are essentially not very useful. The end result is clearly high quality implementation in this case a voting system. Often times that implementation needs to be interoperable, reliable, secure, and tests are a very, very, very key way to enable that.

We at NIST have a long history of helping develop tests in many, many arenas starting before some of you were born probably in the 70's or writing tests for compiler standards, tests for SEQUEL, tests for a whole family of XML standards, and now we're in the process of writing test sweeps for the new next iteration of the VVSG.

So testing is our last name out of the four names and it's something that we believe in and we believe is absolutely instrumental in developing a high quality product.

DR. KING:

Okay, thank you, Mark. Dawn?

MS. MEHLHAFF:

Again, I'm Dawn Mehlhaff. I'm one of the EAC technical reviewers and our role is to basically review the test plans and the test reports and any of your requests for interpretation, and all those fun things and all those, you know, issues where there's not a consensus on which direction to go. So we try and pull together and try and report back and give you guys a unified answer. But our approach is, you know, we're looking at the test plans, we're looking at the

test reports. We're trying to make sure that what's being tested, what's being submitted is actually meeting standards.

So I know it's still -- there are some hiccups along the way and we're trying to refine the process as we go and, you know, hopefully we're moving in that direction. We're certainly, you know, we certainly look to the advice and opinions of others when we're consulting and making our determination.

So, you know, from our approach, we're trying to make sure that the standards are being met. That these systems are the, you know, the best that they can be. And coming from the perspective where, you know, I used to be at the state level testing these systems and I know most of the vendors are familiar with me because I've probably been at your facility testing them for a state testing process. So, you know, I come to this process from that state level where I was actually in the position of having to, you know, purchase these or allow the counties to purchase these and deploy them. So I have been on that end where I've been on that end of the phone call to the labs calling them and begging them to please push something along. And then now I'm on the other side of the coin where I'm looking at it and making sure that we're doing the best job that we can.

So, you know, I see it from both perspectives. I've been on both sides of the coin so that's kind of what I bring to the table in terms of, you know, seeing both sides of it and trying to find that middle ground somewhere.

DR. KING:

Okay, thank you, Dawn. And John, if you could share Dawn's microphone, I think the smaller mikes only...

MR. CRICKENBERGER:

Okay.

DR. KING:

The smaller mikes only go into the transcription mikes.

MR. CRICKENBERGER:

John Crickenberger, again, I'm with the NVLAP Group and NIST. And what we do is we perform accreditation services using the ISO Standard 17025. As a group, we have limited scopes of accreditation that we operate to. We have other programs like asbestos testing, calibration lab, accreditations, UMC telecomm, a few groups of that nature.

The voting system was mandated and we took that on a couple years ago. And what we do is our job is to go into the lab and use the standard. Our version of ISO 17025 is our NIST Handbook 150. And we use that standard to go in and look at the lab's quality system and then also look at the test method. The things that you call procedures or standards we call test methods. And we look to see that the lab is competent to perform the test methods that we're going to accredit them for.

And for the voting systems testing, we use the four test methods that are defined and on our website, excuse me, as far as things like security, accessibility, and that sort of thing. And we really strive to find a consistent way of testing the program, accrediting all the labs so that we're looking when we show up and do an accreditation what that is is we do an on site assessment.

That is a snapshot of what that lab's ability is and we can make a determination based on technical experts, quality system experts, whether that lab is competent to perform those tests as defined in the standard.

DR. KING:

Okay, thank you, John. Tom?

MR. CADDY:

Yes, my name is Tom Caddy. I'm with InfoGard Laboratory, representing them today. And as InfoGard Laboratories we have been evaluating products to the NVLAP standards Handbook 150 for the last twelve years. That includes cryptographic modules, common criteria, personal identity verification. And we've also supported other vertical requirements such as voting requires some of those requirements now but there's also requirements within the financial industry and also within the postal environments worldwide. So we've been the guide way to products to those standards for a number of years. My role has been as lab director of that facility and as such we've done hundreds of these type modules.

We've been involved with voting for the last seven or eight years and not primarily as evaluating the equipment but evaluating the systems and the processes and the way people are actually using the systems in the field so we've been supporting the counties in the local regions with optimizing how they do use the security on the equipment that they currently have in place. Thank you.

DR. KING:

Thank you. Gail?

MS. AUDETTE:

Hi, I'm Gail Audette and I'm representing iBeta Quality Assurance. iBeta was founded in 1999. We are a full quality assurance laboratory. Our business verticals are business quality assurance for some of the major Fortune 500 companies, as well as, interactive entertainment. We are a Microsoft certified lab and we test titles, as well as, hardware compatibility on all three of the major entertainment systems. We were accredited on February 21, 2007 and that was pretty much the kickoff for our voting business. We have a few voting manufacturers in-house and I do not know what percentage of voting our company is. It's a very small percentage based on the number of people working in this business vertical versus the other business verticals. Thank you.

DR. KING:

Thank you again. Brian?

MR. PHILLIPS:

I'm Brian Phillips from SysTest Labs. We've been in software test engineering and quality assurance since 1996. And our sole focus with the company is testing and quality assurance. There are three lines of business that the company has. There's a government practice which focuses on providing independent verification and validation services for state agencies and some federal government agencies. There's a commercial practice which provides testing and quality assurance services for enterprise solutions, security, and similarly to iBeta interactive entertainment.

And lastly, there is our compliance line of business which is primarily our voting system test lab services. We started testing voting systems under the NASED Program in 2001. In August of 2001 we were given provisional approval to begin that. We worked with a number of different manufacturers over the years. In February of 2007, we were accredited as a voting system test lab and we ourselves have a number of the manufacturers in-house right now going through certification testing. And voting is about 30, 35 percent of our business. Voting testing is about that much of our business.

DR. KING:

Thank you. Frank?

MR. PADILLA:

Good morning, Frank Padilla, Wyle Laboratories. Wyle has been in business for about 50 years, a very large company spread across the United States. The voting machine business is centered out of Huntsville, Alabama's office which is testing, engineering, and research, east. We have been doing voting machine business there since the 1990's. We were the first company that started testing voting machines. When there was -- there became a need to do that, we worked with the government then and NASED and everything and the Secretaries of States to try to come up with methodologies and ways to test voting machines. So we've been doing it there for about twelve years now. What percentage of our business? Being as Wyle is all the way across the United States and been doing testing, I can't give the exact percentage. It's probably not that big as far as company wide. As far as Huntsville

wide, it is a very large part of Huntsville. We do testing for every market though. We do commercial, aerospace, DOD, military. It's really a variety of testing that we've been doing over the years.

DR. KING:

Okay, thank you. I'd like to pause for just a moment and recognize Commissioner Rodriguez, the Chair of the EAC has joined us.

Good morning. Steve?

MR. BERGER:

I'm Steve Berger. I am also with Dawn, a technical reviewer for the EAC. And as Dawn has said, in that capacity, we review test plans, test reports, and seek to make sure that the labs are evaluating systems on a consistent basis and that those evaluations are rigorous and thorough to the standards.

I also get the opportunity to come at the same material from a couple of different viewpoints. A few years ago, I was a member of the TGDC so I probably share some blame for what we have. I do state reviews for three states and so I get to look at the same material from the viewpoint of particular concerns of individual states. And have been involved in lab assessment as well, which all kind of shifts the view of the same material and is an interesting way to see things differently.

DR. KING:

Okay, thank you, Steve. Brian's job is self-defined.

Very good, well thank you. That's really helpful. There has been a lot of change in the testing environment over the past three to four years so it's very helpful for me and I'm sure others that are here



today to kind of put into context where testing is in your organization and what your role is in that testing.

I think we have our first question. And I'll read it and then we'll jump right into it. The 2005 VVSG states that one of the goals for the next iteration and that's the iteration we're looking at today in the 2007 draft, is being to create performance standards that promote innovation rather than design oriented standards. And the concern perhaps is that design standards may limit choices down the road for manufacturers. Do you think this document achieves the goal and do you view the performance, I'm sorry, the performance guidelines as sufficiently testable? And that's been an ongoing concern with all of the standards, is the testability.

So what I'd like to do is to ask Steve Berger first to make some introductory comments on this question and then Gail has a presentation that she's volunteered and then we will move around the table and ask each of you for your feedback on this question. Steve?

MR. BERGER:

Okay, thank you, Merle. In my written testimony, I've answered this question in a very strong fashion primarily to make sure the communication was clear. I do not believe the standard as presented achieves these goals. I do not believe it is testable and it is significantly failing in achieving those goals.

I would say having said that, in my experience in standards and have been involved for a couple of decades now, this is not an unusual place at this point in the process. It is typical when a document comes out of committee to serve a function like this that

it needs to go through the process of being viewed from other perspectives, from the perspectives of test engineers who have to perform the test, from the viewpoint of, in this case, state officials who have to receive the output of those test reports and then perform their own function. And when those different perspectives are used, issues arise very often of arrangement of material, of detail that may be missing, or not sufficiently clear to perform a linked function.

And so I'm actually probably quite a bit more positive on many of the pieces but I think a lot will be learned by having others who have to look at the document and use it, take that look, give that feedback, and have the opportunity to reorganize it so it serves function to the fuller system that it has to work into.

DR. KING:

Thank you, Steve. Gail?

MS. AUDETTE:

Okay, thank you. Okay, I'm a tester. I'm an engineer, so when I read this question, my first thought went to what actually Mark Skall had said at the last roundtable when he was discussing functional design and performance requirements. So I wanted to make sure that I put down on paper what the definitions for those three types of requirements are. Now functional and performance requirements are in all the documentation I looked at. Those are very standard. But design requirements really are -- don't have good definitions. And...

DR. KING:

Could you move closer to the mike?

MS. AUDETTE:

I'm sorry.

DR. KING:

Thank you.

MS. AUDETTE:

So I put together just the functional requirements definition and that was pretty easy. It's what the system must do, what it must perform. Performance requirements how, how fast? And these are sometimes called quality of service requirements. Now for the design requirements, the definition I really struggled finding one because it's not in the VVSG. It's not in IEEE.. It's not in a lot of the places I looked. So I came up with this definition that the requirements that specified the normal operating environments for a voting system. So they're not functional requirements, but they're adding to those functional requirement constraints. They impose the constraints on the design. And I think this lends well to this discussion because design requirements do, by definition then, not allow for innovation.

On my next slide, I put in just some examples of functional requirements. There's a lot of functional requirements in the VVSG. The voting device shall ensure that the user name is not the password. That's a functional requirement. I can test that and manufacturers can design to that.

On the next slide, I listed a couple of design requirements. The second one imposes the TCPIP protocol. So by imposing that as a requirement with a shell, the manufacturers have no choice but to use that protocol. Now the first one on that sheet, depending

on the implementation, this could either be a functional requirement or a design requirement. And then finally, the performance requirements which are mostly the benchmarks, these are a couple of examples.

So I hope that my definition is what everybody else has been thinking of as a definition, as that's how I answered this question.

Thank you.

DR. KING:

Okay, thank you, Gail. With that, I'd like to open up the discussion now and Matt, if we could go back to the initial question. Is this tension, if you will, between the design requirements and the functional requirements, what are the implications for testing labs? Mark?

MR. SKALL:

Thank you. I'm glad someone was at the last roundtable and listening to what we said. And thank you, Gail, for pointing that out.

So there really are three types of requirements as Gail said the functional, the performance, and the design. And I think you did a pretty good job at fleshing out exactly what they mean and even the design requirements. There are times we feel when design requirements are appropriate. We try to minimize those but you can't always avoid some type of design requirements. Typically a design requirement will be in a standard when you cannot develop a performance requirement or perhaps if that design requirement is so universally accepted such as font size or how to place icons or something that's universally accepted. To some degree, it does constrain innovation, but again you try to avoid the design

requirements but I think just about in every standard there's some subset of those.

As far as the standard being testable, all standards when they're written have some requirements that are later found out to probably be ambiguous, perhaps un-testable. The whole point of writing the test sweeps, especially to do them early on when the standard is in a draft stage before implementations have begun is first of all to try to flush out some of those issues. We at NIST have begun writing tests for the next iteration and we've been pretty successful, we believe in writing some fairly comprehensive drafts of tests. You will all be seeing those. I want to assure you that we're not writing these behind closed doors. We will undergo an extensive level of public reviews and we'd like everyone's comments on it especially the test labs.

But we have certainly been able to write tests. Again, one of the important functions of writing tests early is to flush out problems. This happens in every standard. It's also to get those tests out there so that in this case manufacturers who are developing implementations have the benefit of the test to get the bugs out early. We haven't solved any problem if we get implementations to market that don't end up passing tests and get certified. So the more tests that are out there so that you all, all the manufacturers can actually use those, the better off we are.

So, so far again in summary, we really haven't found any additional ambiguities. Now of course we actually, in most cases wrote the requirement so we could be too close to that. But this is the period when we will find that out. And we have spent many

pains to write requirements that are testable. They're not perfect and in some cases we'll find out that there are some issues, but that's the feedback that we expect and we will see it happen, thanks.

DR. KING:

Thank you, Mark. And I did not see who is -- all right, Gail?

MS. AUDETTE:

Oh, I was pretty sure Stephen was first, but I just wanted to say real quickly that we have been submitting comments on the VVSG every time we find a requirement that is not testable. A lot of the trigger words are: easy, easily, small, legible. The ones that require judgment by the manufacturer to design it, require judgment calls by the labs to test it and then require judgment calls by the EAC technical reviewers to approve it. And we've got probably close to 100 plus comments on testables that -- I mean, I'm sorry, on requirements that are not testable because of these types of words.

DR. KING:

Okay, thank you. Steve?

MR. BERGER:

Yeah, I'd like to challenge whether the construct, the thought construct between performance and design requirements is really what serves us best. I'm going to pick up on in agreement with some of what Mark said. In a number of industry sectors there's been a movement towards model driven architecture to assure that disparate processes support each other. And so, as an example, in elections, we knew that at a certain point all vendors would be providing data in the same format, same data interchange format.

Do several things. First of all, testing organizations could develop automated tests that would test all systems because say to cast vote records from all vendors would be in the same format. Also downstream in elections it would support vendor independent audit and forensic type functions. It comes at the issue a little differently. It doesn't tell vendors how to design their system but it says at certain places because other people need to be able to monitor the data flow and test the system, things need to be the same for that reason.

DR. KING:

Okay, thank you. Frank?

MR. PADILLO:

Thank you. My comment on this is, I think the VVSG did a varied job in this. I mean, it seemed to me reading the section and going to some of the roundtables and working with NIST that one of the issues I found and this was very sectionalized in the writing and that there are certain sections that everything is performance and then another section everything is design, in another section everything -- and it seemed like then the sections were put together and they didn't overlap. That nobody looked at the manual as a whole and, therefore, you have sections that there's a couple that are very well written and there's performance requirements that leave the door open of how you could go about doing that that don't stifle innovation. And then you get to the very next section and it contradicts that one and says, thou must have this module, crypto module. You've got to have this font size. You've got to have this which totally negated what the other people said. And I don't think,

in my opinion, and I didn't see anywhere that anybody that almost knew the whole process sat and read the manual together as a book. It looked like the groups worked on it individually, it got put together, but nobody took the whole piece and said does it make sense in one book. And did we follow one methodology or even close?

A good point was brought up, the use of adjectives was very abundant in this book, you know, what's near, what's close, you know, what's legible, what's not legible, what can a -- adequate time? You know, the test labs can't -- that leaves way too much to judgment. I mean if we want a solid test case, we can't have that type of stuff in a manual.

Performance guidelines are a unique thing and I know that's, you know, they're testable to ask that question. Do we think they're testable? Yes, they are testable. The problem with performance guidelines is that, how you test them. I mean it's easy to say, can you test how something goes 100 miles an hour as a performance guideline? But what's the criteria for that test? Is it at sea level? Is it at relative humidity? What temperature? If all of those factors aren't known, then that -- just putting out a performance matrix or a requirement then makes that un-testable or really unrepeatable is the word because every lab is going to have a different interpretation of how to get there, but it does promote innovation.

DR. KING:

Thank you. Frank, if I may follow up and then Tom we'll go to you. You had mentioned an uneven treatment of the specificity within



the requirements and contradictory requirements in some sections.  
Have -- has Wyle forwarded those comments forward?

MR. PADILLO:

We're -- I thank the EAC for giving us some more time in getting that and we have been submitting them. I think we've got about 60 in right now.

DR. KING:

Very good.

MR. PADILLO:

I think our total is about 300 that we've made so far on them that we'll probably get in by the end of the month. Just, you know, all those examples but looking at it and like I said, I really worked -- to even take that step further when we looked at this manual and published it, how did it affect the other manuals? I mean, I see Mr. Crickenberger in here, you know, how does this affect and this came up at the last roundtable, the programmatic manuals. It doesn't look like anybody looked at those effects. I mean we're calling out things in here that totally do not jive or work with how the program is interpreted and I think that's a big picture look that we have to look back at with EAC and NIST and say, if this is the direction we're going, this is not the way the program is set up.

DR. KING:

Thank you. Tom?

MR. CADDY:

Sure, I'd like to make just a couple comments. One on the ability to have innovation but also to have good definition of things like protocols and so forth, I think that's a tough challenge. But it is one

of the cases that we found and NIST has actually followed really strictly in the security side of the business, in that there's certainly only certain algorithms and protocols, methods and processes that are known to be secure and if you don't follow those, you really enter into an arena in which you have a huge job to prove that something is going to be trustable or repeatable or secure from a variety of angles. So in many cases, I do think it is important to rely on trusted and known proven protocols and processes that are at least a starting point.

I think to add to that though I think that there should be a process included in how the program operates that allows that to evolve over time. So if somebody comes up with a new version of a protocol or they come up with a new protocol, a way that that can be evaluated and incorporated into the process and as long as the IG process or something is able to deal with that, then I don't think that necessarily suppresses the innovation side of this.

The other thing relative to the not quantitative terms, that's always been a challenge too, because in the case of security and crypto modules there's a lot of definitions in there that are similar to that, so they're like, the module must zeroize immediately or quickly and how do you decide if it does that? And so it's real challenge. By the same token, it needs to be in the context of the whole system. So in some cases, it's very likely that quickly could be minutes in other cases because of the other parameters, the physical security or the other parameters in the system that might be milliseconds or microseconds.

And so typically, what we have been able to do is to evaluate what the intent of that is. Is that solving an issue that the intent of the requirement is satisfied in that time zone? So certainly the more of those that can be precisely defined the better, but I think that really does stifle innovation to try to precisely define a lot of those terms. It's going to vary by each product.

DR. KING:

Thank you, Tom. Dawn?

MS. MEHLHAFF:

You know this issue goes back. I mean we've talked about this years ago in terms of what is this process and we struggled with it back then in terms of how much do you define it? And the argument was well if you completely define it, then you're basically developing the system and that's what -- all the vendor systems are going to look alike. It's going to be in maybe a different box or a different color but it's all going to have the same functionality. And so we struggled with that question and as we moved, it's kind of gone to the point well, you know what, the vendors need to develop a system that works that meets the standards but we've seen you guys struggle.

And we've struggled as technical reviewers where we will get something from one lab and there's those ambiguous statements where it needs to be reasonable or legible or easily detected. There's no definition for that. So when we see that coming back from you guys in those test plans, we struggle with it amongst ourselves. I mean we don't always agree and we have those debates in terms of what is reasonable. And, you know, we'll

get something from you and it may say one thing, something different from you, and something different from you.

And so, you know, we try and look at through the glasses of you are the experts, you are the test labs, you guys know how to test so what do you think is reasonable? And then we will take that and we'll debate amongst ourselves and sometimes we agree, sometimes we don't. And I know there's been a lot of frustration through that process because we will get things from you and we will bounce it back and we'll say this isn't defined we don't -- we have no idea how you're testing this, explain it to us.

And so the more that these things can be defined, I think the better off we're all going to be because it's going to be very clear. This is what it means, does it meet or pass it versus is it reasonable. Define reasonable. And so, you know, we are aware of that. We struggle with that, trying to move forward so, you know, I echo what they're saying in terms of, it needs to be more clearly defined if we're going to put it in there. We need to have a way to test it and there needs to be the parameter so that we're all working off the same page.

DR. KING:

I'd like to, maybe Frank if I could, I'd like to ask a follow up question to something I heard earlier and I'd really like the four testing labs to comment on this. And as a professor, I always encourage my students to ask what I consider to be the best question and I call it the so what question. And so Gail, you had said earlier that requirements that are ambiguous, things like, easy, small, legible and near are problematic in what way? Kind of, so what? They're

problematic. How does that translate into challenges within the lab environment and in terms of cost and time to completion, quality of product coming out the other end? So if I could get -- and maybe start with you, Gail because you made the comment but get each of the other labs to comment.

MS. AUDETTE:

Okay. When you have a requirement that doesn't lend itself to a clean design by the manufacturer, it then comes to the lab without a clean way to test it. As an example, if we have a requirement that something shall provide a means to safely and easily handle transport and install, before it even gets to the lab, the manufacturers have to decide what they're going to build that's easily, safely and easily transportable. Now their definition might not be ours. Their -- we're not applying any real standards which, you know, it can't be more than 35 pounds and it has to have a handle and two people lift it. It is simply it shall be safely and easily transportable. So by the time it gets to the lab, we look at the box and we say, what do we think? And we must build our test case and our test method around that. We decide what we think is safely and easily. We then pass or fail the manufacturer on that. We also put it in our test method.

Then the third interpretation is by the EAC technical reviewer. They may not agree with us that it's easily or safely transportable. And so the cost to it is, that the manufacturer first must complete the full design of their system. I mean they are to submit it to a VSTL not as a prototype but as a full system. That's

all the manufacturing cost to get it to the test lab so they've already invested quite a bit to meet that requirement.

If our interpretation is different than their requirement and we go then for a notice of clarification, we're asking the EAC for their resources to provide guidance. And of course if we have our interpretation and we're asking the EAC technical reviewers for the cost of their review. So the one requirement and in software, everyone knows the requirements are the first thing that has to be defined, testable, clear, the clarity of it, the six C's of requirements. And that's what we want out of this is what we expect in our business side from the requirements going to all the other businesses. So there's a substantial cost.

DR. KING:

If I can, let me get with Brian and then Frank and then over to Tom with that same question.

MR. PHILLIPS:

Well quite frankly, I echo, I'll echo what Gail has said. It comes down to the number of iterations that you have to make on -- as a test lab on whether or not your interpreting what that easy, legible, et cetera requirements are. And when you put that into your test plans and your test methods and how to test that and again the interpretation from the EAC reviewers may or may not agree with that.

The impact of going back to the manufacturer with a discrepancy against their particular product and Gail's example is a very good one, they've got to redesign, rebuild, retest internally. They need to then remanufacture that product again as Gail said,

they can't submit a prototype. And then it comes back into the test lab for retesting and, you know, so it really comes down to the cost of time and dollars associated with all of that. And at that point, the test lab has to basically go back to a stage. They can't just begin where they left off. Go back to a stage and start looking at the products again so that it just -- without a clear definition, puts the manufacturers, the labs, the EAC at risk that there will be interpretation and mistakes made or differences throughout the process. It will just delay the process.

DR. KING:

Thank you, Brian. Frank?

MR. PADILLO:

You know, I agree totally with what Brian and Gail said and I want to expand upon that a little further, is you've got to even step back from that. The first thing the labs have to do is get inspected. And we have to write a matrix up. Everything that says, thou shall test and everything else. And if it says, that it shall be easy or it shall be simple or it shall be close to this, close to you and close to me, I mean I live close to Atlanta in relative terms, but it's a four hour drive because it's the biggest city around and I tell people that. I mean that's not going to fly in today's world. And even worse, we're trying to say that these tests are repeatable.

And if we use adjectives like that and I understand what Tom was saying, there's a time you have to but you can -- you don't have to get so definitive, you need to put parameters to give leeway and that's what most of the middle standard and IEEE does. It doesn't have to be 100, it's plus or minus X, but to say close, to say

these standards. So you take from the lab accreditation standpoint all the time and we have to be at work with NIST and everything else that how are you going to test to what's close and do they agree with you? And then writing that and then take that even on to what they're saying. I don't know how the reviewers would do it. And then when the state's get it, take it the next period it's got to go to the states after it leaves EAC and they're going to say we don't believe that that's close. So they're not going to buy the system. We just start a loophole that is never going to correct itself and I think that's where we got to correct it.

DR. KING:

So there's a cascading effect of the problems. All right, Tom?

MR. CADDY:

I agree. I think that it is definitely, probably even actually, maybe the most significant cost because when I think when there's confusion or issues then I think that it does -- that's where most of the effort goes. It doesn't go to the things, the task, or they're clear or they're defined, it goes to the things that are vague, so virtually all of the extra effort goes into those specific kinds of questions to be resolved in one sense or another.

And I think that, I addressed it at a later stage in here but I think that a part of the process that makes this difficult in the current paradigm is the statement that Gail made that the product comes completed. And actually if there's a mechanism which exists in some other programs that enables vendors to start being able to give closer feedback interpretations on some of this while they're still in the design phase, it can really eliminate a lot of this because



they know what some of their risky design features are and they can make the decision if they're going to go down that path or not rather than being surprised after the product's completely done. It does create other risks out there with who's providing that advice and how knowledgeable they are and it's in the labs and so forth so it's not -- it creates another set of issues but it can help solve this one.

DR. KING:

Before I go to Mark and then Brian, I would like to recognize Commissioner Gracia Hillman has joined us this morning. Good morning, Commissioner.

MS. HILLMAN:

Good morning.

DR. KING:

In the interest of moving forward, I have one additional follow on question I'd like to ask after Mark and Brian respond.

MR. SKALL:

Yeah, in answer to your question, Merle, clearly the problem with having words like that are the difference between the subjective and the objective interpretation. To give an example, so when you're writing a standard, typically you start with sort of vagueness and you drill down until you have precise requirements. So a requirement may be that the instruction shall be readable. Now that's not testable, that's sort of a high level functional requirement. We would all agree it's not testable. You would drill down and say what does that mean? Well it may mean the text has to be a certain size, icons have to look like a certain way, placed a certain

difference, length between them. The irony of this is, as you drill down on some of these, you may end up with design requirements. Design requirements are inherently testable so that's very ironic. One of the issues are you can be very testable and put a lot of design requirements on. But we're trying to stay away from design requirements.

So typically in the VVSG, if you see things at a high level, it probably means that the TGDC and NIST with NIST help were not able to drill down and come up with specific requirements beneath that that were not too design oriented. But that is the trade off. You can drill down and have tons of design requirements that are very testable but they are very restrictive.

DR. KING:

Okay, thank you. And Brian?

MR. PHILLIPS:

Yes. Well Mark actually brought up the point that I wanted to make, that is if you do clarify these sort of ambiguous statements further, sometimes you will end up with constraining the design of the system. And I know that one of the goals is to promote innovation as much as possible at times and so but, you know, I was going to ask if the TGDC was actually looking at not trying to constrain but sort of leave it a little bit open, so that like you said, is it readable, what does that mean? Does it, you know, readable has a number of different definitions for some folks, that maybe new innovation that makes it a little more readable in certain other ways, and if they defined it further, you're limited. So that was my point, thank you, Mark.

DR. KING:

Thank you. Stephen and Frank?

MR. BERGER:

There's just one question I'd like to put out in this context and it's really a companion question to that which has been discussed. And this is, very simply, why should I believe if there's a flaw in the system that the test that the labs will be running will find it? And I think that's one that we hit over and over again. That's the one at the state level and at the procuring level when they look at a system, when they look at the certification, you know, they want to have a real good feeling that yeah, that means that if there's a flaw almost certainly the test will have found it. That means that the labs need to have guidance on what is that minimum because obviously there are not enough hours in the day to do every imaginable test and every imaginable configuration.

DR. KING:

Thank you, Stephen. Frank?

MR. PADILLO:

I would just like to follow up on Mark's comment. And I agree with what you're saying totally is that you start defining these, the problem that I see is a programmatic one is we're getting inspected to those exact interpretations when they come by your sister organization NVLAP that says, what's easy. I have to write a thing, what's easy? They have to write a thing that's easy. Now we have four labs, five labs, whatever it is all with a different interpretation, the technical reviewers with a different interpretation, the manufacturers with a different interpretation, worst of all the general

public with a different interpretation. And we're just going to have to find some way that either you're going to tell us what's easy whether it's in the manual or not and we're all going to agree to it, but we can't leave it like that or we're going to have 20 interpretations. And if it means it's going to be some design constraints, I don't see a way around it to get where we need to go.

DR. KING:

Okay. In the context of design specifications, one of the concepts introduced in the 2007 VVSG is the software dependence requirement. And the question that I'd like to put before the group is, do the methodologies that currently exist within your organizations, do they reliably test the systems so that the software independence concept is redundant? Or does the software independence concept add value in some way to the testing process? Frank?

MR. PADILLA:

First, let me address does the software independence add value to the testing process. My understanding of the software independence requirement is that regardless of what may happen with the system and then we'll use the example of the VV pad, that you can verify the vote results without having to rely upon the actual system that was counting as well so you have an independent process of doing so. That doesn't necessarily help in the testing process, that's just another set of requirements that we have to test and validate.

Now do our processes currently -- are they sufficient enough to test to ensure that the vote, let's say that the vote totals will

always be reliable and accurate and that you don't need to have a software independence approach to keeping track of those things? I would say that they are and that they can be, but I think someone said earlier how many day -- how many hours in the day are there for testing some of this. And we're basing our testing on the requirements of currently the 2002 to 2005 and we'll be looking, you know, when they implement the 2007 we'll be implementing those. We have to develop our test plans, our test methods based on what the requirements are saying. And if the requirements have a software independence approach to it we will test to that. If they don't, we then have to test to validate what they're saying.

In other words, if the test says that in all instances you have to be able to ensure the accuracy and reliability of the vote totals, we will create tests to show that. We may do it differently than maybe another lab would because of differences of -- slight differences or methodology perhaps and -- but we're hoping to get more definition from NIST on the repeatable testing and so forth and I think that will help a great deal.

So does it actually affect our testing methodology? No, it will just add to our testing methodology. Can we currently validate it? Yes, we can.

DR. KING:

Okay. Frank?

MR. PADILLO:

I did flip my tag up but, no, I agree with him. Can we test the software independence? Yes. I always liked that term because the first thing I like is, define software independence. Working since

that's came up in the last year, there's about eight definitions of what software independence means. Once we're in that, that's one of those I'll call ambiguous terms that depending on who you talk to, software can't affect the paper ballot anyway. I mean is a paper ballot really software independent or is it generated by the software that runs the voting machine? And if it's that, is it software independence?

So I think with your question, what are we looking for with software independence? Can we test to it? We test to the standards and I'll comment on that. Do we test -- do we know that the voting machine we're testing is accurate and everything else when it goes out there? We test everything to the standards that we can. That it's an approved methodology from NIST and NVLAP. Does that mean that every test and everything that the states do is out there? No. I mean there's valid designs. You can only test -- we cannot test 800 ballot designs that are out there in America. There's probably more than that. We pick the general ones that we think will cover them all but does that mean some state might have an issue with their ballot design working with a particular machine at the federal level? I don't think there's a way that we could go there and say it meets all the requirements everywhere so we have to be careful there.

DR. KING:

Okay, thank you, Frank. Gail?

MS. AUDETTE:

Okay. If the underlying theme of software independence is that software is not trusted, then our testing of that software isn't trusted

either. So can we test the software independence system? Sure. But what value does it bring, given that software independence by definition is that you've got to have a second system because your software is not workable? Did I go around enough to confuse everyone? Okay, I'm sorry.

DR. KING:

I think Mark just pulled the brake on the merry-go-round.

MR. SKALL:

Okay. So yes, I think we're all in absolute agreement that you cannot be comprehensive in your testing. That's the state of the art. You can never write a test sweep that will absolutely find every error and everyone has said that. That doesn't mean the value of testing is not very, very important. The high -- the more extensively you test, the higher confidence you have that the system will, in fact, work correctly.

Software independence and I guess I've heard it described as sort of the parachute and so if the plane fails, you have a secondary way to get out before it crashes. Software independence is intended to allow one to detect if there are problems. That doesn't mean you want, you don't want to minimize the problems. The more extensive the tests are, the more reliable your software will be, the less problems you will have. Software independence is the backup. Hopefully, you never have to get to that point, but we all know the state of the art is that you can't prove implementation is correct. That's the whole reason for having software independence. We know you cannot rely on the accuracy of the software no matter how well your tests work.

In other systems, as we all know there are ways to guard against that. There are receipts in the financial institution. There are tons of backup systems in airplane systems, which to be quite frank, the voting systems do not have the funds to develop tons of backups. This is the essentially the backup system. So it's intended to work in concert with the testing regime but the more extensive the testing regime is, the better off we all are.

DR. KING:

Well Mark and Tom you're next. I'd like to ask a follow up question, but first I'd like to recognize, Commissioner Hunter has joined us this morning and we appreciate her stopping in.

Mark, you said something that I wanted to follow up on and I've written here, you're addressing the VSTL's that they cannot be comprehensive in the testing. And my question is, is that a function of the standard, that the standard is not comprehensive or is it addressing that the protocols and methodologies aren't comprehensive or is it a blend of both of those?

MR. SKALL:

It is a product of computer science, the fact that you can never prove a program correct. It's well beyond the state of the art. I think the current -- you can prove a program of up to about ten statements correct. So those are, I don't know how many -- these programs are many orders of magnitude. So essentially you test by what we call, falsification test. You try to find errors. You try to falsify. To say if I'm trying to fool the system, this is what I would do to see if I could find these errors and you probe and you keep probing. And you can probe 100 times, 1,000 times, a million times



but you will never, ever be sure that you've probed every possible potential error because there are an infinite number of combinations of functions that you can test. So you have to be selective. You have to produce a sample of those, a subset of those. And at some point, there's a point of diminishing returns. There's only a limited amount of funds, so you can never comprehensively test every combination of functions.

So by definition, you can never be sure that, in fact, the system you are testing is correct. You can be sure it's incorrect if you find an error, but if you don't find errors you know either that it's correct or that your testing wasn't comprehensive enough.

DR. KING:

And when you say sure, we're talking about absolute assuredness?

MR. SKALL:

Metaphysical certitude.

DR. KING:

Okay. That's a good way to put it. Tom?

MR. CADDY:

Just a quick comment. I think that it also adds to the complication of having the software independence by the utilization of off the shelf software and software where code and other things aren't available to evaluate either and they may not be practical. So a lot of people are using off the shelf operating systems and other things which their interaction with the specific software we're doing may be very difficult to test comprehensively.

DR. KING:

And Stephen, I'll let you have the last word on this question and then we're going to move onto Question 2.

MR. BERGER:

Very good. Well I just wanted to put a question on the table and that is, if we go to software independence, what are we then in the election system dependent upon? And I think we owe an answer to that question and hopefully the answer is, whatever we're depending on has a better accuracy, is more secure than what we have today.

DR. KING:

I'm recording that question, Steve. Okay. Matt, could we go on to Question #2?

As I said at the very beginning, we are going to try to -- well we won't try we will stay on schedule today and in interest of that, I'd like to move on to Question #2. How can innovative systems be evaluated for purposes of certification? If the EAC were to undertake creating an innovation class, what suggestions would you make regarding the testing of innovative or new technology?

I'd like to make just a brief prefatory statement that voting systems are a combination of legacy technologies and I think that's a polite way to describe the state of the art voting systems, but they're mapped onto the historical practices of jurisdictions. They're mapped onto a complex matrix of statute and rules and regs, but from a jurisdiction's point of view, stability has long been a valued quality in systems and not without good reason, stability reduces risk. Stability maximizes training. Stability can make the system more predictable and more manageable in that regard. And

over a long period of time, systems have a tendency to become static and stable. And that produces economies of scale in the manufacturing which can reduce the cost of the systems.

And so there's a compelling argument from the jurisdiction point of view that innovation is a good thing, just not this election cycle. Of course every election cycle is this election cycle. But at the same time, we have societal, you know, political forces that are moving this industry towards innovation.

And so, the question that we have here is really talking about this tension between stability, a very highly desired goal in voting systems and innovation which is another generally desirable goal in any system and how we can manage the benefits of the innovation while adhering to reasonable cost and time schedules in the testing of those systems.

So I'd like to put Question 2 out on the floor for discussion.

Brian?

MR. PHILLIPS:

My observations when I've gone around to the states and the counties, jurisdictions and so forth addressing what you were just talking about regarding innovation and stability, I think that there's a combination of the jurisdictions requiring stability for the points you said and requiring innovation as well but not a completely innovative new system, but components of the system. There are, you know, jurisdictions who have, who are very happy with some of the voting systems that they have in-house, they serve them well, but new regulations laws, rules, and so forth have come about that require them to have new pieces to that particular voting system

and it might be a whole new set of technology to solve that. And what they're looking at are additions to some of the legacy systems. And I think that, you know, we want to promote innovation there because of the new technologies that are coming available both in design, as well as, manufacture of those products and because that will help possibly to reduce the time and cost of getting those innovative products out to them.

It's also important though that you look at the innovative products as a separate component that has to go through, you know, the testing and certification process in and of itself and then as an integrated aspect of the legacy systems. The challenge there is that some of these legacy systems may not have been through testing in quite a number of years. So again, looking from a jurisdictions point of view and stability, I don't want to change out something that's worked well but I have to meet a new requirement.

And from the EAC's point of view, that new component must be certified with the voting system and it must meet all of the requirements within the VVSG, regardless of whether or not it's a new product or an updated older product. So I think it's a challenge. How do you manage certification of innovative products, which is what the question is about that might be integrated into some of these legacy systems. That's what my observations have been in a lot of the counties and jurisdictions that I've met.

DR. KING:

More of an evolutionary approach rather than a revolution?

MR. BERGER:

Right.

DR. KING:

All right, Gail?

MS. AUDETTE:

Following a bit on Brian's theme, what is out there has been working and that's the stability. And the same goes with innovation. We've had systems come through against the 1990 standards, the 2002 standards, as well as, coming through on the 2005 that do have innovation. And the current way of handling innovation by the EAC is to do the notice of clarifications and the interpretations. And I don't see why an innovation class needs to be put into the 2007 standard. Obviously innovations have been handled over the last 20 years without an innovation class.

Going along with that, I read through the paper, the white paper, the voting system innovation class that was prepared by the STS Subcommittee dated June 26, 2007 and that paper suggested, actually stated that part of the innovation class would be to go through iterations with the lab to submit the designs to the lab and go through an iterative process. That is currently not allowed in the EAC 150 -- the NIST 150-22, as well as, the EAC Notice of Clarification 2007-02. The labs are not part of the design process. So the innovation class as suggested in this white paper actually conflicts with the lab's current direction by the EAC and that is a very big concern to the lab, to my lab. Thank you.

DR. KING:

Frank and then Mark.

MR. PADILLA:

Yeah, I agree with what they said and innovation it's a unique word. There's a lot out there. The world's -- you're right, the voting machines today aren't the technology of today. The technology is changing hourly, daily, minute and -- but if we change the -- we have to leave a way for that technology to come into the standards without writing a whole new standard, because of the time frame it takes.

It's putting a section in there called innovation class that basically says, whatever you want to submit, going to fix it. I think it causes more problems than it starts. If we test -- had performance standards, you don't need an innovation class. Here is your performance standards that the people want, that the election people want. Your innovation needs to meet those standards. And I use the analogy again of, how do you get to 100 miles an hour? It doesn't matter. That's your goal, get there. Don't put how you got to get there. And I think that leads to innovation. It's when we do the design standards and all, we don't leave that door open.

I'm very worried with this innovation class as a lab, seeing, looking at, it's a blank slate. I look at it from the manufacturing point that Gail brought up, that, who's going to develop anything innovative if you don't know what the standard you're testing it to is? If you don't know the time frame to get the test methodologies approved and the test plans approved are, and then the test plan and the testing. I mean it would be a blank slate, that if somebody came to me today and asked, you would say, I don't know. I couldn't even give them a guess of the cost, the time frame, or anything else of what it would take a system to get through. And I

think we need to look at those questions before we put that in there because otherwise nobody's going to be able to use it. If we put a section in there that people are going to try to use but it's realistically an unusable section because we'd never be able to achieve it.

DR. KING:

Okay, thank you, Frank. Mark?

MR. SKALL:

Well Frank, about halfway through your remarks, I was almost going to put my card down because I said to myself, you're saying what I want to say but then it went south after that. So the beginning point, I agree with 100 percent. The way innovation perhaps has been handled in the past is through attempts to produce new standards quite often, new standards that keep changing on a moving target. So we've had a slew of different standards. We have a 2005 standard and we have one that was recommended in 2007. The intent of an innovation class is to incorporate new ideas which thus have to translate into new requirements without producing a new standard. We can't keep creating a moving target and I think that was your point at the beginning, Frank.

I don't know, I think you'd have to poll everyone on the TGDC to see why they thought the innovation class was a good idea, so I can only give you my interpretation, but it's precisely that. That you need a way and this has been done in other standards. I was involved with computer graphic standards. We had these escape clauses, ways to include new functionality, new ideas

without producing a new standard. The problem is, you have to come up with procedures. You have to come up with mechanisms. It's a complicated process. But the alternative in my mind is not a good alternative. That every time you come up with a breakthrough new idea, you have to say, okay all you guys who have spent all this money on producing implementations and being tested for a certain standard, stop producing a new standard. That's untenable. So we've come up with this invocation class, a way to incrementally change the standard without starting all over. And yes, in theory if everything was performance based, you wouldn't have to keep doing this, but I don't think you can write performance standards at that high a level to cover everything.

DR. KING:

Okay. Well thank you. I think this is an opportune time for us to take a short break, refill our water glasses. When we come back, we're going to start with Question 3. Matt, why don't you go ahead and put Question 3 up on Open Ended Vulnerability and Stephen has some introductory comments that we'll start with, so let's take a hard fifteen minute break and let's be back here in fifteen minutes and ready to go. Thank you.

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[Recess from 10:25 a.m. until 10:45 a.m.]

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DR. KING:

Okay, thank you all for coming back. We're moving on now to Question #3, which deals with the Open Ended Vulnerability Testing. And the question is displayed on the PowerPoint. Is



Open Ended Vulnerability Testing, as presented in the proposed standards, feasible in a conformance assessment process? What advantages or disadvantages exist with the OEVT as proposed? And if the EAC were to require OEVT, how could it best be included into the EAC's Testing and Certification Program? And Steve Berger has offered to give some introductory comments.

MR. BERGER:

Okay. Thank you, Merle. A theme throughout this and I'm not the originator of this, is, to worry about unintended consequences, what's going to happen if we go in a certain direction that we may not intend? On a high level, there are significant concerns about what the draft 2007 standard is doing to the cost of certification. By my count, there are 805 testable requirements in the 2002 VSS. That grew to 921 in the 2005 VVSG, the current standard. And there are approximately 1,200 testable requirements in the draft. It's an increase of 252. And my count may not be entirely accurate but it's in that range certainly. It -- the change goes deeper than that. If you look at the number of requirements that are new or significantly extended, modified from the existing requirements, it's on the order of 60 percent. That's going to do a number of things.

First, let me talk about cost of testing. It appears from the best numbers I've seen, that the cost of testing before 2000 to get a product certified was on the order of 100,000 to 250,000 from -- and that's external cost from a vendor to the lab. It looks to my eyes from the information I've seen and we had a workshop on this that today's costs are running in the order of 1 to 2 million. And that this standard looks like that will raise that by two to four times in the

area of \$2 to \$6 million. I think we need to worry at that point, what are we doing? What consequences will come at those cost levels? And this OEVT is at the center of that. What is the cost? How do you know what it's done? What happens to vendors to start with?

I'll say one of the predictable consequences is, the only way you can pass with confidence an OEVT evaluation is to over-design the system. You've got to make systems more expensive than they otherwise would be because you don't know exactly what will come out. Certainly, it increases the barrier to entry for new companies. It's a more insecure, uncertain environment looking at different business opportunities. Fewer companies will be interested in coming into this environment as opposed to other lines of business. It will basically assure that we will come down to a fewer number of vendors bringing systems through the process, less frequently.

There are I think other consequences and that is, while the requirement is -- envisions a rigorous Open Ended Vulnerability Testing, is it required? Could NVLAP refuse certification to a lab that brought someone in who was very marginally trained, even less motivated, and walked in said, that looks like a secure system to me and walks out? You know, at what level could we say, that is insufficient, as opposed to what's apparently envisioned of something that's very rigorous and done by very well trained people who are highly motivated.

I think the place for this sort of thing is in research on current equipment and then what may come from that research gets folded in, in an orderly process so that vendors can see new requirements coming in. They can plan it into their design process. Laboratories

can prepare tests that are consistent across the labs and specific in what they're looking for and therefore facilitate the flow of new designs.

So with that, I'll turn it over.

DR. KING:

Okay, thank you. While -- if I can follow up on one of Steve's comments. John, has NVLAP looked at the implications of OEVT in the certification of labs?

MR. CRICKENBERGER:

Actually the Open Ended Vulnerability testing has not really been looked at in labs for reviewing standards.

DR. KING:

Do you share Steve's concerns that it could be problematic in terms of...

MR. CRICKENBERGER:

Yes, yes, and his concerns about people involved in the testing is a real concern. And NVLAP requires the labs that are being assessed and who have a turnover of people, to let us know when something like this happens so we can then evaluate anybody they bring into the system. And something like that might require even another on-site assessment to make sure that these people are qualified to make decisions and to run the test. They've been validated through the training process, where somebody has taken them through and made sure that they can perform the necessary tests. So these things have to be documented. We have to be aware of any changes that occur and we have to make decisions as to whether any new person involved in the testing is qualified.

DR. KING:

Okay, thank you. Frank?

MR. PADILLA:

One of the questions of OEVT, and should it be in the standard, you know, is feasible, is just using the definition and I'd like since we've started that way today, I'm going to stay with that a little while. You know, Open Ended Vulnerability Testing, sort of, how can that even be in the testing standard? I mean by definition alone open ending means, it never ends. There is no end point. I disagree with -- I mean, I agree with the making the systems more robust might find them but, by definition, a good OVET team is still going to find problems in that system, because I don't care how well you designed it, as we heard earlier, you can't design anything to the absolute. There is nothing that can be done that way. So, therefore, if an OVET team had enough time, energy, manpower and resources, they might be able to find an issue.

With that said, I don't see how we can even put it in the standard. Is there a need for it in some part of the process or the program? I think that's what the states and the public want. If it -- who manages that part of the program I think, is the key interpretation that, you know, is it something the VSTL's could subcontract out in the specialty experts? Is it something that goes after the testing is done? Because once again going back to the definition there is no pass/fail criteria, it's based on threat scenario. And I think that's taking that to the testing example of cost. I know the EAC's about to publish something for -- to get a threat scenario for voting machines. I don't think there is, anybody could say for all

the voting systems out there, that there has ever been a threat analysis done that all the labs could use, that says this is the base threat analysis that we should go by. So, therefore, once again, we'd be back to that opinionated, almost unrepeatable type of testing based on its nature.

The other issue I see with it, as it's written in the guideline, is it was very unique, once again, that disjointed effort I talked about in the standard, that this one place in the standard actually laid out the qualifications of every person and how long you must spend testing. And all the standards I've looked at over the years, I don't think I've ever seen that in the standard. I've seen it in programmatic manuals. I've seen it maybe mentioned in a standard but this was more the program level description to me of how this test should be done, not the standard level of how this test should be done.

DR. KING:

Okay. Gail and then I want to come back Frank and ask you a follow up question in a moment.

MS. AUDETTE:

Okay, thank you. First, I want to applaud the EAC for putting out an RFI and then RFP on a threat model. I think that's going to take us many steps closer to defining what the red team or Open Ended Vulnerability Testing might be moving forward.

As it's written in here, and I'm going to quote from the standard itself that says, "it is conducted without the confines of a pre-determined test sweep. It relies -- it instead relies heavily on the experience and expertise of the OEVT team members and their

knowledge of the system.” So by definition it’s not repeatable. And yet our NIST Handbook 150-22 puts a requirement on the test lab that all our testing is repeatable and it’s documented to a point that when we issue our test report, another lab can come in, review what we’ve done and accept our work.

So this, the OEVT concept as written and in the standard, conflicts with our auditing criteria and from that perspective, I think it needs to be considered removed or at the very least to be put in concert with what the labs are being held to.

DR. KING:

I’d like to come back. And Frank, both you and Gail touched on the risk assessment and one of the goals of our roundtable discussions and I’m sorry, Tom, I’ll get to you in just a moment, is, trying to get as much clarity as we can on these issues. And I want to follow up and kind of pose the question more directly about the value of a risk assessment to a testing lab. If a comprehensive risk assessment was done on voting systems, would that be of value to the testing labs and then more importantly how would that be of value to the testing labs?

MR. PADILLA:

Well I definitely think it would be of value. I mean today you already have security testing built into the program in the 2005 and 2002 standards. What level do you take that security? I mean there’s been a lot in the public media about what is a lock? What is a secure area? Is the seal secure? Is a lock with one key secure? Do they all have to be separate keys? Does it need to be, you know, in a sealed case? What are those? What is the threat matrix

out there that says what these should be? And I think it would benefit today. It would definitely benefit the OEVT question because without that there's no boundary.

And I want to give credit to the one, I can't remember who talked about it the last time on top of what Gail said in the last meeting is, you know, part of the OEVT process is not having the set standards and giving that info back as it was discussed, I think at the first meeting. And if you give that data back, people are going to fix those problems. And then if you only tested those problems, you're never going to find any other problems, which is why OEVT by nature has to be open ended, that you go in there with a clean mind and a clean slate every time you do it or you've defeated its purpose. It's become more of a standard test sweep that you're never going to find new issues or new problems or new anomalies that come out. And that sort of puts us, Gail put it, programmatic problems throughout the whole thing if you put in the VSTL context.

DR. KING:

Okay. Tom?

MR. CADDY:

Yeah, I think as has been mentioned, I think that the skill of the team members is really hard in this case because it's really hard to get a level playing field among the labs as to their various skills of specifically finding Open Ended Vulnerabilities as to somewhat of a different skill than normal testing processes. I do concur though.

I think it's been mentioned that I think it's important for it go be included as a concept in the program. And we've seen other

programs that have been compliance-based testing or other things in which the lab gets put into a really awkward position because they may know of vulnerabilities. They may know of issues in the system but they have no way of raising that issue to the authorities, to the regulators if they don't have some mechanism in either the program manual or the standard to create -- to document that and move the issue forward. So the -- and if they do that without having some formal mechanism that's in there, then that's really out of scope with what the vendors typically want them to do.

So I think it's important to have that opening in the program so that when things do come to light that -- I know in another meeting, I think Frank had mentioned it, they had by accident they had seen a whole set of things and it was not appropriate but they didn't know exactly how to deal with those processes. So I mean it's a good concept, maybe not for the standard, but certainly for the program.

I think the other thing with vulnerabilities is, in truth, even Microsoft on their website will acknowledge that they -- if you don't have physical security, we don't really have any way to protect your logical security. And so what you have is, you have a scenario with almost all voting equipment that they have, they don't have a lot of physical security associated with the product. And so, by definition, Open Ended Vulnerability is one of those things in which, in truth, anybody that's actually doing that kind of business can export them very quickly because they actually have the minimal physical security associated with it. So it's a very difficult thing to say, okay,



now that we have identified the vulnerability, what's the real threshold of, is that a risk or not a risk associated with it.

The other thing that I think is important to associate with this is NIST is actually participating in some other programs that are targeting a lot of system vulnerabilities. The newest thing happens to be part of an SCAP Program, they call it, but it's really utilizing some of Mitre's work and the National Vulnerability Database in being able to assess in a much more definitive fashion how those vulnerabilities might be present in the systems. And I think there's actually a lot of applicability as I've been involved in that program over the last two or three months to how it could be used in this program and actually potentially mitigate some of the open ended part of the costs.

DR. KING:

Okay, thank you, Tom. Mark and then Steve.

MR. SKALL:

Thank you. I think this is a difficult issue. On the one hand, this type of red team testing is fairly standard in security testing. And as Frank himself said, it's fairly likely that this will find problems that could not be found any other way and that is the objective of why we're all here to make our systems better. I agree that we're breaking new ground by putting this in a standard. On the other hand, we've already broken a lot of new ground in the next iteration. We've never had usability performance benchmarks in any standard. We've never had the levels of security requirements at the level of specificity we have now. So we've already broken

new ground. I don't think we should be afraid to break more new ground in trying to include this.

In my view, the biggest impediment is the repeatability issue. I think that's a serious concern and ensuring consistency among the test labs. You certainly don't want an unlevel playing field where one could be tested by one lab and fail and be tested by a second lab and pass. One of the things we've talked about in some preliminary discussions, and I have no idea if this is feasible from a policy standpoint and perhaps even a legal standpoint is perhaps having these red teams not come from each lab but perhaps cross labs sort of one team with participants from each lab so at least you'd have some sort of consistency. That same team would report to all of the labs, just throwing it out there. But I think the repeatability issue and the consistency issue is one that we clearly have to solve.

DR. KING:

Thank you, Mark. Stephen and then Frank.

MR. BERGER:

I'd like to say two things. First of all, I'd like to loudly applaud what Tom said. However we end up, I think we want to preserve that if an engineer at a VSTL see's a clear flaw, something that clearly should not get out in the deployment, it ought to be not only, should they have the ability but they should have the responsibility to report that forward for review. And no matter how we write this, it's always possible that something could slip through the cracks, the exact wording or the specifications. So I just, Tom, I think that was an excellent point.

The question I'd like to put on the table is, what is this replacing? And as I contemplate that and what really worries me is that Open Ended Vulnerability Testing may be replacing and drawing resources away from integrating in what we've learned through experience and what we are learning through experience and making sure that the specifications and the testing get better from that body of information.

Mark, I think these somehow may blend. I'm not sure I'm smart enough to do it on the spot, but I think we want to make sure that however we come out of this, we have a very robust process by which what's found out in the real election with experience in the field comes in and improves this process. And I also would agree with you that I think red team testing is an important part, I'm just concerned that it will work in a way that doesn't end up too disruptive to the process.

DR. KING:

Okay. Frank and then Brian.

MR. PADILLA:

No, I agree with Mark. The new manual has lots of changes but we don't -- we always don't need to change for the sake of change. All change isn't good. I think the OEVT and red team testing, as I said, has an advantage. My problem with the manual in trying to test we're back to the adjectives, I'm defining timelines. I'm defining a report that somebody's got to say, this passes, yet by definition OEVT says the next team that's going to do that test is going to find problems. So, therefore, for the lab to write a statement which is the requirement then that you find the system in compliance.

Basically OEVT never finds a thing in compliance. By nature it says it passed that threat scenario. Renew the threat scenario, you expect to find new problems.

One of the major points with OEVT that was brought up before and I talked with lab disclosing and I agree with Tom. I think it's our obligation to bring problems forward as a test lab if we find them both to the EAC and the manufacturers, but with OEVT brings up another concern that I think was brought up by both the first board and the Manufacturer's Board is if we go out there and say we found this problem today and the election is tomorrow, there's no time to fix it. And now we're going to exploit this problem to the public that could utilize this issue to exploit a voting machine. Where is that line going to be drawn? And I don't know if we've done enough research on that part of it to say, is that right?

I thought that was a very good discussion point in that and I didn't really look at that. Say something fails a hardware test or a software test, you're going to go back and test it, but at the end of testing to say that this had a vulnerability and we need to get it fixed today, that's not going to get it fixed today and fielded to all the machines, it's going to take awhile.

DR. KING:

And I think that's an excellent point. And I was thinking about the recent grounding of the F-15's. When does a problem reach a critical mass when you can't remediate it in the field and you have to pull the system? A very complex problem. Brian?

MR. PHILLIPS:

One of the things I think we need to keep in mind when we're thinking of vulnerability testing, threats, and so forth that come about, is what you brought up earlier regarding risk assessment. We may find flaws in the system that are -- you can exploit through various ways through vulnerability testing, but what is the risk of that particular flaw being encountered? You know, what's the probability that that may actually happen?

At what point, somebody mentioned earlier the cost of diminishing returns. At what point does it become senseless to keep testing when you know what you're testing has, you know, virtually no probability of actually happening in the field? I think that needs to be taken into consideration when you're looking at the threat models and the types of testing that you do. Like there have been many studies as we all know at states where they've done some risk assessments and they've done their own testing. And I've read the reports. I've seen the results of those tests and very few of them that I can even recall, state what the probability of the particular threat might be. And when I spoke to the individuals about that issue, they basically are saying, well regardless of the probability we have to be able to show that it has a flaw and show that it has the problem and needs to get fixed.

So I think that needs to be taken into consideration and it could help to limit the overall Open Ended Vulnerability Testing effort and put at least some form of definement on it.

The second point I want to make is, with Gail had pointed out earlier very well that when a manufacturer submits a voting system to a VSTL, they're submitting essentially a finished product.

It's been manufactured, it's been designed, coded, done their own internal testing, and it's ready to go. We start performing Open Ended Vulnerability Testing throughout our certification engagement and to standards that are not clearly defined, it puts a challenge on the whole process. If we find issues that are totally unexpected, then the system has to be completely redesigned potentially, go through all the process within the manufacturing before it comes back to the VSTL.

It goes back to the question of, what can we do to help minimize the time and cost associated with the certification while maintaining the integrity and the effort. I don't necessarily have an answer for it. We had talked a little bit about -- Gail had pointed out how perhaps maybe getting involved in the earlier life cycles of the manufacturer's process and how that's contrary to what our guidelines say that we can do, but perhaps it's something we should think about.

Through the concept of independent verification validation which is used in the Department of Defense, state agencies, and so forth where an independent testing organization, if you will, is involved with the evolution of the product throughout the life cycle of development and a completely independent organization. And in many instances, not allowed to get involved with any design changes whatsoever but they're involved very early in the life cycle. So that you end up with very close to the end of development and ready for implementation. You end up with a product that can be certified right then and there.

I would like the EAC and the Standards Committee and so forth to -- and NVLAP to consider that as an option for going forward to help at least reduce the time. It won't necessarily reduce the cost per se, although I think it will because you will probably eliminate a lot of re-work and the whole concept of how much it costs to fix a problem later in the life cycle versus fixing that problem early on in the life cycle.

DR. KING:

Okay, thank you. Dawn, I'll let you have the last word and then we'll move onto the next question.

MR. MEHLHAFF:

And my only comment on this is, I think a lot of what you've heard today is that a lot of us are looking to the guidelines to set the parameters and to take away the ambiguity. And I think with this that puts that back into it where it's, you know, define it. How are you going to test it? How are you going to test it? And so where we're coming from, I think, I mean personally, you know, I'm looking at the guidelines to set those so that we can eliminate the request for interpretations or at least narrow it down a little bit to make sure that it's in black and white. All of you know exactly what you have to test to. The vendors know exactly what they have to design to. And so wherever we can reduce that ambiguous language, I think is where we need to go.

And I don't think any of us are saying that we shouldn't, you know, break new ground or go a different direction, I just think we need to keep in mind that if we do break new ground and go in a new direction that we have to be able to define it and to put the

parameters around it as to where we need to go with that. So I don't think any of us are saying new ground, new territory isn't a good place to go if we do go down that path. We just have to have the parameters and put it around it because if we do something like this as it's written, that just opens it up to another, you know, a whole other list of, you know, ambiguous statements and we're right back to where we started where we're looking at this document to try and clarify things.

DR. KING:

Okay, thank you. Matt, could we go to Question #4?

I think both Brian and Gail talked about the issues related to full system testing and the challenges that it creates. And at the very beginning of today's session, Dawn used a coin as an analogy and you had seen, I guess both sides of the coin in testing. You know, I thought about that and I thought well maybe elections are more like a dice there are six sides to them because there's certainly more than vendors, there's more than testing labs, there's more than jurisdictions.

And I think this next topic is really very, very important to all of the stakeholders. But today, we want to talk about how it impacts the testing labs. And so the question is, how could the processes of the draft VVSG be modified to incorporate minor revisions without incurring the cost in both time and money of a total system test, and still maintain the integrity of the standard? So what we're looking for here is a statement of possibilities. Can this be done? Is it done in other lines of testing? What have you



learned in other component testing models that could be carried forward to the VVSG?

So I'll put that question out for discussion. Steve?

MR. BERGER:

Well I mentioned it earlier, but I think that it comes directly to this point and that is to move to a model during architecture. If we look at the voting system, there are some natural places where we could say at this point that all vendors will do it the same way. For instance, at the point of which votes come out of the ballot box, you know, moving forward for accumulation tabulation, that they all were using the same electronic data format, then a whole lot of things could be done. And one of them would be testing on either side of that interface because now you're testing to an interface and you can start breaking down the system both to test all components more rigorously but also to be able to modify on a quicker basis. That has a history in multiple other industry sectors and works pretty well.

DR. KING:

Okay, thank you, Steve. Gail?

MS. AUDETTE:

Yes, thank you. The VVSG, in my mind, should contain all of the requirements that every voting system should meet. How to apply those requirements is really a policy decision of the EAC. So as de minimis changes or larger changes come in, that's really the policy of how to apply those requirements. We all want every system out there to meet all of the requirements of the VVSG. So I don't believe having it in the VVSG and how to apply itself is the right

place for it. If the EAC wants to set guidelines, as they do now, in the lab manual, as well as, the manufacturer's manual for de minimis changes and how it goes, the labs are to prove and certify that these small changes meet the entire intent of the VVSG as it stands now, should stand going forward. As if we go to component testing, again that is an EAC policy of how to imply that entire requirements document to the entire voting system.

So I don't feel that the VVSG should be in a way controlling how it itself applies in certain situations. This document needs to contain everything from the performance and function that every voting system must do so that if there is a certification on a voting system, you know it meets everything within that document, not subsets of it. Thank you.

DR. KING:

Okay, thank you. Frank and then Brian.

MR. PADILLA:

I agree with that. The current EAC does have a process for de minimis changes, but I want to step back from that a little bit and totally agree with what Stephen said. Module testing, I mean there are logical breakpoints. I think we sat and talked about it some earlier, where, in the past you can look at, we almost did that. We separated -- you had hardware labs and software labs. We did -- that brought systems together because they thought that that was a good breakpoint. We found problems with that and I honestly think we maybe overreacted in how we came up with the definition somewhat per se. There are in electronics and system testing there's good breakpoints that you can look at and say, why do

these have to -- why would you read -- what would be the gain versus the dollar of redoing this test when the expected results are the same? Just to do it, to say, because it's part of a system.

But I think the problem goes bigger than that is, you know, we have to go back and, you know, I won't say share the blame but look at how these systems have been developed and matured over the years. The easiest process was everything came under a big umbrella and then you add that ton of components which made it really hard to say that Component A worked with Z. And I think the manufacturers are going to slowly go to streamlining that process so that they can make changes and it's going to take some work.

But with that, I think one of the problems we then -- and I've heard this before is with the de minimis changes and everything as it stands now, it's basically saying that, it's very finite. I mean we -- basically the way where we're saying now is, anything with software or firmware cannot be changed, you got to go back through all system testing. And I can't believe that there's not software changes -- I totally agreed the other day when I was at the last roundtable that there are some software changes out there that should be able to be changed without total system testing. I mean there's comment changes in a piece of code that, why would you go back and test the whole thing to change a comment? I mean it would make no sense. Yes, you have to change your revision number but then we get into the problem that says, when do all these revisions need to be wrapped and retested? You know, when do you have seventeen revisions and who's going to make that call that we haven't tested this as a whole system again.

And that's the problem with the industry. I mean that's not just the voting industry, I think that's electronics industry as a whole, is that nobody's got a good wrap on that when you modular test. And I think if we're going to go that route, which I think we can, we've just got to be careful when we say, when do you -- when is the requirement to bring it? Is it every year? Is it every two years? What's the life cycle before enough change is going to affect the total outcome.

DR. KING:

Okay, thank you. Brian?

MR. PHILLIPS:

I just have sort of a quick comment to make. Regardless of whether the changes are to the VVSG, minor revisions to it or changes to a system being proposed for certain recertification, I think the issue is establishing a baseline of trusted certified systems. So once we establish a baseline of trusted certified systems, because modifications to the VVSG or modifications to the systems really are affecting those, the process of recertifying those should be relatively minor. I mean a delta change to a system or delta change to the standards can be identified and the impact can be assessed to the actual system and then a series of tests could be designed to determine whether or not it meets the new standard or the new components meet the existing standard. So I think we're still trying to overcome the challenge of getting a baseline of trusted certified systems at this point.

DR. KING:

Okay. Tom?

MR. CADDY:

Yeah, I think the comments have been really good. I think it is mandatory for the program to be able to have this process in there somehow to where these kinds of changes can be readdressed and the trust can be established. I think it is done in other programs. I think it is difficult to draw the lines as to how much and where and when that will be done, so I think it is there. But I think it is necessary.

And as kind of a side to that, one of the things that I think is important and it's often there in questioning in the standard changing. I think that's also an important question with regard to the -- to even the interpretations of the guidance that comes down incrementally because the system goes back through and has some small change associated with it and if you do a delta change process, do you then have to go back and certify that it's compliant with all of the IG's since the last time it was reviewed. Because then that kind of throws in a whole other dimension but when you start doing that then it changes the implications of the testing by quite a bit if you pull all of these standards to all those interpretations.

DR. KING:

Thank you. Tom, I wanted to follow up with a question for both you and Gail because I think you said a similar thing in perhaps a different way. You said that the program needs to have the ability and I know you didn't say the standard.

MR. CADDY:

Right.

DR. KING:

And Gail, you talked about component testing, perhaps as a policy issue rather than a standard issue. Did I understand both of you correctly in that regard?

MR. CADDY:

Yeah, I think that in my case you did. I mean, it can be part of the standard in a sense but it can also be part of the way the program defines the way the standard is going to be used and the program operates. So I think that needs to be included but I think there's variance into how that would occur.

DR. KING:

Okay. I have an additional follow-up question that really goes back to some numbers that Steve brought up in terms of the best data that we have so far and the cost of testing systems under either the 2002 or the 2005 and the 2007 standard. But since the topic of our discussion today is the 2007 standard, the question that I have is, there appears to be a significant cost estimate difference between testing to the '05 and testing to the '07 standard. What is the source of that delta? What is the difference? And then the kind of the, so what question, what are we getting, what value are we getting for that difference? Is there bang for that buck? So Frank, you've already got your tent up.

MR. PADILLA:

No, and the numbers are really good. They are almost exactly the numbers I came up with when I was doing the survey so your -- I think you're pretty accurate on those. You know testing is always one of those things you got to look at what's the bang for the buck?

You know is there a reason? What -- I think we heard it at the last meetings is the state's have a limited amount of money to spend on these. If we design a Cadillac, I think it was used as a Rolls Royce and they can only afford a Volkswagen, what good did we do? They're still going to use the Volkswagen, nobody's going to the Rolls Royce.

Other issues I think drove up costs. I mean, we did the red team, definitely when you throw in those analysis that you've laid out what the people are, who they are, and the timeline, that's easy cost analysis. Any lab can do that and say to get these people.

One of the big implications I saw in the manual was, that I think even more so and I was going to bring it up in the next question, with limiting new manufacturers from coming in and the theory of how testing is going to do, is, there is a requirement in there that says the volume testing, that you have to test a minimum of 100 VEBD's for -- as part of the volume test. So that means right now if a manufacturer comes in we'll say they need to submit three to seven voting systems to the lab for testing. Looking at a VEBD, that number went up to about, with the red team testing, about 125 to 130 systems to the lab for testing. Who's going to have 130 systems, before they can sell any, that they can give to a test lab for a year? If you look at the tabulators, it was 50. And you throw those numbers into today's numbers, not only does that amount the manufacturer's got to provide the test labs, but then the test labs you can take space. I mean, how many people have a test lab that can hold a 100 VEBD's running through testing, the power requirements, the testing requirements. I know we're trying to get

through with some of the state stuff by putting them in the standard but we've added a lot of tests in the standard, that, what is the bang for the buck by doing 100 versus 10? Is that test -- should it be in the standard. You know, the time frame for the red team analysis to put X dollar time frame.

The usability testing is another one we're going to get to and that's the same thing is, till we define it a little more -- we went to really good usability conference that NIST hosted last summer. It was very interesting and listening to the perspective of the people that wrote the usability standard. I can't remember the doctor's name but -- and the cost to do that new portion of testing by the labs, there's where your new cost comes from. The gain, that's going to have to be determined by the states and the EAC. Is there a gain for doing all this testing? I mean where almost every vote has to count, we all know that and we all live by that. But how much is over testing? How -- I mean that's been brought up by Mark. When can you test the -- you just got to draw the line and say there is no more gain.

DR. KING:

Okay. Gail?

MS. AUDETTE:

When you look at the cost of testing, there's also the cost of the setup. All the labs are going to have to go through the recertification to this new manual. And the requirements document as written is going to be very difficult to get accredited to. A lot of the issues that we've brought up today with the ambiguous requirements, as well as, you know if I had to today write my



procedures and processes for John to come and audit me to get certified, that is a very large cost that is being born solely by the labs and that cost also gets floated down to the manufacturers.

There's also the training issue. This is a 600 page document and anyone who comes in to test is going to need to be trained on this document. It would be wonderful if the EAC would run classes or if there was an organization that would run an introductory to the VVSG, not just for the labs but for the manufacturers and for the states and for the county clerks because the concepts within this document, as well as, the large number of new requirements and modified requirements is going to take a lot of getting used to. And that's going to put an upfront cost even before any manufacturer can come in the door, the labs are going to have to do an incredible amount of work to prepare for that first system to walk through the door.

At the manufacturing conference -- or roundtable, the discussion was of course how many manufacturers would be around at the conclusion of the 2007 implementation. I think that same question is, how many labs would be around. The upfront cost to remain in this business would at least triple and that of course then can only be recovered if you were fortunate enough to have a manufacturer come to you, but unfortunately that cost does go to the manufacturer.

DR. KING:

Okay. Mark?

MR. SKALL:

Every requirement in any standard has to be tested. If it's not tested, it's a meaningless requirement and we've all wasted our time. So the increased cost of testing for this new iteration of the VVSG is because we have much more comprehensive requirements, security, dramatic improvement over 2005, usability testing as well.

The second question you asked, Merle was, what's -- what are the benefits? Can you measure the benefits? The benefits of testing equal the benefits of having those new requirements and ensuring that those new requirements are met. So it's not really the benefits of testing, it's the benefits of having those new requirements. If you have those new requirements they must be tested.

And we have, you know, a lot of studies about some of the usability issues. So many problems in voting that have to do with usability. We, of course, have had heard many stories about the security issues and these are requirements that their intent is to address those problems and if you're going to do that, you have to incur the cost of testing to see those requirements are met.

DR. KING:

Thank you. Frank, I'll let you have the last word.

MR. PADILLA:

And I agree with that, you know, and that goes back to then, we need to re-look at the requirements. Right, the labs have to test to the requirements. But if we're building a program here and we're looking into our crystal ball and I don't want to see that, but we're only going to have, all the manufacturers aren't going to be around.

Well if there's not enough manufacturers and the cost goes up, you can almost guarantee all of the labs aren't going to be around because they rely on the manufacturers for their business. The states can't afford the voting machine. What vicious cycle are we putting ourselves in? I used the, you know, the analogy earlier, but I mean, there's enough states out there, I don't know what the study would be or the numbers but I'm sure the EAC does, how many states out there today are using systems that aren't even certified to any current standard because they can't afford to change them? They don't want to change them. They still work right and if we make this program, that now that voting system, I mean bottom line, the taxpayers are going to pay this dollar unless the Federal Government and Congress steps in. If we make these so expensive for them to do, where are we going there?

I mean I used the analogy from the manual of the 100 voting, you know, sitting for the volume test. I worked with my boss and he did an analogy that for stuff we've tested at Wyle for NASA and we've tested two and it's up on the space shuttle. I mean they only sent two samples and both had to make it through the testing, okay? And it's on the shuttle right now. I mean they felt confident enough. Somebody did the threat analysis and the business case analysis. Yes, could they have done a thousand samples and their probability of success would have been higher, but they had to do the money versus gain route in there and I don't think that study has been done either.

DR. KING:

Okay. Brian, I think you wanted to comment?

MR. PHILLIPS:

Yeah, just real quick. And I think Frank hit on it pretty well, but let's just bring it out in the open. Everybody wants improved standards, improved testing, improved systems. The only way that that's going to happen is, as Frank noted, is by someone, somewhere at the federal legislative level or at the state legislative level bringing more money into this process. It's going to be more expensive. I don't think anybody around this table would disagree with that. Funding is going to have to come from somewhere for the program to continue. It cannot continue without a source of funding. And that's the bottom line. I don't -- would anybody disagree with that? Mark?

MR. SKALL:

No, no, I was just going to say I felt the EAC was independently wealthy and that would be the solution but apparently not.

MR. PHILLIPS:

We're just use the money from NIST.

DR. KING:

Okay. Well I think this is a good time, Matt, to go on to Question #5. At the very beginning of today's session, Brian talked about the next roundtable discussion at Gallaudet which will really look at in deeper detail at usability and accessibility. But the question before this group is, what are the implications of the proposed usability benchmarks to use a Voting System Lab? What are the current capabilities to test using human subjects?

And I think Gail made a reference to this, that every organization builds its human capital and you build it for current and

future applications and one of the concerns that we've heard expressed is, is this particular requirement one in which it is easy to construct the test? Is it easy to find the expertise in this field? And so I'll throw this question out to the panel for discussion.

MR. PADILLA:

Sure.

DR. KING:

Frank?

MR. PADILLA:

Like I said, it was very interesting with this question and I go back to the usability workshop I went to at NIST and sat on this. And I went back and did some research because of the manual to see if -- one, I didn't like pushing the I believe button, but is it true? Your point is, are there people out there to do this type of testing? Very limited, I was very shocked. They made that a clear point, that there aren't a ton of people out there compared to, I'll say electrical engineers, you know, that do usability testing.

So with that said and we look at the -- what percentage of the test and the business case model that all the labs have to look at, what percentage of this is our testing for a year of testing? So if we say usability testing is a three or four week test, basically we have to go out and find people that are full-time employees under the NIST Program or NVLAP Program or subcontractors but not a separate agency to do these tests for us. And I don't think we can keep them employed to just say I only need to use you for a month but I'm not going to pay you for the other eleven but you got to work for me. And that would be, that's going to be a challenge. We're

going to have to find other work. There is a -- there are quite a few companies that specialize in this testing but under our current program guidelines, we can't go to that company and sub to them and say, you are the usability expert, we would like you to conduct the usability test, we'll oversee it. That's not legal under this -- the program.

So I think that same answer, we need to go back and look at, is it a programmatic issue? And I think it is. What are the core requirements? What are the non-core requirements? How -- who breaks them out? I think we had that discussion earlier. Is that NIST defines them, what those are? Is it the EAC's defining what those are? Is it NVLAP defining what those are? Because that by definition is what our labs have to test to and what we can outsource and what we can't outsource. And I think this is -- it goes back to the red team vulnerability and this one. We really need to look at that document.

DR. KING:

Okay, thank you. Brian?

MR. PHILLIPS:

Well I wanted to echo what Frank said, that it's the challenge of having the testing, the human subjects, as well as, other human factors and engineers when you don't need them but a fraction of the time throughout the year. And that that needs to be looked at from a programmatic model. There are organizations that, in Colorado for instance, that we have used in the past for some of our 508 -- Section 508 testing and other ADA types of testing that we've done for organizations and that's been very helpful, but

we've been able to contract those people in on a limited basis under that program. So we don't -- there are ways to do that. I mean you just contract in on a limited basis. And again, not being a separate agency but there are organizations out there that could be of great benefit to the VSTL's in a situation such as this.

I looked at the usability benchmarks and struggled with, what are the numbers that we're talking about. How many do we need to have? How many data points do we need to gather on everything? And it also talks about your gathering this information throughout the whole test campaign which is anywhere from, you know, say six months to a year or more. So that needs to be, I believe, tightened up because that's an impact on our test methods and what we're going to be doing throughout the whole test campaign regarding usability benchmarks.

But going back to the human subjects, whether they're let's say disabled or non-disabled voters and the numbers of them, you know, they're -- we just have to work with the EAC to figure out a way to make it financially viable for a lab to be able to have those types of people available to us to do the testing.

DR. KING:

Okay. I think I heard again the term program guidelines, that perhaps related to component testing and the use of subs here may be a programmatic issue as opposed to a standard issue.

MR. PADILLA:

Well if I can -- yeah, the biggest change I saw in the VVSG iteration over the last ones, they took the onus from the manufacturers and

gave it to the VSTL's to do this type of testing. And, you know, with that said, you know, when you -- what is the sample rate? What is -- the manual didn't go into that really good. You know, what is, you know, once again I hate to dwell on definitions because as the testing lab we like to. What is handicapped?

You know, I sat in the usability conference and I really hope to go to the next one is, wow, that's a definition I wouldn't even try to define in today's world because, you know, what is blind? What is legally blind? What is -- you know, and somebody's already done these studies and they're out there and somebody's going to have to commission these studies and say this is the percentage of the populace and this is where you get them. And if we don't look at it as a countrywide populace and then we go to the labs and I'll say the downside of going to the labs for this type testing is, you know, we're in Alabama so we're going to get -- we're not going to get a good representative of America in Alabama. We'll get a representation but I don't think you could choose your source just from Alabama. I think you would have to go everywhere.

And I can say that from every lab, the ones in Colorado, the ones in California. This is going to have to be a little bit bigger scale than that and say, because of the language issues, because of the other issues that are in there. And I don't think we discussed it enough in the manual to even go there but I think it can, once that's done looking at the program side between this and NVLAP and the EAC how to do it best, is going to be a programmatic issue.

DR. KING:



All right, Matt, could we bring up Question #6? At each of the roundtable discussions, I think we've closed out with the same question and this is really a great opportunity to be specific and the question, are there any changes to the draft VVSG in either scope or depth, which would significantly reduce cost and time of compliance without adversely affecting the integrity of the VVSG or more importantly the systems that are derived from its implementation? Brian?

MR. PHILLIPS:

Initially, here I just want to go back to my concept of independent verification and validation throughout the life cycle of development. You know, what we're looking at with our certification testing that might be in this world, it might be different than other areas, is the amount of time it takes to get through. Not to mention cost of course, but the amount of time it actually takes to get through it. And it's at the very end of development of the system.

I think that it would be good for the EAC to look at, when the VSTL's get involved with the manufacturer's product development or upgrade or enhancement process and how that can be moved forward in the life cycle to reduce the number of problems or discrepancies encountered during certification testing at the very end. That doesn't -- and I'm not suggesting that you eliminate a final certification test, but perhaps that, you know, that's a limited test or sort of a final check but you can eliminate problems earlier in the cycle, it saves everyone cost and time, and still maintain independence throughout. So I would just suggest that that is one possible area of improvement.

DR. KING:

Okay. So the timing, in other words, to reduce the cost to correct and other issues related with errors introduced in the system. Gail?

MS. AUDETTE:

My background also is IVNV from the full perspective of IEEE 1012. And it does bring the test lab as a complete independent entity at the start of the process and allow for testing requirements analysis, review of unit testing in conjunction. And we had some of these same discussions when we were doing IVNV because every test process reaches a point where you say, are we done yet and how do we know if we're done? And the natural progression is to say we're not done until everything's been found, but of course you're not going to find everything. So, when you argue against excessive testing, you seem to be arguing against quality. When, in fact, you're arguing that finding defects sooner in the process and taking them out before they become actual defective parts within the full component, gives you a better quality product at the end.

Having said that, to answer, to actually answer the question is there anything in the VVSG and scope or depth which would significantly reduce the cost and time? Right now, in Part 1, Section 6.4, the workmanship requirements, it's still forcing a manual source code review. That has been a very time consuming effort for all of the certification. Now, there are issues that are covered during source code reviews, during manual source code reviews, but again, the cost of finding those issues is questionable. This is a very long poll in the certification effort. This is a very timely, time consuming task.

It also, with the requirements, it doesn't allow us to get rid of that dead code, to go to the depth of inherent structure, to really do the best practices that are out there in industry. There's ten metrics that industry uses to assess a good code and this requirements document does not allow us to even pull those in. And forcing a manual review, even if we are allowed to use automated tools, we don't have the hammer to fix some of those maintainability, testability issues within the code, but we do spend, we are forced to spend a large amount of time looking for that set of requirements. And because it's in the conformance clause, if there is not a comment at that point, that's a fail. That's just as bad as if the system shocks a voter when they walk right up to it.

So I believe that would be one way to reduce the cost, but also potentially increase the benefit of that.

DR. KING:

Okay. Steve and then Frank, but first Gail, I wanted to follow up on something you said, and correct me if I didn't paraphrase it correctly here. The VVSG does not let us utilize some industry best practices. Could you give an example of what -- of a practice that would be advantageous to incorporate into the process but it's prohibited by the VVSG?

MS. AUDETTE:

Okay. My favorite is the requirement that modules do not exceed 240 lines in length of code. That requirement is a carry-forward from, when people were developing on the screens that were black in nature. What industry uses is cyclomatic complexity. Cyclomatic complexity tells you how many conversations or paths there are

through the code. And that tells you how maintainable the code is going to be. How testable the code is going to be. And it does not relate, though, to number of lines of code. You can have a cyclomatic complexity of a 160 lines of code and you can have a cyclomatic complexity of one in 250 lines of code. So that requirement does not drive the system to meet the industry best practices, which is anywhere academic states that it should be ten or less. So if you have a module there's only ten paths through that, whereas in practice businesses, manufacturing companies, are typically between 20 and 30 in cyclomatic complexity. Something like that the automated tools will calculate your cyclomatic complexity and they will tell you what modules are so complex that one, the unit testing probably could not have hit every path. And two, how difficult is this code going to be to maintain?

DR. KING:

Okay, thank you. Steve and then Frank.

MR. BERGER:

Well several comments. First of all, we have a testing process that's highly labor intensive and that's a key component of the cost. Automation is one way to get down cost. And a way you'd further reduce that, is to share the cost of developing the automation tools. Over and over again, you can increase the thoroughness of your testing, decrease your test cost often by as much as 80 to 90 percent by automating testing. I've talked about...

DR. KING:

Can I just real quickly follow up?

MR. BERGER:

Yes.

DR. KING:

Is that a program issue or a standards issue?

MR. BERGER:

Probably both. On the standards side, the specs need to be written to support automated testing at selected points so I'll talk a little bit more. But then on the programmatic side, is there a way that we can let the lab share the cost of developing those tools and then jointly use them which brings down the total cost to vendors and to those who buy the systems.

MR. SKALL:

Could I ask a point of clarification as well?

MR. BERGER:

Yes.

MR. SKALL:

You're talking about automating the generation of tests or automating how the labs conduct the testing given the fact they already have the test sweeps or the test tools?

MR. BERGER:

I'm talking about automating how the tests are conducted.

MR. SKALL:

The tests are conducted, not generated, okay.

MR. BERGER:

Right, although that might be a point for exploration as well. In some cases, there's research that's needed and right now it looks like that research is on the individual labs. For example, I'll ask the question, why should I believe that if there's a flaw, the test the labs

are going to run will find it? Ideally what we'd like is, a study of the range of elections as typically confronted face to voting system and then to study that and identify some smaller number or corner cases. You know, if a system can pass these six elections, you can believe it's going to stand up to the normal range of elections it's going to be asked to run. If that bit of research could be done jointly or funded through the EAC or some other mechanism, all the labs could then say, okay, now we have a minimum set. We're going to run these four elections on all systems. We might do more because of a particular worry about a system, but we have a pretty good confidence that this set of elections will ring out a fault if it's there. So the opportunity for shared costs.

We also, I think, miss major opportunities by setting up inappropriate dichotomies. A lot of benefit could be coming from hybrid testing. For example, I frankly think we're missing major benefit from a source code review and it's been said that's a major component cost. Over and over again there appear to be benefits that could come from source code review that would then direct the downstream testing so you would hybridize, what do you see in the source code and then you, for the functional testing, say, make sure you do this, this, and this, to force data through these paths to make sure they hold up, those sorts of things. Information, like, what modules will legitimately write data files so that in the functional testing it can be monitored and validated, that nothing but the source code reviewed valid modules are writing data to the critical data files in the election.

Another hybrid that I think could be explored much more beneficially is, that between module testing and system testing. Right now we tend to do one or the other, but I think there's blends of which we could get major benefit.

So those would be my comments at this point.

DR. KING:

Okay, good. Frank and then Brian.

MR. PADILLA:

One, are there changes? And this is a tricky subject if you just look at how the question was written. That said, reduce the -- without adversely affecting the integrity, but once again, what's the integrity? What are we looking at? If we lower the amount of tests are we lowering the quality of testing, the amount we're recovering? We discussed that. And, you know, here's the lab saying that, are we doing too much testing which people should look at as a weird analogy because more testing for us means more money. I mean, now we're telling you that maybe we are doing too much testing so, you know, it's a weird analogy coming from a lab that we're telling you this.

But with that said, you know, go back to the 100, you know, the volume testing. I think we need to look at that. I think we need to look at the requirements of how many systems a manufacturer is going to have to come in with for testing. I don't see any -- I don't see a new vendor willing to play based on what I heard, you know, a manufacturer the other day saying if I told them they had to start with 150 systems coming to the lab with, the capital expense of doing that, I don't see that we'd have anybody jumping up at the

table, especially with the new -- if we can throw an innovation class in there. Who's got 150 innovative systems to give a lab? You're going to have one, maybe two. You know, it's just not going to be there. Nobody's got that kind of backing until you sell it.

One of the other things that I saw in the manual that really I think is going to help drive up costs in small increments but it's going to end up being large is, there was a big section on COTS on -- and I haven't heard it addressed before but it was addressed that, from now on the labs have to buy all the COTTs material off the shelf instead of getting it from the manufacturers. And do I mind that? No, I think there's merit to that, possibly. But me going out and buying a Dell laptop, I cannot get the kind of deal that a manufacturer can if he goes out and gets it because he's buying a thousand of them. As long as I verify I'm getting the same Dell laptop, who matters who buys it? Windows, if he gives me a sealed box, that, why do I need to go purchase it with my one-on-one power? That's going to drive up testing costs a lot. It's going to -- the time to go out and purchase the supplies, add on getting them, no benefit because we're a major buyer of these products because we're going to use them once and we can't use them again. And I think that, it might be a little area in the big scheme but it's going to be a big area and it's a new requirement that's out there that hasn't been talked about much and it's going to have a major impact on people.

As far as testing with, from the beginning to the end with the manufacturers, I understand the EAC's and the public's perception that that's, you know, that the labs maybe are getting too close with



the manufacturers by doing that and I understand the background and there's programs that do it both ways.

I mean, Wyle does a lot of varied testing. There's programs you work with the manufacturer and the one that comes in is Sample 1. I mean, usually, I would say about 80 percent of your testing worldwide, you test Serial #1, unless it blew up and then you get Serial #2. But you usually aren't getting Serial #1000 or 100, you know, because they haven't produced those yet. Till it gets through the certification process, they're not going to make a thousand of them or a hundred of them because they're going to have to go back and fix them.

And I think our terminology is, these must be mature manufactured systems before they ever get the certification, is I think, what Brian and them were getting at. How can we say that? And who's going to do that kind of investment to say I'm going to pre-make a thousand of them or X number to say -- and then they don't even know if they're going to make it through certification. And really at risk is that one with the OEVT testing, you would never know. I mean, in what would be a pass, what would be a fail. I mean I don't know who could develop the system. And I think that would just drive the cost enormously.

DR. KING:

Okay, thank you. Brian and then Dawn.

MR. PHILLIPS:

I want to address the suggestion Steve made about automated testing. Steve was talking about how automated testing could

reduce the time and cost potentially and of course the investment in automated testing might be able to be shared across the labs.

Let's understand where the benefit of automated testing comes in. If a manufacturer comes to our company for the first time and we're asked to certify their system, if I were to develop automated tests for conducting the tests, it would most likely cost three to seven times more than would be if I were just doing it all manually.

Automated testing, given the tools we have today and the techniques is a development effort in and of itself. So you have, with automated tests you have testing of the automated tests you have to go through. In automated tests, the benefits come from downstream testing efforts. Once you've completed your automated test sweep development, you've certified the product, the next time that product comes in for certification is where your benefit will come from. I don't have to rerun my manual tests. Now I can rerun all my automated tests against the manufacturer's product, its progression testing on through. I can maybe get 80 to 90 percent of all the tests done and look at the other 10 to 20 percent manually and create an automated test for that. Of course that assumes the manufacturer is going to come back for a second certification to our lab or that maybe be coming back for a second certification or updated certification at all.

But to look at automated testing as a means to shorten the time frame and reduce the cost on initial certifications, that will not happen and actually be significantly more and you have to look at the number of iterations later on before you start to even realize a

simple payback. And that is based on the 27 years I've been in software testing.

DR. KING:

Um-hum, okay, thank you. Dawn?

MR. MEHLHAFF:

I think my question is more for the labs. One thing that we talked about internally and I'm sure Brian has shared it with you is trying to come up with a sample test plan, a sample test report, test methods, those things to kind of cut down on this back and forth that's going on when you submit something and, you know.

Anyway just to give you a framework, do you, I guess I'm just curious to know what is your opinion on where that's a better tool? Is that in the standards or is that just an EAC Program product if you have feedback on that, I don't know? Because I mean that's something that I think is critical that we have. We need to have that template and we need to have a standard so we're all playing by the same rules. Okay, everyone has an opinion.

So anyway, just I mean briefly what -- where do you guys see that from your opinion as to being the best use of that?

DR. KING:

Tom?

MR. CADDY:

They sound like they want to impress Dawn, I had something to address earlier, so why don't you let him go first.

DR. KING:

Okay. That's great. And I don't remember the order but I'll start with Brian.

MR. PHILLIPS:

Well one of the things I think that came up from what I heard. I wasn't in the sessions yesterday but we agree. Let's -- we need to get a test plan, test report, overall testing methods and everything standardized across the board. And we all may feel that we're trying to saddle a galloping horse to some extent.

And what I'd like to see happen is, we sit down with you and your colleagues and the EAC and let's all get -- I mean the labs, we all get together and just establish that based on the current standards that we have. We're all sharp enough to come up with what kind of test plan, what you're looking for, the test report.

We had talked about this with Brian and his staff before the February 2007 time frame. I think it was too early at that point in time and I don't think it ever really gained any recognition after the fact, so, that's the kind of thing I think would be extremely helpful. It doesn't have to be a huge public roundtable but it can be a great roll up the sleeves working session for the four labs, five labs, and the four reviewers and the EAC to do. That will actually then set expectations for everyone evenly across the board and we can leave those meetings with a template if you will or the basic or at least a current approach and then of course in the 2007 do similar things as those get adopted.

MR. MEHLHAFF:

So we're using it more as just an EAC program tool versus -- okay.

MR. PHILLIPS:

Yeah, yeah, I mean it's -- we are writing our test plans to ensure that we're certifying, we're testing and certifying that -- testing the

product to the standards. And the test plans are being reviewed by the EAC and the reviewers. And as we've all discussed earlier, we have interpretations of what the test method should be, how detailed it should be, what the requirements might mean in certain cases and so forth, and it would be great for all of us to sit down and share our ideas and thoughts about what those are, so that when we come away from it, now you've got a consistent plan, report style or report format of what's supposed to be in the report, test cases, methods, et cetera.

MR. MEHLHAFF:

And I'm assuming you would all agree that would cut down the time frame and the cost?

MS. AUDETTE:

It would. I would like to add a conformance matrix to that, if we could, which would be included in the reports and if it was standardized across all three labs it would help immensely.

DR. KING:

Okay, Frank?

MR. PADILLA:

I'll try to keep it short.

DR. KING:

Thank you.

MR. PADILLA:

We did have this discussion yesterday and that hopefully, we'll get somewhere. It's sort of out of the contents of where we are. I know it will help. I mean, I challenged everybody here as we did that as a voluntary thing about five years ago, six years ago where the, you

know, the three labs at the time got together and wrote a matrix and said, we all agree to use this and we submitted to NASED.

The issue, I guess, the labs have been working on in their programmatic with this, you know, and it goes with the cost. I think if we have good test sweeps the cost will go down. The problem is in today's world, we don't have any of that, zero. There are no test sweeps that have come from this. There are no test sweeps that have come from NVLAP. I don't know what the working process is.

I've made the recommendation numerous times, you get the labs together, we'll write them ourselves so that we can help guarantee the product, but is that the right answer? Should NIST be at the table? Should NVLAP be at the table? Should they be doing this already? I don't know the answer to those questions but with that, it's already in the manual. I mean the test plan is in the manual, all that. So is it right in the manual? I don't see a problem. It shouldn't be drilled down. It should be the outlined form and in my opinion let the EAC -- but that way, you don't want to not put how you're going to do a test report or your expectations of what that report should be in the manual sometimes or once again, what's that manual -- what you're looking for as reporting criteria out of that manual, you know, and you might get away from that.

A little quick on the test sweeps and stuff. I did agree that, you know, there are certain situations with programs and software out there and I look at source code review as a good one that, you know, shared costs, shared things like, the best source code programs out there for security and all are \$100,000 to \$200,000 a

copy and a 30 year, \$30,000 to \$40,000 annual renewal cost. How are you going to use tools like that that are rated as the best in the industry and make a vendor pay for it or a manufacturer pay for it unless your business case said, you can use this tool across a variety or there was a way that you could get these tools that are industry standard.

I mean there was one company, I won't mention any company's names that just gave their tools to all the states, free, pro bono to do security and code review and said that this will find bugs in code, use it. And -- now if the labs aren't using that and the states are and the manufacturer's aren't using it to develop, I mean it was smart ploy of theirs. They're going to find bugs that nobody else has used but they know that that's what their software costs and they're not willing to make big price breaks, you know. They did the reverse end-around and probably good business logic on their part.

DR. KING:

Good. Tom?

MR. CADDY:

Yeah, I was going to just kind of emphasize the thread that Gail started and was brought up a couple times, but I do think that it is important to emphasize how early the process starts with the labs, between the labs and the vendors or between the expert source and the vendors on being able to start this, because, in most programs it's well known that you're going to have much better quality in your products if you can design it in from the start and anytime you're doing repairs or fixes, there's almost always

unintended consequences. And by not having involvement and the kind of testing that the labs are doing here until the product is completed, it mandates that all fixes are repairs. And that's by definition going to be a much less trustable product than designing in and implementing those fixes as part of the core architecture of the products.

DR. KING:

Okay, thank you. Steve, the last word and briefly, you're standing between us and lunch.

MR. BERGER:

I wanted to just pick up on what Brian said about automation. First of all, I completely agree. Automation raises the cost on the first test. You get the benefit over if you have volume.

I wanted to highlight an implicit opportunity of what you said. After national certification, we go to state certification. I've never been involved in one of those that something wasn't found. They say to the vendor we'd like you to change this. Sometimes those are very important findings. If we had better automation as you pointed out, we might be able to enhance that cycle so that anything found in state certification, any desires from the states that could be modified quickly and brought back in and go out with the final fully certified version.

DR. KING:

Very good. Well thank you all. We have accomplished our first goal which is to address the six questions that were the first part of our program. We're going to take a break for lunch and when we come back from lunch, they'll be an opportunity for each member of



the panel to make a closing statement. And in that statement, what we're really hoping for, if there's a handful of issues that you think really need to be addressed and reinforced from earlier discussions or something that was not completely addressed in an earlier discussion that will be your opportunity to do so. And I will be a timekeeper in that part of the program, so we're allocating about five minutes for each person and I will be guiding you through the ticks of the clock on that.

So and one word about security in this room, I don't think we can lock this room so if you have valuables with you, please consider taking them with you for lunch and we will meet back here at 1:00. Thank you.

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[Luncheon recess from 12:10 p.m. until 1:14 p.m.]

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DR. KING:

And welcome back from lunch. We are going to do our best to stay on schedule. And as I said before lunch, this is an opportunity now for each member of the panel to make some summarizing statements about the draft of the VVSG from their perspective, either as a VSTL or NIST or EAC certifier, I'm sorry, reviewer. And I'd like to hold the comments to five minutes and if you start to get close to the finish line, I'm going to hold up a one minute signal and that will be the sign to kind of look for a soft landing on wherever you're headed with your comments. As always, we let the EAC have the last word and so Brian will close up the comments today.

And so what I'd like to do is to begin with Steve and then we'll just work our way around the table and with that, Steve.

MR. BERGER:

All right, thank you, Merle. I'm the closest so you can really use the hook on me. Well I thank you for the opportunity. I've really enjoyed this chance to be on this roundtable.

In closing, I would say I think it's abundantly clear. The path to the future is not an extension of the past. We've got to do things a different way. We can't just add requirements and add tests and get where we want to be.

Let me also say this is, in my experience a normal stage of developing a regulatory standard. We could not have gotten here without the hard work, dedication, and expertise of particularly NIST and the NIST staff who have put so much into this document. I think what needs to happen next is for the document to be looked at from very different viewpoints. Particularly, the viewpoints of those who have to use it and implement it in other processes, the VSTL's and their testing processes and NVLAP and lab assessment, state certifiers and local election administrators, to make sure that we deliver to them the full benefit that this process could deliver.

Personally, I think model driven architecture has a lot to offer. There's a lot to learn from other industry sectors that have gone that way. And I think where we would start, and this is also a well traveled path is what -- with a very thorough failure modes, effects analysis, making sure we know where -- what failures both security and accuracy reliability would do the most damage and

make sure we put the greatest emphasis on making sure they cannot happen and if they do happen, they are remedied before the full effect as experienced by the system. In the security area, that's called a risk assessment. We absolutely need one. We need one that's a consensus and shared among all parties. And so those would be the directions I would advise.

DR. KING:

Okay, thank you, Steve. Frank?

MR. PADILLA:

I'll echo some of those remarks. One, I thank the EAC for giving me the opportunity to represent Wyle here today. Merle, great job. I think it's a great opportunity to hear everybody's viewpoints and listen to what the other ones have. This is the third one I've been to and I learn something new every time I attend one of these and hopefully that goes through.

With the new standard, I'm hoping what I heard just then was the right that, you know, we had a year on the standard. That this is where a standard in development should be at this point, yes, if we look at it that way and we're not saying this thing is going to be published in the next year. I totally agree with that. It's at the right point of the infancy stage. I don't think it's anywhere close to being done and we need to remember that.

Some key points I want to bring back up that I think we maybe didn't spend a lot of time on. Innovation class, I think we need to be really careful how we word that in the standard or if even it needs to be in the standard based on the performance if we use performance testing. We use modular testing. Could it be an

addendum to the standard. But I think we need to very -- put care in there because it's not really -- it basically is a clean slate and no way to test it. And I think there are some objectives behind how it's written now that it's pointing to a certain innovation which then means it's not innovative.

OEVT once again, I really think we need to look at where that belongs in the standard, does it belong in the standard. Does it belong in the standard? Does it belong in the subset of standards? Who should test it? And that really needs to be a concentration point of where this goes.

Cost, I think an analysis and I mean, I applaud the EAC on the risk case analysis. I've heard it before. I think there needs to be a cost benefit analysis. You know, it's hard to say, you know, that we added 200 more tests. Does that mean we're doing a better job? If you use that analogy, of course we're doing a better job,. we added 200 more tests. Are all those tests needed to that extent to get a product or are we just adding 200 more tests? I don't know if anybody's ever done that analysis and it would be a good analysis to see done and what that would get. What the bang for the buck would be.

And NIST/NVLAP today, I put that on my note. It's great to hear their working on test cases for this standard for the next iteration but if the standards of the innovation, you know, right now we're looking at, can this stuff even go? What are we doing for today? What are we doing for the 2005, 2002 standards that are out there today for test cases? I challenged the EAC yesterday, talking to them and NIST today, is what can we do today? Where

can -- and that was brought up when the labs came together. You know where are we in today's testing? How can NIST and NVLAP get together and come up with test sweeps and things like that today? This is the today, the real world. The standards five years down the road, three years down the road. We don't have anything today.

Programmatical versus standards, I think, is the other big issue that came up, where should it be? I think that needs to be careful because I think the standard needs a way to grow. I think a discussion I had yesterday that was very interesting with Matt was how it limits, what a change to the standard is. Most standards allow you to make revisions. There's a revision way that you can add revisions without rewriting the whole standard. There's update ways you can do and we were trying to find a way to look at that. How can you revise a standard without rewriting the whole standard and making it a two or three year process if something new comes about and I think we need to look at that very heavy. And I don't know whether that's something that's got to go back to Congress or what, but this has to be a living document. It can't be every two years and we'll write a new standard because then the target changes. And that goes with the program manuals. These need to be living, changing, adapting, and how we're going to adapt those.

And once again, thank you.

DR. KING:

Thank you. Brian?

MR. PHILLIPS:

Well I want to thank the EAC for giving -- allowing us to discuss the VVSG and allow NIST test labs to be here for that.

First, I echo everything that Frank just said. I agree with all the items you -- so I'm not going to repeat what he said, just understand that I do say ditto.

I do want to point out that, in order for a test lab to be effective in a program such as this, we have to have clear standards, both from the requirements what the manufacturers have to build, as far as requirements for what the test lab needs to do in order to test to show compliance and to certify a product. I think the VVSG was an incredible effort by the TGDC and, you know, there are some clear improvements over previous, but I think there are still some areas that need to be improved. As I mentioned, we also have quite a list of items that we will be submitting very shortly to the EAC for -- or the TGDC for consideration. I didn't want to get into those here today. And all of those are really to help clarify the questions answered on what we believe are ambiguous or fuzzy or poorly defined, perhaps, requirements of test methods.

I want to go back to the concept of how long it takes to get a product through testing and certification and point out that I think the -- this is more of a programmatic change but perhaps getting the test labs involved far earlier in the life cycle whether it's complete redesign and development of the loading system or a component. Get it involved earlier. The model for IVNV has been out there for years and there are methods and techniques to ensure independence throughout the process and I would encourage the

EAC to look at that and perhaps consider adopting that type of approach that will help with a number of the more lengthy time frame type of issues.

And Dawn, I want to thank your for asking that and I know these people gave you grief and I want to thank you for asking the last question. I think as Frank said, the here and now, we need to - - this hasn't to do with the new VVSG that will help, I believe with the new VVSG or whatever new standards come out, if we could establish a consistent set of test plans, test methods, and so forth for the current set of standards, much of those can be given to the NIST organization and certainly welcome their involvement but much could be given to NIST to help to develop the new set of test methods for the new standards.

DR. KING:

Okay, thank you, Brian. Gail?

MS. AUDETTE:

Yes, thank you. Thank you to the EAC for holding this roundtable. I have learned a bunch today and I really appreciate it. And thank you so much also for extending the comment period on the VVSG. That aids us quite a bit too. When going through a 600 page document, it's very difficult to get all your comments the first or even the second time through, so the third time through I'm sure I'll see things that I didn't see the first two times through.

I wanted to discuss a couple of things. I'm so glad Stephen said that this is where we should be at this time. I have not been through a requirements documentation effort like this. And I have been in software testing for seventeen years and I think we're also

at the same place from understanding test labs in its infancy. Every client I get always asks me to find the big bugs first and let's use automation to make it cheaper and faster and go ahead and look through 3 million lines of code so you know where to focus your functional test effort. I think we're all starting to learn about each other's processes.

From the VVSG, the design requirements, and I'm learning that in some cases there may need to be design requirements, but I would like to caution that those design requirements are documented well as to why they cannot be functional and what those design requirements are. The design requirements will stifle innovation, but they will also have a secondary effect on the manufacturers and the test labs. As we look forward and new technologies are emerging, not just that can be applied to the voting systems but also in the development realm, I'm thinking mainly of something like AGILE , the AGILE development process. IBM has bought Rational, AGILE is really going mainstream. Would design requirements, AGILE cannot be applied to this so you are putting the manufacturers, as well as the labs, in a position where we cannot pull from industry best and we cannot pull from the labor pool out there.

Also, the cost benefits of OEVT, I think is something that needs to be considered. I think the question is, OEVT in or out of the standards, should more focus on should it be driven by the cost benefit? And the threat model being developed by the EAC is excellent, that's going to help with that analysis. I also -- somebody had mentioned intro disciplinary teams and that was in my paper to



potentially get us to the consistency of having the same red team on every single federal certification, having the labs all work together.

And finally, I've worked in the IVNV realm successfully for seven of those seventeen years and the principles of IVNV do allow the test lab a completely independent organization to do the testing while the development is going on, to be part of the development process but independent. The IVNV does not take the place of the manufacturer's stringent testing. It is a second independent verification and validation effort as defined by the IEEE-1012 and that process may be, because it is so mature, a way to apply the standards to the next generation of voting systems. Thank you.

DR. KING:

Okay, thank you, Gail. Tom?

MR. CADDY:

Sure. I'd like to thank the EAC also and to everybody on this roundtable. I think it's been a very good discussion and has been very enlightening. I think that the EAC did a great job of putting the six questions talked about in discussion and viewed they were core questions that got to the essence of the cost effectiveness and the thoroughness of issues that are driving a lot of the real questions about how viable this is as a future standard.

I concur with Steve that I think that the standards in a fairly typical place much where I would expect it at this point. I think that it will require a different mindset to be able to consolidate the views and comments and move forward to arrive at the real standard in a timely fashion. So I think there is a lot of hard work in maybe a little

bit of a process that's ahead of us to get to where we optimize it for cost effectiveness or thoroughness or testability, all of those factors that we all really want. Thank you.

DR. KING:

Okay, thank you. John?

MR. CRICKENBERGER:

I'd like to clarify, probably, some things about NVLAP's involvement in the VVSG. What we do and I think I've heard some things is, we are end users of the standard. I think there may be some misconception that we help write it or that we're going to write test methods or test sweeps. NVLAP is an ISO 17011 accrediting body and that's what we do. We use the documented standards and we're prohibited from writing or being involved in the test method process. Other than the things of this nature and the attending to see how things are going and what the state of the standard is going to be.

What we use are from the 17025 standard itself. In our handbook which is a program specific handbook, but that's something we write which is merged with 17025. It's the standard and it's some guidance for implementing that standard in the 17025 lab. So the -- what you see from us will be that document, as it has already. But the lab is responsible for 17025 the 17025-22 and the standard itself, everything that's inclusive. The 17 or excuse me, the 150-22 is a way of documenting the non-conformities within the labs and showing where that exists in the standard.

So that's where our involvement is. We're an end user just like you are and we I guess the lessons that we've learned so far

are some of the problems that the labs have had. We have a problem with test methods not being well defined. So what we have to do is, we go into the labs and we see, well, did the labs have the ability to write test methods. And did they have the ability to validate those methods? So what we're hoping for with the newer version of the standard is a little more definition, a little more as guidance as to what the actual test methods are going to be, so that we can go into the labs and apply all of these requirements consistently.

What we do now consistently is we use the same assessments. We go in. We're looking for mappings between the standard and what kind of test methods they develop. So what I would like to see with the new VVSG and what I think we're seeing, what I think what we agreed to here is a little more definition in the test methods and some interpretation too, because as we've said here, too, this is a living document and what we have to do is, as innovations are made, there are going to be questions and we have to have a device for discussion of how we're going to handle these and maybe it's an interpretation website on the EAC, maybe it's some sort of forum, but somewhere where we can document, so all the labs have access to the same interpretation and know that here's the standard, we're not going to be able to update the standard all the time or write addendums. But we can come up with some interpretation which the labs are expected to have.

DR. KING:

Okay, thank you, John. Dawn?

MR. MEHLHAFF:

First, I think we should rename it to the 2012 standards but I mean, I think we can all agree that, you know, throughout this process and 2020 maybe? You're looking at me like I was bad. I think we can all agree that basically when we look a system and whether it goes through the lab or whether the vendors or comes through the EAC, that basically the goal and I think we're all on the same page here, we want that to be the most secure, the most reliable, the most user friendly voting system that's out there. The question is, how do we get there and how do we test it using the tools and the parameters that we have in front of us. And there's always going to be anomalies and that's just the reality of the situation and we understand that.

But in terms of the guidelines, you know, I think the, you know, the subjective language needs to come out and if it doesn't come out, then that's going to put the burden back on the EAC to come up with an addendum to the guidelines in terms of okay, what are the parameters because, you know, it's clear that, you know, there are different interpretations and when you have that subjective language out there, one lab is going to interpret it differently than another lab, from another technical reviewer, from another vendor. And so, as much as we can narrow that language down and set those parameters, I think we have a better document and we're getting closer to where we'd need to go.

But I think you guys are absolutely right. We need to look at what we're doing with today's standards, and today's guidelines in terms of developing the tools so that we are all using the same set of documents, the same basis for test methods, the same, you

know, templates for the test reports. And I think getting us over that hurdle to where we're all on the same page, I think that becomes a resource for this next iteration to make that document better.

Because if we just keep going down this path and think, okay, we're just going to focus on the 2007 guidelines, you know what, we need to focus on the 2005 and make that better and flesh out the details there because there's still a lot in there that's up in the air that we can narrow down.

So I think that that's critical that we do need to come together. We need to work as a team. And we need to get those documents and, you know, hone it in a little bit and then that's going to become a critical document for the '07 that you can take that and the '07 is going to be a better document because of it.

And then the other thing though, that I did like, is -- this is one of the times that Brian kicks me and says I'm not allowed to speak anymore but, you know, your comment about a training on the VVSG and I think that's an important piece. And I don't necessarily know if, you know, the EAC is the correct body to actually do the training, but I think that it's certainly an agency to possibly coordinate it or direct that training to occur or at least pull together the appropriate people. But I think that you're right, that's a critical piece. There's this document out there and there's never really been a clear and concise, sit down training and pulling it apart to say here are the parts you really need to look at, here is what this means. And a lot of the clarification I think can happen in that arena as well so.

Sorry, I know you're going to kill me for that one later but.

DR. KING:

All right, thank you, Dawn. Mark?

MR. SKALL:

Thank you. So writing and then thinking about how to test a standard like this 2020 standard and I think that is...

MR. MEHLHAFF:

Sorry.

MR. SKALL:

We'll be calling that 2020 internally as well is a very, very complex issue. There are no real easy answers. So anyone who tells you they have an easy answer they're just not telling the truth. Forms like this are absolutely necessary to look at the issues and look at the trade offs, because it's all about trade offs. So thank you, Brian and Matt for organizing this and Merle for hosting it and being such a good moderator.

There are many, many new requirements in this version of the standard. Are they perfect? No. By looking and starting testing earlier, again we will be able to vet some of these requirements and find even more things wrong than the things you've pointed out. And we will also have tests early so that implementers can use them before they're locked into their implementation and can find bugs earlier because we all know the earlier you find bugs, the cheaper they are to correct.

There are many, many tradeoffs because we talked about things not perhaps being testable. We talked about performance requirements. Everyone loves performance requirements, but there are issues with performance requirements. In some sense

unless you can quantify them, they can be too vague to test. And when you do quantify them and test them, you're in a situation like the usability test where you sometimes need to hire people who are experts in the subject matter. So it's not the panacea it seems to be, there are tradeoffs. Design requirements to some degree at least are testable. I'm not saying you do all the design requirements, but you have to look at each situation differently and come up with answers and they're fairly complex answers.

As far as cost, I agree that's the big elephant in the room. That this is going to very costly. The better a standard is, the more comprehensive the tests are, the more costs you're going to incur. One of the nice things, I guess, is that we at NIST are funded by the EAC to develop a comprehensive test sweep for this 2020 standard and it will be done in 2020. No, the tests will be done actually probably in the next year or so. They will be vetted. They are going to be reviewed by test labs and other experts, as much review as we can get, but hopefully that will help the costs. We all know how expensive to write good tests and we've been doing it for years and it's -- like we all know, you can't write a perfect test, you have to figure out what to test. You have to figure out when to stop and we have some experience in that, so we will be providing that. So in a way there is a little bit of a government subsidy already built in. So I guess in conclusion, my summary is we're from the government and we're here to help.

DR. KING:

Thank you, Mark. I'd like to make a few summarizing observations that really I just drew from listening to the people speak here today.

And it's a way for me to kind of consolidate my own thoughts about what we've accomplished in this roundtable discussion.

I think one of the first things I heard here was that standards are a means to an end. That the production of the standards is an intermediate goal and we should not take our eye off of the real goal which is better systems and that this is a, if you will, a necessary evil for us to work through on our way to producing what we really need, which is the best possible voting systems.

I've also heard that the refining of the document that's before us, the VVSG is a heuristic process. We get better as we go along. We learn from the 2002. We learn from the 2005. We're learning every day more about what the standard is and about how to make it better. I heard that the development of the testing standards is evolutionary and that we are about where we need to be perhaps at this point in the process, maybe not as far along as we would like to be, but in a not unexpected position.

We heard that there is a lot of concurrent work going on in every organization that's represented here and that's not always obvious to other parties, so that NIST is working concurrently on developing test protocols. The testing labs are looking over the horizon at the cost associated with the 2007 VVSG. NVLAP is looking at creating perhaps a posting of interpretations that would be available to help unify and create a standard of interpretation. But there's still some problems. There's ambiguity in the standard. There is in places an uneven treatment of specificity. There is on occasion contradictory requirements.



There's an interest in modifying the program perhaps in a way to allow vendors and test labs to interact earlier in the process, to correct design errors in time to not only accelerate the development of the system and improve the design of the system, but to reduce the cost in those systems. That we should look for ways to make component innovation a part of either the program or the standard and that the research associated with the OEVT concept perhaps needs to be folded into the standard and the program in a way.

I heard, I think a profound consensus on the need for risk assessment by all parties involved that I think everybody here and it's certainly been true at the other roundtables, spoke to the value of having a detailed risk assessment.

I heard that the standards must be clear and they must be mapped to the goals of the voting system, which are the accuracy, security, usability, reliability, and affordability, and ultimately they must be testable. That we should explore means by getting the testing labs involved earlier as a way in the development life cycle to decrease cost and improve design and that on those areas of the VVSG that do approach a design specification, that there be an annotation that describes why that is needed here, a justification and a rationale which would help all parties understand why we are seeing this blend of functional performance and design specification.

So those are the things that I heard today. And it's an impressive list and I'll echo what those before me have said that I've learned a lot today and I think this is a perspective that I

personally needed more depth on to understand the issues that are going on in the testing of the system. With that, Brian, I'll let you have the last word.

MR. Hanclock:

Thanks, Merle. Again, thank you for a great job moderating. In these groups it's always a tough task to keep everyone on point and on time but you do a great job. And again, thank you all for coming today and participating. It's been a very successful, perhaps one of the most successful of the roundtables we've had so far and so we hope that the future ones are equally as good as what we've had today.

I'll echo Merle in saying that I learned a lot today. In fact, all the roundtables I always take away something new, hear new things, find new things we need to look into. It's very clear that we have a lot of work to do over the ensuing months to bring our commissioners the very best documents, the most -- the best thought out document possible for them to vote on, at whatever point in the future that that comes to pass.

Just a couple things and Dawn, I'll thank you for reminding me. You brought up the issue and I think Gail earlier, about training. We certainly understand the value of the training and, in fact, before we even set up our program here we had an RFP out two years ago to develop a training program for our technical reviewers. We had three very unqualified respondents to that RFP and decided that it wasn't quite the time to go in that direction. But the point is, we are very well aware of the need for that and as we go forward, we will continue to explore ways to provide better

training for everyone on the VVSG documents, as well as, our program manuals.

And the other point is just something that John brought up and that is related to the interpretations. You know, we do currently have our library of interpretations up on the EAC's website under our Voting Systems Center. You will see all of our interpretations and notices of clarification for our program manual is under there. And I think we try to keep that pretty much as updated as we can. With that, Merle, would you like to adjourn?

DR. KING:

Well, I will read into the official minutes that we are ten minutes early on conclusion of this. And I again, I thank all of you for attending. Thank you for your contributions and have a great afternoon. The meeting is adjourned.

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[Whereupon, the roundtable discussion adjourned at 1:47 p.m.]