HVDC TRANSMISSION FOR RURAL ALASKA

STAKEHOLDERS' ADVISORY GROUP FIRST MEETING

April 27, 2010
Fairbanks, Alaska

TRANSCRIPT OF PROCEEDINGS

Marriott Springhill Suites
April 27, 2010
3:30 o'clock p.m.

APPEARANCES:
Ms. Denali Daniels
Mr. Joel Groves
Mr. Jason Meyer
Mr. Earle Ausman

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P R O C E E D I N G S

(On record)

MS. DENALI DANIELS: Well, welcome everyone. My name is Denali Daniels, and I think I've met most of you, but anyone I haven't met, yes, it's true, I work at the Denali Commission; I manage the Energy Program.

And I would like to thank everyone for coming together today for the first of three Stakeholder Advisory Group meetings around the HVDC project that the Denali Commission has funded, now currently in Phase II.

And so for folks online, we're getting a little bit of feedback. If you could go ahead and press mute from your end, that would be very helpful. Thank you.

I'm going to go ahead and start off with introductions, and then we'll get into a little bit of detail on what the group is tasked with doing.

Again, I'm Denali Daniels; I'm with the Energy Program. I'll be chairing this group. And if you could, we'll go around the room and ask everyone to introduce yourselves. If you are on the committee, please state so. If you are representing a delegate to the committee or if you're a member of the public, that would be good to know.

So we'll go ahead and start with you.

MR. INGEMAR MATHIASSON: Ingemar Mathiasson, Northwest Arctic Borough. I guess we are on the committee.

MS. DENALI DANIELS: Committee member, very good.

MR. JERALD BROWN: Jerald Brown, Bering Strait's Native Corporation, on the committee.

MR. MIKE WRIGHT: Mike Wright with Golden Valley Electric. I think I'm on the committee since Brian is not going to do it, so I am.

MS. DENALI DANIELS: Okay.

MR. MITCH ERICKSON: Mitch Erickson, Nome Chamber of Commerce and on the committee.

MS. LESLIE WALLS: My name is Leslie Walls, I'm with the University of Alaska. I am the grant manager for this program, and I'm just hear to hear about the program.

MR. BRENT PETRIE: Brent Petrie with Alaska Village Electric Co-op. I'm here on behalf of Meera.

MR. ERIC MARCHEGIANI: My name is Eric Marchegiani; I work for USDA. I'm on the committee, and I'm also on the Energy Advisory Committee for the Commission.

MR. JASON MEYER: Jason Meyer with the Alaska Center for Energy & Power. We're managing this project on behalf of the Denali Commission.

MR. JOEL GROVES: And Joel Groves with Polarconsult Alaska. Polarconsult is the contractor doing the work for Phase II, and I'm the project manager with Polarconsult.

MR. EARLE AUSMAN: Earle Ausman, Polarconsult.

MR. KENT GRINAGE: Kent Grinage, North Slope Borough. I don't know if I'm on the committee or not.

MR. JOEL GROVES: I believe you are, Ken. I believe you are, yeah. Come on down.

MS. GWEN HOLDMAN: I'm Gwen Holdman. I'm the director of the Alaska Center for Energy & Power. I'm just here to learn a little bit more about what's going on, and I'll set down my phone now.

MR. KIRK HARDCASTLE: Kirk Hardcastle, Alaska Center for Energy & Power out of Juneau, Alaska.

MR. AL NAGEL: Al Nagel, State of Alaska Department of Labor Workforce Development. And Jason invited us since we're going to have some effect on State statutes and regulations.

MR. JASON MEYER: Al, please feel free to join us at the table if you'd like.

MR. DANIEL GREINER: Daniel Greiner, State electrical inspector for the Department of Labor here in Fairbanks.

MS. DENALI DANIELS: Okay. So this is a committee member here now? Okay. We're going to try and manage the discussion. So please make sure and pipe in as a committee member.

Again, thank you, and then, I guess, let's go

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ahead and turn it to the teleconference. I believe we have two people on line.

MR. TOM LOVAS: Well, one, Tom Lovas, Energy & Resource Economics, and I believe I'm on the committee.

MS. DENALI DANIELS: I believe you are too. Welcome, Tom.

MR. TOM LOVAS: Thank you.

MS. DENALI DANIELS: And then we have a gentleman from MEA?

MR. PRIZIKAM MINGARAJ: Prizikam Mingaraj, and I'm on the committee.

MS. DENALI DANIELS: Okay. Welcome. Thank you for joining us. Okay. So what I'd also like to draw your attention to next on the agenda is a discussion just about the charge to the Stakeholder Advisory Group.

In terms of just a bit of background, we're going to be getting a presentation from Polarconsult about where we've been, where we are today, and then we'll have a bit of a discussion about the role of this group in that process.

This document that I draw your attention to, I think Jason passed it out, or did you?

MR. JASON MEYER: No, I had planned to.

MS. DENALI DANIELS: Oh, okay. I'm going to go ahead and pass a couple stacks around. This is a charge to

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the group, and this is attached to the original invite that went out to everyone.

MR. JASON MEYER: I'm not sure if this was. Basically, this is just the more technical document outlining the policies and procedures of the Stakeholder Advisory Group.

A lot of the details of this document will just be covered throughout the meeting today, but more just for your reference, just more structural pertaining to the committee. For those online, I'll email one out shortly after the presentation here.

MS. DENALI DANIELS: So the document that's going around is really, as Jason mentioned, hopefully a good, brief summary of what the role and responsibility of this group is. It is an advisory group, and the Denali Commission, as the funder, will remain kind of in a chairmanship role with the advisory group.

Our relationship is directly with the Alaska Center for Energy & Power as our grantee. And, in turn, the Alaska Center for Energy & Power is fulfilling two functions; number one, they are overseeing the contractual relationship with Polarconsult; and, number, two they are conducting data collection and reporting independent of the contract.

And so I think we're all feeling very good about the manner in which the process has been structured. And as part of the process, it was agreed that we would transition into this new role that I just described.

We previously had a grant with AVEC, and AVEC had kind of a similar relationship with Polarconsult. And we decided that having a stakeholder advisory group would -- would hopefully prove to be a good way to transition from the AVEC relationship over to the ACEP relationship.

This also dovetails the Denali Commission's involvement with the Emerging Technologies Program, and the HVDC actually predates that initiative coming to fruition; however, I think it's a good example of opportunities that the Denali Commission and the State and the University and others are interested in pursuing. And so I think we can look to this project as an example of other things that we'd like to see under the emerging technologies program.

This committee is intended to be an independent, really second set of eyes or third set of eyes on not only the process, but also on the technology and the lessons that were learned throughout this process.

And so one of the things that we all know about research is that the more independent we can be, the better everyone is going to be off in the long run, and certainly it's helpful for someone in the role of Polarconsult to have that validity maintained through some independent review process.

And so that's really the main goal of this group is to provide oversight recommendations in an advisory capacity to Denali Commission, and, in turn, to ACEP and on to Polarconsult.

And what we're trying to accomplish is sort of that arm's length between this group and Polarconsult as a way to ensure that integrity of the process, the research project itself and really gain from the expertise of the folks that are represented in this group.

So with that in mind, we're proposing two functions over the next year and a half for the Stakeholder Advisory Group. One, we are proposing three meetings, this being the first, where we can hear the progress of the project, ask questions, provide feedback and so forth; and then, secondly, between meetings, we are hoping to have milestones that are reached. And those milestones may be communicated to the Stakeholder Advisory Group requesting feedback.

And so it's my understanding that we'll have kind of a communication mechanism that's in place and that the University is going to be putting together a ListServ for folks to use as a way to communicate. And so I think when we talk about communications, I want to encourage folks to engage as much as you can about this technology and the progress of the project.

There are some policy issues that we may ask for feedback on as well, and that, as well, is something that we need to maintain the integrity of the contractor's role in policy development, and those are things and functions that the Denali Commission or others may be more appropriate to take on.

So what I'd like folks on this group to do is try to recognize the role of each one of our entities and communicate to my office directly about any Stakeholder Advisory Committee functions, you know, feedback that you may have. We'll kind of manage that between ACEP and the Denali Commission so that that way we can maintain the integrity of the role of our contractor as they do the work that they're set out to do.

So any questions about that or, Gwen, Jason, is there anything that I've left out?

MR. JASON MEYER: I would just turn it over to the SAG if there's any questions at this time about the intent of the SAG or just kind of the initial introductions or the process.

MS. DENALI DANIELS: Okay. I've probably talked enough about it then. So what I'm going to do is just keep us moving here.

Next up on the agenda is basically we've got two presentations. And what I'm going to do is I'm going to ask that you hold your questions until after the first presentation. We'll pause and then have a little bit of discussion just depending on the nature of any questions, and then we'll move forward. In the interest of time, we really don't have a lot of time here and I know it's real easy to get into the details, and my suspicion is that some of your questions may be answered once we get through it. So if you could just get your pen ready, write your questions down.

I'm going to turn it over to Joel and have him go through the Phase I overview. And then once he's finished with that, we'll go ahead and stop and we'll have an opportunity for discussions. So, Joel, go ahead.

MR. JOEL GROVES: Okay. Thank you, Denali. And then once -- just a little procedural thing. Once we do get into the Q & A, because we are doing a transcript of the meeting, if you try to keep the comments very serial so we don't get a lot of cross talk. That becomes very, very difficult to get on the transcription; just a minor note there.

So, yeah, what I'd like to do first is just give an overview of the HVDC project. This is -- well, we'll even go quicker than that. You know, what is the point of this project? And it's really simple; we're trying to reduce remote Alaska energy costs. You probably heard a lot of this down the street already.

But the way that we're looking at doing that on this particular project is to provide a lower cost, technically superior transmission technology to tie rural Alaska communities and energy resources together. Existing practice three or four wire overhead AC interties, extremely expensive to build out in the Bush. They're looking at experience of 200- to $400,000 a mile. If you want to go out five miles to try and connect a village, get to a hydro wind site, whatever, you're looking at a million dollars right there just for capital costs. Extremely prohibitive.

What we're looking at trying to do with HVDC is reduce that. We're looking at cutting those costs in half, and that's a project-specific cost savings, but on a conceptual basis, we're looking at cutting those costs in half, and that will help to encourage the villages to form microgrids.

You know, there's a number of them that have been talked about down around Naknek; you've got a 25 village intertie. Around Bethel you have these large interties that have been proposed.

Trying to get the cost of building those interties down to the point where they can actually happen, in so doing, we'll start to build economies of scale where you'll have larger loads. You can start to put in larger generation assets.

You can drive down the unit cost of hydro developments, wind farms, geothermal, et cetera, et cetera and start to -- you know, start to do things with, let's say, a 1 megawatt grid that you just can't do with a 100 hundred kilowatt or even a 250 kilowatt grid; so start to drive those costs down.

Another thing that the lower cost transmission can do is if you can afford a million dollars of transmission in some project, you have this five-mile radius or two and a half to five-mile radius, if you cut the cost per mile in half, you can go out twice as far to reach these local renewable -- or these local energy resources. They don't have to be renewable, they might be a gas field or a coal field or whatever.

So, again, lower cost transmission; it just increases -- I mean, I guess if you cut the cost in half, it doubles the amount of area that you can reach out and harvest renewable energy resources or local energy resources. So that's the big picture; that's what we're trying to do here.

What is high-voltage direct current transmission? It's a proven technology that's been used all over the world for decades. It's used for very large scale power transmission, thousands of megawatts, typical hundreds of thousands of megawatts.

There's three general situations where you'll find HVDC used in the world today: Very large-scale power transmission. If you look at getting power from the Three Gorges Dam in China out to the coastal cities, you have three or four HVDC interties moving thousands of megawatts each to get that power to the market.

The Pacific Intertie along the Pacific coast of the United States, 3100 megawatt intertie that goes from Celilo, Oregon along the Columbia River down to Sylmar in southern California. So that's one example is very large-scale power transfer. HVDC is a lower cost, more efficient and has a smaller footprint than comparable AC interties.

Another key one is submarine cables. You cannot run long distance with AC because of the reactive or the capacitance of the cable. You can do that with DC. And so you'll find between Scandinavia and mainland Europe you have a number of DC interties, between the north and south islands of New Zealand, between Australia and Tasmania, et cetera, et cetera.

And then the third prevailing existing application is for clutches or basically asynchronous interties between large grids.

Throughout the Lower 48, you have between the Pacific grid -- or the West Coast grid, the Northeast grid, Hydro-Quebec up in Canada, Texas, et cetera, et cetera, you have back-to-back HVDC stations that just provide an asynchronous power transfer capability so you don't have to synchronize and phase on those water systems.

If we are -- so that's the existing technology. If we move forward to Alaska, all of those same attributes of HVDC technology apply and are beneficial in Alaska, but what we need is a much, much smaller technology. HVDC systems right now are -- like I said, they're sized for thousands of -- or hundreds or thousands of megawatts, and if we look into rural Alaska, we need about 1 megawatt. That doesn't exist commercially today.

So this project is developing a 1 megawatt monopolar bi-directional HVDC converter, and it's also developing conceptual intertie designs or, if you will, a design manual that will guide the design of rural Alaska interties that are optimized to use HVDC and are cognizant of the logistical and technological constraints of working in the Bush.

So we want to design new intertie systems that you can actually build with the, you know, very long supply chain, very limited availability of construction equipment, shipping, logistics, et cetera, et cetera. It will actually bring down the cost these systems out there.

And then a key part of this project -- because we're talking about new stuff here, and new technology and rural Alaska often don't get along very well together -- is we want to gain industry support.

And this is one of the aspects of the SAG that's going to be very useful to tailor the design of this technology and understand this technology so that when this thing is commercially ready, the rural utilities are going to be ready to actually use this technology.

We don't want some -- we don't want a study that sits on a shelf, we don't want a technology that never gets past the demonstration phase. We want to actually revolutionize the way that power transmission is done in the Bush.

And then an adjunct to that is that there's some regulatory impediments to fully utilizing the capabilities of HVDC that we want to work on to try and -- to try and optimize and maximize the benefits of what we're doing.

So to get into this project in a little bit more detail, Phase I was funded by the Denali Commission, like Denali mentioned, and that was completed through AVEC in 2008 and 2009.

There were two main things that went on there; one was the construction of a proof of concept of the converter technology, because that's a -- a key part of this system is a commercially viable, functional, 1 megawatt HVDC converter. So that was successfully completed.

And then the other side was looking at a conceptual level at some of the overall system costs, system life cycle costs, and the basic technical feasibility of some of the intertie -- the physical or structural elements of the intertie technologies.

Phase II, which is just now getting underway is to build a fully functional, 1 megawatt, 50 kilovolt bi-directional DC converter, sort of the first article commercial unit and test that. So design, build and test it, and then also to advance a lot of transmission concepts so that they are basically ready to go into the design phase of a specific project somewhere, a commercial installation in the Bush.

And then Phase III would be a demonstration project between two villages in the Bush or some other configuration of the technology in a fully functional commercial implementation of the technology, and the location of that is to be determined.

And that's one of the things that we'll want to focus on in trying to determine in Phase II -- as early as possible in Phase II so that we can tailor some of the Phase II work to that Phase III demonstration project if we know specifically what type of intertie that is, we can focus some of the Phase II work on developing the aspects that we'll need for that Phase III project.

So a little bit more detail on the Phase I findings. The demonstrator unit that was built was a 12 kilovolt DC to three-phase 480 volt AC converter that -- operating at 250 kilowatts, and that successfully demonstrated the basic technical functionality of it, but it worked, but, importantly, also the converter efficiency and the cost of the converter. So it demonstrated that the technology would actually meet the basic commercial threshold to compete with AC and deliver the savings that were necessary for this entire endeavor to make sense.

Looking at a conceptual comparison of a 25-mile intertie between an AC versus the DC system, we estimate a 56 percent capital cost savings and a 28 percent life cycle cost savings.

The lower life cycle savings was due to the converters having a slightly higher power loss than a comparable AC power transformer. So that brought down the savings a little bit, but there's still a substantial 28 percent savings on a life cycle basis.

These are just some pictures of some of the testing apparatus. This was done by subcontractor Princeton Power Systems located down in New Jersey, they're sort of a startup -- or I don't know if you really call them a startup anymore there; they're doing quite well. But they're a startup out the Princeton University incubator, so-to-speak.

And just the upper left there is just some rectifiers and filters to -- to synthesize the 12 kilovolt DC input into the converter, and then this other one is some conditioning circuits and other control circuits for the converter.

This right here is the controller -- the controller -- this is the motherboard and this is the triggering card. Basically, the converter -- not to get into too much detail -- is a bunch of a solid state switches, chopping up the DC or AC waveform into a bunch of a little packets and storing those packets in a capaciter and rebuilding those little energy packets into the output waveform.

And that's achieved with -- these are fiber-optic triggering circuits that go off into the IGBTs, which are the solid state switches that deconstruct or reconstruct those waveforms. Let's see if everyone has gotten completely glossed over there, though. It's a very, very.....

MS. DENALI DANIELS: No, that was good.

MR. JOEL GROVES: Interview. This is the projected efficiency curve of the 1 megawatt unit, and a lot of this is in the Phase I report that hopefully everyone picked up. If you didn't, there's a stack of them right there and I have some more in the event we run out, but there's a lot more detail on these slides in the Phase I report.

Basically, across the bottom here you have the power throughput from 0 to 100 kilowatts -- 1000 kilowatts, and on the side you have the converter efficiency. So at very low -- at a 10 percent loading, you're at about 97 percent efficiency. Up around 300 kilowatts or 30 percent loading, you come up to 97.75. And then it tapers off; at full throughput you have about 96.75 percent efficiency. And this -- this efficiency curve is what was used in the life cycle analysis of the system.

This might be a little bit complicated to see, but what we did here is looking at the savings has a function of intertie distance. So across the bottom is you have the intertie distance for a point-to-point intertie.

And the blue line up there is -- this is all relative to what a hypothetical AC intertie would cost. So the blue line is the AC intertie at 100 percent. And what you have is these two black lines coming down.

The higher one is for a conventional construction rural intertie; so wooden poles perhaps on steel, HV interfoundations with your four-wire intertie. And all we've done is we've simply taken two of those wires off. We insulated it for DC operation, and that's the cost savings that you get for that.

The lower one is a more optimized, a single wire earth return circuit using long spans, 1000-foot spans and very tall fiberglass poles, which is what we view as one example of an optimized overhead intertie using the DC technology, and you can see you get a much more significant savings.

So there's a couple of take-home messages off this curve. Very short interties, because the converters are relative expensive, those don't make sense. You can see using the innovative technology, a 10-mile intertie with HVDC is about the same cost as for an AC intertie. Anything shorter than that, it's going to be more expensive. The longer they get, the cheaper they get compared to an AC intertie.

And so for a 50-mile intertie, you're looking at a savings of about almost about 40 percent for the innovative overhead intertie technology. If you're going with conventional construction, you'll still see about a 14 percent savings. But, obviously, you can see there's a large -- there's a large sum of money there from a capital basis -- or a capital-cost basis of an intertie that can be saved by using innovative intertie construction methods. So it's something worth working towards.

Phase II.

MR. JASON MEYER: Joel, did you want to -- should we stop for questions?

MR. JOEL GROVES: Oh, I'm sorry, yeah. I'm running.....

MS. DENALI DANIELS: So I'll open it up if anyone has any questions on Phase I. And, I guess, the only thing I would say is if you think we're going to answer it in Phase II, then we'll just wait.

MR. JOEL GROVES: Okay.

MS. DENALI DANIELS: Open it up for questions.

MR. JERALD BROWN: You were talking about the difference between the cost savings -- the installation-cost savings versus life-cycle cost savings. On this chart here, is that life-cycle or installation?

MR. JOEL GROVES: This is life-cycle.

MR. JERALD BROWN: Okay.

MR. JOEL GROVES: Yeah.

MR. JERALD BROWN: And does the -- you said that the reason for the difference between the savings on the two, the life-cycle versus the installation was basically line loss or efficiencies.

MR. JOEL GROVES: No, on this chart here, the difference between the curves is.....

MR. JERALD BROWN: No, I'm not talking about the.....

MR. JOEL GROVES: Oh, I'm sorry. Go ahead.

MR. JERALD BROWN: The -- what was it, around 50 percent less expensive to install, but only 28 percent less expensive life-cycle?

MR. JOEL GROVES: Yeah.

MR. JERALD BROWN: And the reason for the difference was?

MR. JOEL GROVES: Is the lower efficiency of the HVDC relative to an AC transformer. And actually to -- I guess, to.....

MR. JERALD BROWN: My ultimate question then is does that change with the number of miles that you're covering, that inefficiency in the -- in the.....

MR. JOEL GROVES: Let me start and then I think Earle wants to add --

MR. EARLE AUSMAN: Yeah.

MR. JOEL GROVES: Well, go ahead, Earle.

MR. EARLE AUSMAN: Your question is well-taken. What happens with the DC, because the amount of amps we're carrying is so low, that in a general case and everything else like that, our line loss is dropped. So our line losses eventually overcome -- more than overcome the converter costs losses.

In other words, if the -- the transformer is maybe at 98 -- 98.5 percent and we're under that, but as the line becomes longer and longer, we are better off efficient-wise, as well as cost-wise.

The only part that we don't change the cost on, of course, is the end station as far as what is more expensive than the transformer. And so that's why these big, big lines are all -- almost all DC for that reason, among other reasons. It's just cheaper and run more effective and less costly.

MS. DENALI DANIELS: Does that answer your question, Jerry?

MR. JERALD BROWN: It does.

MS. DENALI DANIELS: Great. Any other questions on Phase I? On the teleconference do we have any questions about Phase I? Hearing none, thank you. Let's go ahead and move on to Phase II.

MR. JOEL GROVES: Okay. And I guess I'll just start off with a good question. Thank you.

So in Phase II -- and I already touched on this a little bit -- the primary tasks are we're going to design, build, and test the full-scale, first-article, bi-directional monopolar HVDC converter. That will be a 50 kilovolt, 1 megawatt converter.

We're going to develop and test some of the conceptual designs for the transmission lines, and there we're looking at buried overland cable, submarine cable and overhead systems.

We're going to test the direct current single wire earth return performance in Alaska soils. One of the key issues with that is permafrost soils are typically at very high resistivity, so we want to go ahead and put in -- install a test installation, run a DC current through an earth return circuit and develop some design parameters and develop some industry confidence that those types of circuits actually work; they're safe and they're effective, and they're something that we should do.

That will lead into some of the co-changes that are necessary because currently single wire earth return is not allowed by the electric codes except for emergency situations.

With that data, we're going to go ahead and resist those, reanalyze and update those, some of the economic charts and calculations that we saw. Once we have more of this -- more of the cost data, we can refine those and make sure that the system still make sense and quantify how much it makes sense.

And then advanced industry support for the system, again, that's where the SAG is key, in my view, is we want to make sure that you guys are getting your questions, the utility folks in the room are getting your questions and your concerns about this answered early on.

And to the extent that we need to do testing or research to answer any of these questions, we can identify that early on and do that work so that this system gains broad industry support.

And then the one that's invisible down there is to identify the project for the Phase III system. Obviously, the sooner we know where we're going to build the Phase III demonstration project, the more we can tailor the Phase II work to those -- to that specific application.

This is pretty basic. The converter we will -- for the HVDC converter -- and, again, this will be through subcontractor, Princeton Power Systems -- develop the functional and technical specifications for the converter, design and model the converter, and then build and test it. It seems so simple when I put it that way.

And then the -- on the transmission side, what we'll be doing is, for example, for the overhead system, we'll do a conceptual design of that system and this -- what was advanced in Phase II, basically the system that we're looking at consists of what I call the long-spans tall poles concept, about a 1,000-foot span, 70-foot tall poles; and those would be fiberglass guide poles that is -- you know, it's one of -- one of almost an infinite variety of designs you could use for an overhead system in rural Alaska.

This one is designed to -- it would be a lower cost to build in an area like the YK Delta where you're very -- you have marginal permafrost, weak soils, you know, the salt-rich soils out there. It's very difficult to build cantilevered pole systems like they're doing now or very expensive to do, I should say.

So we'll start with that conceptual design, come

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up with loadings for all of the -- you know, structural loadings for that design, come up with a series of conceptual design-basis documents that will basically put in the environmental parameters that go into the system, develop performance specifications that will develop the structural loadings and whatnot for the various components, determine the commercial availability of those components.

For example, the fiberglass poles might be something that is available off the shelf, in which case you can look at the cost and availability of that device or that component, decide if it's cost effective for this technology and, if need be, decide if you can optimize that for this particular application as opposed to using that off-the-shelf-component.

Some of these items may not be commercially available, in which case, we will design, build, and test those to make sure they're ready for use on a project.

Then, like I mentioned, we'll be installing a ground circuit in permafrost soils to make sure that it works, and we'll operate that for a period of time, monitor the performance on that ground circuit, and collect a bunch of data on the performance of that that will be useful for designing future earth return circuits. Sort of the end result here you might think of as a design manual for how you build a DC earth return circuit in an arctic climate.

And then the agenda has a break.

MR. DANIELS: We don't need a break.

MR. GROVES: Oh, we don't need a break. So.....

MR. DANIELS: Sorry. I bet you guys have been at this for a while, but.....

MR. GROVES: So the purpose of the SAG, Denali mentioned a lot of -- sort of gave an overview of the SAG. From our perspective, I think it -- I think everything that she said is spot-on.

But, you know, the end result is to help this technology become a useful -- or this system become a useful technology for Alaska. At the end of the day, we want this stuff to be successful, we want it to be deployed, and we want Alaska to benefit from it.

So to that end, system review; there will be a number of points where we look at the design basis for some of the aspects of this system, some of the functional aspects, and then some of the political aspects of this system. We'll be looking at the SAG for input on that to make sure that the way that we are advancing this is something that will be embraced and used in the state.

And then part of that also is to define, understand, and support the code revisions that we think are necessary to fully utilize this technology.

And then to extent that there is -- that there maybe a level of uncomfort with some of those revisions to define -- I've never really talked about what those are. I think I'm going to have to do that.

MR. DANIELS: Can I just -- I'm going.....

MR. JOEL GROVES: Yeah.

MS. DENALI DANIELS: Are we done with the Phase II part of your presentation?

MR. JOEL GROVES: Yes.

MS. DENALI DANIELS: Okay.

MR. JOEL GROVES: Yes.

MS. DENALI DANIELS: If we -- why don't we go ahead and pause there.

MR. JOEL GROVES: Okay.

MS. DENALI DANIELS: And open it up for questions about Phase II. And so I actually have a question, so I'll -- but the permafrost soil testing, where will that be taking place?

MR. JOEL GROVES: We haven't determined that yet. Conceptually, it will probably be like somewhere up around Glennallen, for example. We'll find maybe some land up there and install that installation.

MR. EARLE AUSMAN: We're looking at areas that are common to the ones that cause people a lot of trouble and -- and like YK Delta and the places that are marginal permafrost.

It's easy to deal with Kent's type of permafrost up on the North Slope because it stays frozen. We're looking for a place that might not stay frozen, and so we're trying to solve that particular problem. And if we can solve that problem, we would have a universal solution. And so that's going to be very helpful for people that -- that now go out and drive piling and everything else.

MR. JOEL GROVES: Yeah. And from a -- you know for the sake of Phase II, we're looking at something on the road system because, you know, we're not trying to solve the logistic issues, we're looking at the technical issues of working on the ground. So we'll probably go to the road systems because we don't want to incur the cost of doing something, let's say, in Bethel.

MS. DENALI DANIELS: So a place.....

MR. TOM LOVAS: You can get enough data from just one location?

MS. DENALI DANIELS: Good question.

MR. JOEL GROVES: Earle, do you want.....

MR. EARLE AUSMAN: We don't get all the data, but we get the most important data, and the data that we're getting is that on the margin. We're looking at the margin.

For example, if we're in Kent Grinage's area, we can go in and basically put in standard poles but just a little deeper to deal with a seasonal frost and things. We're looking for a place that's nasty and that -- and make sure it works in that. And if it works in that, then it will work in all these other places as well.

MR. TOM LOVAS: Eventually identifying a worst case.

MR. JOEL GROVES: Exactly and that's -- you know, the overhead system that we're advancing here is really one of infinite intertie -- overhead intertie designs that you might use, and it's the one that we think addresses the most difficult technical conditions, and that's why we're doing that one.

MS. DENALI DANIELS: Jason, and then do I see another hand?

MR. JASON MEYER: Joel, I was wondering if you could talk about the codes and just for people who might not be aware of the codes and kind of the ramifications or the state only, national.

MR. JOEL GROVES: Yeah, absolutely. There's -- I sort have been realizing that's missing out of my presentation.

Yeah, there's two aspects of the codes that we've identified that warrant revision. Now, what those are is -- I think I mentioned the NEC and NESC, one, the other, or both; I can't remember off the top of my head.

MR. EARLE AUSMAN: NESC.

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MR. JOEL GROVES: Which is it?

MR. EARLE AUSMAN: It's the NESC.

MR. JOEL GROVES: It's the NESC. Thank you.

MR. EARLE AUSMAN: We're not under the NEC for this stuff that's outside the buildings.

MR. JOEL GROVES: Right, okay. So the NESC does not allow ground return transmission circuits for best standard practice. It's allowed under emergency situations, but the current NESC does not allow it as standard practice.

The two main reasons for that is public safety because you have the potential for -- the possibility of step potential. Basically you have a voltage gradient on the ground that becomes a public safety hazard.

And the other is the potential with a DC return circuit. You have the potential to -- I need to stop saying potential in this context. You have the possibility of inducing corrosion in metallic utilities.

The problem is that the NESC is thinking about the Lower 48. If you move to rural Alaska situations, you don't have a lot of utilities to corrode, so in most situations that's not an issue.

And the step potential is something that is going to be isolated to the grounding grid area. That's something we want to define in the test that we're doing here. If need be, you may need to fence off a certain perimeter or possibly you can just put the grounding system in deep enough that you don't develop that step potential on the surface and it's just not an issue.

The other potential code revision is the minimal burial depth for cables. Again, that's something that in the middle of nowhere, a transmission line between two remote villages, there's just -- there's no good rationale to go ahead and bury a cable when it's going to significantly increase the cost of putting in an overland cable. So that's something else that we think warrants studying to see if there's a state amendment or waiver to the code that does not require that. Mr. Grinage.

MR. KENT GRINAGE: We run into a lot of fish and wildlife concerns about pole lines.

MR. JOEL GROVES: Yeah, and that's.....

MR. KENT GRINAGE: And when we bring this Barrow to Atqasuk line up, we're going to have a battle on our hands.

MR. JOEL GROVES: Yeah, and that's -- you know, there's a couple of aspects of that. Number one is a single-wire overhead DC line will have one wire aloft; an AC line has three or four wires aloft depending on the configuration. So there's a -- and the -- with the long-span tall pole concept, it's also higher up and may be out of most the bird traffic.

So the overhead line may actually be preferable from a permitting standpoint. That's obviously a discussion that you'd have to get into with Fish & Wildlife on a specific project.

And then the other possibility is with DC, just like with submarine cables, you can use buried overland cables for essentially unlimited distances. So that becomes a real opportunity that the DC creates is if do you have a critical bird flight corridor that you're just not going to get an overhead line through, you can do a buried cable for, you know, essentially unlimited distances.

MR. EARLE AUSMAN: Tell them about the cases that we're going to look at -- we're going to look at that's part of our job that we're going to look at after cracking.

MR. JOEL GROVES: Well, yeah, yeah, definitely. One of the key issues with buried cables in arctic climates is polygonal cracking, as I'm sure you're aware of up on the North Slope.

And polygonal cracking has -- Brent has had a lot of experience with or frost cracking -- is if you don't properly design those cables, when the ground contracts, it will simply pull the cable apart and it will fail. So that's something that using overland cables will -- those cables will need to address that technical challenge.

MS. DENALI DANIELS: Okay. I had Kirk, Ingemar and then Mitch. Mitch.

MR. KIRK HARDCASTLE: I want to build off of Denali's question in regards to submarine cables for southeast Alaska. Are there any plans on moving into doing testing down there to be able to access a lot of the resources we have?

MR. JOEL GROVES: Yeah, one of the -- I assume everyone heard the question. I can repeat it if not.

MR. KIRK HARDCASTLE: Submarine DC cables.

MR. JOEL GROVES: Yeah, submarine DC cables and with regard to southeast. That's, obviously, a major implication of this technology is the ability to use submarine cables.

What we have right now -- and Earle has done a fair amount of research on this on in Phase I -- is the question of all of the -- if you look at a submarine cable, a cross section, all of the little bits and pieces in there are existing commercial materials that will work for the application.

The question is, is anybody building that cable that you need, or is there an existing commercial cable that's available that's close enough that does the job and is cost effective? That's something we need to work on in Phase II because Earle's initial research in Phase I, the answer is this cable doesn't exist and none these cables are really what you want. So that's the first that we'll be doing in Phase I -- or Phase II is to work on trying to find a vendor or find a cable that's ready that works.

And to me, you know, one of the things that we've tentatively identified is that there might be some existing cables that maybe need some testing done, and we'll starting working with the vendors or their manufacturers of those cables to develop a specific plan of action to find that.

MR. KIRK HARDCASTLE: So is that pretty far away?

MR. JOEL GROVES: Yes, they're all over the world. Earle?

MR. EARLE AUSMAN: We've talked to cable manufacturers, and cable manufacturers tell us they will provide us with their cable so that we can do some of this testing utilizing their cable. So they want to know what the answers are too, and we want to know what the answers are so we can get the cables that we need to do some of this work.

MS. DENALI DANIELS: Okay. Ingemar?

MR. INGEMAR MATHIASSON: You seem to indicate there's three circuits running in Scandinavia even to this day. And, if so, are there any in the arctic? And if there are, could we look at the code they use over there and what kind of conditions they.....

MR. JOEL GROVES: Yeah, there are SWER circuits operating in Scandinavia. Some of the submarine cables that run under the Baltic are monopolar cables using a C return, but the grounding grids are onshore.

MR. INGEMAR MATHIASSON: I'm aware of that. I just wondered if you were aware of any overland, like what you are proposing, like in the arctic conditions.

MR. JOEL GROVES: Yeah, functionally those ones -- I don't know if there are any that are strictly overland, but, you know, with the grounding grids on land, it's basically the same thing.

Once the return current gets a little ways away from the grounding grids, it's so diffuse that if it's running through the ocean or the sea bed or the land, it's almost immaterial because it has these massively parallel pathways and it just goes everywhere.

As to the codes over there, I don't know, have if you looked into that Earle.

MR. EARLE AUSMAN: No, I have not; however, one of the first underwater cables that was laid was to the Island of Gotland by the Scandinavians, and they used the first solid state valve -- what they call valve, which is part of one of these rectifier circuits. And they utilized that, and that was a monopolar in that particular project, and they discussed in detail the grounding situation.

MR. INGEMAR MATHIASSON: I'm aware of that. When I grew up, I was about 50 miles away it.

MR. EARLE AUSMAN: So did you get electrocuted?

MR. JERALD BROWN: That's why he moved here.

MS. DENALI DANIELS: Did that answer your question?

MR. INGEMAR MATHIASSON: Yeah.

MS. DENALI DANIELS: It sounds like we need some more research.

MR. INGEMAR MATHIASSON: I think we need to look into the code over there.

MR. JOEL GROVES: Yeah, no, I think that's an excellent point.

MS. DENALI DANIELS: Mitch.

MR. EARLE AUSMAN: We've checked with New Zealand and Australia.

MR. JOEL GROVES: Yeah. I guess to follow up on that, in New Zealand and Australia they do use ground circuits extensively on AC systems. They have a lot of rural areas, and they'll have a single-phase AC line that runs out, and they have a ground return circuit on that.

And we've looked into their codes, and I don't -- I think we've tried and tried and haven't really gotten any feedback from them.

MR. EARLE AUSMAN: I'm trying to get the -- I'm trying to work with those people, and I'm still working on it and will continue this in the Phase II part of it to get a hold of somebody in their code committees to find out what their actual experience is. We can get the code; that's not the problem. The problem is how did it work and did you have any problems with it? And that's the question.

MS. DENALI DANIELS: Okay. Mitch.

MR. MITCH ERICKSON: I just dealt with permafrost and stuff, but would it be beneficial for you if we could get a hold of drill logs and soil samples for you of our areas?

MR. JOEL GROVES: Absolutely. And that's -- you know, one of the things is that we will start developing and route through ACEP or Denali Commission some of these information requests. There's a lot of experience out there in the industry and around the state that -- you know, on some of these, like the foundation issues and what not that we would love to hear some of the experiences because that could help us design the system and advance the technology.

MR. EARLE AUSMAN: Can I add a little something in there? We tapped into -- in the work we've done previously, we tapped into a number of the utilities and called them up and asked them what their loading conditions were and the experience of various kinds of construction and other things like that in the process of starting work on this.

So this Phase II will be a continuation of the same effort, and this organization can provide us with lots of information that's very useful and can be used utilized and incorporated into this entire process, and we hope that you will do that and feel free to do that.

MR. JOEL GROVES: Are there any other questions?

MS. DENALI DANIELS: So how much further do we have on your PowerPoint? And I'm trying to figure out where we're at on the agenda here. I think we've been flirting with the codes discussion, but we haven't addressed the sizing issue; is that coming?

MR. JOEL GROVES: Exactly, yes.

MS. DENALI DANIELS: Okay. I'll let you go ahead then.

MR. JOEL GROVES: Okay. So the process that we see for the SAG, I guess the sort of -- you know, try and crystalize that a little bit is -- and I think Denali Commission is missing when I look at this now. You know, we'll -- what Polarconsult will do is synthesize sort of like a white paper on these issues that we're seeking input from. And we'll run that up the -- sort of up the flagpole within the structure of this project. And that will come out to the SAG members for comment, and then you guys will bring your comments back and we'll go ahead and incorporate those.

And that's where, like, the technical criteria that Mitch was discussing with permafrost -- you know, where we'll put together sort of a design basis for what are the environmental parameters on these issues -- or these designs, you know, say, here's what we've got, we'd love your data. And then hopefully that data will come back in, you know, rather through the Denali Commission.

MS. DENALI DANIELS: I have a question about that.

MR. JOEL GROVES: Yeah.

MS. DENALI DANIELS: Just so committee members know what to expect, are there key milestones coming, say, in the next 60 days, 90 days? You know, when should we be expecting requests like this to be distributed out to the group?

MR. JOEL GROVES: Yeah, I've got -- I'll get to it in a second, but there's four key points that we've identified or key discussion topics we've identified to date, and I'm hoping to get some of those out very soon so we can start to get that dialogue going.

MS. DENALI DANIELS: Okay.

MR. JOEL GROVES: And here are the four, so good question. So, you know, No. 1 is system sizing, and I'll actually present some of the data on the next couple slides here.

Like I've mentioned, we're looking at doing a 1 megawatt system for rural Alaska, and I'll walk you through some of the data that supports why 1 megawatt is the right size.

The second key issue is the system design parameters, the functionality, and the environmental loadings. This goes back to some of Mitch's comments. So we'll get those also synthesized in the near future and distribute those out, you know, through ACEP and the Denali Commission to get feedback on those.

And then the third one, probably a little bit farther out, maybe a month or two away, is -- well, maybe sooner than that. Probably in the next month I think it would be good to get that out -- is the code changes that we think are beneficial. And it starts listing comment on the strategy for, you know, what are the questions the utilities have on those that we should work on answering and how, you know, what's -- what's the strategy to go ahead and make those code changes happen in a rationale way.

And then the fourth key one is sort of the vision, the applications, and the priorities for this technology in this system. Specifically is the Phase III project, but beyond that, state-wide deployment; where do people want this technology to go? You know, there's a huge demand, I think, for building interties that will help to reduce the cost of energy, and this sort of ties into the state-wide energy plan to a very large degree really.

But, you know, where does this technology need to go? Is it really going to fly with DC or with submarine cables, overhead, overland, southeast, arctic, YK Delta, where is it going?

So now I'll look at that first question, the system sizing.

MS. DENALI DANIELS: Why don't we take each of these and stop and have a discussion if there are questions.

MR. JOEL GROVES: Absolutely.

MS. DENALI DANIELS: And then we'll -- before we move on.

MR. JOEL GROVES: Absolutely. Thank you. So system sizing study, like I mentioned, we're looking at a 1 megawatt system. What we did is we reviewed the Power Cost Equalization Program database. The participating utilities report their peak loads every month back to the Alaska Energy Authority.

So we look for the past -- we looked at the past three years of that monthly data for all of the 176 communities/utilities that participated in the PCE Program to sort of look at the peak load that those utilities and entities have against the 1 megawatt intertie capacity. And this is the result. Across the bottom is 176 completely illegible utilities and villages. Don't ask me to read them all off, please. And then across the side is their peak power demand over the past three years.

I'll now take a little segue way here. If you look under the hood of the 1 megawatt design, it's actually two parallel 500 kilowatt converters.

The way that's been -- it's designed that way so that if you have any single component failure in there, the converter will continue to function at half capacity. So you don't have a blackout in terms of your power transmission capability, it's just halved until you get that converter or that component replaced.

And I guess while I'm on that topic, the converters are also being designed so that when you do have to replace one of those components, it's extremely easy to do. You can take the converter down, open it up, pull out a card, put in a new card, power it back up and you're good to go. So that's where this 500 kilowatt threshold comes from.

So this is the failure mode of the 1 megawatt converter. That failure mode can supply 60 percent of the rural utilities participating in the PCE Program. The full 1 megawatt converter can supply 76 percent of the utilities.

And then these two are monopolar systems. So you have a plus-50 kilovolt wire transmitting power, and then you have either a ground wire, if you have a two-wire system, where you have an earth return circuit.

If you switch to a bipolar system so now you're running plus-50 kilovolts, minus-50 kilovolts, now you have a 2-megawatt power transfer capability. And that would be this line up here, and that's serves 82 percent of the rural utilities in the PCE program.

And as you can see looking at the curve, if you wanted to try and increase that above 82 percent, you're going to have to get really big really fast because now you're getting into the hub communities, the Nakneks, the Barrows, the Nomes, places like that. So.....

MS. DENALI DANIELS: Is this the time for questions, or do you have another slide?

MR. JOEL GROVES: Yes, it is. No, I believe this is -- this is a time for questions.

MS. DENALI DANIELS: Go ahead.

MR. JOEL GROVES: Yes.

MR. KENT GRINAGE: How about if you're picking up more than one village.....

MR. JOEL GROVES: Yeah, if you're picking up more than one village.

MR. KENT GRINAGE: .....from the same source?

MR. JOEL GROVES: Yeah, you're going to -- I mean, if you look at -- a good example of that might be the Naknek geothermal system that's reaching out to 25 villages, which I believe I have a picture of. Aha, look at that.

So if you look at this leg down here, here's a branch sort of like what you're talking about. And you'd have to look at the, you know, what's the people of Pilot Point and Egegik and -- well, I guess it's really just those two.

And in most cases, I mean, this is going -- this is going to be a project-specific determination. But in most cases, those two villages or those five villages are going to total less than 1 megawatt, so, you know, a 1 megawatt system for those is going to be fine.

If you look at this on a more general level, the technology that we're working on right now is sort of the branches of the tree. You know, you can imagine -- I don't know if this is a very good picture of a tree, but the trunks that you have -- well, actually, it is. I mean, you might have between Naknek and Dillingham, you're going to have a fairly -- you're going to want a fairly large power transfer capability that will probably exceed even the 2 megawatt bipolar, and there might be enough intermediate loads along there that you might do that with an AC intertie.

But these loads that are going way out to Togiak, Twin Hills, are going down to Pilot Point or other sort of feeder lines that go out, the 1 megawatt system can use -- can serve.

MS. DENALI DANIELS: Eric, did you have a question?

MR. ERIC MARCHEGIANI: Kind in relation to what your question is, Kent. You had mentioned that, okay, you lose the unit, you know, basically you can take it out, put in the other unit, okay, to replace it.

MR. JOEL GROVES: Yeah.

MR. ERIC MARCHEGIANI: Is it also possible to add another unit; in other words, can you go 1 and a half to 2?

MR. JOEL GROVES: Uh-huh.

MR. ERIC MARCHEGIANI: So it's just a matter of adding that increment so you could basically modularize basically the section, whether it's to Dillingham -- maybe Dillingham is, like you said, needs to be AC.

But, theoretically, let's say it was 2 and a half megawatts that you needed to push to Dillingham, then you add just three more to your two that you have, you've got basically two and a half, and now you can push two and a half to Dillingham.

MR. JOEL GROVES: And that's exactly right. This is a very modularized design so you -- in a sense you have these 500 kilowatt blocks that you can stack together and there's -- you know, there will be some mechanical design involved in repackaging it for that, but that's a fairly minor issue.

Another -- you can -- you know, so that would basically be increasing -- you'd be holding at 50 kilovolts and increasing the current throughput on the system. If you recall back to the slide with the little stacks that I showed earlier, you can also adjust the voltage on this system.

And at some point, if you really went beyond what we're talking about now, you might start -- you know, you might end up with a more cost-effective series of components on that including more expensive redesign, but within reason you could probably bump this up to a higher voltage. You might reduce the voltage if it made sense for some reason. So it's also modular in that capacity too.

MS. DENALI DANIELS: Should we go back to that other slide?

MR. JOEL GROVES: Probably. That was just a convenient.....

MS. DENALI DANIELS: Do we have other questions? I had a question but it escapes me at this point.

MR. JASON MEYER: Joel, do you have any specific feedback that you're looking for at this point.

MR. JOEL GROVES: Oh, I guess, on this issue right here, you know, when we put a white paper together on this, it's not going much more than what you just saw.

So the question is here is, is there a strong feeling that this is, you know, the right size or this is the wrong size? We feel pretty confident that the 1 megawatt unit at this stage in the commercial develop of this technology is the right way to go.

MS. DENALI DANIELS: Brent and then Ingemar.

MR. BRENT PETRIE: Question. Have you looked at the applicability of inverters that might be in wind turbines today? And there are -- some of the direct drive turbines generate AC, convert to DC, and then convert back to AC, and it can be 50 hertz or 60 hertz. And, you know, they vary in size from 100 kW to 1 and a half megawatts. Might any of those be usable?

MR. EARLE AUSMAN: That's where I started out. In fact, that's where I started out with Princeton; they were talking about providing wind turbines and so forth.

But we're working with a higher voltage, the necessity of a higher voltage, and that changes the entire paradigm. They're not working at those kind of voltages, so our case is completely different.

There's another thing about DC. DC has the capability of feeding power into a fault. In other words, for example, for some reason whether you have a voltage drop because of the inability of one of our engines on one end to provide enough power to the community, and rather than the whole thing going out, the DC can continue to provide power without necessarily going offline, which is what happens in the United States except when there's DC. DC is unique and that's why it's tying together the United States like stitches in the center of the United States. There's no other way to do it.

MR. INGEMAR MATHIASSON: I understand this is a scalable design then, right, under converters.

MR. JOEL GROVES: Uh-huh.

MR. INGEMAR MATHIASSON: So I was just thinking in terms of if a lot of villages get tied together and the electricity rate actually falls, people have a tendency to use more. So I'm just wondering if you're taking in account what kind of percentage -- how it would grow if people had lower cost elec --

MR. JOEL GROVES: Yeah, and I guess the answer to that would be obviously a case-by-case situation. But when you look at how many of the villages are -- you know, let's say it doubles. You know, people start moving into space heating or something like that if the economics are there to displace diesel in that capacity, and let's say that the load doubles, and, you know, okay, now you're 1 megawatt unit is -- goes from meeting 76 percent of the villages down to 60 percent and it -- you know, it's going to be a case-by-case analysis. And, again, the modular design can scale to that incrementally in the future, but I think, you know, from where we're at today it's pretty.....

MR. EARLE AUSMAN: There's another option we have of this and it's not readily apparent because we don't think of power systems in this regard, but these things are modules.

So we can take out this module and put it over there and put another module over here so we can actually raise the power level or reduce the power level as appropriate for the particular situation and use the unit someplace else.

And the only fly in the ointment, of course, is some of the interconnections to the existing switch gear and things like that which are relatively minor and the capacity of the transmission line.

In a general sense, we're running our transmission lines at a very low loading, extremely low loading so they have the ability to go up. It's 20 amperes on 1 megawatt; that's all it is. It's a household plug-in circuit like in your house and you've got a megawatt right there.

MR. ERIC MARCHEGIANI: I don't think there's a real challenge with the price coming down so far that there's going to be a lot of extra usage.

The first thing you want to think about is, is that I'd say 95 to maybe 99 percent of those communities out there are getting PCE. And they're only getting PCE on, what, the first 450, if I'm right, 500?

Okay. So if they go over the 500, they're going to be paying probably 40, 50 cents a kilowatt hour. Even if you can reduce the cost to get it there, I mean, the cost of generating it still probably is in the 40, 50-cent range. So the likelihood that somebody is going to go over that 500 mark is pretty slim, I think, at least that would my gut level feeling.

MR. INGEMAR MATHIASSON: There is the issue of the communities out there growing. I've been up there in the.....

MR. ERIC MARCHEGIANI: That's true, this growth you could have that.

MR. INGEMAR MATHIASSON: They do double very quick.

MR. ERIC MARCHEGIANI: But up to this point we've had out-migration not in-migration.

MR. INGEMAR MATHIASSON: Yeah, some villages.

MS. DENALI DANIELS: Jerald.

MR. JERALD BROWN: Is it -- I mean, when we're talking about the proper size, is it fair to say that, you know, if you run the test on a 1 megawatt system, that you get the information that you need to produce -- to put in a 5-megawatt system as well, and that the only reason you're looking at the 1 is it's easier?

MR. JOEL GROVES: Yeah, in general, yes. If you wanted to step up to a 5-megawatt system, you're going to have some additional R & D work. It might be as simple as, okay, you stich together, what would that be, ten of these little -- you know, 10 of these modules and you get it -- 10 of the 500-kilowatt modules.

At that point, you might get into a position where it's going to be more cost effective to redesign that system into five 1 megawatt units or, you know, two 2 and a half megawatt units or something like that.

But in terms of the fundamental technology, yeah, it's there, it's proven. You're just going to have to add additional R & D costs to optimize for the 1 meg -- or for the 5 megawatt installation.

MR. MIKE WRIGHT: I guess my thought is that from sizing-wise -- and, of course, I'm here from Fairbanks, so this isn't as big of an issue to us, but you want your project to be a success.

And what's going to make it successful is you're going to have to have a generation source, that the generation source reduction in cost-to-power, plus the cost of running the transmission line to these smaller village results in a lower cost of power, including the capital that they're still going to have to keep in the fuel for backup generation, because if you have an outage, you have an outage and they're going to have to run their backup generation.

So you may as well -- I mean, this is just my input, is I'd go with this 1 megawatt size, find an appropriate place to test it. You test it for reliability of your inverters, reliability of your installation, and you just make your project work. And then you find where that's going to provide the savings, because it may be a 1 megawatt won't work somewhere because the line is so long, you've got the cost of -- it's going to cost just as much as the fuel they brought out there and did their local generation.

So I would say going with the 1 megawatt that you pick, or even 500 kW looks like it picks up 60 percent, but you want to pick one where you think you could be successful, and that's just what I would float out there.

MS. DENALI DANIELS: Any other input on the sizing issue before we move on? Do you feel like you've gotten enough.

MR. JOEL GROVES: Yeah. And I think we're starting to get short on time, so we'll move forward.

MS. DENALI DANIELS: Good discussion.

MR. JOEL GROVES: Yeah. This is some stuff that we've -- this is some of the design parameters we put together for it as part of the Phase I work, and I guess we'll just run through it really quick.

We're looking at an NESC Class B with one inch of radial ice, and that was based on a bunch of information that we did glean in Phase I from the utilities.

And Golden Valley was -- we actually talked to

Steve Hagenson (ph) from Golden Valley -- and got one inch of hoar frost, which was something, or one inch of radial ice equivalent has hoar frost, 120 mile per hour design winds at a 70-foot height.

And then in terms of the ground clearance, we're looking at the NESC ground clearance for 69 kilovolt AC in rural districts, which I think is about 16 feet or so at maximum SAG conditions.

Soils, like I mentioned, the salt-rich, water-saturated, the marginal permafrost conditions are the most technically challenging, in our view, 1 megawatt electrical throughput and 50 kilovolt DC.

And then in terms of some of the other design parameters, I think we've already touched over a lot of these, but I'll just hit them really -- again really quickly.

Modular design, we want to make sure these things are very easy to return and maintain when they do fail. Redundance, so to the extent possible, when they do have a component failure, they can continue to limp along in some capacity.

We want these to be small and light so you can get -- get them -- you know, you get an air cargo like a Sherpa or something like that out to the rural villages, fully automatic, self-diagnosing.

And then in terms of the actual electrical performance, we want them to be able to deal with unbalanced phases on the input and the output size, bad power factor, all the rest; that's very common in the villages. And the technology that's been developed so far in Phase I is conducive to all of the above.

This is another thing that as we start to develop some of the specifications with Princeton for the Phase I converter, I think we'll want to bring some of that forward to the SAG, you know, through ACEP and the Denali Commission to get formal feedback on that to make sure that a lot -- a lot of these issues are -- you know, to the extent that the SAG can weigh in on those are appropriate.

MS. DENALI DANIELS: When do you think that might occur?

MR. JOEL GROVES: This will occur -- thinking through Princeton's schedule, I think in the next two months we'll start to see some of the specification documents coming out of Princeton.

And then on the first item, the sizing issue, I don't know, I mean, do we even -- maybe we don't even really to need to come out with a white paper and go through a written review of that. We can just call that resolved at this meeting. I don't know if there's any.....

MS. DENALI DANIELS: I didn't hear any folks in opposition to the one -- there's no need to process.....

MR. JOEL GROVES: Yeah, I mean, it's just a paperwork that no one really wants to deal with, so.....

MS. DENALI DANIELS: I do the design parameters, that could be a real important and critical piece to get feedback from folks on. And so we'll have to rely on technology to get the information out, and hopefully folks aren't busy fishing this summer when we have requests for your feedback. Is there anything else on the design parameters?

MR. JOEL GROVES: I don't believe so, no.

And then so on the code issues, I think I already -- the two major code issues that we've identified, you know, using the single wire earth return circuits and shallow burial for overland cables.

Already in this meeting we've identified some homework that we have to do or that we should do.

And then as we go forward, there may be other opportunities or, you know, issues in the code that may warrant some review. We'll bring those to the SAG as they come up.

And, then again, the key thing that we'll articulate in this white paper is how do we develop a plan to achieve those code modifications and the industry support that we need to make those happen, and we'll articulate that going forward. So I don't -- and I think that is, yeah, all on that one. So this one is going to be a little bit farther out.

MS. DENALI DANIELS: If there's no objection, I'd like to maybe use the balance of our time to talk about that process, because I do think it could be a long process and we want to make sure that it's well thought out so folks are comfortable, you know, proceeding with a particular position.

I guess I would maybe go back, Joel, to the original reasons why these codes are the way they are today. And I guess I'm wondering do we feel like -- do we still have folks on line?

MR. JOEL GROVES: Tom, are you still there?

MR. TOM LOVAS: Yeah, I'm still here. There was a little break for a little bit.

MS. DENALI DANIELS: Did we lose.....

MR. ERIC MARCHEGIANI: How about this gentleman from MEA?

MR. PRIZIKAM MINGARAJ: Yeah, I am able to hear.

MS. DENALI DANIELS: Okay. Well, moving on, I guess I would like to pose the question to not only Joel but also to the group, the reasons that the codes exist. Do we feel like we have adequate argument for making code changes at this point in time or is there some type of data collection or research just specifically on those issues that may need to take place? And then I'd like to have a discussion about what is the process for code change.

MR. ERIC MARCHEGIANI: Could I jump in? There's two things that I would like to consider. One is, is that the goal here is to get something out in the field as soon as we can. I think time is going by us way too fast. And, you know, the price of oil, I heard somebody say Crowley jacked the price of gasoline by 3 bucks a gallon today. So I don't know if that's really true, but the rural communities are going to really go out of existence if we're not able to implement something soon, a number of them, not all of them, obviously.

So the first thing I would take off the board is burying cable. You know, I'm not -- I'm not against burying cable, but my experience when I worked for AVEC -- and Brent can talk about it -- they basically removed any buried cable they have in their entire system throughout the 53 villages with the exception around airports where they've had to deal with the fracturing and the fighting of the permafrost and whatnot.

And I fully understand that's, you know, maybe something we want to do down the line, but that's one more thing that kind of delays us as far as getting down to where we want to get to put something in the field and have it operational. So I would take that off the table; that would be my first concern and just look at above ground. Let's string the wire, let's do what we need to do to make that happen.

The second thing is, is that the single wire ground was looked at between, was that Napakiak and Bethel back 20, 30 years ago with Alaska Energy Authority. And we got, I think, some type of waiver or exemption.....

MR. BRENT PETRIE: Ten years.

MR. ERIC MARCHEGIANI: Ten years? Okay. We're a small part of the United States, and the rest of the folks as far as code goes, they don't really give a rip about us up here, to be very frank.

Now, we might be able to get some type of waiver or some type of leap, and I don't say that we should not try or not explore it a little bit, but I don't think we want to spend a lot of time. Again, I think we have these rural communities that are really at risk.

And so at the risk of spending additional money to string an extra wire or to basically provide that ground, I'm thinking that maybe we should kind of move on but still kind of still do some research or try to do some backstopping on that issue. That's just my opinion.

MR. EARLE AUSMAN: Good.

MS. DENALI DANIELS: Yes, in the back.

MR. AL NAGEL: Just a short comment on -- a comment on trying to reach back. We're a small part of the United States, that's true, except that the code is adopted here. It's written and it's distributed on a national basis, but the state adopts it in state, so any amendment to that code would happen here.

Now, one of the things -- if I -- while I'm standing, one of the things that I'd be interested in hearing is I hear, you know, we want to explore the code in Scandinavia, the code in Australia, but I have to tell from a code enforcement standpoint, I would really like to hear what the code writers in the U.S. have to say and what IEEE says. Now, again, they're not driver on how we adopt it, but I think their input is important.

MS. DENALI DANIELS: Brent?

MR. BRENT PETRIE: Maybe a question on the adoption process, how does that happen?

MR. AL NAGEL: Well, it doesn't happen overnight, but it's not terribly long. Basically, in this case -- and Earle came to me the last time we adopted the current version of the code, and he made a proposal that we amend the state code. And, quite honestly, we didn't feel comfortable doing it at that point for lack of knowledge on our part and a real grasp of the technology.

So in this case, the commission or Polar or whomever would come to the Department of Labor, propose the code change, why -- give the rationale as to why it's a good idea. We're -- naturally, our main concern is public safety.

So present a case that the technology is safe and no less safe than what the code is written and distributed by IEEE is. Earle, give me half a minute.

MR. EARLE AUSMAN: Oh, of course.

MR. AL NAGEL: At that point, we would go through and we would draft an amended code, a local amendment to the code and present that to the public for 30 days; we'll put it out for public comment. We do that both in writing and we present time for public testimony, if that's appropriate. If it's going to generate the kind of interest and public input that we feel a public hearing is necessary, we would hold a public hearing.

We throw it to the department of law for a legal so they can legalize it. Assuming we flow through all those things, and we're looking at a year process probably, it then goes to the lieutenant governor for signature.

We amend codes in the state by regulation; so it doesn't take legislative action, it takes public input.

MR. EARLE AUSMAN: Al has been very helpful in this whole matter and he said, you know, we could always go with the waiver and then he would certainly entertain that, and he's been helpful in that regard.

And but at the same time -- and Brett can speak more thoroughly about this -- AVEC has been concerned about financing things because what if you couldn't get a waiver?

What you were going to build something someplace and all of a sudden, somebody decided that weren't going to give a waiver, and then introduce an uncertainty.

And so we were presented with a situation where they were telling us we had to have a positive -- absolute positive answer, and he says, well, he's not ready to give it right now. So if we were sure that we could go ahead, that might satisfy, of course, AVEC and then other people who are also concerned about using this technology and all of a sudden find out that they spent all this money and nothing happens, they can't use it.

MS. DENALI DANIELS: Sure. I'm going to actually respond to that and then I think both of you have something to say, and we're almost out of time.

I think it goes back to my question about addressing the reasons that the code exists. And I think my questions are the same; you know, how do we know that the public safety issues, you know, have been addressed or, you know, there's an argument that can be made that they're not an issue in the cases that we're proposing.

And I can tell you that from the commission's standpoint, I don't personally have a comfort level either to, you know, request that my boss go to the department of -- you know, and make that request either if it's in conjunction with our funding.

So I think that's the next step. I'm not really sure what the process would be to do that, but I think we need to put that on our priority list to articulate that a little bit clearer. Brent, and then back to Al.

MR. BRENT PETRIE: And as you look at possible applications or demonstration sites, I would encourage you to look at, you know, a bipolar system. It does meet some of the criteria, it removes a number of uncertainties.

It removes the uncertainty over needing code waivers or code amendments or a single wire earth return. It is an accepted technological method of moving direct current power, and, therefore, it's also a financeable -- likely a financeable type of alternative.

What we would be working with here would be the smaller size inverters, and it would be, perhaps, a maybe some expedited way to test that smaller size inverter.

We would be removing some other uncertainties in the process, just a suggestion. There may be cases out there that you could find where that kind of application might be appropriate, and maybe we could get -- we could move forward with that type of pilot project.

MS. DENALI DANIELS: Back to Al.

MR. AL NAGEL: Just very briefly. In your controlled circumstance, we're going to look upon a variance for that set of circumstances much more favorably than if you come to us and say, yeah, we want to run out of Bethel and go to these 15 villages. So just a comment in that regard.

MS. DENALI DANIELS: Can I ask a question just by way of process? If the Stakeholder Advisory Group were in agreement on the language maybe that were forwarded to the department, would that be something that maybe would add more.....

MR. AL NAGEL: Absolutely it would. Anything that you can give me at the end of the day that shows it meets the aim of -- and, again, being in a controlled circumstance, that adds a lot, because once we have success in that arena, our comfort level gets better just like anything else.

MS. DENALI DANIELS: So this group will meet again in December 2010. At that point, if we have something a little bit more refined, in terms of a timeline, we would be looking about a 12-month process from that point forward.

MR. AL NAGEL: To do a code amendment, a variance, depending on the amount of information that comes with the request itself, I generally tell you that it takes me about ten days.

MS. DENALI DANIELS: And that would be in conjunction with a specific project?

MR. AL NAGEL: Yes, ma'am.

MS. DENALI DANIELS: Got it, okay.

MR. MIKE WRIGHT: I would tend to agree. Why muddy the waters with the single wire earth ground? At the same time, improve up the inverter technology, do the two-pole. You can get the project rolling right away.

At the same time, then you could be applying for the process to get a -- instead of a variance, a permanent change to the code if that proves applicable.

And seeing as that this will probably take funding of a grant nature, it still should be savings over, according to this report, of doing the three-phase transmission and that -- then you would -- you could just move right on forward with the project somewhere, get it put in place, prove the technology, and then hopefully get the lesser cost of a single wire earth ground in the future.

MS. DENALI DANIELS: Okay. Jerald.

MR. JERALD BROWN: I just want to follow up on that. Is there anything with the single wire earth return that we need to study on this phase of it that's really important or is it the scaled-down -- the 1 megawatt versus the thousand megawatt system? Is that what's most important.

MR. JOEL GROVES: Well, we're only looking at the 1 megawatt. The thousand megawatt is, you know, existing stuff out in the lower 48 or the rest of the world. So up here, we're really looking at the 1 megawatt.

And that is the key question is, is there anything we need to do in Phase II, the work we're doing right now, to add data to the question of doing we want to do a code change or a local -- a State of Alaska code amendment? You know, and that's something that I think we're going to need to -- we have some homework to do so we can bring it forward to the SAG. You know, here are the questions that we think need to be answered. Are they the right questions, and here's how we're going to go about answering them. And I don't have that for you today.

MR. TOM LOVAS: This is Tom. I've got a question. Aren't there any waivers or any actions or administrative actions that need to be taken in order to allow a demonstration of the single wire return -- earth return?

MR. JOEL GROVES: Yes, there are.

MR. TOM LOVAS: Okay. I think there's a correlation there in what's granted for that to where it would go into the future as well.

MR. JOEL GROVES: Yeah, and Al Nagel with the Department of Labor did speak to that a little bit.

MR. MIKE WRIGHT: The National Electric Safety Code -- I would not do anything outside the lines of the Natural Electric Safety Code because your risk is way up there, and if you could go down the route of proving this out within the code but at the same time changing it, you -- I mean, just from a risk averse position, that would be the path I would take.

MR. DANIEL GREINER: I just have one comment. You had asked a couple of times about what was the reason behind the code. And from my perspective, the code -- everything that's in that code is related to safety. And the resultant language is from actual situations that have occurred in the past.

So and then to address the bipolar construction, I realize that the modularity of the converter or the inverter is a big attraction for dependability, but if you're using a single wire over immense distances like we have in Alaska, I would be concerned with if that's the one weak point in the system, if that line breaks, it doesn't matter whether you can use half of your DC power conversion process or not, you're not going to have any power.

And having lived in Alaska all my life, like most of these people here, we all know what Mother Nature can do out in the middle of nowhere.

When I lived in Juneau, we had three transmission columns go out. And before they could get repaired, we were paying instead of 150 a month, 750 a month for our electricity, so.....

MR. JOEL GROVES: And, of course, that's true.....

MR. DANIEL GREINER: It's a consideration for the bipolar system.

MR. JOEL GROVES: Yeah. And, of course, that's true of any transmission system you put in out there.

MR. DANIEL GREINER: But if you're down to one -- if you have two, then you can use one. If one breaks, you still have the other one.

MR. JOEL GROVES: That's true.

MR. DANIEL GREINER: If you have one line and it breaks, you're done until that thing gets fixed.

MR. JOEL GROVES: Yeah, that's true. And that's -- you know, that's something with the bipolar system, you know, depending on the design or the reliability of that line, you may actually even move into two separate monopolar, you know, single wire things because, you know, they're not two wires on one pole; you lose the pole, you lose the whole system anyways. And that's going to be a project-specific analysis.

MS. DENALI DANIELS: Thank you. Go ahead.

MR. EARLE AUSMAN: We can give -- we'll provide illustrations of very large systems that utilize single wire ground return either part-time or sometimes full-time. So it's not -- it's not at all unusual in among the big power transmission.

It isn't a safety problem. It doesn't -- it's not a safety problem. We wouldn't do anything that was unsafe. That's why they allow it to operate on emergency conditions.

For example, we've got a 3,000 megawatt line that's hauling power to southern California, and they've got an inverter down on one side. And so they can go on to monopolar and have been running on monopolar for a long time.

And they have designed their returns -- their return grounding systems in such a way one is in the ocean and the other is on a hillside near the Columbia River, and they've designed their grounding system so they can do that.

And the National Electric Safety Code allows that to be done under emergency conditions. They don't want it as a general case because you're going to cause corrosion of pipelines, railroad tracks, and other things like that. It's mainly an economic problem; it's not a safety problem. We're talking about an economic problem in the South 48; it's a different set of circumstances, and over all the world, for that matter.

MR. DANIEL GREINER: So there's no safety concerns with it?

MR. EARLE AUSMAN: Pardon?

MR. DANIEL GREINER: There's no safety concerns?

MR. EARLE AUSMAN: No. No, in fact, there's an unbalance in the DC systems. Even the bipolar and the unbalance is in the order of a number of megawatts. So there's a lot of amps flowing into the ground system that are going all the time into that ground system on the DC intertie that runs the Celio and Sylmar and long distance all the way through California and all the way from Washington. So there say huge imbalance on that system.

MS. DENALI DANIELS: Now we're going to wrap things up.

MR. INGEMAR MATHIASSON: If you have -- if you compare the two systems in just looking at just the effectiveness, which one is more effective in losses, one wire in ground or two?

MR. EARLE AUSMAN: It doesn't really make any difference. The advantage of a two-pole system is you can keep the voltage lower, you can cut the voltage in half.

If you go with a single-pole system, you have to increase the voltage by two if you're carrying the same number of amperes and using the same conductor system.

So on big systems, it's bipolar because -- because -- and why we looked at it for Snettisham, for example, why we wanted to put it into Snettisham was because it got -- it brought us reliability; we could increase the reliability significantly over any other system.

Essentially we were building two parallel lines that weren't in the same place, and that was a huge advantage to that. Unfortunately, it wasn't built -- or unfortunately for southeastern in wasn't built, and for the rest of really in the long run.

MS. DENALI DANIELS: Thank you, Earle. We want to thank Joel and Earle for all of their work on pulling things together for today's meeting. I also want to thank Jason and other folks from ACEP that have been working really hard on the Emerging Technologies Program in general.

We are ten minutes after, and I think we did start about ten minutes late. So I am going to recommend that next meeting we schedule two hours just so -- it sounds like, you know, there's a real desire and appetite for ongoing discussion, and I feel like we've gotten a little bit cut short.

It sounds like, just back to this code issue, that there are a lot of maybe case studies that could be dusted off and pulled together in some kind executive document, and we will have that as a chief agenda item at the meeting in December and have this group weigh in on comfort level at that time.

And I would say from the Commission's perspective, we will look largely to the advice of this group to give us guidance as a federal agency on whether or not to proceed with our partners at the state on some recommendations or whether we're going to hold off if we're not ready. That's really how we're going to handle things.

So in the meantime, everyone have a wonderful summer, and I'm sure we'll be seeing all of you at some point back at the conference and other places.

But please be watching your email for updates, and we'll try and give you a good, you know, two-week window to review things to accommodate fishing schedules and the like.

And, again, it sound like there's a lot of interest around this technology. It could revolutionize rural Alaska, and we really appreciate all of your participation on this group. So thanks again. And with that, we're adjourned.

(Off record)

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TRANSCRIBER'S CERTIFICATE

I, Lynn DiPaolo, hereby certify that the foregoing pages numbered 2 through 72 are a true, accurate, and complete transcript of proceedings of Stakeholder's Advisory Group First Meeting, April 27, 2010, transcribed by me from a copy ofthe electronic sound recording to the best of my knowledge and ability.

May 26, 2010 May 26, 2010

Lynn DiPaolo
Lynn DiPaolo, Transcriber

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