Stakeholder Advisory Group

Policies and Procedures

The Stakeholder Advisory Group (SAG) is an advisory body comprised of representatives of Alaska’s rural electric utility industry and related professionals. The purpose of the SAG is to provide comments, feedback, review, and recommendations to the High Voltage Direct Current (HVDC) project, awarded by the Denali Commission (Commission), managed by the Alaska Center for Energy and Power (ACEP), and contracted to Polarconsult Alaska, Inc. (PCA).

Formation
To maintain independence of the SAG, ACEP shall identify members for participation, with consideration of recommendations from PCA and the Commission. A final candidate list shall be sent out for comment to PCA, and forwarded for approval to the Commission by April 10th, 2010.

Scheduled Meetings
Per the scope of work under Contract #10-0055, the SAG will formally convene three times over the course of the HVDC project. Per the scope of work and budget, the cost of convening these meetings will be the responsibility of PCA. Funding for Member travel and participation costs is not available. The meetings will be convened in a manner conducive to remote participation of Members. The anticipated meeting dates are:


The agenda for these meetings shall be set by ACEP, with input from PCA and the Commission, with final approval by the Commission. ACEP reserves the right to convene extra meetings as necessary, with input from PCA and the Commission, and final approval from the Commission, as budget and scope of the project allow.

Organization
The SAG shall consist of the Chair (the Commission) and Members. To maintain equity on the SAG, individual organizations may hold only one member position. Up to 30 SAG Members will be allowed, the final number determined based on the level of interest. If at any time over the course of the project, one of the Members resigns or is no longer active, ACEP will invite another individual to fill this position, with the approval of the Commission. Members may designate proxies from within their organization to attend meetings.

ACEP encourages organizations and individuals not selected for the SAG to informally participate in this project. Public comment is always welcome and an e-mail list and forum will be made available on the ACEP project website.

Communication
At certain project milestones, or upon recommendation from ACEP, PCA shall solicit comments, feedback, review, and recommendations to the HVDC project. All formal communication between PCA
and the SAG shall be through the Chair, with inclusion of ACEP. PCA is free to contact the whole SAG formally, or contact individual SAG members informally, as need arises. All informal communication will not represent the advice or recommendations of the SAG. In the interests of promoting maximum feedback from the industry, confidential communications will be accepted where there is a demonstrated need to maintain confidentiality.

**Termination**
The SAG shall be formally terminated upon the end of the award issued from the Commission.
Background Information

The purpose of the Stakeholder Advisory Committee (SAG) is to provide independent comments, feedback, review, and recommendations to the High Voltage Direct Current (HVDC) project, awarded by the Denali Commission (Commission), managed by the Alaska Center for Energy and Power (ACEP), and contracted to Polarconsult Alaska, Inc. (PCA).

The HVDC project seeks to investigate the possibility of applying HVDC transmission systems to remote Alaskan applications. HVDC technology has the potential to significantly reduce the cost of remote Alaskan interties, reducing the costs to interconnect remote villages and/or develop local energy resources. Such interties would help to lower the extreme energy costs common in many villages. In addition to capital cost savings, HVDC interties also permit asynchronous interties and long-distance overland or submarine cables. These unique attributes make HVDC very attractive for many remote Alaska applications.

The Commission previously funded Phase I of this project which included feasibility analysis of the proposed HVDC system and construction and testing of a prototype 250 kW 12.5 kV HVDC converter to confirm that the technology meets key performance benchmarks. Phase I was completed in 2009 and the final report is attached.

Phase II of the HVDC Transmission System project includes design, fabrication and testing of fully functional prototypes of the converter system and transmission system elements. This effort will validate the design and functionality of these systems, and will also validate the efficiencies and feasibility necessary to make HVDC systems successful in remote Alaska intertie applications. The information gained in Phase II shall be used to further develop construction cost estimates and refine the economic analysis of the technology developed in Phase I.

Role of the SAG

The SAG is to play a very important role in this project. There are many challenges to implementing HVDC technology in rural Alaska; the input and involvement of Alaska’s rural electric utility industry and related professionals is invaluable. Specifically, the SAG will provide independent professional advice, comments, feedback, and opinion to various technology, policy, and other project topics. Feedback from the SAG may also be used in project scoping.

Some topics that will be put to the SAG include:

- Examination of current Alaska electrical codes. Given the potential of HVDC technology and the unique conditions in Alaska, do they merit modification? What information, testing, or demonstration would be needed to justify code modifications?
• What are the envisioned regional interties or local energy resources that lower-cost HVDC interties might enable? How much power would these HVDC interties move?
• What lessons do existing interties and utility experience offer for design, logistics, and construction of HVDC interties?
• What are potential sites for possible Phase III demonstration activities?
• Feedback on transmission system and component design and demonstration.
• Feedback on project scoping questions, such as appropriate size for converters.

Design of the SAG

The SAG will be chaired by the Denali Commission, and consist of up to 30 members. The SAG will meet formally 3 times over the course of the project (January 1st 2010 – October 3rd 2011), tentatively scheduled for around 4/29/2010, 12/1/2010, and 7/15/2011, to discuss project issues and provide formal feedback to the project. These formal meetings will take place in Fairbanks, Anchorage, or at another convenient location, and also be teleconferenced. The project budget cannot support travel costs or per diem at this time.

Outside of these formal meetings, the SAG membership will receive periodic communications, project updates, questions, or requests for feedback via an electronic mailing list. ACEP and the Denali Commission understand the work load and individual commitments of the SAG membership, and will keep communication and requests for feedback to a respectful level (estimated to be once a month).

SAG Candidate Organizations

The following organizations have been invited to participate:

Alaska Energy Authority  Kotzebue Electric Association
Central Council of Tlingit/Haida Tribes of Alaska  Matanuska Electric Association
Alaska Village Electric Cooperative  Golden Valley Electric Association
Inside Passage Electric Cooperative  Nome Chamber Of Commerce
Alaska Power and Telephone  Bering Straits Native Corp
North Slope Borough  Bethel Electric Utility
Naknek Electric Association  Alaska Department of Labor
Copper Valley Electric Association  Alaska Power Association
Homer Electric Association  Institute of Northern Engineering, UAF
USDA-RUS  Cooperative Research Network, NRECA
Nome Joint Utilities  Northwest Arctic Borough
Kodiak Electric Association

Further organizations may be invited, per the recommendation of the SAG or invitation from the Denali Commission.
The objective of today’s meeting is to introduce the HVDC project to the SAG, establish the role of the SAG in the HVDC project process, establish policies and procedures of the SAG, and to introduce several initial items for comment and feedback from the SAG.

3:30pm  Introductions
3:40pm  SAG Role, Policies, and Procedures
3:50pm  HVDC Phase I Project Overview
4:05pm:  HVDC Phase 2 Project Framework
4:20pm  BREAK
4:30pm  Overview of initial items for comment and feedback
   1)  Phase II Transmission System Sizing
   2)  Alaska State Electrical Code: HVDC research and information needs
   3)  Criteria for Phase III Project Location(s)
4:40pm  Findings of Transmission System Sizing Analysis
4:50pm  Closing Q&A with the SAG
   1)  Call for information and experiences on Alaska transmission
   2)  Instructions for feedback and comments

The Performance Period of Phase II is January 1st, 2010 through October 3rd, 2011.

The SAG is scheduled to have 3 official meetings. This meeting is the first, with future meetings tentatively scheduled for December, 2010 and July 2011.
HVDC Transmission for Rural Alaska

STAKEHOLDERS’ ADVISORY GROUP
FIRST MEETING
April 27, 2010
FAIRBANKS, ALASKA

Joel D. Groves, P.E.
polarconsult alaska, inc.

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HVDC Transmission for Rural Alaska

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MEETING GOALS

1. HVDC PROJECT OVERVIEW
2. ROLE OF THE SAG
3. SAG INPUT TOPICS

hvdc overview – the goal

➢ REDUCE REMOTE AK ENERGY COSTS

➢ Provide a lower cost, technically superior remote Alaska power intertie option
➢ Enable villages to form micro grids and
➢ reach out to local energy resources
HVDC – THE TECHNOLOGY

- HVDC is used world wide for large-scale power transmission and linking large grids
- Asynchronous intertie
- Long-distance cables possible
- Long interties are more efficient & less costly

HVDC PROJECT OVERVIEW

- Develop HVDC system for use in Alaska
  - 1 MW HVDC Converter
  - Conceptual intertie designs optimized for HVDC and remote Alaska conditions
  - Gain industry support so Alaska benefits from the technology and investment
  - Clear regulatory impediments

HVDC PROJECT ORGANIZATION

- PHASE I – Prove Converter Technology
  Successfully completed in 2008-09

- PHASE II – Build and Test Prototypes
  Underway, complete in 2011

- PHASE III – HVDC Demonstration Project
  Fully functional HVDC intertie in Alaska
  Location and schedule TBD
PHASE I FINDINGS

- 12 kVDC to 250 kW 3ø 480 VAC bench top converter was successfully built and tested to prove the technology
- Met cost and performance benchmarks
- 56% capital cost savings over AC line costs
- 28% life-cycle savings over AC line costs
PHASE II OVERVIEW

- Design/build/test full-scale prototype converter
- Develop & test conceptual designs for transmission lines
- Test DC SWER performance in AK soils
- Update system economics with Phase II data
- Advance industry support for the system
- Identify project for Phase III – HVDC demo
PHASE II OVERVIEW – HVDC CONVERTERS

- Develop functional and technical specifications
- Design, model converter
- Build, test converter

PHASE II OVERVIEW – TRANSMISSION DESIGN

- Conceptual Design
  Basis Document(s)
- Performance Specification
- Commercial Availability
  - no
  - yes
- Design, Fabricate, Test
- Cost & Availability
  Optimization Possible?

PHASE II OVERVIEW – SWER TESTING

- Install ground return circuit in permafrost soils
- Operate and monitor performance
- Data collection objectives
  - Test grounding site reconnaissance methods
  - Refine grounding system design criteria
  - Construction methods
  - Voltage rise and step potential data
  - Resistivity data
2. PURPOSE OF THE SAG

- HELP THE HVDC SYSTEM BECOME A USEFUL TECHNOLOGY FOR ALASKA

- System Review
  - Design basis and functional aspects
  - Political aspects

- Understand and Support Code Revisions
  - Define code revisions
  - Define actions necessary to build support

SAG INPUT PROCESS

1. PCA and ACEP will issue documents for SAG input
2. SAG members comment
3. PCA and ACEP will incorporate comments
SAG ISSUES

1. System Sizing (1 MW, 2 MW, 5 MW, 10 MW)
2. System Design Parameters
   - Functionality
   - Environmental Loadings
3. Code Changes & Strategy
4. Vision / Applications / Priorities
   - Phase III Project
   - State-wide deployment

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SAG 1 → SYSTEM SIZING

- Review PCE Database for Peak Loads
  - Past 3 years of Monthly Peak Data
  - 176 communities / utilities
- Evaluate Peak Load vs. Intertie Capacity

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1 MW HVDC CONVERTER ADEQUACY TO MEET REMOTE UTILITY POWER NEEDS

- 1 MW HVDC INTERTIE - ADEQUATE FOR 20% OF UTILITIES
- 3 MW BIPOLAR HVDC INTERTIE - ADEQUATE FOR 40% OF UTILITIES
- 5 MW BIPOLAR HVDC INTERTIE - ADEQUATE FOR 60% OF UTILITIES

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### SAG 2 → TYPICAL DESIGN PARAMETERS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Design Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NESC Design Class</td>
<td>Class 9</td>
</tr>
<tr>
<td>Radial Ice</td>
<td>1 inch</td>
</tr>
<tr>
<td>Wind</td>
<td>120 mph at 70 feet height</td>
</tr>
<tr>
<td>Ground Clearance</td>
<td>NESC for 49 kV AC, roads in rural districts</td>
</tr>
<tr>
<td>Soils</td>
<td>Silt rich, water saturated, marginal permute</td>
</tr>
<tr>
<td>Peak Electrical Throughput</td>
<td>1 MV (L MVA)</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>50 kV DC</td>
</tr>
</tbody>
</table>

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### SAG 2 → DESIGN PARAMETERS

- Modular design – easy to repair/maintain
- Redundant – continue operating with failure
- Small + light – air cargo to hush
- Fully automatic – self diagnosing
- Input / output power
  - Unbalanced phases, low power factor, etc.

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### SAG 3 → CODE MODIFICATIONS

- Allow SWER in remote areas
- Allow shallower cable burial in remote areas
- Other?
- Develop a plan to achieve these goals
  - Research or testing?
  - Board or Council Support?
  - Political leadership?
SAG 4 → PHASE III PROJECT CRITERIA

- Demonstrated need/benefit for intertie
- ~ 25 mile intertie
- No loads / potential loads along route
- Road access desirable
- Permafrost country (overhead line)
- Submarine cable portion

SAG 4 → PHASE III CANDIDATES

- St. Mary’s – Mountain Village (25-mi)
  Consolidate duplicate bulk fuel and generation
- Barrow – Atqasuk (75 mi)
  Bring Barrow’s low-cost electricity to Atqasuk
- Southeast (where?)
  Bring low-cost hydro to nearby villages
- Southwest (where?)
  Wind, geothermal, or hydro to nearby villages

St. Mary’s – Mountain Village

Mountain Village
ST. MARY'S
Pilot Station
MARSHALL
25 MILES

polarconsult alaska, inc.
What can HVDC do for Rural Alaska? - Galena Nuclear Plant

KOYUKUK
NULATO
GALENA
RUBY

25 MILES
KALTAG
TO UNALAKEET

polarconsult alaska, inc.

SAG 4 → STATE-WIDE VISION

- Coordinate state-wide energy plan and policy
- Coordinate with regional grid concepts
  Bethel region, Nenana/Bristol Bay, Southeast Intertie...
- Coordinate with major projects
  Donlin, Pebble, Pilgrim Hot Springs, Gas line, Railbelt expansion...

polarconsult alaska, inc.
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.

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

(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 here 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
Marchegianii; 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. 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
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
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
1 developments, wind farms, geothermal, et cetera, et cetera and
2 start to -- you know, start to do things with, let's say, a 1
3 megawatt grid that you just can't do with a 100 hundred
4 kilowatt or even a 250 kilowatt grid; so start to drive those
5 costs down.

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

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

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

24 There's three general situations where you'll
25 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 Tasmanina, 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 capacitor 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
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.
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 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.


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
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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,
1 you stitch together, what would that be, ten of these little --
2 you know, 10 of these modules and you get it -- 10 of the
3 500-kilowatt modules.
4
5 At that point, you might get into a position
6 where it's going to be more cost effective to redesign that
7 system into five 1 megawatt units or, you know, two 2 and a
8 half megawatt units or something like that.
9
10 But in terms of the fundamental technology,
11 yeah, it's there, it's proven. You're just going to have to
12 add additional R & D costs to optimize for the 1 meg -- or for
13 the 5 megawatt installation.
14
15 MR. MIKE WRIGHT: I guess my thought is that
16 from sizing-wise -- and, of course, I'm here from Fairbanks,
17 so this isn't as big of an issue to us, but you want your
18 project to be a success.
19
20 And what's going to make it successful is you're
21 going to have to have a generation source, that the generation
22 source reduction in cost-to-power, plus the cost of running
23 the transmission line to these smaller village results in a
24 lower cost of power, including the capital that they're still
25 going to have to keep in the fuel for backup generation,
26 because if you have an outage, you have an outage and they're
27 going to have to run their backup generation.
28
29 So you may as well -- I mean, this is just my
30 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
1 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.


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
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 of the electronic sound recording to the best of my knowledge and ability.

MAY 26, 2010
May 26, 2010
Lynn DiPaolo, Transcriber
The objective of today’s meeting is to update the SAG on current project status, and to solicit feedback, discussion, and comment on the Phase III Site Selection paper. In addition, specific work group questions will be identified, and work group membership will be selected.

2:00pm  Introductions
2:15pm  Project Status Update and Overview of Phase III Site Selection Paper
3:15pm  Phase III Site Selection Paper; Feedback and Discussion
3:45pm  Work Groups:
        ▪  Code/Policy
        ▪  Funding Strategy
4:30pm  Question/Answer Session, Member Comments Meeting
4:45pm  Next SAG Meeting Discussion and Work Items

The Performance Period of Phase II is January 1st, 2010 through October 3rd, 2011.

The SAG is scheduled to have 3 official meetings. This meeting is the second, with a future meeting tentatively scheduled for July 2011.
HVDC Transmission for Rural Alaska

STAKEHOLDERS’ ADVISORY GROUP
SECOND MEETING
January 14, 2010
ANCHORAGE, ALASKA

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MEETING GOALS

1. PROJECT STATUS UPDATE
2. DISCUSS PHASE III GOALS, SITES
3. FORM SAG WORK GROUPS
4. PROJECT Q & A
5. NEXT MEETING

Project Status – Highlights

- Manitoba International, LTD under contract as specialist HVDC consultant
- Operates Nelson River Bipoles, 2 HVDC circuits (3,400 MW) in arctic climate.
- Operates HVDC Research Centre, Expertise in HVDC operations, hardware, R&D and testing capabilities
- Tasked with technical review, MTDC network assessment, special hardware, cold climate experience, communications, fault detection, and regulatory assistance.
Low Voltage Cabinet

**Weight & Dims:**
63”H x 42”D x 74”L
2,300 lbs

**Emergency Transport:**
CASA-212-200

**Cooling**
Forced Air

---

High Voltage Assembly

**Weight & Dims**
62”H x 36”D x 127”L
4,900 lbs (wet)
2,100 lbs (dry)

**Emergency Transport**
CASA 212-200

**Cooling**
Coolant is Luminol TR/TRi
Pour Point -60C
Flash Point 170C
Natural Oil Convection
Project Status – Intertie Control

- Phase III Demo Controls
  - Phase III demo will be point-to-point
  - HVDC power regulation by DC line voltage
  - Communications desirable for control and fault detection
  - Communications necessary for load shed

- HVDC Vision for Alaska = MTDC Networks
  - More work is needed to define control schema

Project Status – Overhead System

- Validated conceptual design
- Foundation design in progress
- Waiting for pricing and product development options from vendors
Project Status – OH Example
GVEA Northern Intertie

- Commissioned 1968
- Guyed lattice, 138 kV
- 1,000’ – 1,200’ spans
- Permafrost soils
- Some frost jacking issues

Project Status – Submarine Cable
Work Plan

- Conceptual materials and design of cable done
- Soliciting budgetary pricing from manufacturers to design and manufacture cable in commercial quantities
- No testing needed in Phase II
Project Status – Buried Cable Work Plan

- Unarmored submarine cable is suitable
- Existing 1/0 35kV AC cable is suitable
- Frost cracking is key issue in arctic soils
  - No proven solution from utility/oil industry experience. GCI doing some interesting work with telecom cables – same problem
  - Evaluating test options and developing test plan

Project Status – Construction and O&M Methods

- Identified existing rigs/equip that can be adapted to construct overhead system
- Working on O&M methods
Project Status – Economics

- Collecting cost data
- Economic analysis will start in Q2 2011

Phase III Demonstration Project - PROJECT OBJECTIVES

- Prove up HVDC Hardware
- Prove up innovative technologies
  - Overhead, overland cable, etc.
- Prove functionality of SWER
Phase III Demonstration Project -
PROJECT CRITERIA

- Transmission only
- Lengths >10 miles
- Load < 1 MW
- Benefit
- Readiness
- Constructability
Request for Input

Phase III HVDC Demonstration Project Selection Criteria and Location

Polarconsult Alaska, Inc. is formally requesting the input of the Stakeholder Advisory Committee. The HVDC Development Program calls for the construction of a functional remote Alaskan HVDC intertie to demonstrate that the technology is commercially ready and appropriate for rural Alaska conditions and utilities. This demonstration project will be Phase III of the Development Program, commencing after the current Phase II effort is completed.

The location for the Phase III demonstration intertie is yet to be selected. Members of the Stakeholder Advisory Group are being asked to provide feedback, comment, and discussion on Phase III demonstration project selection criteria and candidate locations. Candidate interties will be analyzed by Polarconsult over the next several months, and the input of the SAG may be used to develop cost estimates and facilitate project partnerships for Phase III funding.

Please send your feedback and input on these questions to:

Jason Meyer
jason.meyer@alaska.edu
Program Manager
Alaska Center for Energy and Power

Question 1: Demonstration Project Objectives

This project is developing a number of new technologies and innovations in power transmission for remote Alaska applications, and a single demonstration project is unlikely to demonstrate all of them. Accordingly, the demonstration project should focus on the core technologies and innovations that have the greatest uncertainty or risk, or will address the most prevalent problems – these are the technologies that most need to be successfully demonstrated in Phase III. We request your input on defining the demonstration project objectives. We have identified the following:

- The HVDC converter technology and electrical hardware.
- Innovative transmission structures / materials / construction methods. This could include guyed fiberglass poles, overland cables, or other elements of the complete system.
- Single Wire Earth Return.

Please send us your thoughts on what the Phase III demonstration project most needs to demonstrate. This will help us select the right project to prove this technology in Alaska, paving the way to more economical rural interties and more affordable electricity in rural Alaska.
Question 2: Demonstration Project Candidates

Please send us your thoughts on potential intertie projects. Key criteria and some example projects are provided below. Polar Consult will use this feedback in determining next steps for project development, specifically to identify and apply for future funding for phase III.

Demonstration Project Criteria

So what makes a good demonstration project? Here are some of the criteria we will consider:

- **Intertie length.** The cost savings of HVDC relative to AC increase with distance, so longer interties are preferred. Our Phase I cost analysis indicated the breakeven point is at about ten miles so as a general rule, only interties longer than ten miles should be considered.

- **Intertie benefit.** There should be a public benefit from the intertie. The clearest example would be an intertie that connects a community with high-cost electricity to a community with excess low-cost electricity.

- **Constructability.** While the phase II HVDC development effort includes conceptual designs for construction in difficult terrain, it would be beneficial for the intertie route to be co-located with a road or trail to facilitate construction, monitoring, and maintenance. Similarly, communities with good airports and reliable barge service will help lower construction costs.

- **System Load.** The HVDC system under development will transmit up to one megawatt of power in a monopolar configuration or two megawatts in a bipolar configuration. In the future, the converter technology can be scaled up to at least 5 megawatts, allowing interties of at least 10 megawatts, but this will require additional converter development work beyond the scope of Phase II. Accordingly, interties of less than two megawatts are preferred for the Phase III demonstration project.

- **Project Readiness.** Our goal is to build the demonstration project as soon as is practical, so this HVDC technology can be commercially proven and deployed to help alleviate the energy crisis in remote Alaskan communities. Accordingly, demonstration projects with existing easements and that avoid significant environmental challenges are preferred.

- **Transmission Only.** This HVDC technology is suitable for transmission applications, not distribution applications. Potential small customers along the intertie route will not be able to get electricity from the HVDC line unless they purchase expensive converter equipment. Connecting intermediate villages or large industrial customers might be practical, but connections to lodges, fish camps, or individual houses will not be economical.

Some example intertie candidates are presented on the following pages.
Demonstration Project Examples
Below are some example candidate demonstration projects that have been suggested. A brief summary of the pros and cons of each intertie as an HVDC demonstration project is provided for each candidate.

**Barrow to Atqasuk**
This 75-mile overland intertie would connect Atqasuk, which uses high-cost diesel for electricity, to Barrow, which generates electricity from low-cost natural gas. This project could include conversion of Atqasuk to electric heating to achieve greater benefits.

**Nome to Teller and Brevig Mission**
This approximately 75-mile overland intertie would connect Teller and Brevig Mission, which both use high-cost diesel for electricity, to Nome, which generates electricity from diesel and some wind. AVEC is preparing for construction of an intertie between Teller and Brevig Mission. If the Pilgrim Hot Springs geothermal resource is developed and is large enough to supply Teller and Brevig Mission, it could significantly reduce electric costs in these villages.

**Pilgrim Hot Springs to Nome**
The geothermal resource at Pilgrim Hot Springs could provide electricity for Nome. One of the challenges with this renewable energy concept is the cost of the approximately 50-mile transmission line between Pilgrim Hot Springs and Nome. Using this HVDC technology could reduce the costs of this intertie, improving project economics. One potential hurdle for this demonstration project candidate is that the Pilgrim Hot Springs resource may be larger than the two megawatt target capacity for the demonstration project. If the Pilgrim geothermal resource is greater than 2 MW, some additional development work will be needed to increase the HVDC converter capacity. ACEP is currently conducting an assessment of the geothermal resource at Pilgrim Hot Springs, which will help determine how much power can be derived from the resource.

**St. Mary’s to Mountain Village**
This 26-mile overland intertie would connect these two Yukon River villages, allowing AVEC to economize by consolidating bulk fuel and generation assets and operations at one village. There is good access to both villages, and an existing road between them would facilitate construction of the overhead intertie.

**Dillingham to Manokotak**
This 20-mile intertie would connect Manokotak to Dillingham. This intertie would allow the Dillingham and Manokotak electric utilities to consolidate operations, lowering costs in Manokotak and improving the economies of scale for both utilities. Also, Dillingham is currently studying two hydroelectric resources, Lake Grant and Lake Elva, that would provide stable, low-cost electricity. If these projects are built, Manokotak would enjoy significantly lower electric rates with this intertie. An intertie between Manokotak and Dillingham has been studied in the past, but has not been constructed. This HVDC technology could reduce costs for the intertie, improving project economics.
Gustavus to Glacier Bay National Park
With the completion of the 800-kilowatt Falls Creek Hydroelectric Project in 2009, Gustavus now has excess hydropower. The headquarters of Glacier Bay National Park, located approximately five to ten miles from Gustavus, continues to rely on diesel gensets for electricity. Connecting the park headquarters with Gustavus would allow the Park to reduce fuel consumption and operating costs and would allow Gustavus to increase its rate base and power sales, lowering overall rates. A buried HVDC cable would be preferable to overhead AC lines in the park, where aesthetics are a major factor. Due to the relatively short length, an HVDC intertie may not be cost-effective compared to an AC intertie.

Green’s Creek to Hoonah
This 26-mile submarine intertie would connect Hoonah to AEL&P’s Juneau power grid, providing lower-cost power to Hoonah. The intertie is a good length for HVDC, and would provide a clear benefit to Hoonah. The intertie has been under consideration for several years, and significant engineering studies have already been completed. The intertie is uneconomic using AC transmission or existing HVDC technology. This HVDC technology could reduce costs for the intertie, improving project economics.

Petersburg to Kake
This approximately 60-mile submarine and overland intertie would connect Kake with the Petersburg-Ketchikan grid. The intertie would allow Kake to convert from high-cost diesel electricity to low-cost hydro electricity, and would be part of the proposed southeast intertie grid. Using HVDC could reduce costs by allowing longer spans, buried cable, or increased use of submarine cable. While a one megawatt monopolar HVDC intertie would be sufficient to serve Kake, future extension of the southeast intertie to Sitka or development of nearby hydropower resources could increase the load on this intertie to 10s of megawatts.
BARROW – ATQASUK
INTERTIE MAP
(EXISTING WINTER TRAILS ARE SHOWN IN RED)
PILGRIM HOT SPRINGS – NOME
AND
NOME – TELLER
INTERTIE MAPS
(EXISTING ROADS ARE SHOWN IN RED)
ST. MARY’S - MOUNTAIN VILLAGE INTERTIE MAP
(PREVIOUSLY PROPOSED ROUTE FOR AN INTERTIE IS SHOWN IN RED)

DILLINGHAM – MANOKOTAK INTERTIE MAP
GREEN’S CREEK – HOONAH AND
GUSTAVUS – GLACIER BAY NATIONAL PARK
INTERTIE MAPS
(PREVIOUSLY PROPOSED ROUTES FOR AN AC INTERTIE ARE SHOWN IN RED)

PETERSBURG – KAKE INTERTIE MAP
(PREVIOUSLY PROPOSED ROUTES FOR AN AC INTERTIE ARE SHOWN IN RED)
HVDC TRANSMISSION FOR RURAL ALASKA

STAKEHOLDERS’ ADVISORY GROUP SECOND MEETING
January 14, 2011
Anchorage, Alaska

TRANSCRIPT OF PROCEEDINGS

Denali Commission
East Conference Room
January 14, 2011
2:00 o’clock p.m.

APPEARANCES:
Ms. Denali Daniels
Mr. Joel Groves
Mr. Jason Meyer
Mr. Earle Ausman
Mr. David Ausman
Mr. Nels Anderson
Mr. Peter Bibb (Telephonic)
Mr. Jerald Brown (Telephonic)
Mr. Daniel Greiner (Telephonic)
Mr. Kent Grinage
Ms. Marilyn Leland
Mr. Tom Lovas
Mr. Eric Marchegiani
Mr. Ingemar Mathiasson (Telephonic)
Mr. Eric O’Brien
Mr. Brent Petrie
Mr. Brad Reeve (Telephonic)
Mr. Trivi Singaraju (Telephonic)
Mr. Mark Teitzel
Mr. Robert Venables
Mr. Mike Wright (Telephonic)

OTHERS PRESENT:
Ms. Dorothy Anderson
Mr. Leland Johnson
Mr. Albert Sakata
Ms. Marcie Sherer
Ms. Leslie Walls (Telephonic)
Dr. Rich Wies (Telephonic)
PROCEEDINGS

(On record at 2:02 p.m.)

MS. DENALI DANIELS: My name is Denali Daniels. I manage the energy program here at the Denali Commission. I think I’ve met just about everyone.

This is the second of third -- second of three meetings that the Stakeholder Advisory Group for High Voltage Direct Current technology that will take place over the course of the next I guess total 18 months with our last meeting being held sometime in the fall.

For just a refresher, this group is comprised with the primary goal of providing a technical feedback opportunity for Polarconsult as well as the Alaska Center for Energy and Power which is the grantee to the Denali Commission and is conducting some data collection and reporting functions for this grant.

This is a function that is a grant condition that the Denali Commission has with our grant to the Alaska Center for Energy and Power. ACEP in turn has a sub-grant and a direct relationship with Polarconsult. And so just so it’s clear what the protocol, the kind of lines of authority really are, they are from a contractual perspective.

So the Stakeholder Advisory Group was identified in our grant conditions as a manner, a vehicle in which technical feedback could be provided on the technology with the hopes that
the long-term goal of statewide deployment of the best
technology for rural Alaska could be leveraged.

And so I want to thank everyone for your participation
in the last meeting. It was a very good discussion and those of
you that weren’t there we were actually up in Fairbanks you may
recall and I think we did it in conjunction with the Rural
Energy Conference and that was I think a bit of a whirlwind but
we had a great deal of participation and a lot of time has gone
by since then. I know that ACEP and Polarconsult have taken
some of the comments from that meeting and put them into place.

Today’s agenda, we’ll first start with some
introductions in just a moment but let me just kind of review
the agenda. It’s similar to what we did in Fairbanks in that we
have a Powerpoint that we will be getting a presentation from
Polarconsult on the status of the project, things that have
occurred since the last time we met.

If you had a chance to review your email traffic you
will have noticed that one of the next key decisions that
Polarconsult would need to make is with regard to site selection
of a potential demonstration project. I want to be clear that
this group is not in a decision making role on that issue.
However, it is very critical that Polarconsult gets feedback
from this technical body so that they can make the best decision
on next steps and how to move forward.

So once we get through the presentation from
Polarconsult we’ll then go ahead and have sort of a facilitated discussion regarding the technology to date, the information that they provide in their presentation and then, you know, if folks have direct comments that could tie into their decision about what the best site or, you know, components of the technology might be and how that all fits together. For those of you that are on line we actually have some flipchart papers up on the wall and we’re going to try and capture, you know, in bullet form some of the key comments that folks have to provide them with that input.

So following that exercise we’re then going to continue our discussion with regard to some of the code issues around HVDC and deployment in Alaska. And then we will have a discussion about -- and I guess I kind of envision this funding strategy discussion more of a brainstorming session for Polar Consult. One of the issues that I should share is that it’s very unlikely that the Denali Commission will be able to provide funding for Phase III of the project. And so some of the discussion that we’re having here is really geared at positioning the project so that it can be successful in that next phase.

So we’ll have questions and answers and I have a goal of wrapping this meeting up early. So with that did you -- did I miss something.

MR. ERIC MARCHEGIANI: The young lady over hasn’t had
a chance to sign in. Unless you have.

MS. DENALI DANIELS: Oh, thanks. Okay. So I heard several beeps on line and I never quite know how to do this. But I guess why don’t we just go ahead and open it up and for those of you on line if you could just kind of try and take turns and not step over each other and intro -- please note whether -- what your name is, your organization and if you’re a committee member or if you’re just observing.

MR. PETER BIBB: All right. This is Pete Bibb with Inside Passage Electric in Auke Bay, Alaska. I’m just here to listen in.

MS. DENALI DANIELS: Hi, Pete.

MR. PETER BIBB: Hello, panel.

UNIDENTIFIED MALE: Hi, this is.....

MS. DENALI DANIELS: Go ahead.

UNIDENTIFIED MALE: Whoever started go ahead.

MS. LESLIE WALLS: Leslie Walls, ACEP Grant Manager, just listening in.

MS. DENALI DANIELS: Thanks, Leslie.

MR. BRAD REEVE: Yeah, this is Brad Reeve up in Kotzebue.

MS. DENALI DANIELS: And Brad’s a committee member.

MR. TRIVI SINGARAJU: This is Trivi with Matanuska Electric, a committee member.

MR. MIKE WRIGHT: Mike Wright, Golden Valley Electric.
MR. RICH WIES:  Rich Wies, University of Alaska, Fairbanks.  I’m working with ACEP on -- as kind of a consultant on the project.


MR. DANIEL GREINER:  Dan Greiner, State Electrical Inspector, Department of Labor up in Fairbanks, just observing.

MS. DENALI DANIELS:  Anyone else?

MR. INGEMAR MATHIASSON:  Ingemar Mathiasson, Energy Coordinator at Northwest Arctic Borough, Kotzebue.

MS. DENALI DANIELS:  Hi, Ingemar.  And you’re a committee member.

MR. INGEMAR MATHIASSON:  Yes.

MS. DENALI DANIELS:  Who else do we have on line? Okay. Thanks everyone. And just for those of you on line, we do have an individual here taking minutes, the meeting will actually be transcribed. And so as you speak if you could be sure to try and clearly state your name before your comment so that those can be reflected for the record.

Again, my name’s Denali Daniels. I manage the energy program here at the Commission and I’m the Chair of this group.

MR. JASON MEYER:  Hi. My name is Jason Meyer. I’m the Grant Manager for the Alaska Center for Energy and Power. Just to repeat what Denali said and just cover a couple other logistics, we do have a presentation here. If you’re on the telephone and you have not received it let me know and I can
email it to you. We do have somebody transcribing the meeting so people in the room and on line please state your name before comments so we can just accurately reflect that. For people in the room, there’s coffee and water. So thank you.

MR. ROBERT VENABLES: Thanks. My name is Robert Venable. I’m the Energy Coordinator for Southeast Conference and I guess the newest committee member. Thank you for the invite.

MS. DENALI DANIELS: Thanks for being here.


MR. MARK TEITZEL: Mark Teitzel, Alaska Village Electric Cooperative, sitting in for Meera Kohler who could not make it today.

MR. ERIC MARCHEGIANI: My name is Eric Marchegian, I’m with USDA Rural Utility Service and I’m a member.

(Background conversation by attendees on telephone)

MR. JASON MEYER: People on line, if you could also mute your telephones.

MS. LESLIE WALLS: (Indiscernible) mine okay on it I thought. Let me make sure here, hang on. If I didn’t I do apologize.

UNIDENTIFIED MALE: I’m sure it’ll all go.

MR. JASON MEYER: Hey, Leslie, we can hear your phone.

MS. LESLIE WALLS: Sorry.
MS. MARCIE SHERER: Okay. My name is Marcie Sherer.
I’m with Association of Village Council Presidents. So thank you. I believe we’re a member but I’m not sure.

MR. BRENT PETRIE: Brent Petrie with Alaska Village Electric Coop.

MR. JOEL GROVES: Joel Groves with Polarconsult Alaska. I’m the Project Manager with Polarconsult for this project.

MR. EARLE AUSMAN: Earle Ausman, Polarconsult.
MR. DAVID AUSMAN: David Ausman, Polarconsult.
MS. DENALI DANIELS: Do you want to introduce yourself?

MS. DOROTHY ANDERSON: I’m Dorothy Anderson. I’m part of his team.

MR. NELS ANDERSON: Nels Anderson from Dillingham.
MS. DENALI DANIELS: Hi, Nels.

MR. ALBERT SAKATA: Albert Sakata, Consulting Engineer with Sakata Engineering Services.

MR. KENT GRINAGE: Kent Grinage, North Slope Borough.
MR. LELAND JOHNSON: Lee Johnson, LA Johnson Consulting Engineers.

MS. MARILYN LELAND: Marilyn Leland, Executive Director of Alaska Power Association.

MS. DENALI DANIELS: I think we got everyone. Is there anyone on line that didn’t have a chance to introduce
themselves?  Okay.  Excellent.

We are going to dive right into the agenda.  So we have one hour set aside to hear a presentation from Joel from Polarconsult.  I’m just going to turn the meeting over to him.  Please do feel free to ask questions as he is presenting and don’t be offended if I redirect the discussion if it does start to get a little bit off track so we can keep to our agenda.  So with that -- did we have someone else join us on line?

MR. JERALD BROWN:  Yes, this is Jerald Brown.

MS. DENALI DANIELS:  Hi, Jerald.  We’re just getting the meeting started.  If you have the agenda in front of you we’re turning the gavel over to -- not the gavel but the floor over to Joel with Polarconsult.  Do you have a copy of the presentation?

MR. JERALD BROWN:  Yes, I do.


MR. JOEL GROVES:  Okay.  Thanks, Denali.  Yeah, so as I think everyone hopefully knows my name is Joel Groves with Polarconsult, Project Manager with Polarconsult.  I’m just going to give you a brief rundown.  Hopefully I can take less than an hour so we can make sure we get everything -- keep everything moving.

On what we’ve been doing for the past several months on the project.
MS. DENALI DANIELS: Can everyone hear Joel on line?

UNIDENTIFIED MALE: Yes.

MS. DENALI DANIELS: Just want to make sure. Okay.

Go ahead.

MR. JOEL GROVES: This is just a recap of the agenda.

So I’m going to be doing the project status update. I’ll also discuss some of the goals and candidate sites that have been raised for the Phase III project which would be the first operational demonstration of this technology. And then we’ll go into the SAG work groups, project Q and A and then some of the logistics for the next meeting.

I guess certainly top level highlights on the project is we’ve been very fortunate. We’ve been able to bring Manitoba Hydro into the fold on this project. For those of you who don’t know, Manitoba Hydro located in Winnipeg, Canada in the province of Manitoba, they operate two HVDC circuits between the Nelson River hydro projects and populations centers in southern Manitoba in similar climates to Alaska. They’re in permafrost country and whatnot. They also operate a HVDC research center. They do a lot of R and D work on HVDC technology. They’re one of the sort of premier global entities in that regard.

And we contacted them several months ago, sort of brought them up to speed on the project and they actually saw a lot of synergies with what they have tried to do and the scale and focus of this project and what we’re trying to do for rural
Alaska. Interestingly some of the senior people at Manitoba actually tried to do something like this back in the 80s, the late 80s. They tried to do a small scale rural HVDC transmission technology. The technology for the converters to really make that feasible did not exist at that time so their effort didn’t go anywhere so they were actually quite excited when they heard about our efforts up here. And so we’ve been able to bring them in in a consulting role to sort of tap their expertise where appropriate as we move this project forward and then in the long run there’s actually a possibility where they may start getting I guess crown funding where they can actually start to advance some of the R and D on their end as well. And that really hasn’t advanced beyond just, you know, very preliminary discussions yet but there’s a -- sort of a long range -- well, in the one to two year timeframe a possibility for that to happen.

Some of the specific things that we’ve tasked Manitoba with, sort of a top level technical review of the project, the converter specifications and whatnot to make sure that there aren’t any -- anything slipping through the cracks as we develop the converter technology. Look at multi-terminal DC networks. That’s one of the key sort of build out concepts with DC technology. Existing DC transmission systems are point to point, you put power in at one end, you take it out at the other or vice versa. The vision for HVDC in Alaska is you have
multipoint networks. You’ve got five, 10 or more villages on a DC bus and you can have multiple generation sites, multiple load centers and you can start to manage power flow by some economic dispatch model in real time. That’s never been done anywhere. There’s been a lot of theory, there’s actually a lot of global interest in that concept, but there’s a little bit of work between where we are and commercial reality for that. We’ve tasked Manitoba to figure out exactly what needs to be done there, come up with sort of a work plan for that.

Other things is there’s a couple of special hardware items with DC transmission at this scale that don’t exist commercially that we’ve been able to find, DC breakers, some of the voltage -- or surge investors and whatnot. They exist for larger scale systems. They don’t necessarily exist at the current or voltage ratings that we’re developing and we’re having Manitoba help us out on that because this is what they do. If we get into a position where we’re going to need to develop a breaker Manitoba can help us do that.

We’re also tapping their cold climate experience. As I said, they operate DC lines up in arctic climates so they have some experience that they can help us with there.

Communications issues. One of the concepts we’ve looked at is carrier technology where you need SCADA communications for a village to village or multi-village DC grid you don’t really have reliable communications necessarily between the villages
and the best way that we see to implement that is to do a carrier communication line over the actual DC conductor. So they’re helping us develop that as well. That has been done on DC lines in Africa, but again you’re talking large scale DC lines and there’s an economic issue of making that hardware available where it’s affordable on the technology that we’re developing. And then we’re also doing some work on fault detection and some of the regulatory assistance where they’re going to be available as we start talking about code changes and whatnot to bring sort of world class expertise to weigh in on that question.

Just to give folks a recap of what we’re looking at doing, this isn’t the best schematic for that. But what we have is village loads would be down here at the bottom and this is the generating source, this is the receiving village. This is the HVDC converter that the technical -- our technical subcontractor, Princeton Power Systems, is developing.

MS. DENALI DANIELS: Do you want to tell them on line what slide you’re on?

MR. JOEL GROVES: I’m sorry. I’m on the first graphic slide.

MS. DENALI DANIELS: Slide five is it?

MR. JOEL GROVES: I’m glad you’re counting, I’m.....

MS. DENALI DANIELS: On the screen it says. There’s that little box right there.
MR. JOEL GROVES: Oh yes, you’re right, slide five.

MS. DENALI DANIELS: So for those of you on line we are on slide five and we’ll just kind of pipe in.

MR. JOEL GROVES: Yeah. Thank you, thank you. Yeah, so slide five.

UNIDENTIFIED MALE: Thank you very much.

MR. JOEL GROVES: So the lower box -- I’m sorry, I wasn’t even thinking about on line people who can’t see what I’m pointing at. The lower box says that it’s a PPS scope of supply are the actual HVDC converter modules and those are bidirectional one megawatt capacity HVDC converters. They transform between three phase, 480 volt AC and one megawatt 50 kilovolt DC and they’ll either -- they’ll move power in either direction.

Outside of those -- and that will then -- in terms of a physical appearance in a village or an application somewhere that’s going to be -- well, it’s going to vary project by project but for a conceptual basis it’s going to be a 20 by 13 foot prefabricated metal building or prefabricated building. That can be situated next to a power plant or anywhere basically on the village grid and it’ll take three phase AC on one side and it’ll output 50 kilovolt DC on the other side.

Outside of that will be a small switchyard which will include the breakers, fault arresters and whatnot and then from there you’ll have, depending on the nature of the intertie,
either overhead conductors or buried or submarine cables that go off to the next village. And then in the other village you’ll basically have the exact same setup where it’ll take off the DC line and put back into the village grid.

And next slide. The next slide is what that 20 by 13 enclosure would look like and inside you’re going to have four large pieces of equipment. You’re going to have two cabinets and those will do the low voltage switching and power stuff. And then you’ll have two large oil tanks with a bunch of radiators on them. Those -- that is where the high voltage operations will be happening. The oil inside the tank is being used as a dielectric to minimize the standoff distances required between different voltage planes inside the unit and it’s also a cooling medium to help cool down the unit and reject the heat to the environment of the building. There’s four -- there’s two each. The topology of this thing is you have two 500 kilowatt converters operating in parallel which provide some equipment redundancy. If you do have a failure in any -- anywhere in this system you can switch from one megawatt capacity down to a 500 kilowatt capacity until you get the equipment replaced.

Going on to the next slide. This is a isometric model of the low voltage cabinet and this thing -- this cabinet will basically take in that 480 volt three phase AC and it will transform it into 700 volt DC power which will be fed off to the high voltage apparatus which will step that up to a 50 kilovolt
DC. And in the reverse operational mode it’ll be taking in that 700 volt DC and outputting the AC power.

This cabinet weighs -- or -- well, it weighs 2,300 pounds. Dimensions are roughly five feet tall, three and a half feet deep and a little bit over six feet long. This has been configured so if you need to mobilize one of these out to a village if you do have a failure in here you might be able to go in there and swap out a component but we’ve designed this thing so you can just unplug this entire cabinet and the -- you can fit this thing into a CASA aircraft, fly one in, fly one out and it’s very quick to repair and then you can diagnose this cabinet in Anchorage or some other centralized location where you have more specialized personnel to work on it.

Cooling on this thing is forced air so it’s just got a series of fans on it and it’ll reject heat into the environment of the building.

MR. ERIC MARCHEGIANI: What length of strip would a CASA go into?

MR. JOEL GROVES: I’m sorry?

MR. ERIC MARCHEGIANI: What length of strip would a CASA go into?

MR. JOEL GROVES: I don’t have that off the top of my head, not very long. It -- CASAs can pretty much get into nearly any strip in the state, so. And they’re widely available up here and -- so.
MR. EARLE AUSMAN: They can get into all the smaller strips that you can’t put the bigger aircraft in and that’s why we selected it and there’s three or four of them in central Alaska that are available.

MR. BRENT PETRIE: Payload’s about 6,600 pounds.

MR. JOEL GROVES: The oil in here is -- to go into a little bit more detail, it’s Luminol TR or TRI. It’s a fairly standard dielectric oil used in the industry. It’s got a pour point of minus 60, flash point of 170 C, minus 60 degrees Celsius. And everything -- all of the heat transfer and whatnot inside is happening by natural convection so there’s no pumps or anything to fail. On top of the oil you’ll have a -- the cylinder on -- the cylinder on the front of the thing is actually a nitrogen blanket system which will -- I believe helps prevent oxidation of the oil over time and also makes sure that you have enough inert atmosphere in there.

When you do need to do maintenance on this thing the entire top lifts. You’ll break the seal, the thing’s under slight pressure, the entire top will lift and you can -- all the electronics are basically hanging on the lid so you can do maintenance there.

Similar to the low voltage cabinet though we’ve configured this thing so you can fly the entire thing in and out if need be. So this -- the high voltage apparatus, it’s about five feet tall, three feet deep, little bit over 10 feet long.
Full of oil it’s 4,900 pounds so it does still fit in a CASA. Dry, about 2,100 pounds. And that’s the high voltage apparatus. One of the key things with the HVDC intertie is going to be how do you integrate this into the villages and how do you deal with the control issues. For the Phase III project we’re looking for a simple point to point intertie. And that actually -- if need be it eliminates a lot of the more complicated control issues. For a two point DC system the two converters can actually regulate power transfer just with the voltage on the line. They don’t need any dedicated communication circuits. Communications are absolutely desirable if you want to do more sophisticated controls or if you want to be able to detect faults but they’re not critical for the system to work.

You know, typically what you’ll have on a village to village intertie is one village will be generating 100 percent of the load for both villages, the other one will be receiving and these converters will regulate power flow, they’ll maintain voltage and phase tolerances on the receiving village and they’re just another load on the generating village grid. And obviously if you want to start doing something where you’re sharing loads or -- load shedding would be a real critical one where you will need some sort of dedicated communication link to coordinate dispatch. But these would work -- you know, in the worst case you could actually have start and stop buttons on the front of these and you would get on the phone with the other
operator and say okay, push start, and they’ll start and if they
see a fault or something they’ll shut off. But obviously -- so
that’s sort of the minimum functionality. We can go a lot
farther where we start to integrate these things where they’re
fully automatic.

Building out. Like I touched on earlier with the
multi-terminal DC networks, where you want to have multi-
villages and there’s a number of these candidates across the
state. You know, southeast we’ve talked about these. Out in
southwest Naknek had that 25 village grid that they proposed.
If you did that with DC you would need dedicated controls and
communications to coordinate that where you would have multiple
generation assets operating. That might change in time, you’d
have a wind farm somewhere, the geothermal, diesel backup,
hydro, (indiscernible), whatever. You would need some sort of
economic dispatch model to figure out who’s going to generate
what when and then which converters are feeding onto the DC bus,
which villages are pulling off the DC bus. That would only
insert an essential command system to orchestrate all that.

And this is where Manitoba will come in to figure out
what’s necessary to get that to a point where that’s a
commercially viable and ready technology. Like I said, there’s
been a lot of R and D work because there’s a lot of interest in
these types of networks but it hasn’t been done anywhere to date
and it’s not commercially ready today. So Manitoba’s going to
Moving on to the next slide which is slide nine. The overhead system, and I guess I’ll even start at a slightly higher level. We’ve talked about the converters. The next key piece of this is the wire that connects village A to village B. The physical manifestation of that wire can be a variety of things. You can have a submarine cable, you can have a buried overland cable, you can have an overhead line or any combination of those and perhaps something else that wouldn’t fit into those three. I’m not sure what that would be.

One of the key things that we’ve been looking at and developing to help make this project economical or the HVDC concept economical is overhead -- a low cost overhead transmission technology that’s optimized to utilize some of the unique attributes of DC versus AC. And I guess just to give you a brief overview of what that is, is with DC we can transmit with one wire as opposed to three or four with AC, presuming that we have a [good earth return] circuit, but in the worst case it’s one or two wires. And what we can do with that is we can -- instead of going with wooden poles every plus or minus 300 feet between the two villages for an overhead intertie we can go with longer spans because you don’t have multiple wires and the conductor separation issues. So you can go with a -- what we’re looking at is 1,000 foot span with 70 foot tall poles, fiberglass guyed poles so that you don’t have to deal
with some of the foundation issues (indiscernible) which has
been one of the key attributes of the existing interties that
have been built in the state that become so expensive is dealing
with the foundations.

So we’re developing this conceptual design to utilize
these -- you know, utilize the single wire and whatnot to try to
bring the cost of these interties down. Because for any
intertie the cost of building the wire is going to -- is very
expensive and is going to be most of the cost for the project.

So what we’re doing is we’ve pretty much completed the
conceptual design, we know what it’s going to look like. We’re
still working on the foundation designs. One of the key things
we’re trying to do is make the foundations constructible with
fairly lightweight equipment that can get into and out of
villages quickly, can get through the very tough terrain that we
have on the ground, the muskeg, the permafrost soils and
whatnot, and can build these foundations less expensively than
what we’re doing right now.

In terms of some of the components, we’ve talked --
we’ve contacted a number of the vendors, fiberglass pole
manufacturers, lattice tower manufacturers and whatnot. We’ve
given them the design criteria for this conceptual transmission
system and we’re waiting on feedback from them for what of their
existing products will work best, what are the costs on, you
know, let’s say a 25 mile project. And then where their
existing product lines aren’t really optimized for this particular application what would be -- what is sort of the optimal, you know, pole diameter, pole wall, lattice structure for this application and what would the one time development cost for that product be and then what would the per pole cost on -- you know, like the first project order look at those costs. So we’re waiting to get those numbers back. We should have those back in the next month or so hopefully and then we can start to put together what this design will actually look like in terms of cost and in terms of the details of construction and whatnot.

So I guess the other aspect of this is the insulator. We’re also talking to vendors on the insulators to get those specified. Those would be the [post-top] insulators that would go on top of the fiberglass pole that the conductor would attach to.

Moving onto the next slide. An example of this entire concept, pretty good analog of it, is actually the original northern intertie on the rail belt grid that runs from Healy to Fairbanks. It was commissioned in 1968. It’s a guyed lattice tower, 138 kilovolt line, with the similar span that we’re looking at, 1,000 foot span, it’s built in permafrost soils. And this project has been operational and in service or this intertie has been in service since 1968, 42 years, and we’ve talked to Golden Valley a little bit about this and they’ve
actually had very few problems with it. They’ve had a few
problems with frost jacking. Some of the actual lattice towers
-- tower foundations have jacked up and actually caused some of
the guides to snap off as the tension builds. And I guess
they’re now putting breakaways on the guides when they’ve got a
loop and a little clip and as the thing does jack up it’ll just
pop loose.

But this has been a very successful design and it’s
very similar to what we’re proposing for the DC. Obviously the
key difference would be instead of -- well, they have five
conductors on top because they have lightening conductors up
above the three power conductors. But whereas they have five we
would have one would be the key difference which eliminates --
the conductor clashing eliminates the cross arm structure at the
top, eliminates some of the torsion and whatnot on the structure
itself. But it’s a very good example and the best we’ve found
in the state of the type of overhead system we’re trying to
pursue for DC.

MR. MARK TEITZEL: How tall is that typical structure
would you guess?

MR. JOEL GROVES: Earle, do you have an estimate of
the structure?

UNIDENTIFIED MALE: Mike’s on line.

UNIDENTIFIED MALE: How tall is it?

MR. JOEL GROVES: Yeah.
MR. EARLE AUSMAN: They go from about 70 feet up to about 100 feet. And these five conductors are all bigger than what we’re talking about. They’re larger. There’s a 556 Dove on the conductors and ours is half an inch in diameter and Dove is much larger in diameter. So the loading on this is much higher than what we have. Our loadings are lower so we can do lighter things. That’s fairly light. That’s helicopter transportable, that’s all made out of aluminum. That’s aluminum lattice tower and we’re looking at aluminum tower. The lattice is an alternative to the fiberglass.

MR. JOEL GROVES: And Mike at Golden Valley, did you have anything to add on that point or.....

MR. MIKE WRIGHT: No, I think what you said was pretty much accurate.

MR. JOEL GROVES: Good, thank you. Moving onto the next slide, the submarine cable work plan. We’ve identified the conceptual materials and design for the cable that will work for the voltage and current that we’re talking about for this project. And I -- Earle, can you speak briefly to what that is?

MR. EARLE AUSMAN: The conceptual materials that we’re looking at are EPR rubber cable with either aluminum or copper, likely copper because we want the weight, and then using a jacket, a poly jacket, and maybe PVC in some cases and then armoring it. And the armor is actually to lay the cable and in some cases it’s utilized to defend the cable from abrasion from
rocks and so forth like that. And also you add -- added armor on the shore ends because the shore ends are always a potential problem. Frequently you try to dig them in but sometimes you can’t because of rocks and things like that. So you have to -- you just armor them well or you put them in heavier duct, maybe even steel. We can put them in steel duct. In our case because we don’t have alternating current and as such we don’t have any losses in our steel duct when we put it in the water and run a cable through it. So we’re much better off than you can possibly be with an AC system because that induces currents and losses into the steel. So we can do some things that they can’t do.

And there’s some other attacks on the problem we’re looking at that are rather novel so that we can buy materials from the United States instead of buying them from Norway and shipping them all the way around the horn or through the Panama Canal. But we don’t know how that’s going to come out yet. We’re looking into it.

MR. JOEL GROVES: Yeah, we’re talking to cable manufacturers, Okonite and others. You know, give them this -- you know, sort of the conceptual design of the cable and then have them come back to us and tell us what it’s going to cost to make this in quantity and to find -- if there’s going to be any testing required then they would also need to do that testing to make this a commercially viable cable.
I mean there’s similar cables being manufactured today. Primarily they’re for x-ray machines at similar voltage and current for DC does this and obviously an x-ray machine cable does not need to go to the bottom of the ocean so there are some different design constraints there.

In terms of what the cable would look like, if you look at the AC cable that went in between Skagway and Haines that cable was, oh, maybe four inches in diameter, three, four inches in diameter, a fairly large cable and it’s fairly expensive to put down. This cable is going to be more on the order of the telecommunication cables that have gone in around the state, the submarine telecommunication cables, and they’re going to be more in the order of inch and a half or so in diameter.

MR. EARLE AUSMAN: Yeah. It’s 1.75 inches in diameter is the cable we’re looking at and the submarine cable will be slightly larger if we put some armor on the outside, (indiscernible) armor. It’ll bring it up around two inches in diameter. It’s relatively light so we don’t need a great big cable laying machine shipped to deal with it like you do on these -- some of these heavy cables. And if you’re dealing with lead sheath cables you’ve got a real handling problem, you’ve got a real repair problem. These are completely different. It’s more like a larger size communications cable. In fact it’s in the same size range as communications is currently being laid.
on that whole area by GCI and other fiber carriers and they
carry five kilovolts by the way of electricity in those cables.
They’re also DC cables believe it or not even though......

MR. JOEL GROVES: You have power (indiscernible).

MR. EARLE AUSMAN: .....even though they have fiber
optics in them.

MR. JOEL GROVES: Yeah. And, you know, some of the
costs, the recent costs that UUI and GCI and whatnot have seen
on those communication cables are on the order of $30,000.00 to
$50,000.00 a mile. So we expect something similar for these DC
cables depending on if the actual cable cost comes in remarkably
different. So that would be a fairly affordable installation
for submarine applications with the DC.

MR. MARK TEITZEL: But this is a single conductor for
ground return operation or you have two conductors in a single
cable or you run two cables or.....

MR. JOEL GROVES: That would be -- we’re looking at --
and I’m not -- Earle, correct me if I’m wrong. There might be a
concentric neutral that could serve as a return circuit.
Otherwise you could use sea return instead of ground return.

MR. EARLE AUSMAN: If we took conventional URD cable,
underground rural distribution cable, and used what they call
full concentric neutral we could carry back the neutral current,
the neutral current carry back and not have any grounding at all
except for we would have to put grounds of course on each end,
it’s always the case, but we could carry the current back if we wanted to do that. And that’s being done by ABB right now, not in that form but we can use standard stuff and may -- they’ll specialize. Everything they do is specialized and extremely expensive and that’s why the proposal for Hoonah is somewhere up around $135 million or something or $40 million for that particular job. So we are looking at something much less expensive and much lighter than what they’re normally accustomed to.

MR. MARK TEITZEL: Is standard distribution cable insulated for that voltage level if you use the concentric neutral for the.....

MR. JOEL GROVES: I don’t know if the (indiscernible).

MR. EARLE AUSMAN: It would be a modification of it.....

MR. JOEL GROVES: Yeah, yeah.

MR. EARLE AUSMAN: .....actually because you do get what -- you get a voltage rise but fortunately we don’t induce much voltage rise in a DC cable because we don’t have any frequency. So we don’t -- we build a magnetic field one time when there’s current moving and we have the losses but the actual voltage losses are low comparative to the operating voltage of the interior of the cable. And the net result of that is we have very little insulation required on it but nonetheless there are losses on it. You have twice the length
of line is what it essentially boils down to. And you’d like to avoid that if you could with your ground returns because you’re going to build a ground anyway, you have to at each end. You have to stabilize the system.

MR. JOEL GROVES: Any other questions on that point or -- Brent.

MR. BRENT PETRIE: The barge that’s used to place the telecommunications cable oftentimes is the same equipment that’s used to place a power cable and that’s very expensive to mobilize and support. So although material cost for the conductor and the line might be less there’s another element here of the actual equipment to put it in place that still doesn’t change unless the line is quite a bit shorter.

MR. JOEL GROVES: Yeah. And it’s my understanding, I mean because it is a smaller cable than what’s used on the AC interties is that a smaller version of that barge which are more readily available to be used or have a lower operating cost. So we’re using -- at this point in time we’re just using the telecommunication -- the recent experience where they have had the $30,000.00 to $50,000.00 installed as guidance on what this can cost. But as we go forward we’ll start to refine that as well.

So next slide. So the third transmission option that I touched on was overland buried cables. And in this case basically the unarmored version of the submarine cable would be
suitable for that as would the existing 1/0 35kV AC cable. The key issue with this that a lot of the utilities up here have experienced over time with buried cables is frost cracking where when the ground contracts in the wintertime and pulls apart and cracks you have a very -- you have a -- well, basically the cable at the crack, the crack opening will break the cable, it pulls it apart. And that’s a very common experience and as a result a lot of utilities are simply moving to overhead or have moved to overhead a long time ago.

Currently there’s no proven solution to this. This has plagued arctic climates for a long time. GCI has been doing some interesting work with putting cable and duct with their telecom cables and they’re actually doing a trial right now where they’re injecting a -- I guess some sort of an antifreeze gel, and we don’t have the details on this yet, into the duct so that that interstitial space is filled with something that will not allow water -- when you eventually have a break in the integrity of that duct you will not get water in there and end up with it cracking again. Basically a duct with a functional void space or interstitial space will -- when you do have it cross a crack that opens it will neck down and break free of the soil and relieve that strain and survive intact.

And what we want to do -- if we can solve this problem in a lot of places buried cable is going to be a lot easier to implement than overhead lines from a permitting standpoint, a
lot of times from a technical standpoint. You don’t have to deal with the wind and contamination factors on an overhead system. And also from a cost standpoint we think buried cables can be a lot less expensive than overhead lines.

So this is a problem that’s worth revisiting because of all those benefits and we want to explore that basically open duct concept and see if we can’t get a cable construction that’s affordable that has a robust interstitial space in it so when it -- where it does cross these cracks it can contract, relieve the strain and become a robust cable in these arctic climates. That would be a pretty major achievement.

We’ve been doing a lot of research to try to figure out what has worked, what has not worked in terms of sizes of cables and pipes and whatnot that are in arctic climates that have survived this or have not survived this to try and quantify the forces at work I guess. And what we’re currently developing is test options and a test plan to try and build some cable, you know, some lengths of cable and test them out to see exactly what will and will not work and see if we can’t solve this problem in a sufficiently robust way where you can actually justify putting in a buried cable on an operational project and see if it performs well.

I guess not going onto the next slide. So in the next -- we’re actually working on this test plan right now. In the next month or so we’re going to have that to ACEP for their
review so we could start to -- what we want to do is capture
this winter season when it’s really easy to freeze stuff and run
a bunch of tests on some candidate cable technologies and see if
we can’t develop a cable that actually survives cracking
robustly.

So moving onto slide 14. The other aspect of this is
construction operation and maintenance methods for these
overhead lines. We’ve been talking quite a bit to operators and
owners of various equipment, construction equipment, that we
think will be more optimized for the types of construction that
we’re doing, for getting these foundations in, getting the poles
and whatnot mobilized out to the sites and erected. And we’ve
actually found some pretty promising existing technology that
can be adapted to the point where you can get it out to a job
and get these fairly small foundations in place quickly where
you do not need to mobilize dedicated heavy equipment out to a
project on a barge, have it stuck there for a full season to
build a project and then demob it the next year. What we want
to do is try and bring down a lot of these fixed costs on these
projects so that you can be a lot more cost effective, bring the
construction costs down. And then at the same time we’re also
still working on O and M methods primarily for the overhead
system.

Moving onto the next slide, the economics of the whole
thing. As we’re going through all these things we’re collecting
cost data. We don’t really have enough of it yet -- back yet to
do -- make any conclusions but that’ll be one of the key things.
Probably in the second quarter of 2011 we’ll have enough of the
data back where we’ll start doing the real analysis on the cost
of these things. We did some of the preliminary work in Phase I
to see if the potential savings made sense. We’ll do a much
more refined analysis of that now starting in the second quarter
to come up with construction costs, life cycle costs for the
technology to see how well it does against AC. So that’s still
in progress.

The next slide is the end of my presentation. I did
it in half an hour. Awesome. So I guess before we get into
Phase III maybe we should open it up for any questions on the
Phase II work that’s been going on to date.

MS. DENALI DANIELS: So thanks, Joel. I think that’s
a good breaking point. The -- just for clarification, the flow
of today’s presentation is we now -- Joel’s now brought us up
to, you know, really what will be involved for the completion of
Phase II which is our open grant. And so I think that’s
probably a good idea. Are there any questions? And why don’t
we open it up on line. We’ve had a few here in the room. Are
there questions so far on that portion of the presentation? The
next portion we’ll actually get into some of the site specific
issues that we’re dealing with. So on line are there any
questions so far?
MR. JERALD BROWN: This is Jerald. I don’t have any questions.

MR. ERIK O’BRIEN: I’m wondering if you could go through the component parts.

MR. TOM LOVAS: This is Tom Lovas. I have no additional questions.

MS. DENALI DANIELS: Okay.

MR. ERIK O’BRIEN: I wonder if you could go through the component pieces and just how does it work just as an overview with the low voltage cabinet, AC to DC converter and the -- how do those pieces work together, how.....

MR. JOEL GROVES: Yeah, I have a slide that I don’t have with me that goes into a lot more detail of certain mechanics of -- or I guess the electrics of what this thing is doing.

MR. ERIK O’BRIEN: And on the previous slide you have a one megawatt enclosure. So how do those three -- those next three slides, how does that all.....

MR. JOEL GROVES: Yeah, sure. This is the -- I’m back to slide six for the folks on the phone. This is basically a plan view of a building that would house the converter apparatus. So you’ve got over here on the far side is a double wide man door where folks would come in and out of and [equipment] would come in and out of as need be. You have two parallel 500 kilowatt modules operating so you’ve got a 480 volt
three phase feed coming into each one of these and you have 500 kilowatt output, 50 kilovolt DC on each one of these and these would normally operate in parallel. So if you have 100 kilowatts of load each one of these would be doing roughly 50 kilowatts, they’d be merged on the outside and go off to the next village.

In terms of -- so that’s what these four things inside the building are. Looking at either one of the two 500 kilowatt blocks the cabinet is converting from three phase 480 volt AC into 700 volt DC. And that’s a fairly straight -- I mean going from AC to DC, it’s a rectifier or whatever. DC to AC, it’s an inverter if I’m getting that right. So there’s not a lot of -- there’s nothing proprietary in those cabinets. It’s basically off the shelf components put together to do that function.

The oil tank is the basically low voltage DC to high voltage DC converter and that’s where some of, for instance, proprietary technology comes into play. At a conceptual level what it’s doing is it’s taking this D -- the 700 volt DC wave form, it’s doing some very high frequency, I think around 12 kilohertz frequency switching. So it’s basically chopping that up into small energy packets and reconstructing those energy packets into a higher voltage wave form. There’s a -- actually in each one of these there’s a high frequency transformer operating at -- in the kilohertz range. So you have a 500 kilowatt transformer inside each one of those tanks that is, you
know, yay tall, yay big around which compared to a 50 KV AC, you
know, 60 cycle transformer is very small because it’s a higher
frequency. And what the -- see, I can go into more detail.
Does that answer your question?

MR. ERIK O’BRIEN: I wouldn’t need anymore detail.
MR. JOEL GROVES: Okay. Yeah, I can.....
MR. ERIK O’BRIEN: Not in like (indiscernible).
MR. JOEL GROVES: Okay, yeah.

MS. DENALI DANIELS: Anymore questions?
MR. ALBERT SAKATA: Yeah.
MS. DENALI DANIELS: Go ahead. State your name for
the record please.
MR. ALBERT SAKATA: Are those converters IGBT?
MR. JOEL GROVES: Yes, they are using IGBT switches
inside.
MR. ALBERT SAKATA: There are proprietary IGBTs or are
they.....
MR. JOEL GROVES: No, they’re -- the overall typology
of the high voltage section, some elements of that are
proprietary. The IGBT switches themselves are off the shelf
switches so they’re not proprietary.
MR. ALBERT SAKATA: Who actually set it up?
MR. JOEL GROVES: I don’t know off the top of my head.
MR. ALBERT SAKATA: ABB or.....
UNIDENTIFIED MALE: No.
MR. JOEL GROVES: I don’t -- no, they’re not from ABB. And I don’t think that -- I mean there are probably a number of semiconductor suppliers that make switches that’ll work in this application. So there’s not really -- the actual IGBTs are not proprietary.

MR. ALBERT SAKATA: Are there any reliability numbers that you see?

MR. JOEL GROVES: I’m sorry?

MR. ALBERT SAKATA: Any reliability, (indiscernible) numbers?

MR. JOEL GROVES: The.....

MR. ALBERT SAKATA: Any proven track record of that anywhere that you have.

MR. JOEL GROVES: Yeah, the subcontractor that’s developing the power electronics, Princeton Power Systems, is doing a reliability analysis which is in progress so I don’t have those numbers for you yet. But the -- in terms of those actual components, they are existing commercial components, you know, with reliability and, you know, failure specifications on them that are industry standard for the power electronics industry.

MR. ALBERT SAKATA: Is this just one single IGBT module or are they (indiscernible)?

MR. JOEL GROVES: They’re.....

MR. EARLE AUSMAN: Stacked.
MR. JOEL GROVES: Yeah, the way that it’s building up the 50 kilovolts is there’s -- I forget how many but there’s a series of stacks. Each one -- yeah, each one running, you know, 2,500 volts or something like that and those are -- those work in parallel to build that full system voltage.

MR. ALBERT SAKATA: So they go from 480 to DC. What level of DC are they going to?

MR. JOEL GROVES: They’re going from 700 volt DC is the input to the DC module. So 700 volts.....

MR. ALBERT SAKATA: AC.

MR. JOEL GROVES: DC.

MR. ALBERT SAKATA: No, no, the input is 480 AC.

MR. JOEL GROVES: That’s right.

MR. ALBERT SAKATA: So they’re going from 480 to 700?

MR. JOEL GROVES: That’s right. So they’re clipping off the top of the AC wave (indiscernible).

MR. ALBERT SAKATA: Okay. And then they just parallel -- I mean (indiscernible).

MR. JOEL GROVES: Yeah.

MR. ALBERT SAKATA: Okay.

MR. JOEL GROVES: In general terms, yeah.

MR. ALBERT SAKATA: Okay.

MR. DAVID AUSMAN: It might be worth -- this is David Ausman with Polarconsult. It might be worthwhile to mention that the way the architectures of this design of these
components are is that any individual IGBT or unit can go down and the system can continue operating at a lower capacity.

MR. JOEL GROVES: That’s right. There’s a -- that’s a good point, Dave. You know, so we have -- and I forget the number but let’s say 15 stacks. If one of those does fail there’s enough margin on the voltage tolerances of each individual -- of the IGBTs on each stack where they can each boost their voltage and still maintain the 50 kilovolt output.

MR. ALBERT SAKATA: Right, drop down to (indiscernible).....

MR. JOEL GROVES: Yeah.

MR. ALBERT SAKATA: ......output level. Okay.

MR. JOEL GROVES: Exactly. And -- you know, and obviously that would result in a -- you know, an error code that would come out, hey, you’ve lost one of your -- one of the cards in the deck so to speak. But it would still maintain functionality.

MR. ALBERT SAKATA: Are those modules hot swap?

MR. JOEL GROVES: No, they are not hot swappable. To replace them -- you know, and this is an interesting question. You can take one of these two banks out of service, maintain operation at a limited throughput, the 500 kilowatt throughput, and then conceptually you could have a technician come out, lift the -- take -- you know, take this thing out of service, de-energize it, ground it out, lift up the lid on the tank and pull
out the card for the -- put a new one in. Or you might -- it
might be easier to fly a new one of these entire units out, fly
this one back to some centralized location and deal with that
maintenance there. So you could do it either way but it would
need to be out of service for that to happen. Yeah, Jason.

MR. JASON MEYER: Jason Meyer with ACEP. I was
wondering about the -- you mentioned lattice structures. I know
you’ve been doing a lot of research on fiberglass poles and the
resulting foundations. Have you done much research on like
lattice structures as an alternative and I guess why going from
lattice to fiberglass poles? Just some of the background. I
guess this is the first time I’ve heard that, so.

MR. JOEL GROVES: Yeah. What we’re doing is, you
know, the functionality of the pole is pretty straightforward,
it’s just a structural member that needs to take these loads.
And it’s basically a function of cost, is it cost effective
weight, because we’re looking at being able to fly the poles out
to the site from a village or whatever and just is it
structurally adequate to carry the loads. And there’s no reason
why an aluminum lattice tower can’t meet that just as well as a
fiberglass tower. So we want to look at it, see how it compares
on all -- you know, on all these technical grounds and make
recommendations.

MR. EARLE AUSMAN: The -- one of the major
differences, several differences in the lattice whereas the
pole, is the pole is aerodynamically cleaner because it’s round and the pressure isn’t as high on it even though it doesn’t have open spaces and it doesn’t pick up ice unlike the lattice structure. The other thing about the lattice structure is you have to bolt them together generally, they come in a whole bunch of pieces, and that takes time and effort. Whereas you get a pole it’s in one piece. And we designed the pole so that we can cut them in half and put them on a CASA and we’re looking into building a splice that puts the two poles back together again so you can just push it together in the field so you can haul it out on a snow machine or something else, like a 35 foot piece, and then put them together out in the field and you got a 70 foot pole. And that’s what -- the kind of thing we’re looking at. These are the kind of attacks on the problem. The general attack is to figure out how to build -- somebody can build this, how they can maintain it and everything else like that and in the conditions that we have. You can’t be dragging a barge up there every year or wait for a barge every year to get a 70 foot pole in like you do if you’re doing wood poles. We’re designing around that and that’s what we’re -- one of the things we’re working on.

MR. DENALI DANIELS: Robert.

MR. ROBERT VENABLES: Robert Venables, Southeast Conference. You talked about the obvious advantage of the HVDC because fewer cables, longer spans up to 1,000 feet. Do you
anticipate bundling the communication wire with that -- going to impact that 1,000 foot spanning much?

MR. EARLE AUSMAN: Yeah, we’ve looked at communications wire methods of applying them to our particular circumstances. Now there are some devices that you can go around and spin the wire onto the main wire but they’re designed to run on suspension insulators and we are using a post insulator and not a suspension insulator. So it would take a special piece of machinery to do that. On top of that it adds more weight. It also picks up more ice and some other factors and that’s glass and we end up having to splice it relatively often and people are not necessarily knowledgeable in splicing and you don’t want to have somebody splicing up there if you have to make a repair. And it looks like it’s too complicated and what we’re trying to do is keep things less complicated and that’s why we’re looking at carrier. Because carrier it’s a terminal condition, something that we can replace and slap into place. Whereas something goes on a wire, a different kind of wire, can be a little bit more difficult for people and that’s one of the things we’re looking at. We’re looking at the O and M all the time, constantly, in any of these decisions to see how we can reduce that problem. And it also reduces construction costs as well.

MR. ROBERT VENABLES: Just a follow up if I may. So you would design then your pole construction design as opposed
to the actual HVDC cable or making sure you have your communication grid built into the electrical grid.

MR. JOEL GROVES: Yeah. And again, we’ve also -- as well as wrapping the conductor onto the cable -- or the communication cable onto the conductor, you can get fiber optics embedded in the core. But like Earle said as well, that there’s an O and M issue that we’re really concerned about, you know, because now you -- now if you have that -- if you have a break in the fiber optic you’re going to have to find it, you’re going to have to drop the cable, splice it. It becomes a real O and M challenge that I don’t -- that we’re concerned is not really suitable for these applications.

Also just to clarify on the carrier, I don’t think that carrier technology running on these DC lines would have enough bandwidth to be useful for commercial communications so it’d probably be limited to utility communications for orchestration and coordination of the power transmission functions as opposed to broadband, so.

MR. ROBERT VENABLES: Right.

MR. EARLE AUSMAN: We’ve looked at conductors, for example, that are very light, they use a carbon core and things like that, but every time we look at them we see some problems that cause a construction and also an O and M problem and we want to stay away from anything that causes an O and M problem. And that people can put together and they don’t have to be quite
as -- every single day because they don’t get the opportunity
maybe to do that every single day and it’s not their business
most of the time. So those are the kind of things we’re looking
at.

MR. MIKE WRIGHT: This is Mike with Golden Valley and
this just crossing my mind and this is speaking out of ignorance
but with fiberglass poles how does the lineman get up to work
the line? So wood poles they climb with their (indiscernible).
If it’s something that requires bucket work that would be a
challenge. Just something that popped in my mind.

MR. EARLE AUSMAN: I knew that was going to come,
Mike, sooner or later. One of the easy ways to do it is with an
ascender and when I say by an ascender is they’re making devices
now that can run off of lithium batteries and things like that
that will haul you up to the top of the pole. So if we leave a
cable on the pole that you can grab hold of and you can ascend
up the pole as long as we put a safety on it too to send up the
pole and everything we can get somebody up at the top of the
pole with all their gear and all their stuff and everything else
like that and heavy clothes on so they’ll be nice and warm and
they don’t have to run around with spikes and have some poor
person that doesn’t do that all the time pumping his way up a
big 70 foot pole and trying to get some work done up at the top
of it. In other words, no spikes.

MR. DAVID AUSMAN: Yeah, the pole manufacturers also
-- this is David Ausman with Polarconsult. The pole manufacturers also provide systems that have embedded hardware or recessed holes that take pins that fit on the lineman’s boots where they can actually climb the pole. So that’s an option as well.

MR. JOEL GROVES: And this......

MR. MIKE WRIGHT: We don’t use them and I -- and not for any reason other than wood’s fine for us but I -- just it popped in my head is you definitely need to have some way for somebody to be climbing the poles to do the work.

MR. DAVID AUSMAN: It is an issue and the fiberglass pole manufacturers address it in detail.

MR. JOEL GROVES: Yeah, and this is also going back to the lattice as an option. You know, the lattice is inherently climbable so that’s another difference between the two different technologies that we’ll be thinking about.

MS. DENALI DANIELS: I want to keep us on schedule here. Are there any other burning questions on Phase II? Yes, sir, go ahead.

MR. MARK TEITZEL: This is Mark Teitzel with AVEC and I was curious where you’re at on the -- like a mockup, a laboratory mockup of the converter for testing.

MR. JOEL GROVES: Right now they are basically done with all the design for the converter. They have a lot of the parts in procurement, some of them are received, and they are
looking at starting construction I believe in the second quarter, so March timeframe. And then the testing -- what they’re going to do is they’re going to -- they’re building one one megawatt converter so they’re going to have two of these, they’re going to operate them back to back for the trials and that will probably occur this summer, so.

MS. DENALI DANIELS: And just to remind everyone, this is on site at Princeton.

MR. JOEL GROVES: Yeah, this’ll be happening down in New Jersey in Princeton.

MS. DENALI DANIELS: So other questions on Phase II. Okay. Hearing none, the duration of Joel’s presentation is going to get into some conceptual sites for Phase III. Again I’ll remind the group that, you know, this is a phase that has not identified funding and so one of the things that is going to be on Polar’s plate is looking at not only what is -- what makes sense in terms of a site that’s appropriate for Phase III but also what partners might be the most suitable from a potential funding application standpoint and that’ll kind of -- we’ll talk about maybe some funding brainstorming later but it’s all interrelated.

So Joel, go ahead and why don’t you just for the sake of time let’s try and blow through just the overview and then as you have questions if you can just note them and then we’ll come back and we’ll bounce around to the different slides if we need
to later. But that should get us through.

MR. JOEL GROVES: Perfect.

MS. DENALI DANIELS: So go ahead.

MR. JOEL GROVES: Okay.

MS. DENALI DANIELS: Bless you. So slide number.....

MR. JOEL GROVES: Slide number -- oops, I went on autopilot. Slide number 15.

MS. DENALI DANIELS: Sixteen?

MR. JOEL GROVES: Fifteen.

MS. DENALI DANIELS: I think it’s 16.

MR. JOEL GROVES: Sixteen. Sorry.

MS. DENALI DANIELS: Okay. Slide 16 for those on line and thanks for hanging in there with us.

MR. JOEL GROVES: So the Phase III demonstration project. As a series of project objectives that is actually something that we would be seeking feedback from the SAG on. Paramount is to prove up the HVDC hardware, the converter systems, make sure that they actually work as they need to. And then another very important goal is to prove up a lot of the innovative technologies that we’re talking about developing, the -- you know, the new submarine cables, any overland cable technologies that prove to be viable to deal with the frost cracking, the overhead structures and whatnot.

And then also because -- and a lot of this ties back into the economic and the cost savings of this whole endeavor is
to prove the functionality of single wire earth return circuits,
prove that they actually do work in Alaska in permafrost soils
and that they’re a practical and economical application.
Obviously any one given demonstration project is very unlikely
to do all of -- to prove up everything but this is something
that we will seek some input -- some feedback from is exactly
what are the objectives of the demonstration phase.

In terms of some of the top level project criteria,
this HVDC technology is really for point to point transmission
only. You’re not going to do distribution functions where
you’re serving fish camps and lodges and stuff between two
villages because the converter hardware to turn that power into
a useful form, into low voltage AC, is going to be prohibitively
expensive. So we’re talking about transmission between
villages, between the village and a large mine, et cetera.

The lengths. The converter technology is -- does have
a cost associated with it and the breakeven between existing AC
technology and the DC concept is about 10 miles. Interties
longer than 10 miles you’re going to start to see an ever
increasing cost savings. Interties smaller or shorter than 10
miles the cost of the converter equipment is going to dwarf the
cost savings on the transmission line and the overall intertie
will end up being more expensive. So we’re looking at laying
more than 10 miles.

Obviously the technology we’re currently developing
you need a load of less than one megawatt. If you went with a bipolar or plus 50 kilovolt, minus 50 kilovolt link you could do two megawatts. But principally we’re looking at loads under one megawatt. And then obviously the intertie needs to have some sort of a benefit. Ideally you have a stranded -- or a community with excess low cost energy and a nearby community with high cost energy and the intertie will, you know, increase sales on one end, lower cost on the other and there’s a clear benefit.

Project readiness is a key issue. We don’t really want to take on a candidate project that has a contentious five year or 10 year permitting process or right-of-way acquisition or whatever. We want to demonstrate this technology in a timely manner so it’s ready to be deployed on a more widespread basis. And then constructability. You know, sites with good airport access, barge access, existing roads and trails will just help project cost and make it an easier project to build.

So those are sort of the key sort of technical criteria for what makes a good project. From there the white paper that we distributed earlier this month had a number of candidate interties around the state. Nothing -- this is certainly not an exhaustive list, there’s nothing really special about these. It was just a representative sampling of projects that might be good candidates.

MS. DENALI DANIELS: Before you go on.....
MR. JOEL GROVES: Yeah.

MS. DENALI DANIELS: .....can you -- as you’re going through each of these projects can you please indicate potential program partners and any discussions that have already taken place or, you know, if it’s just really.....

MR. JOEL GROVES: Yeah.

MS. DENALI DANIELS: .....you know, this is an idea if that’s where you’re at.

MR. JOEL GROVES: Yeah, absolutely.

MS. DENALI DANIELS: So I think that’s important.

MR. JOEL GROVES: Absolutely.

MS. DENALI DANIELS: And the reason -- I’d like to share with the group, the reason why I think that’s important is because, you know, these materials have been distributed widely and anytime communities or potential applicants are in materials, you know, we want to make sure that it’s clear what the intent is. So thanks.

MR. JOEL GROVES: Absolutely. And actually I think what I actually did is zoomed out ever farther than my list of -- or Polarconsult’s list that we put together. And this is borrowed from the 2008 report, Distributing Alaska’s Power, that WH/Pacific, NANA Pacific, NANA/Colt put together. And my understanding of this report, I haven’t read it in awhile, but they basically did a -- they compiled all the proposed interties that are out there. They didn’t do any evaluation of them, they
just said here’s what’s been put on the table in the past. And I thought I’d throw that out there to even cast the net wider than what we did in the white paper to say here’s what’s been proposed. And as you can see, here’s a statewide map and they’ve pretty much got interties all over the state. This is slide 19 for the folks on the phone. And I also just threw up, they had some more regional detail, sort of the North Slope, northwest arctic region. One of the projects we proposed was the Barrow to Atqasuk connection but there’s also Barrow to Wainwright and on to Point Lay, Point Hope, Kivalina, Red Dog, Noatak on down to Kotzebue and up the Kobuk River as well as a line that sort of hugs the foothills or near the Colville all the way back to Prudhoe Bay and down the pipeline corridor and all over the place.

The next slide is southwest and you’ve got a whole array of power interties that have been proposed down there. And then they also had a couple of slides on southcentral which is predom -- or I guess the central part of the state which is predominantly just the existing rail belt grid with a couple of taps off to southwest and also the southeast intertie concepts.

So that’s a more comprehensive list of candidates than what we issued in the white paper without going into a lot of detail. Well, and then continuing there’s the proposal that came out of Naknek a year or two back for a 25 village intertie throughout the southwest part of the state running from INN up
in the northwest out to Togiak, down to -- not Sand Point. I forget the name of the town down there. It’s just off the map. But tying in a lot of the larger communities in Bristol Bay. So there’s another series of candidates. On this one we had proposed a Dillingham, Manokotak line just for discussion purposes.

Then also the southeast intertie graphic. A couple of the ones in here popped up in our -- well, there’s a Kake to Petersburg intertie and a Green’s Creek to Hoonah which would be this guy right here. And then moving into the ones, the candidate interties that were in the white paper. The -- there’s a Barrow to Atqasuk. This has been looked at for a number of years. I actually found on Polarconsult shelves a 1981 study of this route. And we haven’t had any communication with the communities on this project so we don’t really -- we haven’t fully vetted the status or readiness of this project. I do understand that AEA received an application from who I’m not sure but one of the entities here for a final design and permitting of an intertie between the two villages. But I -- like I said, I don’t really have any of the details pertaining to who applicant is or.....

MS. DENALI DANIELS: Under the -- what he’s referring to is they actually are on the list, the renewable energy fund round four list.....

MR. JOEL GROVES: Right.
MS. DENALI DANIELS: .....that was recently released. We just noticed that and so we have no further information about that and unfortunately we don’t have AEA here today. They do have a seat on the committee but -- oh, do we?

MR. EARLE AUSMAN: You’ve got Kent Grinage here.

UNIDENTIFIED MALE: You’ve got the North Slope Borough.

MR. KENT GRINAGE: We’re currently doing the feasibility of that project.

MS. DENALI DANIELS: Oh, are you the applicant?

MR. KENT GRINAGE: Yes.

MS. DENALI DANIELS: Oh, wonderful. Well, I guess in keeping with the intent we’ll go through and then maybe come back and have a discussion about that.

UNIDENTIFIED FEMALE: (Indiscernible).

MR. JOEL GROVES: Now I know. Thank you. Another couple of potential interties that have come up are Nome to Pilgrim Hot Springs. There is an ongoing study of the geothermal resource at Pilgrim Hot Springs to determine -- to quantify and improve understanding of the resource up there to see how much power it might be capable of generating. And then the question is, is it -- does it meet Nome’s needs, electrical needs, and would it be practical to build a transmission line down to Nome.

The number that has been discussed for the size of
that resource is five megawatts which is a larger intertie than
we’re looking at for the Phase III demonstration so it’s unclear
if that would ever pencil out or not. Jason.

MR. JASON MEYER: Yeah, Jason with ACEP. Joel, that
was one of my specific questions. I know in this phase we’re
looking a one megawatt scale with the two 500 kilowatt units.

MR. JOEL GROVES: Right.

MR. JASON MEYER: For the Phase III demonstration, and
I know it gets to the economics and the feasibility of the
project but what is kind of the maximum in terms of like scaling
this technology up modularly? I mean obviously as you put more
and more of these stacks perhaps the economics get worse, I’m
not sure, but. Has there been any thought or analysis on that?

MR. JOEL GROVES: There has. The really easy thing to
do is you can go from the one megawatt monopolar link to a two
megawatt bipolar link where you would have basically a plus 50
kilovolt intertie and a minus 50 kilovolt intertie. And that’s
-- a lot of the DC interties around the world are bipolar where
they’ve actually got two lines running like that. That would
take the technology that’ll be commercially ready at the end of
Phase II, that would be ready to go into that kind of
configuration. So you could easily get to two megawatts.

In terms of the scaling up the technology itself, we
have had discussions with Princeton where they say it would be
fairly straightforward to get up to five megawatts per
converter. You know, just like you said, more stacks, larger capacity IGBTs, whatnot. There’d be some more design work to do that but there are no technical obstacles there and they don’t think any economic obstacles either.

MR. EARLE AUSMAN: In this case it would simply mean that the IGBTs would carry more amperes and we’re carrying a very low amount of amperes. In fact that’s one of our problems is it’s harder to find devices that carry as little as we do at that kind of voltage. But I just -- but we can certainly carry more amperes and that’s really what it boils down to because 50 kilovolts is still a good voltage. In fact that’s what the ABB light is doing essentially, they’re carrying more amperes than conventional 12 volts DC.

MR. JOEL GROVES: Yeah. And that would get you up to -- for a bipolar link would get you up to 10 megawatts. And then as you go -- you can probably go above that. They haven’t specifically looked at higher capacities but there’s no apparent technological threshold that they’re bumping up against at the five megawatt size.

MR. JASON MEYER: In terms of economics, you know, in the last site meeting we discussed this kind of, you know, 10 mile, nine mile threshold. Bumping it up, does -- has there been any analysis in terms of how that affects the economics?

MR. JOEL GROVES: There hasn’t been and I guess it would -- it’s probably good to either clarify that that’s really
a project specific analysis that would need to happen of where is that breakeven distance. You know, that is a -- the 10 mile threshold is a generic analysis of it. It could be radically different for any -- well, I don’t know about radically. It could be significantly different for any specific project.

MR. EARLE AUSMAN: The wire could -- can easily carry five megawatts. It’ll carry 100 amperes without any problem. There’ll be some more losses. So you can have the same transmission structure and instead of it being one megawatt you can have it be five megawatts. So the only increase in cost is primarily in the converter system and the converter system will have a slightly larger transformer and it’ll have IGPs that are slightly different and it’ll have some bus work that’s larger but it’s not going to be double the price or anything else like that. And remember, there’s a lot of O and M prices in this -- I mean, excuse me, original work prices in something like this and as you get bigger and as you get more of them why the prices are likely to go down, hopefully. We hope.

MS. DENALI DANIELS: Let’s keep moving.

MR. JOEL GROVES: Yeah. And then I guess also in this is a -- Nome to Teller is another perspective project. And again, we haven’t really done anything more than draw a line on the map there in terms of talking to the stakeholders and whatnot.

Another one with a little bit.....
MS. DENALI DANIELS: Question here?

MS. MARCIE SHERER: I do have a question.

MR. JOEL GROVES: Oh, I’m sorry.

MS. MARCIE SHERER: My name is Marcie Sherer from AVCP. In your notes you were talking about the possibility of there being too much power -- geothermal power at the source. Can you explain that? Because it seems to me like common sense says if you have too much power you just could -- you could service more area.

MR. JOEL GROVES: Oh, yeah, absolutely. No, the only issue there and I believe that there -- like I said, there’s some assessment work going on up there but it’s too much power not for serving Nome, it’s too much power for this technology to move. Yeah, so if there’s a five megawatt.....

MS. MARCIE SHERER: This demonstration project.

MR. JOEL GROVES: Exactly. If there’s a five megawatt resource up there and we can only move two megawatts it’s not a good project fit is all that that means. I’m sorry?

MR. ALBERT SAKATA: What are the costs that you’ve seen so far, the one and two megawatt systems?

MR. JOEL GROVES: For the converters I believe per megawatt converter the equipment cost is we’re looking at a quarter of a million dollars.

MR. ALBERT SAKATA: What?

MR. JOEL GROVES: Quarter of a million dollars for the
converter, if I’m not mistaken there. And then you’d have the,
you know, cost of the -- site specific cost of the enclosure,
grounding grids, interconnection to the village, whatnot. For
the overhead line in Phase I on a per mile basis I want to say
we had an installed cost of $125,000.00 a mile if I’m not
mistaken.

MR. EARLE AUSMAN: It’s in the report sitting on the
table there.

MR. JOEL GROVES: Yeah, it’s in the reports in the
back, the little black spiral bound reports. And those also
have life cycle analyses and whatnot or total installed cost for
a conceptual 25 mile intertie. So if I’m wrong the report’s
not.

So this is -- in Phase I of the project where we were
working -- I never really went through the history of the
project. We’re currently in Phase I -- Phase II. Phase I was
completed in 2008. It was also Denali Commission funds routed
through AVEC to basically do a -- sort of a first level
practicality and feasibility assessment of this entire
technology to see if continued development was warranted. And
what we looked at in Phase I was a DC intertie between St.
Mary’s and Mountain Village. My understanding, and Brent and
Mark correct me if I’m wrong, is that AVEC is currently pursuing
funds for an AC intertie on this or are you still looking at the
DC? Or no comment?
MR. BRENT PETRIE: Well, we’re looking at the AC.

MR. JOEL GROVES: Okay. Yeah, that’s what I thought.

But I put it up here for continuity just because it’s been in the past.

MR. BRENT PETRIE: There are points along the way that might have wind potential.....

MR. JOEL GROVES: Okay.

MR. BRENT PETRIE: .....but with a DC system we couldn’t integrate that resource into such a line.

MR. JOEL GROVES: That’s right.

MR. BRENT PETRIE: We have anemometer -- we have met stations or one met station up along the line route.

MR. JOEL GROVES: Okay. So it’s a potential that wind resource may make this a poor candidate for a DC intertie.

MR. BRENT PETRIE: Right. However, St. Mary’s to Pilot Station has two stretches of wet ground about three to five -- three to four miles in each place and we have looked at an intertie there if this technology did pan out having longer lines and fewer structures in that kind of environment could be of benefit.

MR. JOEL GROVES: Yeah. And that’s the kind of terrain that this overhead system is really designed to address where it’s really difficult with existing practices.

And I just got handed, so I can be honest about this. Installed -- the Phase I -- to revisit the cost question, the
Phase I installed cost per mile, we came up with about $130,000.00, $140,000.00 using the tall pole, long span guide structure concept. And that was just the line cost, it did not include the converter terminals which when we added in all the ancillary bits and pieces around the actual converter equipment came in at -- with a couple of contingency factors in there like $600,000.00, $700,000.00 per end. And so you can see absorbing that, the high cost of the ends, you take -- you require a certain length of intertie before you get the savings, so.

Keep moving forward through these. Dillingham to Manokotak is another line that’s been looked at in the past down in the southwest part of the state. Again, we haven’t really had any contact with the stakeholders out there before we -- and I didn’t even put the line on the map because I wasn’t sure. There have been some studies of this done in the past and I didn’t have a chance in preparing this information to figure out what the potential routes have been proposed from the past studies. But there was a study done sometime back looking at an intertie there. And this was actually part of -- like I mentioned, part of the larger southwest intertie concept.

Green’s Creek to Hoonah has a lot of history behind it. That -- in terms of project readiness that project is fairly advanced. They’ve done the bathymetry, they’ve developed bid documents and specifications for an AC intertie down there and designs and whatnot. And what happened a few years back,
the cost of this project which I believe was approaching $40
million for an AC project killed it, it was just too expensive.
With this DC technology, as I mentioned it’s a much smaller
conductor, a much smaller diameter cable and it may be
economical with this DC technology. We haven’t really had any
discussion with IPEC, which is the utility on the Hoonah end, or
AEL and P on the Juneau side about doing this but it’s a
candidate.

Also -- and again, we haven’t had any discussion with
the National Park Service or Gustavus Electric but there’s a
potential for an intertie from the Gustavus grid to the National
Park Service. Gustavus, as many of you may know, recently put
-- recently commissioned an 800 kilowatt run-of-river hydro.
They now have excess energy, excess hydro energy. The Park
Service headquarters for Glacier Bay National Park is still
running on diesel. So there’s a -- and they would like to
intertie. Key issues here are aesthetics. You don’t really
want to run overhead power lines through a national park. Some
of the technical challenges of this project is it’s a fairly
short intertie so you may not -- the savings on the intertie
construction methods may not pay for the converters but there’s
-- I don’t really know how this all will play out because you do
need to go underground, there’s a lot of issues out there. So
that’s another candidate.

MR. BRENT PETRIE: No permafrost though.
MR. JOEL GROVES: I doubt it.

MR. BRENT PETRIE: Right.

MR. JOEL GROVES: And then the other one that we had proposed is Kake to Petersburg. These are some of the previously considered intertie routes. And again, we haven’t really had any discussions with the stakeholders in Kake or Petersburg on this but this would be another candidate. It’s been discussed for an intertie. And I believe -- yeah, that’s an overview of the projects and I think probably jump into Q and A on each one or discussion.

MS. DENALI DANIELS: Yeah. I’m just going to open it up for questions, any questions that you have for Joel about any of these projects and or feedback on any of these projects, whether or not -- you know, maybe you think one of them is a horrible idea, maybe you have some feedback on how they may proceed with dialogue with potential partners. I’m just going to open it up for any comments that you all have. I want to make sure we leave enough time for us to have a good discussion about code issues. And I actually think we’re doing pretty good. If anybody needs to step out and take a break, we are not going to take a break so just go ahead and do that as you need to. We’ve got about 15 minutes. So....

MR. PETER BIBB: Okay. This is Pete Bibb up in Juneau, Alaska with Inside Passage Electric. I’ve got a question for Jason.
MR. JASON MEYER: Yeah, Pete, go ahead.

MR. PETER BIBB: Okay. You mentioned that you haven’t heard from AEL and P or Inside Passage Electric on both Juneau to Hoonah and Kake to Petersburg. What kind of forum or what kind of meeting are you expecting to witness on that?

MS. DENALI DANIELS: Thanks for that question, Pete. I’m actually going to just clarify that I think you need to direct that to Joel Groves who’s with Polar. And so.....

MR. PETER BIBB: Oh, excuse me.

MS. DENALI DANIELS: No problem.

MR. PETER BIBB: Joel, did you catch that?

MR. JOEL GROVES: Yes, I did.

MS. DENALI DANIELS: Yeah, go ahead.

MR. JOEL GROVES: Yeah, and I think, you know, initially we would basically need to look at a -- do a quick fatal flaws analysis to see if any of these interties are viable and, you know, is -- step one would be is the utility interested in pursuing an HVDC intertie at the site. You know, from there, you know, we need to do -- sort of I guess gather existing information, figure out if it’s a good fit based on the technical criteria and iteratively drill down through these candidates to come up with a short list of the best project sites. But obviously looking at the stakeholders or the project partners is going to be the first step to make sure that we have a viable team to pursue a project.
MR. PETER BIBB: Okay. So -- this is Pete again. Is that forum, is that a direct phone call to you or is it -- do I present this in some kind of meeting atmosphere or what’s the forum we have a dialogue?

MS. DENALI DANIELS: I would -- this is Denali here, Pete. I would go ahead and communicate directly with Polarconsult.

MR. PETER BIBB: Okay, thanks. That answers my question.

MS. DENALI DANIELS: Eric and then Robert.

MR. ERIC MARCHEGIANI: I’d like you to go back to slide -- your very first slide where you had your project criteria and I’d like to propose something. I think we’re going to get down to it a little bit farther on in your funding strategy but I think Denali has made the point that it’s unlikely that the Commission’s going to have funding to move into Phase III and so I think it’s really important -- I mean I’m really interested in interties. In fact I’ve been a proponent of them for a long time. Brad on the line can probably convince folks the same thing from our discussions in the EAC meetings. What we have is a demonstration project and I think your project criteria is kind of skewed. Okay? I don’t disagree with you that the criteria in the future for projects should be over 10 miles or the benefits should be from a lower to higher, et cetera. What I think we really need to do is
demonstrate the technology and from my standpoint the shorter
the line the less cost. The less cost the more likely you’re
going to get funded to turn around and demonstrate it. Because
at this point we have no budget. I mean Phase III is not funded
at this point. Most likely, and correct me if I’m wrong, the
only place that I can see that we might see some funding because
from our end, USDA’s end, our budget’s being cut back. We’re on
continuing resolution. I presume that Denali’s got the same
problem. So funding’s going to be a real challenge be it the
high cost energy grant program, you’re going to have a hard time
getting anything out of them. You’re going to have a hard time
getting anything out of Denali Commission. The state’s probably
the only place you’re going to find money. So the best bet you
can do is to look at a scope or a project that is fairly small,
less than 10 miles, in fact if you can make it five miles or
less.....

MR. JOEL GROVES: Sure.

MR. ERIC MARCHEGIANI: .....you’re going to be better
off. And then it doesn’t necessarily from a benefit standpoint
have to go from a high cost community to a low cost community.
You know, and the other part of it is is that your cost for
demonstrating it will be a lot less if it’s on the road system.
I would propose that you look really hard for something on the
road system, maybe out by Copper Center or something that’s only
three or four miles down the road, you put something on either
end and you’re able to demonstrate the technology so it actually works. If you have a problem it’s easy to get to. Money wise, you know, let’s say you only spend $600,000.00 on either end, that’s $1.2 million and you spend maybe a half million dollars for the transmission system.

MR. JOEL GROVES: Sure, yeah.

MR. ERIC MARCHEGIANI: So you’re like less than $2 million. I think that’s where you want to be, especially if you’re going to go to the legislature.

MS. DENALI DANIELS: Okay.

MR. ERIC MARCHEGIANI: But I -- that’s my pitch.

MS. DENALI DANIELS: Okay. Robert and then Brad.

MR. ROBERT VENABLES: And I don’t disagree, Eric, with that assessment and I think, you know, the Glacier Bay project might have one with some legs, although that’s a longer term. The state probably wouldn’t fund that one because it’s a federal project but the feds have prioritized that. So that one might be a partnership that could give you a smaller project. But for a project with the best of all worlds the Kake, Petersburg one may prove out to be worth some extra analysis because that project is already under the NEPA process, it’s going to be hopefully fully permitted by next year. The state has shown a lot of interest in funding that and it goes -- and it meets every single one of these criterias. And all but about 11 miles of it is roaded and so, you know, there’s going to be some
challenges as we go through NEPA because it’s in the Tongass but it does -- that project is moving forward and it’s going to happen if all the project stakeholders get the continued support that they’ve received to date. So it’s fully funded through final design and they’re en route -- you know, looking for construction funding. So there’s an active stakeholder’s group meeting and it definitely should rise to the top cut for further consideration.

MS. DENALI DANIELS: Are you responding to his.....

MR. DAVID AUSMAN: Yeah, I was going to respond to that.

MS. DENALI DANIELS: Okay. Go ahead.

MR. DAVID AUSMAN: This is David Ausman with Polarconsult. I was just going to say that along those lines there’s no reason that these converter modules and the terminals can’t be moved and put somewhere else after the technology’s been proven. And another possibility is with these locations is that they can benefit from interconnection of a renewable resource which can happen in the future and can also improve the economics overall once it’s proven up. So we don’t see any reason why you couldn’t be shorter. We just simply went ahead and looked at it from the standpoint of -- from an engineering standpoint how do we make this the best economic benefit given the alternatives, so.

MR. ERIC MARCHEGIANI: Long term I think your pitch is
good. Don’t get me wrong.

MR. DAVID AUSMAN: Yeah.


MR. BRENT PETRIE: I guess a suggestion for a site might be to look at an existing three phase system that you could put -- where you could put a module on -- someplace on that and someplace down the line you could operate monopolar, bipolar, you could do it with an earth return and operate for six months or a year so you get some good operating data. One would have to search around and find a host utility that might be interested in doing that but that would demonstrate the converter technology. It would also, you know, eliminate the need for significant investment in transmission. I mean you could use it for multiple purposes and if it wasn’t working you could go back to the -- using the AC system. So that might be a way to look at demonstrating the converter technology and getting people’s confidence up so we could take a step out to a longer system in the future. But one would have to search for a host that would have that system.

MR. JOEL GROVES: Yeah, and I guess just to respond to that, it’s an excellent point. We’ve actually -- we’ve done internally some brainstorming on that and some of the tendrils of the rail belt grid have come up. One example, well actually out of the rail belt grid. But I’ll highjack a chunk of Golden Valley Electric system and their line -- they have a single
phase line from Glennallen out to Eureka. It’s a 40 some odd
mile line, two conductor line, that could conceptually be
converted to -- or to a DC for some period of time, run a bunch
of tests on it for a year or two, maintain service at the end of
that line and then convert it back. So that could be.....

MR. ERIC MARCHEGIANI: I just threw Copper Valley out.
I didn’t -- I don’t have a clue.....

MR. JOEL GROVES: Oh, yeah, yeah.
MR. ERIC MARCHEGIANI: .....as to what’s out there.
MR. JOEL GROVES: I mean could you do this with the
Homer Electric system that runs to the south side of Kachemak
Bay perhaps. I don’t know. But that -- yeah, that’s a good
idea and I think that’s a viable approach for Phase III.
MR. ERIC MARCHEGIANI: I’m just thinking of the best
way we can demonstrate the technology and keep the cost down as
much as possible.
MR. JOEL GROVES: Yeah.
MR. ERIC MARCHEGIANI: Because you’re going to have to
find some funding source.
MR. JOEL GROVES: Yeah. And a significant advantage
of this would be project readiness. You have an existing
infrastructure in there with right-of-ways and permits and
everything and.....
MR. ERIC MARCHEGIANI: Oh yeah, permit.
MR. JOEL GROVES: Yeah. I mean it may be nothing more
than you get your code waiver from the Department of Labor and
your funding and you go. So it could be a very viable approach.

MR. RICH WIES: This is Rich Wies. I’m going to have
to step out. I just wanted to (indiscernible).

MR. JASON MEYER: Hi, Rich, this is Jason. Could you
speak up please?

MR. RICH WHITE: I’m sorry, let me see if I can turn
my volume up.

MS. DENALI DANIELS: There you go.

MR. RICH WHITE: Hear me better?

MS. DENALI DANIELS: Yep.

MR. RICH WIES: Okay. I’m going to have to step out
in a little bit but I like this idea of demonstrating the
technology, you know, and existing -- like off of an existing
three phase line but one of the things that I guess I’m
concerned with and I have been for some time is making sure that
the -- you know, the technology’s going to work in the kinds of
systems that we have in the villages where you’re running off a
diesel and there could be wind and the potential of, you know,
turn on and turn off of the diesel. You know, these are things
that I guess that I, you know, would like to see proven and
demonstrated beyond just proving that the technology will work
on a line where you have, you know, fairly stable generation
sources.

MR. NELS ANDERSON: Yeah, thank you. My name is Nels Anderson. I was born and raised in Dillingham and just recently moved to Anchorage. And Senator McGuire is now my senator and Representative Tuck is now my representative so they’re going to get an earful of a rural Alaskan’s perspective on what’s going on out there. Villages are in an energy crisis right now, just for your information. All right? We don’t have too much time to quaddle around. And so the villages are only on fumes and even watching oil prices, where are they going and where are they going to keep going. All right? We’re getting close to $100.00 a barrel. When they hit $120.00 -- when they get to $100.00 a barrel we’re paying $10.00 a gallon for diesel up in bush Alaska and we can’t keep that up much longer.

So I very seldom ever put my eggs in one basket but I met Earle years ago and I told him what I had in mind was that we need a statewide energy grid. And every time I brought that up, oh no Nels, you can’t do it, the existing technology is too expensive, we can’t tie the whole state together. Well, over the years I’ve gotten so tired of seeing state money being spent on the rail belt to make sure that they’re energy secure and so seldom do I hear anybody ever say, well, let’s try that out in rural Alaska to make sure it really works there. Too often I’ve seen technology tested in ideal conditions, perhaps on a road system, that is then transponded to rural Alaska just because it worked there. It doesn’t necessarily mean it’s going to work in
rural Alaska.

So I hope that people would look at the real cost of inserting this technology in rural Alaska under rural Alaska conditions taking into account the cost of transportation and other costs. Now this year we have a $5 billion surplus projected for the State of Alaska. If we can get some one angel to pay for Phase III, and I’m going to work my tail off, I’m going to work Lesil McGuire’s tail off and Representative Tuck’s tail off to work with the bush delegation to work on this project to prove it up. I mean we all want certainty, everybody wants certainty, let’s not do it unless it’s absolutely 100 percent proven, but that’s not how America was won. America went out and took a lot of risk. But also the federal government helped Alaska and rural projects in America, in the lower 48. The federal government subsidized that. The State of Alaska has subsidized Bradley Lake and many other projects in the state. And so it comes to rural Alaska, we have a little difficulty thinking about those villages out there being a part of our state and they are a part of our state and we need all the help we can get, we need all the people that we can get working together to make sure that we approve this project as quickly as possible and if it works to begin implementing it. Because, as I said, the villages are running on fumes and we’ve really got to push this ahead as quickly as possible. Thank you.
MS. DENALI DANIELS: I really want to thank you for coming to our meeting and providing that input and you obviously have a long history with the Denali Commission and your involvement with our energy program so it’s good to have you here at the table. Thanks.

Are there other questions, comments or, you know, burning issues that folks want to get out on the table and read into the record with regard to the site selection discussion here?

MR. ERIK O’BRIEN: You’re talking about funding issues and just after Mr. Anderson spoke there. Have you looked at the Native corporations and the CDQ groups? I see a lot of this area is covered by CDQ groups that’s private money that has a stake and an obligation to work on ideas that are the constituents there. Do you.....

MR. JOEL GROVES: Yeah, we haven’t had any.....

MR. ERIK O’BRIEN: .....investigated that avenue.

MR. JOEL GROVES: .....dialogue with either of those sets of energies at this point in time. But they’re good....

MR. ERIK O’BRIEN: Well, finding is an issue.

MR. JOEL GROVES: Yeah, they’re good candidate partners, sure.

MS. DENALI DANIELS: Well, with that I think we’re actually right on schedule here and I’ve actually -- I meant to kind of put it up on the board but I’ve got some pretty good
notes here about the feedback that this group is giving. You
know, it sounds to me, and we’ll talk a little bit more about
this funding concept in a moment, that’s on the agenda too. So,
you know, your comments are well taken there.

But in terms of the site specific questions, you know,
Polar is going to have to, you know, probably have some key
meetings with a lot of these folks that you all are giving
feedback on. And so, you know, I would encourage anyone that’s
part of this group that wants to participate in that discussion
to go ahead and do so. It’s not necessarily something that
we’ll be hosting as part of the agenda for this group but
certainly we want to support that activity and make sure that
that’s going on.

MR. JOEL GROVES: Yeah, absolutely.

MS. DENALI DANIELS: So I’m going to move us forward
on the agenda. So it’s 3:46 and the next item on the agenda is
what we called work groups. I think the last thing we want to
do is create more subcommittees and, you know, that type of
thing. But I want to encourage folks that are interested in
this technology to, you know, coordinate and collaborate as it
makes sense to do so. At the last meeting we had a discussion
about the existing code and I think Jason’s prepared to go ahead
and refresh our memories of what the situation is, how it
relates to national code and potential need for an in state code
revision as it relates to this technology. So I’m going to turn
it over to Jason to refresh our memory on that. If there are
folks around this table and on line that wish to participate in
some kind of follow up workgroup of some sort to take action and
if the time is right for us to do that that’s why I kind of said
work group. But I don’t intend to create a whole, you know,
other group so that’s kind of what that means. So Jason, why
don’t you refresh us on what the code issues are and what
actions or feedback this group can take on?

MR. JASON MEYER: Yeah, certainly. So Jason with
ACEP. And I want to start with just kind of a 30,000 foot level
of the project and the Stakeholder Advisory Group. Many of you
were a part of this last time, some of you are new. What this
group does, it’s a -- basically a group of stakeholders that
have various professional and technical expertise that could
relate to this project providing good feedback.

There’s -- per the grant conditions there’s three
official meetings so this is number two in that series. The
project is slated to go through I believe October, September,
October of this year.

MR. JOEL GROVES: Yeah, early October I think.

MR. JASON MEYER: So our window in terms of feedback
on the project is going to quickly come to a close here as it
gets nice out and everyone starts, you know, being outside and
such. So what we’d like to do is effectively get feedback from
this committee that could feed not only into the work that
Polarconsult’s currently doing but then also looking forward to this Phase III issue.

So that’s really where we’re at in terms of trying to leverage your various expertise. Obviously I’m not an electrical engineer, some of you are electrical engineers, so that area is a little out of my league. So I’m really kind of concentrating expertise and providing meaningful feedback.

I’ve identified four general areas. I think that we could perhaps self select if people have time or energy or interest. Thinking about a timeline, we’re looking at the next Stakeholder Advisory Group perhaps in mid-summer so looking at the July timeframe which would allow more feedback to be incorporated into the project before our end date but also would give us ample time to work on some of these issues.

So this first issue, as Denali mentions, is the code issue. What that’s really referring to is the single wire earth return portion of this project and I might need some technical or policy input. Dan with the Department of Labor is also on line. What this really refers to is currently in the U.S. the national and state code prohibits the use of earth return systems, so basically using the earth to close the loop if you will. A lot of that’s due to perhaps safety issues with corrosion, if there’s pipelines in the ground or railroads. I’m not sure if it’s necessarily a safety issue related to human interaction, correct me if I’m wrong.
MR. JOEL GROVES: Yeah, this is Joel. Yeah, it’s not really a safety issue so much as, exactly like I said, it’s an economic issue with potential corrosion of buried metallic infrastructure, railroads, pipelines, pile, et cetera, et cetera.

MR. JASON MEYER: And single wire earth return is used in other countries I believe, Australia, various regions of Africa, Brazil.

UNIDENTIFIED MALE: New Zealand.

MR. JASON MEYER: New Zealand. So there is precedent. The issue though is how does this relate to Alaska. Obviously the code currently prohibits single wire earth return and there’s obviously very good reason for that. But what are the issues in terms of the state that the state needs in order to address it, review it, perhaps amend the code. What questions do the state need to look at, examine, address, is there any testing or research that needs to be done on a national level, international level.

So that’s really what this issue refers to. It’s obviously a very specific interest and skill, people on the Stakeholder Advisory Group, but it’s very fundamentally important to the project. So that’s kind of the first issue.

MS. DENALI DANIELS: Can we go ahead and address that one?

MR. JASON MEYER: Yeah, certainly. So Al from the
Department of Labor, he unfortunately couldn’t join us today. He gave a pretty good overview of this issue to the last Stakeholder Advisory Group and Dan based in Fairbanks is currently on the line. Dan, have I spoken correctly thus far, is there anything you wish to add to that?

MR. DANIEL GREINER: No, Jason I think you pretty well covered it. The only thing that I would like to add from our perspective is that I’ve submitted a couple of inquiries to the code writing committee, the NESC people, haven’t received any reply yet back. We need some kind of -- we need to get some information or some kind of documentation about what’s been done in these other places so that we can make an informed recommendation or move forward with any kind of possible revision. We’ve talked about this before. I know that most of the systems in place are much larger than the ones you’re proposing. But what research I’ve been able to do while the main concern about the corrosion of existing infrastructures is probably the most prominent one there is reference to danger to livestock around where the electrode for the earth return ground is put in so we need to find out more about that. I think at this time, you know, we certainly would be able to entertain a waiver on a case by case basis to the NESC but we just -- you know, we -- when we start doing revisions to the code like that there’s sometimes unintended consequences. When that language is taken out then there’s no restrictions on those type of
MR. DAVID AUSMAN: This is David Ausman with Polarconsult. One of the things that we have done is collected some of the codes that exist in other countries, including New Zealand and Australia. The Queensland electrical grid has some rules and guidances for the use of AC single wire earth return systems and they’ve addressed a number of these different issues. And the reason that they might be a little more applicable is because they are very small scale systems, they’re in rural settings and they also address issues as that relates to telecommunications that might be in the ground and interference issues with regards to that. So we’ve collected them for probably precisely what you’ve expressed as your interest might be as getting a point where we can step off from and some ideas on how other people have done it and what sort of issues they’ve had to confront. So there’s -- so we don’t start from square one, we get a little bit of a precedent for moving forward.

MR. DANIEL GREINER: Yeah, and I appreciate that. I guess that’s what I was looking -- we were looking for was, you know, somewhere we could -- you guys could provide us with that information or we can just work together and try and find it and, you know, reach a consensus.

MS. DENALI DANIELS: Thanks, Dan. It sounds like that information exists so maybe it makes sense for some kind of
abbreviated memo to be produced that summarizes that and it
would make sense for everyone to have access to that as well.
Brent.

MR. BRENT PETRIE: Yeah, I’d just like to point out
there’s two cases that I’m aware of where single ground -- or
single wire ground return waivers have been issued in Alaska.
That was for the Bethel to Napakiak line and the Shungnak, Kobuk
line and those have since been rebuilt as AC -- three phase AC
lines. But Department of Labor approximately 1980, ’81, issued
a 20 year -- 10 or 20 year waiver for single wire ground return.
It might be worth going back to the files if they can be found
and -- or just note that, that they were -- that it has been
done before.

MR. JASON MEYER: And this is Jason. I think what I
propose to do, there’s a lot of obviously like offline work that
needs to be done in terms of researching some of these files and
precedents. But if people have interest or expertise or leads
in this issue after the meeting we’ll be sending out some
emails, just let me know your interest. Dan, we’ll obviously be
working with you and Al. But kind of solidifying some of these
issues, collecting them and drafting a formal like white paper
or memo for the next meeting just kind of summarizing all this.
So that’s my proposal at least unless anyone has any
recommendations otherwise.

MS. DENALI DANIELS: This is Denali and I think
1 Jason’s raising his hand that he wants to chair that.
2 MR. EARLE AUSMAN: He volunteered.
3 UNIDENTIFIED MALE: Volunteer.
4 MS. DENALI DANIELS: Yeah. I mean it sounds to me
5 like there’s already a lot of information that exists about this
6 issue and it’s just a matter of summarizing that information. I
7 guess in terms of just closing up this conversation, Dan, a
8 question I have is can you kind of just give us a snapshot of --
9 and maybe others around the table know this information but can
10 you tell us, what is involved in some kind of code revision? Is
11 that long drawn out process, is it something that, you know,
12 we.....
13 MR. DANIEL GREINER: Well, now, Mr. Nagel is the
14 expert, I’m not, and unfortunately he’s ill today so I can
15 address it in general terms. It goes -- has to go through the
16 regulation process where we put it out to public review for them
17 -- for comment and there’s a period by statute that it has to be
18 out there. I’m not exactly sure the timeframe. I think it’s
19 (indiscernible).
20 MS. DENALI DANIELS: Go ahead, Dave.
21 MR. DAVID AUSMAN: Yeah, this is Dave again. Maybe
22 you have, as Brent was mentioning, probably a better solution at
23 this particular point is getting a waiver as opposed to actually
24 changing the code.
25 MS. DENALI DANIELS: Yeah.
MR. DAVID AUSMAN: Is -- do you have some information on -- or any ideas on what it would take to go ahead and get a waiver similar to what was issued before?

MR. DANIEL GREINER: Yes. We have a standard waiver request form that we -- I can forward to anybody that’s interested, you know, to Jason or whatever. But -- and it’s used on a case by case basis and I agree, that’s probably the most painless way to go about this, especially with the -- you know, this is going to be a one time thing at least at first and, you know, we’re not putting up 20, 30 of these at once that have to be dealt with. So I think at first a waiver in the process would be the way to go.

MS. DENALI DANIELS: Okay.

MR. JASON MEYER: Dan, this is Jason. I’d love to have a copy of that waiver just to review and such.

MR. DANIEL GREINER: I’ll forward it to you, Jason.

MR. JASON MEYER: Great, thank you.

MS. DENALI DANIELS: Okay. Are there any other comments or questions with regard to the code issue?

(Whispered conversation)

MS. DENALI DANIELS: So we’re going to just keep moving on with the agenda here. Let’s go ahead and open up this discussion now with regard to the funding strategy. Obviously some key discussions need to occur and decisions need to be made about the site and really that’s probably the next step. But in
terms of timing, you know, I think Mr. Anderson raises a good point, that the obvious place for funding is probably the State of Alaska. And so I’m just going to open up for some general brainstorming on that issue and just kind of see where this discussion goes. Mr. Anderson.

MR. NELS ANDERSON: Going back. It seems to me the -- if we’re going to get money from the State of Alaska probably it’d be a good idea to pick a site as soon as possible, get that determination out of the way, and then get an estimate of what we think it might cost and then get it to the legislature as soon as possible. Because they’re -- you know, the house and the senate haven’t devised their budgets yet. I don’t know if they’ve even gotten a copy of the governor’s budget but they will be shortly. And so the sooner we can get an estimate to the legislature I think the better. Thank you.

MS. DENALI DANIELS: Okay.

MR. JOEL GROVES: And I think I might just add to that. I don’t know how much the state is even really aware of this effort and to the extent that there’s a deficiency in their awareness that this project is out there and in the pipeline so to speak I guess I would suggest that all the stakeholders talk to their legislators, talk to the appropriate people to make sure that there is awareness that this project is out there, what its implications are that they need to be thinking about funding for it just at a generic level before we even get to a
MR. EARLE AUSMAN: I -- this is Earle Ausman. I certainly agree with that. It’s not something -- it’s not high on some people’s priority and the people who it is high on the priority need to speak up about it. You have, Nels, as -- many times and things like that and I think we need a few more people like yourself to speak up about what we can do for them potentially.

MR. ERIK O’BRIEN: What is the payback or what is -- when you’re looking at the benefits. If you’re going to go to the state you’re going to want to tell them some benefits, what are potential benefits. I mean savings, at what rate and what timeframe and.....

MR. EARLE AUSMAN: What are potential benefits? Well, let me give you an illustration. It’s proposed to build the Susitna hydro plant. They estimate the price of power at six cents. If we could give southwestern -- or I mean western Alaska and southcentral Alaska six cent power they would now have $2.00 fuel. That’s what they would have essentially in their hand. And so if they can convert as many things as possible that burn fuel right now they could save a tremendous amount of money. Now it’s going to cost more than that because you’ve got to add the cost of transmission to it but once you’ve done this all the other expenditures that the state has made of various forms and kinds don’t have to continue any longer. It
changes the entire game, everything changes. The state doesn’t have to spend as much money, the federal government doesn’t have to spend as much money and the people can live just like they do in Anchorage almost. So -- if they want to and they can use electric heat and things.

And so there’s all kinds of possibilities that can be done on interconnections and things and the Susitna project is one and I recommended that today, had an opportunity to talk with people and I recommended it today as a consideration to build a line to Donlin where we’ve got a load of several hundred megawatts and better and continue on and then come off with branches to our communities all the way in that whole area there, every place we can reach, and as a start on this. But that’s a greater vision and we need help on the greater vision. If we get somebody to be able to kick it along on Phase III so we can get the rest of it to prove that we can do it. And we can do it, I mean we should be able to do it. It’s not rocket science, it’s just application.

MS. DENALI DANIELS: Robert, did you have.....

MR. ROBERT VENABLES: Well, I just wanted to follow up I mean because that was a great answer as to why interties are necessary. But I think the question was more, you know, why an HVDC intertie as opposed to an AC intertie and that’s the kind of white paper we’re going to have to get together if we’re going to get Phase III funding.
UNIDENTIFIED MALE:  Right, right.

MR. ROBERT VENABLES:  And so I just wanted to follow up on that just to -- because we want to -- we have to be clear. Because like in the case of where I’m facilitating the NEPA process for the village of Kake. And, you know, so if we’re going to go in there and say, well, we want to consider an HVDC alternate, you know, we need to be able to come to the table and say okay, why would you do that versus the AC.

UNIDENTIFIED MALE:  That was (indiscernible).

MR. ROBERT VENABLES:  And that’s where he was going with it.

MR. EARLE AUSMAN:  I could give you some answers to this in fact but the man that could probably tell you more about anything is Brent attempting to put wires across the YK Delta and his tinsel job and things, going out looking for dead birds.

MS. DENALI DANIELS:  So I mean I.....

MR. EARLE AUSMAN:  That’s why DC.

MS. DENALI DANIELS:  I think the point here is that the audience, really the legislature, you know, is very hungry for, you know, specific black and white concise, you know, maybe three bullets really as to why in order for them to actually say oh, you know, I can do that. You know, it’s a bridge between really the technical kind of language that this group is maybe a little bit more used to into kind of the more generalist language. And, you know, I don’t know if we have the ability to
come up with kind of a one pager that takes some of the layman’s
approach, you know, in terms of communication and that might be
helpful. I think that’s what I’m hearing.

The other thing I’m going to -- and I’ll get to Eric.

My walk away from the discussion so far in this meeting is that
it may be that the Phase III as it currently is structured, if
may be that we have maybe an interim piece and I don’t know what
the price tag might be on something like that. But the emerging
energy technology fund, you know, it has -- the RFA is out on
the streets right now. There is a cap of $750,000.00. You
know, perhaps there’s a way that, you know, an application could
be moved forward through that process with the idea that you
take on kind of a smaller chunk of Phase III in order to
formulate a better argument for carrying out the balance of
that. And maybe that means that you aren’t wedding yourself to
a specific site as much as you would otherwise be and maybe you
take on some of the ideas that Eric had or -- you know, I’m just
brainstorming here. But that’s an obvious immediate funding
opportunity and certainly the Commission would be able to, you
know, provide support to that. So, Eric.

MR. ERIC MARCHEGIANI: My suggestion is, is that
there’s nothing wrong with approaching our legislators and most
of your legislators are more than willing to give a listen to
whatever you have. Again, you want to make it short and sweet
so that they can grab a hold of it and work with it. But the
reality of everything is, is through the state legislature they may appropriate the money but the bottom line it’s going to-- it’s not going to come to you directly, it’s going to basically be routed through AEA. So if it’s going to come through AEA then you should do a two or three or four prong approach. One, you know, you approach your various legislators but at the same time you put a package together to the AEA and try to get them to submit that to the legislature. If it comes from the agency it’s going to have more credibility, it may get on the table quicker, it may come up front and then a particular legislator can grab a hold of it and say oh, here’s a project from AEA and they’re saying that this would be a good idea to go forward to fund this demonstration project. So I think you want to think about a couple of different approaches, not just your legislators but I think you want to try to feed it through AEA if you can. If you can go over and talk to, I don’t know, Mike Harper or Chris Mello or somebody there to kind of work it through.

MS. DENALI DANIELS: Good comments.  
MR. ERIC MARCHEGIANI: That’s my two cents.  
MS. DENALI DANIELS: Others? Discussion about funding options. You raising your hand?  
UNIDENTIFIED MALE: No.  
MR. ERIC MARCHEGIANI: For whatever it’s worth I-- you know, I will throw out on the table that, you know, our
budget is continuing to be a continuing resolution, what we call a CR, and we’re funded through March on that CR. Okay? I’ve been told we may be as far as June on that CR which basically means that we really won’t know what our budget is and then even then you only have three months to finish up your budget. I assume the Denali Commission’s going to be under that same guise because they’re a federal entity as far as what their money’s going to be. What you need to know is, is that if you’re thinking about the high energy cost grant program that we administer the reality is the President’s budget had zero in it. Last year Senator Murkowski and Senator Begich basically got it put back in and -- at the level it was. Whether that happens this year or not, you know, it’s anybody’s guess at this point just because the way congress is moving forward and whatnot. I mean there’s a struggle for leadership, et cetera, and, you know, who’s going to do what in the house and then the senate I think it’s pretty much fixed with the democrats that are there.

But what I’m trying to say is from a federal side we don’t know what our money is, period. And there is a very high likelihood that there may be zero money in the high energy cost grant program this year just because the President put -- didn’t put anything in the budget and that’s kind of ancillary with what I was saying about AEA. If you get AEA to put it in the budget then there’s a number there. Whether it be the right number or the wrong number at least it’s something a legislator
can latch onto and maybe add or, you know, do whatever they need to.

MS. DENALI DANIELS: Brent.

MR. BRENT PETRIE: Just one thing to maybe consider as we look at a project type as one that could be flexible that might be able to be adapted to be an AC project or a DC project so in case something doesn’t quite work out we can go to the conventional AC and make it work so whoever’s providing the money for the project knows that they’re going to have something that works no matter what. I think we can -- you know, offline we can probably get our heads together for some sites that might be conducive to that.

MS. DENALI DANIELS: Okay. Other comments on funding? It’s a fun topic to end on, isn’t it?

MR. ERIK O’BRIEN: Is there going to be the document of benefits, just I mean the bullet point, the one page, something simple, layman that’s not the electrical engineer that can understand, is that in the works to be created?

MR. JOEL GROVES: It -- you know, it’s something we have a lot of the bits and pieces for from our past efforts related to this project and we can probably put out I mean I guess a generic one page benefits of the HVDC versus the AC. I think we could probably, you know, at least get a first cut of that and work with the stakeholders and whatnot to get a finalized document like that together.
MR. EARLE AUSMAN: Can we send out interim things to the stakeholders, things that we were talking about and ask for their comment?

MS. DENALI DANIELS: Sure.

MR. EARLE AUSMAN: Would you think that appropriate, Denali?

MS. DENALI DANIELS: Yes, and I appreciate your asking that. You know, from the Commission’s standpoint we’re bringing all of these folks together to provide critical feedback on a project that we have, you know, millions of dollars invested in but we want to make sure that we also maintain an arm’s length in that, you know, the applicant themselves, you know, will be more effective if they’re with other funding agencies, if they’re not wrapped up in our politics I guess you could say. Maybe that’s one way to put it, but. So in terms of communication with the Stakeholder Advisory Group, Jason is the holy grail in terms of communication so, you know.....

MR. EARLE AUSMAN: So we go through Jason and (indiscernible).

MS. DENALI DANIELS: Go through Jason and he’ll kind of go through me. We might say oh, that’s a little bit much but, you know, generally speaking yes, we’ll use the Stakeholder Advisory Group over the next year -- not the next year, the next.....

MR. JASON MEYER: Ten months.
MS. DENALI DANIELS: Ten months? Oh, that is a year.

Okay. Yes.

MS. MARCIE SHERER: Denali, my name is Marcie Sherer with AVCP again. Being really new to the whole process and not being really familiar with trying to get money from the congress or from the State of Alaska it seems to me that I really like Nels’ idea, is if we could choose a site that we could demonstrate it would be a lot easier for us to all advocate funding for that specific site. My concern is, is that I believe that the state legislator, if you’re going to ask for capital funding for 2012 I mean that deadline is next week I think. And so, you know, we’re going to miss that -- or we may miss that. I shouldn’t say we’re going to miss that because we’d have to move pretty fast and I don’t know that we’re ready to do that. And then the congressional ask is what, February 15? I’m looking at Nels. You know, sometime soon, like within the next 30 days or less and I don’t know that we’re -- if we don’t take action if we’re going to get funding, congressional or state, in the next -- for 2012. And so we’re prolonging, you know, the crisis, I mean we’re not helping with the crisis. We’re doing great things or you’re doing great things but it’s not going to move as fast as we need it to move. So I just wanted to comment on that. And....

MS. DENALI DANIELS: I think those are really good comments in terms of the timing and I think for this group to be
thinking about timeline, you know, 12 months from now where would we like to be and what can we do and what can we not do. You know, the existing phase of the project ends in October. So, you know, there’s still work that needs to be done between now and October. Is it the end of the world if we’re unable to really engage in the legislative process this year but we work over the next, you know, several months to get ourselves prepared for that next cycle and, you know, is -- what would the impacts be of having kind of a gap there between October and, you know, maybe say June when potentially that legislative -- I don’t know the answer to that but I think those are probably realistic terms that we should be getting comfortable with.

Yes, sir.

MR. MARK TEITZEL: Yeah, Mark Teitzel. It seems like if it somehow could be the funding request tied into the Susitna study money it might have a chance. The Susitna study money has been indicated to be very popular and it’s.....

MS. DENALI DANIELS: Yeah.

MR. MARK TEITZEL: .....been indicated to be essential to the rail belt and this lowered cost of HVDC is just as essential to rural Alaska. So it’s kind of a benefit for all of the state if it kind of went together.

MR. EARLE AUSMAN: Would.....

MS. DENALI DANIELS: There’s an idea.

MR. EARLE AUSMAN: .....AVEC support that do you
think?

MR. BRENT PETRIE: We think so.

MR. EARLE AUSMAN: Think so.

MR. MARK TEITZEL: I mean lowering the cost of interties in rural Alaska seems to be the only hope, like Nels says, right now to hold energy costs down or even reduce energy costs.

MR. EARLE AUSMAN: Yeah, well there’s a good possibility that something like that might flow if we got on it right away. If you sent a letter to the governor or something pretty quick why it might help.

MR. JOEL GROVES: Yeah. And I guess.....

MR. EARLE AUSMAN: Because the money’s going into the -- I’m a member of the stakeholders for the Susitna project and money’s going into the Susitna project.

MR. MARK MARCHEGIANI: The challenge is you’ve got to have something definitive if you want to ask for money. If you haven’t defined it well it becomes amorphous and it’s hard for a particular legislator to feel comfortable that they’re going to support it.

So I think the real key here is a couple things. One is timing, like you’re saying. Well, Nels is saying. The other thing is is to -- I think it’s incumbent upon you to go back, take a look at the alternatives you have, maybe look at the comments that everybody’s made and maybe make a decision as what
you think would be the best alternative somewhere along the line
and then put together kind of -- I don’t want to call it a white
paper but a one pager or something or other. You can’t make it
too long. You make it any more than two pages long they’re not
going to look at. Okay?

UNIDENTIFIED MALE: Right.

MR. MARK MARCHEGIANI: And then that becomes your
alternative, that becomes your budget, that becomes what you
want to move forward with. I would make an appointment with
Mike Harper, go over and talk to him, go over and talk to Meera
and then start talking to legislators.

MR. EARLE AUSMAN: Would the committee support
something like this and get behind it?

MS. DENALI DANIELS: If you’re asking if this
committee would support that, this committee is not in a
position to be weighing in on policy. We can provide feedback
on, you know, things like -- if you were to narrow down those
two sites and get a little bit more specific about, you know,
why, you know, maybe these two sites should be in the running
and what the process will be over the next six to nine months to
determine, you know, the best site then I think this committee
can provide you with comments and feedback and that’s a goal of
ours. But in terms of taking a position I think that’s
something that we wouldn’t be doing.

MR. EARLE AUSMAN: So the committee can’t do it as I
understand it but individuals, individual organizations and individuals can certainly support this.

MR. JOEL GROVES: Yeah, and there would -- as I see it there’d be sort of a transfer. Let’s say we boil it down to two projects or something. Well, the stakeholders for those projects would need to pick up the ball and pursue those projects. They would need to champion that to pursue funding.

MS. DENALI DANIELS: I think that’s a key piece here. So Robert, you had your hand up earlier and then Mark.

MR. ROBERT VENABLES: I was going to say the amount of process working with the state legislature I think, you know, as I sense the possibilities with this group and the timeline it’d probably be more realistic to try to come up with some basic information to get into on the energy resources committee sometime during this session. This is the first sitting of two sessions. So, you know, you can introduce the concept and it may or may not have a fund -- physical note attached to it yet but you would introduce that sometime during this 90 day session so that it was, you know, cued up and ready for funding at the next, you know, fiscal year so it doesn’t die. So you’ve got a couple different avenues to go but I think that’s more realistic to try to get some basic information and maybe have a couple sites and let them know which way you’re going and then after it gets traction you can, you know, make it more effective that way.
MR. MARK TEITZEL: I just wish that Phase II was a little farther along, you know, to show that truly it is going to be successful and truly you can build line for say $125,000.00 a mile instead of $450,000.00 a mile. And that’s the key right there, that you can truly build intertie......

MR. JOEL GROVES: Yeah.

MR. MARK TEITZEL: ......less than what’s being done now.

MS. DENALI DANIELS: Nels and then Jason.

MR. NELS ANDERSON: Well, I would feel com -- I intend to do a lot of advocating for this activity and.....

MS. DENALI DANIELS: Okay.

MR. NELS ANDERSON: .....and I have done it in the past and I will continue to do so until the -- but until we select the site and we all walked away from here agreeing on a site and then what we estimate the cost might be then I feel more comfortable talking to my senator, my representative and the governor and SWAMC and all the other rural organizations that are willing to listen and I feel comfortable that if someone else writes from another organization they’re saying basically the same thing. And rather than me individually saying, well, I’d rather have.....

MS. DENALI DANIELS: Yes.

MR. NELS ANDERSON: .....this site and it’s going to cost this much.
MS. DENALI DANIELS: Jason.

MR. JASON MEYER: Just to tack onto that. Joel, just for the benefit of the committee, talking about the actual converter development. So maybe go over that timeline, where we’re going to be at at the next stakeholder meeting, are we going to have results to show for that testing, just in order to have kind of a tangible technology result to feed into this overall proposal.

MR. JOEL GROVES: Yeah, absolutely. So like I said earlier, the converter should be going into construction the second quarter and the schedule does call for them to have -- you know, do a series of tests on the converter to demonstrate it works, you know, quantify the efficiencies, functionality and everything. And we should have those results back by the third SAG meeting in July.

And one -- to go a step beyond that I’m kind of thinking of some of the discussion on what Phase III is. The output of Phase II will be, you know, article -- first article converters, two 500 kilowatt converters, and in terms of bringing the cost of a Phase III project down it’s conceivable you could deploy that as a 500 kilowatt short term, you know, one or two year program, whatever it needs to be, demonstration project somewhere. The converters are already paid for. Now you’ve got to do whatever the line is, the grounding, all the ancillary bits and pieces of it and it might bring the cost down
where maybe it fits inside the AEA’s EETG program, $750,000.00. I don’t know.

But maybe we need to look at that as a rapid deployment in the next year or two demonstration, that’s done, now we’re looking -- everybody’s got their comfort levels where it needs to be, we’re looking at production. That might make sense.

MR. ERIC MARCHEGIANI: One thing that you want to consider, and I think Nels is hitting it on the head, so are you as far as time, if in fact you were to put something in the legislature this year the earliest, the absolute earliest you would see any money is July 2011. Well, most likely it’s going to be more like September or October by the time they get the RSA and the money’s routed through, everything and whatnot. That means there’s no construction in 2011. That means you have to wait until 2012 to basically go in and start any type of construction. Now, if we miss that cycle, if nothing is done this year that means you’re not going to see any money until 2012 which means you’re not going to see anything in place until 2013.

MR. EARLE AUSMAN: Thirteen, yeah.

MR. ERIC MARCHEGIANI: I mean that’s three years from now. So.....

MR. EARLE AUSMAN: That’s true.

MR. ERIC MARCHEGIANI: I just want to kind of keep an
1 eye on the ball I guess is the best way to put it.

MS. DENALI DANIELS: Yeah.

MR. ROBERT VENABLES: And that’s why we need to be
timely doing these things about waivers. It may take a year or
two to get all the waivers in place. So I mean there’s.....

MR. ERIC MARCHEGIANI: The waiver will come fairly
easy.

MR. ROBERT VENABLES: I don’t know.

MR. ERIC MARCHEGIANI: Change in the regulation’s
going to be a challenge.

MR. ROBERT VENABLES: Yeah. But.....

MR. ERIC MARCHEGIANI: Waiver I think you can probably
get in six months or so.

MR. ERIK O’BRIEN: On a case by case.

MR. ERIC MARCHEGIANI: Case by case you’ll be okay.

MR. EARLE AUSMAN: Al said it was -- he could do that
rapidly, the waiver.

MR. JOEL GROVES: Yeah, it -- some of the.....

MR. EARLE AUSMAN: Because it doesn’t have to go far.

MR. JOEL GROVES: Sorry. Some of the scheduling was
discussed in the first meeting with Department of Labor and Al
said, and this is a key part, once he has everything he needs to
make a decision, and that’s ill defined I think, he can get a
waiver out in a week or two.

UNIDENTIFIED MALE: But does that apply to federal? I
mean you said it was against federal code as well as state code.

Is there a federal application that you.....

MR. EARLE AUSMAN: No. No, no, it’s not -- this is

not a federal thing, it’s a.....

UNIDENTIFIED MALE: State.

MR. JOEL GROVES: Yeah.

MS. DENALI DANIELS: It’s just state.

MR. EARLE AUSMAN: .....it’s a state.

UNIDENTIFIED MALE: Okay. I had written down somebody

said.....

MR. ROBERT VENABLES: The state code is based on

national.....

UNIDENTIFIED MALE: Right.

MR. JOEL GROVES: Yeah, it’s -- the National Electric

Safety Code is not a federal document per se, it’s a nationwide

committee comes up with this technical document. The State of

Alaska can adopt it in toto, which is what they’ve done in the

past, they can amend it piecemeal, they could do something else

entirely.

MR. EARLE AUSMAN: And that’s true for the other

states as well.

UNIDENTIFIED MALE: Okay. So there’s not a federal

issue there.

MR. EARLE AUSMAN: No.

UNIDENTIFIED MALE: Okay.
MR. EARLE AUSMAN: No.

UNIDENTIFIED MALE: We adopt the federal. Bottom line is we.....

MR. JOEL GROVES: Yeah.

UNIDENTIFIED MALE: .....decide to amend it, we can amend it.

UNIDENTIFIED MALE: Okay. Thanks.

UNIDENTIFIED MALE: I don’t think the waiver’s the problem, I think the problem is is funding and scheduling.

MR. ERIK O’BRIEN: One idea on a site. Kodiak Electric Association down in Kodiak is going to be expanding their hydroelectric plant five megawatts. I believe it’s funded. It may be a good test bed for the larger Susitna project because I mean the larger Susitna project’s not going to be ready to go for a decade but it would be a hydro plant. There -- it’s rural Alaska so you’re having the.....

MR. EARLE AUSMAN: Which one is that?

MR. ERIK O’BRIEN: What’s that?

MR. EARLE AUSMAN: Which plant is that?

MR. ERIC MARCHEGIANI: Terror Lake they’re putting in a third turbine.

MR. ERIK O’BRIEN: So if they expand it I don’t know if they are going to add lines but they have a fairly established set of infrastructure while being a rural place, while being a test for a larger hydro plant and I believe it is
funded.

UNIDENTIFIED MALE: Correct.

MR. EARLE AUSMAN: But it is not the existing transmission line?

MR. ERIK O’BRIEN: I don’t know. Is it not? I don’t know.

UNIDENTIFIED MALE: It is.

MR. EARLE AUSMAN: You have another.....

MR. ERIC MARCHEGIANI: Another thing you could do is potentially go back to what Brent was saying. I believe there’s either a single phase line or a three phase line over to Port Lions. And so what you could do is run your cable on existing poles, et cetera, and run it over to there and, you know, do your converters and kind of go from there and your cost would be fairly minimal I think. I don’t know what the line length is. Ten miles?

UNIDENTIFIED MALE: There’s some other sites that might fit that situation too.

MR. EARLE AUSMAN: You have another hydro plant over on that side.

MR. BRENT PETRIE: The hydro plant is.....

MR. EARLE AUSMAN: Another possibility. You’ve got gauges on the lake and everything else. It’s been there for quite a long time. It’s a interesting hydroelectric power plant site. So if you want more power that’s one place you can go for
it. And we’d be glad to carry your power. But you probably
make that -- that would probably be 10 to 15 megawatts at least
or more.

MS. DENALI DANIELS: Jason.

MR. JASON MEYER: This is Jason with ACEP. One
question I have, a lot of the funding discussion is focused on
state or federal money. What about some of these locations
perhaps like private partnerships or partnerships with
utilities, perhaps funding mechanisms outside of public money?
I don’t know if that’s feasible given the demonstration tag with
the technology but I mean is that realistic?

MR. JOEL GROVES: This is Joel. I guess it would be a
question for the stakeholders if they would entertain, you know,
self-financing or raising bonding or whatever. I mean a utility
or something could conceivably do bonds for building an
intertie. That’s another business model for these sorts of
things. But the viability of that I don’t know.

MR. ROBERT VENABLES: But really I mean transmission
lines are risk. I mean so a utility that’s in business is not
going to embrace an RD risk. You know, there’s not a payback
for that so you’d have to find a public.....

MR. EARLE AUSMAN: That’s right.

MR. ROBERT VENABLES: ......necessity, a need.

MR. ERIC MARCHEGIANI: Something like the -- what is
it, the National Science Foundation might be something you could
look at, see if they had, you know, some type of grant money.

   UNIDENTIFIED MALE: NREL.

   MR. ERIC MARCHEGIANI: NREL might be another. I don’t
know -- we don’t have what’s his name here today.

   UNIDENTIFIED MALE: Brian.

   UNIDENTIFIED MALE: Brian Hirsch.

   MR. ERIC MARCHEGIANI: Brian.

   MS. DENALI DANIELS: He must be in another meeting.

   MR. ERIC MARCHEGIANI: Yeah.

   MR. EARLE AUSMAN: If we just put a solar panel on the
end of it maybe Obama would give us the money.

   MR. ERIC MARCHEGIANI: I don’t know. I think the
state funding is probably your best bet but I wouldn’t discount
others. And the other part of it is is if you -- although
there’s no time to do the homework at this point but if you can
come to the state legislature with more than one funding source
legislators like that better. And then you spread the PR around
to several people and that usually goes a lot better too. But I
don’t think you have enough time to go to the legislature with
something in hand that you feel comfortable with even with let’s
say a couple alternatives with some type of budget and still be
able to come up with, you know, possibly a partner with
Department of Energy or NREL or, you know, whomever.

   MS. DENALI DANIELS: Well, I’m sensing a Friday
afternoon settling in here. I want to close up the discussion.
We did kind of call this work groups. I think the way we rounded this out with the code -- potential code group, Jason will send a note out to everyone and if you’re interested just reply and let him know and he’ll go ahead and take the ball and run with that.

In terms of funding strategy, I think the more this discussion proceeds the more I’m convinced that this site selection issue is one that has to take place before the funding strategy can really evolve. So I guess I’m just going to make the suggestion that folks that are involved or associated with any of the proposed sites or if you have other sites that might make sense that you get in contact with Polar directly and that those discussions just kind of take on a life of their own.

Really that’s what I think needs to occur is that those partnerships need to organically kind of occur.

And so, you know, if there’s anything we can do to, you know, help with those discussions let us know kind of in an informal manner. I want to be clear that Denali Commission has millions of dollars invested in this project and so we would like to see it move forward. But we also want to make sure that the ultimate recipient of whatever that project might be, you know, is in a position to really champion it themselves. And so that’s not going to happen with big brother, you know, making it happen for them and so I feel very strongly about that.

So anything we can do to help with the dialogue and
help get the information out and help those discussions take place we’re happy to do that. So I guess I’m convinced we don’t need a work group. But I would encourage anyone that would like to follow up and, you know, have those discussions that I hope you do so and that you do so quickly.

So Jason, I think you had a few other issues you wanted to just kind of float with the group before we wrap things up.

MR. JASON MEYER: Yeah.

MS. DENALI DANIELS: Why don’t you go ahead and do that.

MR. JASON MEYER: So just two more items. They’re not necessarily work group items but definitely areas that Polarconsult could use feedback on. One is, again, site selection so just being diligent in that. If you have any ideas or feedback as we start narrowing down a site or, you know, providing feedback to Polarconsult on specific sites.

But the second one, and I think we’ve been implicitly talking about it, is just feedback on the transmission work. So talking about fiberglass poles versus lattice structures versus wood poles, long lengths, short lengths, foundations. The converter development, a lot of that’s out of our control. It’s in very -- some of it’s proprietary, super technical, but Polarconsult is working a lot on the actual transmission side of the project and I know a lot of people in this room have a lot
of expertise in that area. So as we go along if you do have any
questions, if Polarconsult floats any questions please feel free
to provide that feedback, so.

And Joel, just to again just kind of walk through the
timeline for the SAG. So the next meeting is in July so talk
about where you’re going to be at in terms of your conceptual
designing, your -- we’ve already talked about the converter side
so just walking the committee through that.

MR. JOEL GROVES: Yeah, this is Joel. Yeah, what we
anticipate is that we will largely be complete by July where
we’ll have -- you know, we’ll have cost data, we’ll have, you
know, detailed conceptual designs for these foundation
assemblies and whatnot. To the extent that we do end up doing
any testing on the overland cable we’ll have, you know, a
verdict on that, did we find anything that works that, you know,
warrants further investigation, did everything fail and it’s
just an in -- unsolvable problem and so on.

So we anticipate in July, you know, it’ll be a
presentation similar to this only instead of everything being in
progress we’ll have results. You know, we’ll have new cost
estimates, we’ll have design, you know, designs for all these
details and we’ll have findings. There will probably be a few
outstanding items that we’ll still be bird dogging to resolution
between there and the end of the contract which is in October
but we’re anticipating by July we’re pretty much done with the
1 heavy lifting on this project, we’re moving into the reporting
2 and documentation phase, get everything wrapped up. And
3 there’ll be loose ends but that’s sort of the vision of the
4 schedule.

5 MR. JASON MEYER: Great. And just to add to that, I
6 know -- I guess I’ve been taking it for granted that a lot of
7 you have been involved in the process but a lot of you have not.
8 So if anyone has any questions generally just about the project,
9 the progress, where we’re at now and where we’re going I think
10 this would be a great time to address those.

11 MS. DENALI DANIELS: Yeah. Open it up for any
12 questions. Nels.

13 MR. NELS ANDERSON: Well, you’ve assigned Polarconsult
14 with the task of getting into the site selection.

15 MS. DENALI DANIELS: Yes.

16 MR. NELS ANDERSON: Do you have a timeline in mind?
17 What are you looking at? Because, you know, I heard somebody
18 say July (indiscernible) forget this legislative session.

19 MS. DENALI DANIELS: Well, I mean I guess that’s a
20 question for folks around the table that, you know, what is the
21 appetite for, you know, aggressively moving forward and kind of
22 helping Polar, you know, in the near future. I don’t know the
23 answer to that. You know, if folks feel strongly enough that
24 they want to sink their teeth in and pick a site and, you know,
25 start some of these discussions with the legislature. I think,
you know, what I’m hearing is that there’s not a lot of optimism that something could happen this session but that it would make sense to start the discussions this session. So, you know, if folks are interested in doing that I think that that’s a good idea. So yeah.

MR. NELS ANDERSON: Just to follow up on that. The discussion will make more sense if a site is selected, so.

MS. DENALI DANIELS: Yeah.

MR. NELS ANDERSON: And we get a rough idea of what the cost may be. And the goal is to improve the technology. Right?

MS. DENALI DANIELS: Right.

MR. NELS ANDERSON: So the sooner we can do that then the sooner we can -- if it works the sooner we can open up the flood gates of funding and get this thing moving. That’s all I’m (indiscernible).

MS. DENALI DANIELS: Yeah. I mean how many sites did we hear about, seven?

MR. JOEL GROVES: Yeah, seven to 10, something like that.

MS. DENALI DANIELS: Uh-huh (affirmative). And some of those haven’t even -- you haven’t even really talked to yet. So.....

MR. JOEL GROVES: That’s right.

MS. DENALI DANIELS: .....you know, I mean my
suggestion would be that, you know, maybe Polar wants to, you
know, through Jason communicate. If folks are interested in
helping with some of those discussions maybe next week send a
communication out and, you know, you all can kind of meet
informally and do some brainstorming. And, you know, ultimately
Polar is going to have to partner with another organization that
frankly is probably going to be the applicant, you know, whether
it’s a utility or a non-profit of some sort. So that’s
something that needs to occur and that doesn’t happen overnight.
So, you know, there’s a lot of heavy lifting I think is what I’m
sensing.

MR. JOEL GROVES: Yeah, that’s right. I mean if --
you know, if we just take those -- let’s say it’s 10 projects,
you need to start, you know, initially like I said earlier, you
know, contact the stakeholders or the owners or the perspective
applicants or owners of this project, see if they’re interested.
Let’s say half of those drop out right there. You’re going to
have five projects, you need to start doing due diligence on
these. Are they good interties, are they -- you know, period.
Are they good candidates for DC, do they make sense for the
demonstration project, you know, and then start to -- I mean
before you really go to the legislature or your legislators with
a specific project you want to have a pretty good price
estimate, you know, how much money are you asking for, sort of a
business plan. I mean there’s a lot of work that needs to be
done before you’re really ready to bring one of these forward
and stand up behind it and advocate for it.

So we can certainly, you know, push that forward and
it’s part of our scope on this project to push it forward in
terms of figuring out which project is it and do some of that
due diligence but at some point, like I said earlier, the
applicant or the advocate for this project’s going to need to
step up and take the ball and bring it forward, so.

MR. ERIK O’BRIEN:  Are there other options like Eric
-- what’s his name.  Sorry.  Was suggesting with the low hanging
fruits the more accessible, easier.  It looked like a lot of
these were remote which is probably good more long term but also
make the cost go up and there isn’t money to fund the next
phase.  Right?

MR. ERIC MARCHEGIANI:  Correct, yeah.

MR. ERIK O’BRIEN:  Is there (indiscernible).

UNIDENTIFIED MALE:  You need to do some digging.

MR. ERIC MARCHEGIANI:  Yeah, I mean I -- well, I
worked with Brent, I worked for the state for a long time.
There’s a lot of short options.  I mean you can go Togiak to
Twin Hills with a cable, you can probably go, what, Koyukuk (ph)
to Ekwok.  It’s not all that far.  Kong to Kwig.  I mean there’s
a number of shorter lines out there that you could kind of
decrease your overall investment cost.  Agreed it doesn’t, you
know, go that 10 miles extra above and beyond but it would keep
your overall development cost down. I can go back and go
through what I remember as far as interties, Brent probably has
a real good handle on a number of them also, and forward some
options.

Most of the local utilities, again, will probably be
more than happy to see anything happen and so they would be --
support it. I would say, this is just throwing it out on the
table, I think you -- if you can find a couple of AVEC
communities to intertie you’ve got a large organization to lobby
let’s say in Juneau if they’re willing to do that. You know,
it’s entirely up to Meera, but. And New Stu to Ekwok, Ekwok’s
not an AVEC community but New Stu is. What is it, Togiak is an
AVEC community but Twin Hills is not. I mean so.....

MR. BRENT PETRIE: I think we’d want to -- one of the
elements there, we’d want to make sure that there’s sufficient
generation resources at one end of that intertie to be able to
serve the other village. For a quick deployment we wouldn’t
want to have to, you know, build new generation at the same
time. But there are -- there.....

MR. ERIC MARCHEGIANI: We don’t want a black eye
either. I mean that’s a good point, you don’t want a black eye.
You don’t want to make -- put the intertie in and all of a
sudden can’t supply the power.

MR. BRENT PETRIE: But there may -- it’s worth kind of
stepping back and thinking a little bit and trying to come up
with something I think. I think there’s some possibilities out there.

MS. DENALI DANIELS: Well, let me ask this. Is there a desire that this group, you know, maybe a little bit more formally work on the site selection activities? I mean I guess my first blush was, you know, it needed to take on a life of its own and what I’m sensing from this discussion is that there is kind of an appetite to participate in that. You know, there’s no reason we can’t do that. I think the importance is that the application and the partners, you know, decide to be partners on their own and that we’re simply providing feedback and we’re not driving or forcing anyone’s hand. That’s what I want to be cautious of. So, you know, I’m open for, you know, taking that on under this structure if there’s a desire under this group for that. Robert.

MR. ROBERT VENABLES: It might just be good -- we’re -- we’ve been promised two or three different pages of information, get that over the next week and so then maybe have a teleconference or email chain to see if that’s the logical next step and maybe we only have one meeting and we don’t take it any further but it would be nice to see.

MS. DENALI DANIELS: Close the loop.

MR. ROBERT VENABLES: Yeah.

MS. DENALI DANIELS: It does seem like there are a lot of questions on the table and waiting until July is....
UNIDENTIFIED MALE: Might be helpful.

MS. DENALI DANIELS: So I guess I -- any other comments on that? Mark.

MR. MARK TEITZEL: I was curious when an actual converter -- 20 by 13 converter station will be constructed. Will that be done under Phase II or not expected to be done under -- until we do a demonstration (indiscernible).

MR. EARLE AUSMAN: The entire station?

MR. MARK TEITZEL: Yes.

MR. EARLE AUSMAN: It would be Phase III.

MR. MARK TEITZEL: Great.

MR. JOEL GROVES: Yeah.

MR. MARK TEITZEL: But you could use some Phase II equipment.

MR. EARLE AUSMAN: Oh yeah.

MR. JOEL GROVES: That’s right, Phase II is a fully functional first article one converter.

UNIDENTIFIED MALE: One converter?

MR. JOEL GROVES: One converter.

UNIDENTIFIED MALE: In a laboratory environment.

MR. JOEL GROVES: It’ll -- yeah, it does not have the enclosure and everything because that becomes site specific issues that, you know, what does that thing need to look like.

MR. EARLE AUSMAN: And they had to construct special power supplies and things like that to do this testing.
UNIDENTIFIED MALE: Sure.
MR. MARK TEITZEL: To sell it, you know, if you have something already built it’s -- a lot of people like to see what they’re getting.
MR. JOEL GROVES: Yeah.
MR. EARLE AUSMAN: Well, they can come look at it, that’s for sure.
MR. MARK TEITZEL: Well -- yeah, okay.
MS. DENALI DANIELS: Well, why don’t we do this. Go ahead, sir.
MR. ALBERT SAKATA: Just one comment. For the converters, you know, were they intended to be bidirectional?
MR. JOEL GROVES: Yes, they are bidirectional.
MR. ALBERT SAKATA: Okay.
MS. DENALI DANIELS: So.....
MR. EARLE AUSMAN: Yeah, we can change the polarity. We asked that they be made so they change the polarity. We can change the polarity if we want to.
UNIDENTIFIED MALE: (Indiscernible).
MR. EARLE AUSMAN: In other words there could be a minus to plus or a plus to minus.
MR. ALBERT SAKATA: Well.....
MR. JOEL GROVES: They.....
MR. ALBERT SAKATA: .....what I meant to ask is in terms of, you know, going one way sometimes but then maybe --
there may be a need to go the other way.

   MR. JOEL GROVES: Yeah, it’s......

   MR. ALBERT SAKATA: You know, that’s what......

   MR. JOEL GROVES: ......the answer -- yeah, the answer is yes to both questions. What Earle was saying is the intertie can operate at plus 50 kilovolts or minus 50 kilovolts relative to ground. And then also power flow can move in either direction. So......

   MR. ALBERT SAKATA: Excellent.

   MR. JOEL GROVES: Yeah.

   MR. ERIC MARCHEGIANI: So, Denali, do you think maybe a teleconference next week or......

   MS. DENALI DANIELS: Next week’s going to be tough.

   MR. ERIC MARCHEGIANI: Okay.

   MS. DENALI DANIELS: And actually I was just trying to list in my mind these things that Polar, you know, would have to do between now and that meeting and what a realistic timeline would be. We talked about a white paper or kind of a bulletized document that could be widely distributed. And then I would say reaching out and maybe narrowing the site list down and maybe really thinking about things like project readiness and the timeline. I mean to me those are key issues that, you know, maybe you don’t even reach out to some of them if you already know the answer to that.

   MR. JOEL GROVES: Yeah. Yeah, the white paper I think
-- I mean if next week is out that’s fine in terms of giving us
a little more time to get something crafted. The week after?

   MS. DENALI DANIELS: I would say two weeks.

   MR. JOEL GROVES: Yeah, the week after I think is
realistic. Vetting some of these projects it’s a little bit
harder to say how long that’s going to take. I mean if we --
you know, you could spend months looking at these projects and
really figuring out what’s viable, what’s not. We need to do
something.....

   MS. DENALI DANIELS: Well.....

   MR. JOEL GROVES: .....more expeditiously than that.

   MS. DENALI DANIELS: .....I guess my sense is that,
you know, many of these are going to just fall off because you
don’t have a program partner that’s willing to carry the torch
for you.....

   MR. JOEL GROVES: Right.

   MS. DENALI DANIELS: .....because that’s kind of the
transition that’s taking place here. And so, you know, it may
be that, you know, someone raises their hand and says we want to
do this and that’s really what makes sense and then you get into
some of those technical questions. So to me, you know, we’re
really at a critical point here where if there isn’t a champion
that’s ultimately going to be the owner and operator of the
infrastructure then, you know, we’re really going to have
trouble moving this forward. I mean that’s kind of the bottom
MR. ROBERT VENABLES: Especially if the proposed project’s going to take a five year NEPA process.

MS. DENALI DANIELS: Yeah, yeah.

MR. ROBERT VENABLES: I mean really, I mean.....

MR. JOEL GROVES: Yeah.

MS. DENALI DANIELS: Yeah. So two weeks. Can people do the doodle calendar, do people know how to do that? No. I shouldn’t have asked that question.

UNIDENTIFIED MALE: I tried recently, it didn’t work.

MS. DENALI DANIELS: It didn’t work?

UNIDENTIFIED MALE: I couldn’t make it work.

UNIDENTIFIED MALE: What is it?

MR. ERIC MARCHEGIANI: Why don’t you just send out a proposed date and time and.....

MS. DENALI DANIELS: Yeah. So I think that’s -- we have our Energy Advisory Committee meeting and I’m also not going to be rude but I literally have to run out the door for the airport in five minutes. So -- but let’s just look at the calendar real quick. So that is the week of the 31st?

MR. JASON MEYER: No, the 23rd.

UNIDENTIFIED MALE: Twenty-third.

MS. DENALI DANIELS: Oh. Right. Could I be so lucky next week would go away.

MR. JASON MEYER: So yeah, the -- I think the Energy
Advisory Committee is on......

MS. DENALI DANIELS: Yeah. Okay. I mean that’s actually not a bad week for me. I have a lot of work to do but not a lot of meetings, so. So Jason will send out maybe two or three dates and times and, you know, whatever works best for most folks. We’ll just do it on teleconference. We’ll put together -- really the agenda’s going to be, you know, looking at the white paper, some of our layman’s terms communications and then narrow down this site selection discussion and, you know, maybe some other -- maybe there’s -- you can reach out to AEA or, you know, have some more conversations there. So.....

(Whispered conversation)

MS. DENALI DANIELS: Well, since Jason’s already going to be sending out a calendar invite for two weeks from now I -- it sounds like maybe we’ll want to go ahead and do the same thing with our July dates. So that’ll be the next kind of half day meeting that we’ll have.

So again, I want to thank everyone for your time, for your expertise, for your interest in the success of this project. It’s complicated, there’s a lot at stake and, you know, we really appreciate the work that Polar and ACEP have been doing on the Commission’s behalf. And, you know, thank you. The meeting transcript will be available at some point soon so we’ll get that out to the group and look forward to talking with everybody again in about two weeks. Yes.
MR. BRENT PETRIE: I’d also just like to say thank you to Polarconsult for engaging Manitoba International.

MS. DENALI DANIELS: Yeah, yeah.

MR. BRENT PETRIE: They are a very respected group in HVDC technology and I think that’s a very good -- lends credibility to this effort.

MS. DENALI DANIELS: Well, meeting’s adjourned. Thank you.

(Off record at 4:49 p.m.)
TRANScriber's CERTIFICATE

I, Nicolette Hernandez, hereby certify that the foregoing pages numbered 2 through 121 are a true, accurate and complete transcript of the proceedings of The Stakeholder Advisory Group meeting held January 14, 2011, transcribed by me from a copy of the electronic sound recording to the best of my knowledge and ability.

_____________________________  _____________________________
Date       Nicolette Hernandez
The objective of today's meeting is to update the SAG on current project status. In addition, specifics will be provided on converter development and testing as well as testing plans for transmission infrastructure. Feedback will be solicited from the SAG on future project goals and project assessment content.
HVDC Transmission for Rural Alaska

STAKEHOLDERS’ ADVISORY GROUP
THIRD MEETING
October 25, 2011
ANCHORAGE, ALASKA

Joel D. Groves, P.E.
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ENGINEERS - PLANNERS - ENERGY CONSULTANTS
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Anchorage, Alaska
(907) 258-2420
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joel@polarconsult.net
# PHASE II PROJECT TEAM

- Denali Commission (Funding Agency)
- ACEP (Grant Management, Economic Analysis, Independent Assessment / Reporting)
- Polarconsult (Project Management, Strategic Vision, Concept Design, Reporting)
- Princeton Power Systems (Converter Development)
- UAF/Dr. Wies (Alaska Integration / Practicality / Converter / System Review)
- AVEC (Alaska Integration / Practicality)
- SAG (Practicality / Industry Acceptance)
- Manitoba HVDC Research Centre (HVDC Expert – Integration, Technical Issues)
- Line Design Engineering (Structural and Code Expert)
- Golder Associates (Geotechnical Expert)
- Almita (Foundation Supplier)
- Arctic Foundations (Foundation Supplier)
- Zarling Aero Consulting (Thermal Soils Analysis)
- STG (Rural Intertie Contractor – logistics, cost)
- Alaska Foundation Technology (Foundation Contractor – logistics, cost)
- GeoTek Alaska (geotech. contractor – logistics, equipment)
- Cabletricity (Submarine Cable / HVDC Expert)
- Okonite (Cable Supplier)
PROJECT STATUS UPDATE

- Converters built, testing underway
- Overhead conceptual design complete, field tests starting in Fairbanks Nov. 7
- Submarine cable concept designs complete
- Overland cable testing next week
- Economic analysis underway
- Final report to ACEP for review Nov. 21
PROJECT STATUS UPDATE

Overhead System

- Conceptual design is very flexible, robust, adaptable
- Foundations are key - systems are being installed and validated in Fairbanks
- Long-term performance monitoring will be performed by ACEP
PROJECT STATUS UPDATE
Submarine System

- Existing cables work
  - Okonite URO-J 1/0 Cu Cable…

- Economics in Progress
  - Guidelines on need for armor
  - Laying equipment and costs

- Tel/co Integration
  - No technical hurdles
  - Looking for interested vendors
PROJECT STATUS UPDATE

Field Tests

- Fairbanks Test Site
- Erect guyed fiberglass pole
  - Test installation methods
  - Test pole base foundation
  - Test four guy foundations
  - Setup for multi-season monitoring by ACEP
- Materials and Contractors queuing for Nov. 7
Phase II Final Report

- Executive Summary – 2 or 3 pages
- Main Body of Report – ~ 30 pages
  - What was done
  - Current status of technology / system
  - Next steps for deployment

- Appendices
  - Project Record
  - Technical Data
  - References
  - Examples
Phase II Final Report

- SAG – Main Narrative
  - Main Narrative – overview of SAG’s role, members
  - Appendix - Transcripts, Correspondence, etc.

- Code Issues
  - Main Narrative – Summary of Findings
  - Appendix - Discussions with Dept of Labor, MHRC White Paper
Phase II Final Report

- Demonstration Site Selection
  - Main Narrative - List of Goals, Criteria, Sites, Future Actions
  - Appendix - detailed info on candidate sites
Phase II Final Report

❖ System Integration

➢ Main Narrative – How it all fits together. Interface with village micro grids, diesels, etc.

➢ Appendix – Technical reports from sub-consultants (MHRC, etc) on MTDC networks, SCADA integration, communication options, etc.
Final Report

- Converter Development
  - Main Narrative – Headline functionality, footprint, cost, test results, etc.
  - Appendix - detailed info on development, specifications, testing, etc (PPS Report)
Phase II Final Report

- Overhead Transmission System
- Submarine Cable System
- Buried Overland Cable System
  - Main Narrative – Conceptual design methodology, conceptual designs, applications
  - Appendix - detailed info on design, loadings, etc. Technical reports from sub-consultants
Phase II Final Report

- Construction & Maintenance Methods
  - Main Narrative – design objective, results
  - Appendix – detailed technical data and subconsultant reports. Findings from Fairbanks Test Site.
Phase II Final Report

❖ Economic Analysis

➢ Main Narrative – cost estimates for representative systems – similar to Ph 1 Report
➢ Appendix – Detailed support for cost data, life cycle analysis, comparative costs.
Example

- Overhead System
OVERHEAD SYSTEM

Conceptual Design Methodology

- Gather load data from utilities
- Design target is ‘worst case common’ condition
- Deal with unique loadings by reducing spans, doubling components, etc.
- Maintain robust, adaptive design
  - Deal with varying geotechnical conditions
  - Deal with variety of installation / repair conditions
OVERHEAD SYSTEM Conceptual Design

- 60-foot fiberglass pole, 14” dia x 0.3” wall. 4 guys per pole
- Post top insulator for monopolar
- Cross arm and suspension insulators for bipolar (shorter spans)
- All three for AC lines. (neutral lower on pole)
- Suite of standard foundation options for pole base and guys
  - Thermosiphon (1-1/2” x 25’ pipe, CO₂ working fluid)
  - Screw Anchor (multiple suppliers exist)
  - Micropile (2” – 3” pipe, 25-50’ long (as required)
- 19#10 Alumoweld at 30-40% initial tension
POLE SPLICE

1. Pole section will be stacked in 10ft and 8ft lengths.

2. Locate screws on non-seam faces.

3. Pole cap and plug must be stocked independently.
SPECIAL INSTRUCTIONS:
Weld the top 5" pup onto the unit after the valve has been installed and pressure tested. Then, drill 3 each 1/8" drainage holes equally spaced around the pipe at the lower end of the 5" pup.
Prior to finishing, grind all girth welds smooth to the diameter of the pipe.

<table>
<thead>
<tr>
<th>NOTES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) All pressure retaining welds are full penetration v-groove welds. Welding procedure specifications are qualified in accordance with ASME Section IX. Welding is performed by welders qualified per ASME Section IX.</td>
</tr>
<tr>
<td>2) The brass valve to steel connection is silver brazed per AFI standard procedure.</td>
</tr>
<tr>
<td>3) Coat upper twelve feet of anchor with H.B.Fuller IF-1074 fusion bond epoxy over 3 mils flame sprayed aluminum applied per AWS C2.2. Extend the 3 mils of flame sprayed aluminum applied per AWS C2.2 down the anchor shaft an additional 2 feet. Brush blast mill finish off bearing zone of anchors.</td>
</tr>
<tr>
<td>4) Charge Thermoprobes with R-744 per AFI standard procedure.</td>
</tr>
<tr>
<td>5) Materials are AFI standard for the intended service.</td>
</tr>
<tr>
<td>6) Build 5 units as shown hereon.</td>
</tr>
</tbody>
</table>
Thin organic layer, no insulation and thermal pile unit conductance is 1.0 BTU/hr-ft-F.
Thick organic layer, four-inch thick insulation and thermal pile unit conductance is 1.0 BTU/hr-ft-F.
Thin organic layer, four-inch thick insulation and thermal pile unit conductance is 1.0 BTU/hr-ft-F
Thick organic layer, no insulation and thermal pile unit conductance is 1.0 BTU/hr-ft-F
SCREW ANCHOR
PROJECT STATUS UPDATE

Overhead System Load Cases

- NESC 250B, 4 psf wind, no ice
- NESC 250C, 120 mph wind, no ice
- NESC 250D, 80 mph wind, ¼” ice
- 1” ice, no wind

- Max final tension (42.1%) and sag (25.5’) with 1” ice
- Max transverse load on guys with 120 mph wind (27.8% of NESC limit, 3/8” EHS guy wire)
- 24’ ground clearance goal met with 50’ pole/insulator.
- Standard construction OK for 10-degree angles
PROJECT STATUS UPDATE
Overhead System Foundations

- Pole base – compression (and some moment)
  - 5,000# short-term load
  - 10,000# long-term load

- Guys – tension loads
  - 5,000# short-term load
  - 10,000# short-term load

- Guys must resist creep and frost jacking
SAG Discussion
Future of Project and Technology

❖ Recap

➤ Extensive review of possible demonstration sites
➤ Applied for Phase III Funding (EETF)
Phase III Demonstration Project

Candidate Projects:

- Barrow-Atqasuk Intertie
- Nome-Pilgrim Hot Springs Intertie
- Nome-Teller Intertie
- St. Mary's-Mountain Village Intertie
- Dillingham-Manokotak Intertie
- Glacier Bay Nat'l Park-Gustavus Intertie
- Green's Creek-Hoonah Intertie
- Petersburg-Kake Intertie
- Kodiak-Ouzinkie
Future of Project and Technology

 Lessons Learned

- Focus on successful converter demonstration
- Shouldn’t wait for a rural intertie (~5 years?)
- Railbelt feeder line ‘demo conversions’ don’t demonstrate much, not very cost effective. (thanks to utilities for helping!)
- Focus on useful demo of converter with rapid deployment schedule
Current Working Plan

- **Part 1**
  - More testing in Princeton, final commercialization work

- **Part 2**
  - Alaska demonstration installation
  - Working on a site

- **Part 3**
  - Work with utilities to find HVDC projects
  - Forge partnership with utilities/communities for full demo
HVDC Power Converter Project Review

October 25th 2011

Darren Hammell, Executive Vice President & Co-Founder
dhammell@princetonpower.com
Who is Princeton Power?

Princeton Power Systems designs and builds high-performance power electronic converters for military and commercial distributed generation applications, and designs and installs complete photovoltaic systems.

Our Distributed Generation Systems, including solar systems, include energy storage, critical load control, backup power, and other advanced features.

Competitive advantages come from patented technologies, and system engineering expertise.

CLEAN POWER, MADE SIMPLE.

3490 US Route 1
Princeton, NJ 08540
www.princetonpower.com
sales@princetonpower.com
p. 609.955.5390 x 103
Company Timeline

- **2001**: Princeton University spin-out
- **2002 – 2007**: R&D programs with NASA, DOE, ONR, Navsea, Army, NJ BPU, private clients
- **2008**: Hybrid (wind, solar, battery) systems installed in Bermuda, Virginia, California, New Jersey
- **2009**: GTIB 480-100 UL 1741 listing, “Green Product of the Year” Award, $3.3M NJ-sponsored investment in manufacturing plant begins
- **2010**: Military VSD deployments on the Gerald Ford Aircraft Carrier
- **2011**: ~3MW GTIB’s deployed, new production facility opened with 12 MW capacity, Demand Response Inverter final pre-production testing
The Princeton Power Team

Management Team

Dr. Marshall Cohen
President & CEO
- Ph.D. Physics
- 35 years experience in solar and optoelectronics
- Co-founder and last CEO of Sensors Unlimited

Darren Hammell
Co-founder, EVP Business Development
- BSE Computer Science, Princeton University
- CEO of PPS 2001–2009
- NJBiz 40-under-40 Business Leaders

Mark Holveck
Chief Technical Officer

Paul Heavener
Engineering Manager

Rich Jaccard, PE
Production Manager

Mike Yam
Finance Administrator

Cynthia Rosen, MBA
Administration / HR

Board of Directors

Dr. Ed Zschau (Chairman)
- Congressman, California’s 12th District (Silicon Valley)
- Former CEO Systems Industries, General Manager IBM
- Professor of Entrepreneurship at Princeton University

Dr. Greg Olsen
- Co-founder and CEO of Sensors Unlimited, Epitaxx
- 3rd private astronaut

Stephen Morgan
- Former President, CEO, and Chairman of the Board of Jersey Central Power and Light
- More than 30 years industry experience in all aspects of energy generation and delivery

Dr. Joseph Stach
- Former Executive Director of Massachusetts Technology Collaborative
- CEO of RF Power in Voorhees, NJ

Dr. Chris Dries
- Princeton PhD in Electronics
- President & CEO of United Silicon Carbide


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Sample Projects

- **Princeton Power Systems Facility: Princeton, NJ**
  - 200 kW / 164 kWh lithium-ion
  - Multi-functional Demonstration, grid-tied and backup
- **‘Earth Day’ PHEV Chicago, IL**
  - 100 kW / 26 kWh lithium-ion
  - PHEV Charging Station, grid-tied storage
- **U.S. Army Forward Operating Base**
  - 100kW Solar Configuration, 100kW deep-cycle lead-acid
  - Field-deployed microgrid
- **Alcatraz Island, National Park Service (Q3 2011)**
  - 400 kW Solar, 400 kW Deka Unigy AGM batteries, twin 400kW Diesel GenSets
  - ‘Standalone Controller’ for microgrid operation
- **Bermuda Electric Light Company (BELCO)**
  - Wind, solar, battery system deployed in Bermuda, lead-acid
Demand Response Inverter Concept

Utility Control

Non-Critical Loads

Critical Loads

DRI

PV Power

Weather Station

Energy Storage

EV & PHEV

Battery

Communication Connection

Terminals 1, 2, 3, 4
HVDC Power Converter Background

• The HVDC power converter changes low-voltage alternating current (LVAC) power to high-voltage direct current (HVDC) to allow efficient power transmission between communities, and usable power within the community
• The HVDC Power Converter plays a key role in reducing transmission costs and increasing grid reliability for remote and isolated electrical systems
• The HVDC power converter has been a ‘missing link’ in realizing the HVDC Transmission concept
• PPS’ HVDC converter, partially funded through PolarConsult, is a 500 kW power converter, capable of parallel operation to 10 MW or more, and bi-directional power conversion between three-phase 480 VAC and 50 kVDC.
1MW Transmission Line Diagram

PPS Scope Of Supply
Generating Village

Monopolar Earth Return with Village Interties

PPS Scope Of Supply
Receiving Village

Medium Voltage Village Grid
Power Converter Components

Low-Voltage Enclosure
(480 VAC ↔ 6-8 kHz 800 VAC)

High-Voltage Enclosure
(800 VAC ↔ 50 kVDC)
Includes xformer in oil

HV Enclosure
LV Enclosure
Phased Development Summary

• In Phase I, a design was completed and a bench-scale concept and feasibility unit was constructed, and concept validation testing performed (December 2007 – February 2009)

• In this Phase II, 2 500kW prototype units are being built and tested
  – Contractual PoP: May 2010 – October 2011
  – PPS will work through December 2011 to complete Testing

• A Phase II technology demonstration is scheduled for November 14th 2011, at Princeton Power Systems High Voltage Testing Facility in Princeton, NJ.
Phase II Status Summary

- Previously Completed Milestones

- Schedule for Completion of Phase II

May 2010

Dec 2011

Nov 2011

Technology Demonstration
## Phase II Task Status

<table>
<thead>
<tr>
<th>Task</th>
<th>Percent Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1 Develop Converter Voltage Standards</strong></td>
<td></td>
</tr>
<tr>
<td>2.1.1 Review Voltage Stds with PCA and AVEC</td>
<td>100%</td>
</tr>
<tr>
<td>2.1.2 Review Safety Packaging &amp; Perf. Req. with PCA &amp; AVEC</td>
<td>100%</td>
</tr>
<tr>
<td>2.1.3 Review Power Line Comm System</td>
<td>100%</td>
</tr>
<tr>
<td>2.1.4 Develop System Spec for 1MW and Sign off w/PCA</td>
<td>100%</td>
</tr>
<tr>
<td><strong>2.2 Converter Design and Construction</strong></td>
<td></td>
</tr>
<tr>
<td>2.2.1 Modify PE and Circuit Topology (Procurement Spec)</td>
<td>100%</td>
</tr>
<tr>
<td>2.2.2 Perform Computer Modeling</td>
<td>100%</td>
</tr>
<tr>
<td>2.2.3 Reliability / failure analysis of HVDC Converter Design</td>
<td>100%</td>
</tr>
<tr>
<td>2.2.4 Modify Control Software</td>
<td>100%</td>
</tr>
<tr>
<td>2.2.5 Evaluate and Mod design to diagnose faults/failures</td>
<td>100%</td>
</tr>
<tr>
<td>2.2.6 Develop Thermal Management System</td>
<td>100%</td>
</tr>
<tr>
<td>2.2.7 Generate Mech Design (HVDC System)</td>
<td>100%</td>
</tr>
<tr>
<td>2.2.8 Generate 3D Model and Detailed Metalwork Fab Dwgs</td>
<td>100%</td>
</tr>
<tr>
<td>2.2.9 Identify / Develop Vendor / Procurement</td>
<td>100%</td>
</tr>
<tr>
<td>2.2.10 Assemble (1) 1MW Unit</td>
<td>95%</td>
</tr>
<tr>
<td><strong>2.3 Converter Test Plan</strong></td>
<td></td>
</tr>
<tr>
<td>2.3.1 Develop Converter Test Plan</td>
<td>100%</td>
</tr>
<tr>
<td>2.3.2 Review and Appr of Test Plan by ACEP</td>
<td>0%</td>
</tr>
<tr>
<td>2.3.3 Test Plan Revisions</td>
<td>0%</td>
</tr>
<tr>
<td><strong>2.4 Converter Testing and Reporting</strong></td>
<td></td>
</tr>
<tr>
<td>2.4.1 Di-electric Test</td>
<td>80%</td>
</tr>
<tr>
<td>2.4.2 Various failure mode response testing</td>
<td>50%</td>
</tr>
<tr>
<td>2.4.3 Operational / Functional Testing</td>
<td>50%</td>
</tr>
<tr>
<td>2.4.4 Efficiency Testing</td>
<td>30%</td>
</tr>
<tr>
<td>2.4.5 Temperature Rise Testing</td>
<td>20%</td>
</tr>
<tr>
<td>2.4.6 Test Report</td>
<td>0%</td>
</tr>
</tbody>
</table>
Completed Milestones

– Air Testing Completed on Transformer assembly #1.
  • Issues with design exposed during Hi-Pot test.
  • Changes Implemented, 20kV Hi-Pot test Passed.

– Transformer #1 immersed in oil
  • Hi-Pot 70kV Test Passed

– Implemented design changes to Transformer #2.
  • Transformer #2 20kV Hi-Pot Test Passed.

– LV Enclosure #1 assembly complete.
  • Functional testing completed

– LV Enclosure #2 assembly complete.
Transformer and HV Stacks

Completed:
Assembly of Module #1 completed, Hi-Pot tested in air to 15kV
Operational Testing to 9kV
HV Transformer #1

Transformer #1 immersed in oil tank for in-oil testing
Controls Sub-Assembly Testing

Component Tests Completed

- Tank Status Board
  - Fiber Optic assembly
  - FPGA Configuration
  - Individual Circuit tests
    - Sensor inputs
    - Status output
    - UART input/output
Controls Sub-Assembly Testing

Component Tests Completed

- Peripheral board
  - Trigger Tests
  - Sensor Tests
  - Fiber Optic Tests
- Simulated system test of the Tank Status board
- DSP software coding and modification
  - Software start up
    - Initialization
    - Calibration
- Basic peripheral control and monitoring
Current Status

500kW Module 1
HVDC Transformer and LVAC Enclosure
Installed in PPS HV Test Lab for HV Bring Up

500kW Module 2
Transformer Tank
awaiting in air testing completion

LVAC Unit completed at PPS HV Lab

Transformer HV Assy
ready for In Air testing
10-28
## Schedule for Completion of Remaining Phase II Tasks as of 10/25/2011

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessors</th>
</tr>
</thead>
<tbody>
<tr>
<td>System #1 Hi-Pot Testing</td>
<td>1 day</td>
<td>Mon 8/15/11</td>
<td>Mon 8/15/11</td>
<td></td>
</tr>
<tr>
<td>System #1 Bring Up in Air</td>
<td>35 days?</td>
<td>Tue 8/30/11</td>
<td>Mon 10/17/11</td>
<td>2</td>
</tr>
<tr>
<td>Re install BNC's 90 deg.</td>
<td>1 day?</td>
<td>Tue 8/30/11</td>
<td>Tue 8/30/11</td>
<td></td>
</tr>
<tr>
<td>Repair 2 Trigger Bds</td>
<td>3 days</td>
<td>Wed 8/31/11</td>
<td>Fri 9/2/11</td>
<td></td>
</tr>
<tr>
<td>Rework Transformer more Kapton</td>
<td>1 day?</td>
<td>Thu 9/1/11</td>
<td>Thu 9/1/11</td>
<td></td>
</tr>
<tr>
<td>Hi Pot Transformer</td>
<td>1 day?</td>
<td>Fri 9/2/11</td>
<td>Fri 9/2/11</td>
<td></td>
</tr>
<tr>
<td>Integrate IGBT Temp Sensors</td>
<td>1 day</td>
<td>Wed 6/31/11</td>
<td>Wed 6/31/11</td>
<td></td>
</tr>
<tr>
<td>Power Supply Switcher Bd</td>
<td>22 days</td>
<td>Wed 8/31/11</td>
<td>Thu 9/29/11</td>
<td></td>
</tr>
<tr>
<td>AC to DC Test</td>
<td>2 days</td>
<td>Mon 9/5/11</td>
<td>Tue 9/6/11</td>
<td>5, 6, 7</td>
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<tr>
<td>DC to AC Switching Test</td>
<td>4 days</td>
<td>Wed 9/7/11</td>
<td>Mon 9/12/11</td>
<td>10</td>
</tr>
<tr>
<td>Final Verification</td>
<td>3 days</td>
<td>Tue 9/13/11</td>
<td>Thu 9/15/11</td>
<td>11</td>
</tr>
<tr>
<td>Tank #1 Transformer Insert to NVML for Oil Processing</td>
<td>5 days</td>
<td>Tue 10/11/11</td>
<td>Mon 10/17/11</td>
<td>12</td>
</tr>
<tr>
<td>System #1 LV Controls Bring up</td>
<td>20 days</td>
<td>Wed 10/5/11</td>
<td>Tue 11/1/11</td>
<td></td>
</tr>
<tr>
<td>Control Bd DSP Code</td>
<td>20 days</td>
<td>Wed 10/5/11</td>
<td>Tue 11/1/11</td>
<td></td>
</tr>
<tr>
<td>System #2 Kit for NVL</td>
<td>45 days?</td>
<td>Mon 8/22/11</td>
<td>Fri 10/21/11</td>
<td></td>
</tr>
<tr>
<td>System #1 HV Testing at 3175</td>
<td>13 days?</td>
<td>Tue 10/18/11</td>
<td>Thu 11/3/11</td>
<td></td>
</tr>
<tr>
<td>Tank #1 Returned Processed</td>
<td>1 day?</td>
<td>Tue 10/18/11</td>
<td>Tue 10/18/11</td>
<td></td>
</tr>
<tr>
<td>System #1 HV Bring Up</td>
<td>12 days</td>
<td>Wed 10/19/11</td>
<td>Thu 11/3/11</td>
<td></td>
</tr>
<tr>
<td>System #2 Bring Up in Air</td>
<td>9 days?</td>
<td>Fri 10/28/11</td>
<td>Wed 11/9/11</td>
<td></td>
</tr>
<tr>
<td>Tank Insert #2 Returned to PPS for Dry Testing</td>
<td>1 day?</td>
<td>Fri 10/28/11</td>
<td>Fri 10/28/11</td>
<td></td>
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<tr>
<td>System #2 Hi-Pot Testing</td>
<td>3 days</td>
<td>Mon 10/3/11</td>
<td>Wed 11/2/11</td>
<td>22</td>
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<tr>
<td>System #2 Bring Up in Air</td>
<td>5 days</td>
<td>Thu 11/3/11</td>
<td>Wed 11/9/11</td>
<td>28</td>
</tr>
<tr>
<td>System #2 LV Controls Bring Up</td>
<td>4 days</td>
<td>Tue 11/4/11</td>
<td>Fri 11/4/11</td>
<td>22</td>
</tr>
<tr>
<td>Bring Up LV Enclosure #2</td>
<td>3 days</td>
<td>Tue 11/1/11</td>
<td>Thu 11/3/11</td>
<td>22</td>
</tr>
<tr>
<td>Bring Up and Verify</td>
<td>3 days</td>
<td>Wed 11/2/11</td>
<td>Fri 11/4/11</td>
<td>15, 27</td>
</tr>
<tr>
<td>System #2 HV Testing at 3175</td>
<td>9 days?</td>
<td>Mon 11/7/11</td>
<td>Thu 11/17/11</td>
<td></td>
</tr>
<tr>
<td>Tank #2 Transformer insert to NVML for Processing in Oil</td>
<td>3 days</td>
<td>Mon 11/7/11</td>
<td>Wed 11/9/11</td>
<td>30</td>
</tr>
<tr>
<td>Tank #2 Returned to PPS Processed</td>
<td>1 day?</td>
<td>Thu 11/10/11</td>
<td>Thu 11/10/11</td>
<td></td>
</tr>
<tr>
<td>System #2 HV Bring Up</td>
<td>5 days</td>
<td>Fri 11/11/11</td>
<td>Thu 11/17/11</td>
<td>35</td>
</tr>
<tr>
<td>System HV Testing</td>
<td>24 days?</td>
<td>Mon 11/14/11</td>
<td>Thu 12/15/11</td>
<td></td>
</tr>
<tr>
<td>HV System Testing</td>
<td>20 days</td>
<td>Fri 11/18/11</td>
<td>Thu 12/15/11</td>
<td>25, 36</td>
</tr>
<tr>
<td>Technology Demonstration</td>
<td>1 day?</td>
<td>Mon 11/14/11</td>
<td>Mon 11/14/11</td>
<td></td>
</tr>
</tbody>
</table>
Phase II Remaining Tasks

- LV Enclosure #1 with Transformer #1 Operational Testing to 50kV underway
- Transformer #2 assembly ready for Air Testing. 10-28
- LV Enclosure #2 Operational Testing underway
- Transformer #2 immersed in oil 11-7
- LV Enclosure #2 with Transformer #2 Operational Testing to 50kV 11-17
- Dual-module System Testing 11-17 to 12-15
“Module 1” HV Testing

• Module Integration (Underway)

• Visual inspection
  – Tank:
    • Electrical / Mechanical
  – LV Enclosure:
    • Electrical / Mechanical

• Hi-Pot
  – Tank
    • Across transformer, 71 kV
    • DC to ground
    • AC to ground
  – LV Enclosure
    • (DC and AC) to ground
“Module 1” HV Testing

- Controls Operational Testing (Underway)
  - Control power
  - Communication interfaces
  - Sensor input
  - System I/O
  - User I/O
  - Triggering check
    - Check trigger lines for basic operation
    - Characterize propagation delay and skew between electrical and optical transmission lines, and correct if necessary.
    - Switch power using a test pattern and LVLE (Low voltage, Limited Energy) power source to confirm correct ability to switch at frequency, with dead time etc.
1MW Dual-module System Testing

• Functional tests
  – Rated voltage test- 50kV DC using earth return
    • 3 phase 480 VAC to 50 kVDC
    • 50 kVDC to 3 phase 480 VAC
  – Power sharing between parallel systems
• Efficiency test @ several power levels
• Temperature rise test @ rated current and low voltage
HV Facility Layout

NOTES
NESC Table 124.1 Clearances:
Vertical 9'6"-10"
Horizontal Guard 4' - 4'4"
1'4"
Facility available S.C. current
Air Testing Configuration

Resistive Load

HV Transformer

LVAC Enclosure
Summary of Key Performance Metrics
Phase II Converter Materials Costs

<table>
<thead>
<tr>
<th>BOM Summary</th>
<th>10pcs.</th>
<th>100pcs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Electronics</td>
<td>$116K</td>
<td>$100K</td>
</tr>
<tr>
<td>Controls &amp; Monitoring</td>
<td>$32K</td>
<td>$26K</td>
</tr>
<tr>
<td>Mechanical- BOS</td>
<td>$69K</td>
<td>$56K</td>
</tr>
<tr>
<td>Total Parts Cost 1MW</td>
<td>$217K</td>
<td>$182K</td>
</tr>
</tbody>
</table>

We have a $250/kW cost target for a ‘commercial production’ unit in low-medium volumes.

‘Commercial Production’ means that substantial work has been done to take the functional Phase II prototype and perform thorough testing and manufacturing engineering to reduce costs. This will require additional work for testing and design refinement/cost reduction.

This additional work accounts for achieving $250/kW based on the actual numbers from Phase II.
### Phase II Converter Efficiency

#### Total Full-Power Loss Calculation

<table>
<thead>
<tr>
<th>Component</th>
<th>RMS</th>
<th>Linear</th>
<th>Fixed</th>
<th>sum</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parasitic</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>1500</td>
<td>0.300%</td>
</tr>
<tr>
<td>HVDC Bridge :</td>
<td>979</td>
<td>2774</td>
<td>3</td>
<td>3756</td>
<td>0.751%</td>
</tr>
<tr>
<td>HF Transformer :</td>
<td>716</td>
<td>0</td>
<td>1300</td>
<td>2016</td>
<td>0.403%</td>
</tr>
<tr>
<td>HF Capacitors :</td>
<td>226</td>
<td>0</td>
<td>0</td>
<td>226</td>
<td>0.045%</td>
</tr>
<tr>
<td>HV Stack 50kV Balancing:</td>
<td>0</td>
<td>0</td>
<td>781</td>
<td>781</td>
<td>0.156%</td>
</tr>
<tr>
<td>HV Stack 24V Balancing:</td>
<td>0</td>
<td>0</td>
<td>150</td>
<td>150</td>
<td>0.030%</td>
</tr>
<tr>
<td>LVDC Bridge :</td>
<td>1349</td>
<td>0</td>
<td>0</td>
<td>1349</td>
<td>0.270%</td>
</tr>
<tr>
<td>LVAC Bridge :</td>
<td>7224</td>
<td>2382</td>
<td>0</td>
<td>9606</td>
<td>1.921%</td>
</tr>
<tr>
<td>AC Filter Inductor (L1) :</td>
<td>755</td>
<td>0</td>
<td>113</td>
<td>868</td>
<td>0.174%</td>
</tr>
<tr>
<td>AC Filter Capacitor (Cac) :</td>
<td>150</td>
<td>0</td>
<td>150</td>
<td>150</td>
<td>0.030%</td>
</tr>
<tr>
<td>Grid Inductor (L2) :</td>
<td>748</td>
<td>0</td>
<td>0</td>
<td>748</td>
<td>0.150%</td>
</tr>
<tr>
<td>Control System :</td>
<td>100</td>
<td>50</td>
<td>150</td>
<td>50</td>
<td>0.100%</td>
</tr>
<tr>
<td>Cooling System :</td>
<td>826</td>
<td>0</td>
<td>826</td>
<td>826</td>
<td>0.165%</td>
</tr>
<tr>
<td>Wiring &amp; Bus Bar :</td>
<td>100</td>
<td>400</td>
<td>0</td>
<td>500</td>
<td>0.100%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12747</td>
<td>6982</td>
<td>2897</td>
<td>22627</td>
<td>4.525%</td>
</tr>
</tbody>
</table>

#### Converter Efficiency w/aux losses

<table>
<thead>
<tr>
<th>Power %</th>
<th>RMS loss</th>
<th>Linear Loss</th>
<th>Fixed loss</th>
<th>Total Loss</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>1.3</td>
<td>69.8</td>
<td>2897.4</td>
<td>2968.5</td>
<td>40.6%</td>
</tr>
<tr>
<td>3%</td>
<td>11.5</td>
<td>209.5</td>
<td>2897.4</td>
<td>3118.3</td>
<td>79.2%</td>
</tr>
<tr>
<td>10%</td>
<td>127.5</td>
<td>698.2</td>
<td>2897.4</td>
<td>3723.1</td>
<td>92.6%</td>
</tr>
<tr>
<td>20%</td>
<td>509.9</td>
<td>1396.4</td>
<td>2897.4</td>
<td>4803.7</td>
<td>95.2%</td>
</tr>
<tr>
<td>30%</td>
<td>1147.3</td>
<td>2094.6</td>
<td>2897.4</td>
<td>6139.3</td>
<td>95.9%</td>
</tr>
<tr>
<td>40%</td>
<td>2039.6</td>
<td>2792.8</td>
<td>2897.4</td>
<td>7729.8</td>
<td>96.1%</td>
</tr>
<tr>
<td>50%</td>
<td>3186.9</td>
<td>3491.0</td>
<td>2897.4</td>
<td>9575.3</td>
<td>96.2%</td>
</tr>
<tr>
<td>60%</td>
<td>4589.1</td>
<td>4189.2</td>
<td>2897.4</td>
<td>11675.7</td>
<td>96.1%</td>
</tr>
<tr>
<td>75%</td>
<td>7170.4</td>
<td>5236.5</td>
<td>2897.4</td>
<td>15304.3</td>
<td>95.9%</td>
</tr>
<tr>
<td>80%</td>
<td>8158.3</td>
<td>5585.6</td>
<td>2897.4</td>
<td>16641.3</td>
<td>95.8%</td>
</tr>
<tr>
<td>90%</td>
<td>10325.4</td>
<td>6283.8</td>
<td>2897.4</td>
<td>19506.6</td>
<td>95.7%</td>
</tr>
<tr>
<td>100%</td>
<td>12747.4</td>
<td>6982.0</td>
<td>2897.4</td>
<td>22626.8</td>
<td>95.5%</td>
</tr>
</tbody>
</table>
Possible System Application

Pedro Bay
500kW

Newhalen (INN System)
1.5MW

Kokhanok
500kW

Igiugig
500kW

Village 1

Village 2

Village 3

Village 4

Village 5

50kVDC Transmission Bus

Local Grid Bus Tie

Homer (Railbelt)
2.5MW

Pedro Bay
500kW

Newhalen (INN System)
1.5MW

Kokhanok
500kW

Igiugig
500kW

Village 1

Village 2

Village 3

Village 4

Village 5

50kVDC Transmission Bus

Local Grid Bus Tie

Homer (Railbelt)
2.5MW

---

Bar chart showing energy generation and distribution information:

- Pedro Bay: 500kW
- Newhalen (INN System): 1.5MW
- Kokhanok: 500kW
- Igiugig: 500kW
- Homer (Railbelt): 2.5MW

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Diagram details:

- Scale: 1:1
- Sheet: 1 of 3
- PRINCETON POWER SYSTEMS
- Date: 11 MAY 2010
Beyond Phase II

• The Phase II project includes the following: Dielectric test, Basic failure mode response testing, Basic Operational / Functional testing, Efficiency testing at various power levels, and temperature rise testing at rated current and low voltage.

• We anticipate that the following testing will be required to prepare the 500kW HVDC units for deployment in a commercial setting:
  – Detailed Failure Mode Response Testing.
  – Thorough Operational and Functional Testing.
  – Confidence Testing including load and endurance tests.
  – Design review and modifications based on test results.
Beyond Phase II

• Documentation including Operations Manual.
• Training for Utility Team, Installation and Commissioning.
• On-site support for Installation and Commissioning.
• Site development
  – General Electrical Design
  – Protective Relay Design
  – System Dielectric Coordination
  – Communications System Design
  – Structure / Container Design
• PPS recommends having spare modules and components that may be required throughout this phase.
• It is anticipated that this phase would require 8-10 Months and cost between $600k and $800k
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• Paul Heavener, Engineering Manager
  • pheavener@princetonpower.com
  • +1 609.955.5390 x116

• Mark Holveck, CTO
  • mholveck@princetonpower.com
HVDC TRANSMISSION FOR RURAL ALASKA

STAKEHOLDERS’ ADVISORY GROUP THIRD MEETING
October 25, 2011
Anchorage, Alaska

TRANSCRIPT OF PROCEEDINGS

Denali Commission
East Conference Room
October 25, 2011
2:00 o’clock p.m.

APPEARANCES:
Ms. Denali Daniels
Mr. Joel Groves
Mr. Jason Meyer
Mr. Earle Ausman
Ms. Elaine Brown
Mr. Bob Grimm (Telephonic)
Mr. Kent Grinage
Ns, Gwen Holdmann (Telephonic)
Ms. Meera Kohler
Mr. David Lockard
Mr. Eric Marchegiani
Ms. Jodi Mitchell (Telephonic)
Mr. Robert Venables
Ms. Lesli Walls (Telephonic)

OTHERS PRESENT:
Mr. Darren Hammell
Senator Lyman Hoffman
Dr. Rich Wies (Telephonic)
PROCEEDINGS

(On record at 2:05 p.m.)

THE REPORTER: Okay. We are on the record at 2:05 p.m., October the 25th.

MS. DENALI DANIELS: Thank you. I feel like I should have a gavel. There is a phenomenal rainbow outside, my goodness. Do you see that?

UNIDENTIFIED MALE: Yeah.

MS. DENALI DANIELS: It’s that way. Maybe it’s just through the window. Okay. I’m glad that was on the record.

Denali Daniels here, I manage the energy program for the Denali Commission. And I guess a few opening comments just to kind of recap the purpose of this group and what we hope to accomplish with this afternoon.

As most of you are aware, the Denali Commission has been involved financially in supporting some research around high voltage direct current technology with the idea that hopefully we can figure out some silver bullet to better serve and/or connect rural Alaska communities that are off the grid.

The Stakeholder Advisory Group is comprised of a fairly long and comprehensive list of individuals that in one shape or form have an interest in this issue or have some level of technical expertise.

And I guess what I’d like to propose is before we start introductions, this is the third of three meetings that we
had planned for an active grant that the Denali Commission
currently has for -- are we calling it phase two? Phase two of
the HVDC project. And there are some specific deliverables that
we’ll be hearing about today from Polarconsult which is under
contract by the University. So the relationships here are that
the Denali Commission has a grant with the University,
specifically Alaska Center for Energy and Power. So in turn
ACEP has a contract with Polarconsult for delivery of the grant
activities. And so we’re going to hear about the outcomes there
today. We also have a guest with us from Princeton Power who is
a sub to Polarconsult. So we’ve got a couple -- several levels
here to the cake.

So as an outcome of today’s meeting, in addition to
learning more about the work that has been accomplished on the
grant we will be asking for feedback from this group on
questions that we would like ACEP to address over the next six
to nine months as they do follow-up on an independent review of
this particular technology and what it may or may not be able to
do in the given environment that we’re all under. So we’re
going to be hearing about the technology, some of it’s going to
be fairly technical, but we’ve also got some questions that we’d
really like to hear your feedback on so that we can chart the
course over the next six to nine months with a separate
arrangement that ACEP will be undertaking independent of this
particular contract. So I hope that makes sense.
So with that, I’ve introduced myself. I represent the Denali Commission here and I think it’s probably best to start with Jason since he’s the program manager on this for ACEP.

MR. JASON MEYER: Yeah, my name is Jason Meyer with the Alaska Center for Energy and Power. I’m managing this grant on behalf of the Denali Commission working with Polarconsult.

MS. ELAINE BROWN: I’m Elaine Brown with Nuvista Light and Electric, a subsidiary of Calista Corporation.

MS. MEERA KOHLER: I’m Meera Kohler, CEO of Alaska Village Electric Coop. And we actually were the principle instigator of this project when we launched into this about three years ago so it’s very near and dear to my heart.

MR. KENT GRINAGE: Kent Grinage, North Slope Borough.

MR. JOEL GROVES: Joel Groves with Polarconsult. I’m the project manager for Polarconsult for this project.

MR. DARREN HAMMELL: Darren Hammell with Princeton Power Systems as a co-founder and Executive Vice President.

MR. DAVID LOCKARD: David Lockard, project manager at the Alaska Energy Authority.

MR. ERIC MARCHEGIANI: My name’s Eric Marchegiani. I work for USDA RUS and I’m also a member of the Energy Advisory Board for the Commission.

MR. ROBERT VENABLES: Robert Venables, Southeast Conference, energy coordinator.

SENATOR LYMAN HOFFMAN: Lyman Hoffman, Chairman of the
Senate Finance Committee.

MS. DENALI DANIELS: Thanks for being here, Senator.

MR. EARLE AUSMAN: Earl Ausman, Polarconsult.

MS. DENALI DANIELS: Okay. I’m not sure how many we have online but I’m going to go ahead and just ask folks to pipe in. Please identify yourself and your organization.

DR. RICH WIES: This is Rich Wies, I’m with the University of Alaska, Fairbanks, Electrical and Computer Engineering Department, and I’m a technical consultant through ACEP on the project.

MS. DENALI DANIELS: Hi, Rich. Who else do we have online?

MS. GWEN HOLDMANN: This is.....

MS. DENALI DANIELS: Go ahead.

MS. GWEN HOLDMANN: This is Gwen Holdmann, I’m the Director of the Alaska Center for Energy and Power at UAF.

MR. BOB GRIMM: Bob Grimm, Alaska Power and Telephone.

MS. DENALI DANIELS: Anyone else online? Okay. So -- you need a pen? Oh.

UNIDENTIFIED MALE: Sorry.

MS. DENALI DANIELS: Okay. Well, that was a quick introduction. Usually it takes a lot longer. So we’re looking at 2:12, we’re actually only two minutes behind schedule, which is my goal, to keep us on schedule here. So I am going to go ahead and turn it over to -- unless, Jason, do you have anything
MR. JASON MEYER: No.

MS. DENALI DANIELS: Okay. So Joel, Joel Groves, on behalf of Polarconsult will be providing a presentation. And how long will we go with the presentation or will we wait for questions until after?

MR. JOEL GROVES: I was going to start off with just a really brief overview of the project status and then I was going to switch over to Darren, have him give a overview of Princeton Power Systems a little bit and then the converter technology and the status of that and then have a Q and A with Darren on the.....

MS. DENALI DANIELS: Okay.

MR. JOEL GROVES: .....converter side of it.

MS. DENALI DANIELS: So we’ve got Darren on the agenda at 2:20.

MR. JOEL GROVES: Yeah.

MS. DENALI DANIELS: So is that -- we’ll just flow right through it?

MR. JOEL GROVES: Yeah, I was going to give just a very quick high level sketch of the project status.

MS. DENALI DANIELS: So you don’t need 10 minutes.

MR. JOEL GROVES: What time is it now?


MS. MEERA KOHLER: We’re whipping away into it.
MR. JOEL GROVES: How about seven minutes?

MS. MEERA KOHLER: Eight minutes and counting down.

MR. JOEL GROVES: Seven minutes.....

MS. DENALI DANIELS: All right.

MR. JOEL GROVES: .....will suffice.

MS. DENALI DANIELS: Joel, take it away.

MR. JASON MEYER: Joel, just for note, the presentation you’re giving, is that part of the one we sent out?

MR. JOEL GROVES: Yeah, it’s the first one that you had.

MR. JASON MEYER: Okay. For those online, I just emailed out the presentations and so this will be a component of Joel’s Polarconsult presentation.

MR. JOEL GROVES: Yeah, so first off -- yeah.

THE REPORTER: Hold it if you want to, unclip it and hold it.

MR. JOEL GROVES: That would be different. Okay.

THE REPORTER: Yeah, just unclip it.

MS. DENALI DANIELS: Or you could sit.

THE REPORTER: Just -- there we go.

MR. JOEL GROVES: I’ll just disassemble it for you.

MS. DENALI DANIELS: What other options do we have?

Come on gang, feedback.

MR. JOEL GROVES: Okay. This is Joel Groves with Polarconsult. I thought I’d just start off with a really high
level sketch of the project and highlight some of the team members involved in the project. Denali just covered the top end of this. Obviously, Denali Commission is the funding agency. The Alaska Center for Energy and Power is the project -- the grant manager, they’re managing the grant for the Denali Commission. Polarconsult, my firm, is sort of the principle investigator and project manager for the project. Princeton Power Systems is one of the key sub-consultants to Polarconsult. They are charged with developing the actual converter technology. And then we go into a whole host of -- well, actually first I should say Dr. Wies at UAF is a key part of the project and the -- sort of the technical review capability for ACEP. Then AVEC, as Meera spoke to earlier, has been involved in the project from the outset. They’ve been a key stakeholder in this providing their technical insight and, you know, sort of real world experience of how do you make this technology work in the villages. The Stakeholder Advisory group of course is another key part of this project to bring practicality and a lot of guidance, strategic guidance into the project and the steering of the project. Manitoba High Voltage DC Research Center has been one of our experts on HVDC system control integration and a lot of technical issues. We’ve tasked them with a number of questions, they’ve provided us a number of deliverables that’ll be folded into the final report. Line Design Engineering is a sub-consultant we have doing some of the
structural and code analysis, some of the code specific analysis
for the overhead system primarily. We’ve retained Golder
Associates, do some of the geotechnical designs and give us some
guidance on practical designs for the overhead system in
permafrost conditions with saline permafrost, warm permafrost, a
lot of the typical soil -- really challenging soil conditions
across the State for overhead systems. Almeda is the foundation
supplier. We’ve been consulting with them as well as Arctic
Foundations who specialize in the thermal siphons or the -- you
know, dual phase or two phase active or passive cooling systems
I should say. Zarling Aero Consulting has been doing some
thermal soils analysis for us. With regard to those, what
global warming’s projected to do to some of the permafrost as
well as evaluating how the arctic foundations, thermal siphon
foundation systems actually will cool down the soil, what kind
of thermal performance we’ll get from those. We’ve been talking
also to STG and Alaska Foundation Technology, they’re both power
line contractors, to get some guidance on logistics and cost of
the systems that we’ve been developing. Additionally, GeoTek
Alaska is another geotech contractor. We’ve been consulting
with them quite a bit. And then we’ve also brought on
Cabletricity as a submarine cable expert and also an HVDC expert
to help us out with the -- some of the costing and technical
analysis of submarine cable options, primarily in southeast.
And then, lastly on the slide at least, is -- certainly not
leastly, Okonite Cables. We’ve been talking to them for
existing cable lines that would work at 50 kilovolt DC at the
kind of ampacity we’re talking about for both buried cable and
submarine cable applications.

So really high level -- that was probably about half
of my seven minutes. Really high level project status update.
The converters are built and testing is currently underway and
Darren will speak to that in quite a bit more detail. The
overhead conceptual designs are complete. This is for overhead
transmission systems, the tall poles, long spans concept that
most of the SAG members are familiar with.

We’re going to be doing some field testing in
Fairbanks starting November 7th, in a little bit over a week
here, principally looking at some of the foundation systems.
You know, the -- we’ve actually found over the course of the
project a lot of the -- we actually feel pretty good about the
designs. They’re fairly robust, flexible systems. One of the
key issues that we’ve found that there isn’t really a lot of
hard data on is using some of these smaller foundation systems
for guy situations where you have a tension on the guy
compounded with frost jacking forces and so on. So that’s one
of the things, we want to get some of those in the ground in
Fairbanks and get some data coming back on those, but we’ll be
testing a number of other things up there as well.

The economic analysis of the overall system is
underway. We have most of the data back in now on various costs, insufficiencies and so on. We’re just starting the -- to bring all that data together and come up with updated cost estimates, life cycle analysis, savings compared to the AC systems and so on.

And then lastly, we’ll have the final report to ACEP for review November 21st, so that’s coming up just under a month now. So that’s what I’m going to be doing for the next month.

I guess just a really quick -- to drill into the overhead system just a little bit. Like I mentioned, the conceptual design we’ve come up with is a very flexible and robust system. It’s going to be adaptable to a lot of different field conditions and there’s a fair amount of margin in the design for it to deal with whatever the specific project applications are. So we feel pretty good about that.

Like I eluded to, the foundations are going to be the key to that and that’s what our testing up in Fairbanks is going to be focused on is the performance, the -- both the installation requirements to get the foundations into the ground and then also the multi-season performance of those in warm permafrost conditions. And then long-term monitoring of those will be taken over by ACEP. That’ll be at least one full year and depending on what the data comes back on that it may go on longer, make sure we get some steady state data on those -- the foundations over multiple seasons.
Similar high level review of the submarine system. Existing cables will work for submarine applications at this voltage and ampacity. Okonite URO-J one-aught cable is an example of that. There are others. We’re looking with Cabletricity at the economics of the cable system. We’re trying to keep the cost as low as possible without compromising the — you know, the practicality of the system. The need for armor is the key question and also what kind of laying equipment you’re going to need to deploy the cable and repair the cable, raise it up when you do have breaks and so on, and Cabletricity is helping us out with that part.

Telecommunication integration is an opportunity we developed or identified sort of midway through the project. That one, you know, we’ve iden -- we’ve determined that there are no technical hurdles to bundling fiber optics into a submarine cable of this type. The only question is finding a manufacturer who’s willing to manufacture that cable. There’s not an existing cable product out there that would meet that purpose. And again, Cabletricity is helping us. They have more contacts with the manufacturers than we do and hopefully we’ll find a cable out there. If not, we’ll develop a spec for it and when a project comes along we’ll have to try and get someone who’s willing to, you know, doing the tooling required to manufacture that type of cable.

MS. MEERA KOHLER: Joel.
MR. JOEL GROVES: Yes.

MS. MEERA KOHLER: Actually we just laid some submarine cable between Brevig Mission and Teller and we did telephone cable at the same time, fiber optic, and they just latched to our cable. It seems to work fine.

MR. JOEL GROVES: Yeah, that is another possibility. If -- you know, and it’s.....

MS. MEERA KOHLER: Versus integrating. You’re not going to find integrated for that voltage level I don’t think.

MR. JOEL GROVES: Yeah, and that’s always going to be the problem is, okay, you have, you know, some modest length of cable, you’re not going to retool for a special run for that. And that is a practical solution, potentially practical solution.

Let’s see. Okay. Well, so much for my seven minute thing. I’ll just skip over this I think and keep us on schedule with Darren. I think I probably talked about a lot of this already anyways. Yeah. Okay. I’ll give it to Darren now.

MR. JASON MEYER: This is Jason again. For those online, the second presentation is from Princeton Power, the one we’re going to be going over now. Does everyone have that online?

MR. BOB GRIMM: Yeah. This is Bob, I got it.

MR. JASON MEYER: Great.

MS. MEERA KOHLER: Is it integrated into this?
MR. DARREN HAMMELL: Okay. I will get started. Thank you everybody.....

MS. MEERA KOHLER: No, I don’t have that.

MR. DARREN HAMMELL: .....for inviting us here. We’ve been working on this project for a number of years and it’s nice to come out here and meet everybody else that’s involved.

So I thought I’d start out just by.....

MS. MEERA KOHLER: Darren, I don’t have that one.

MR. DARREN HAMMELL: This one?

MS. MEERA KOHLER: I mean there’s not a copy here.

MR. DARREN HAMMELL: I don’t think there are printouts of it, it’s just -- Jason has a copy that I emailed and I think it’s just on the screen here.

MS. MEERA KOHLER: Okay.

MR. DARREN HAMMELL: Will that -- is that workable?

MS. DENALI DANIELS: We don’t have printed copies of his, do we?

MR. JASON MEYER: No, we don’t have printed copies, but I did just email it to the group, so.

MR. DARREN HAMMELL: Okay.

MS. MEERA KOHLER: I need a copy.

MR. DARREN HAMMELL: Yeah, we can.....

MS. DENALI DANIELS: How about.....

MR. DARREN HAMMELL: .....email one out and print one out.
MS. DENALI DANIELS: So everybody got it?

MR. JASON MEYER: Yeah.

MS. DENALI DANIELS: So, Meera, you have it in your email.

MS. MEERA KOHLER: I’m just looking it up.

MS. DENALI DANIELS: Okay.

UNIDENTIFIED MALE: I got it. It’s on my Blackberry.

MS. DENALI DANIELS: Okay.

MR. DARREN HAMMELL: Okay. So I thought I’d start just by introducing Princeton Power, the company, since most people are probably not very familiar with us. We have been developing power converters and power converter technology for about 10 years. We are a spinout from Princeton University. And we started out working mostly on naval systems, on electric shipboard power distribution, working with the Navy and the Army on forward operating bases and generally making three phase power converters at the 100 kilowatt or higher power level. We have a number of unique circuit topologies that we’ve used, we use different ones in different applications, and we’ve developed and prototyped a lot of kind of unique transformer materials and our specialty is really in getting these systems all integrated and working together. We have about 50 employees all in Princeton, New Jersey. Manufacturing is all done in New Jersey and it’s a very heavily engineering based organization. So of those 50 people about 40, 42 are engineers, mostly
electrical, mechanical and software.

So just a little bit of a timeline. We did a number of R and D programs for various government agencies when we were starting out, again mostly with the Navy, and we’ve now deployed our initial technology on the newest aircraft carrier. We made a variable speed motor drive where some of the benefits of it were that it had a very low EMI signature and very good harmonics performance. That’s always been sort of the thing that ties together all of our products is very good power quality. So in many applications that doesn’t necessarily matter and we’re not the right people for those, like industrial variable speed drives, things like that. We tend to focus on the nitch applications that need high power quality. So the Navy is an obvious example. On the ship high power quality leads to gains in efficiency. And then also applications where we’re tying into an electric grid or creating an electric grid there’s a need for higher power quality than typical electronics would deliver.

So those are the applications that we’ve focused on, deployed our products on the aircraft carrier. And we’ve released several commercial products and I won’t talk about those too much but I wanted to touch on them briefly just to give you an idea of the types of products we make and then projects that we do. We are really a manufacturing company. We manufacture, test and assemble all of these power converters at
our place in Princeton. We also do system design and system
integration on the east coast and a little bit on the west coast
for primarily renewable energy installations, a lot of solar in
New Jersey oddly enough. We have a pretty good solar program
and California obviously is doing a lot. So in the commercial
market that’s most of what we’ve focused on is solar with
electrical energy storage, so battery systems.

And we’ve deployed about three megawatts of our
product and we just opened a new manufacturing facility. And
down here our -- Governor Corzine came to our ribbon cutting for
the new facility and promptly lost the election. So we like --
call this the kiss of death picture. But Governor Christie did
not show up for our most recent ribbon cutting so he’s got a
shot at reelection.

Just -- this is more for your records, just a
description of some of the people that we have involved in the
company. Since day one we’ve tried to get really good technical
advisors on board, some ex-utility presidents and some technical
people that have really helped grow the company. We have --
it’s a small company but we’ve been profitable for a number of
years and we have some strong financial backers. So we’re -- we
like to think we’re here to stay.

So I thought I’d start out, just show some of the
sample products that we’ve done recently to give you an idea of
the types of things that we work on. We have a facility in
Princeton where we’ve combined a 200 kilowatt solar array with a lithium iron phosphate battery system and the electronics that coordinate both of those assets together and then can create what we call a microgrid basically, the ability to disconnect from the local utility and power a number of critical loads for whatever reason. So in New Jersey we have, you know, a fine electrical supply so the reasons you would do that have more to do with the economics of reducing your peak power or maximizing the types of returns you can get from your solar project, but there are a number of different places that that same basic technology can be used. And again, we designed and manufactured the inverters, the electronics that tie all these things together and then do the system design for the batteries and the solar array and the other components.

The second piece, we have a grid support system in Chicago that’s used for electric vehicle charging. So again, it’s a battery system with electronics connections to the utility grid, connections to some other generators and some fairly unique types of DC loads.

We’ve been working with the Army pretty closely. Recently we have a test microgrid that we integrated at Fort Irwin which included solar power battery systems and diesel generators coupled into an AC bus. And this was all demonstrated in Fort Irwin about a year ago I guess and then shipped off to Yemen and Qatar, it kind of goes back and forth.
They actually left the solar arrays back home in the U.S. because they were seen by a lot of military folks as giant targets for Al-Qaeda. So the solar stayed but just adding the batteries to the diesel generators can save about 30 to 40 percent of the fuel that they’re using in these operating bases. And basically, as a lot of you probably know, the way that works is just if you only have a diesel generator you have to size it to the maximum load at the microgrid and then the generator’s always running. And by adding energy storage you can charge the batteries, power the loads off of the batteries for the majority of the time and then flip on the generator when you need it. We call this Chevy volt model since that’s essentially how the Chevy volt works.

So -- and then Alcatraz Island we’re doing something similar. This will be a total microgrid using deep cycle acid batteries and solar and two redundant diesel generators. And we use this as an example to talk to people about why microgrids matter in the rest of the world, even though we have pretty strong grids in a lot of the lower 48. Alcatraz used to have a cable tie to the city until a fishing trawler dragged its anchor and ripped the cable up. And they were about eight weeks away from building the next intertie when they said, you know, this is just going to happen again, there’s got to be a better way to do this. So they’re th -- the National Park Service is thinking of it as sort of a demonstration of what we can do with new
solar battery and electronics technology. And a similar system in Bermuda working on -- with wind, solar and batteries.

So this is the last part about the company before I get into the specifics of this project. This is a product that we just released that was developed with the Department of Energy and the idea is to tie in multiple generation resources and electrical energy storage and provide a sort of pre-engineered solution to creating microgrids or combining multiple generation sources. It’s a 100 kilowatt unit and it’s programmable. So you can basically pre-engineer this at the factory, design it for the types of batteries you want to use and it’s compatible with lead acid but also with some of the more advanced technologies, lithium, iron, phosphate, lead carbon technologies, some of the batteries that we’ve tested it with. I just thought it might be interesting for this group, since it is really focused on creating reliable microgrids using various energy sources.

Okay. So now getting into the specifics of this program which we started working on several years ago. As Joel highlighted, our piece of this project is developing the power converter that transforms low voltage AC, 480 volt AC which we call the community power, up to a 50 kilovolt DC line for transmission basically and then conversion back from 50 kilovolts down to 480 volts. So the key with this converter is it has to be bidirectional, it has to be able to let power flow
in both directions. It has to be able to make that
transformation up to 50 kilovolts and the whole goal is to do
this with a very efficient and lower cost converter. So people
have been able to convert to high DC voltages for awhile, but
there’s been a very large cost associated with it since there’s
no such thing as a DC transformer essentially. So you need to
build a set of active electronics which includes semiconductor
switches, a transformer and various control systems and this has
been very expensive. So companies like ABB and Siemens will do
this but they focus on much, much larger installations, 500
megawatts and higher, before typically high voltage DC tends to
make sense. And really a key reason for that is that the power
converter technology has not been there to do this at a lower
power level cost effectively.

So some of the pieces that we’re bringing to this
puzzle are new circuit typologies that have been developed that
we’ve worked on before in many other applications that lend
themselves very well to this. And a transformer technology that
is a high frequency single phase transformer made out of some
sort of new materials that make it much, much smaller, much more
efficient by orders of magnitude and new semiconductor
technology that allows us to build this whole converter in a
much more cost effective package.

So this is a little bit hard to see but it’s basically
just a conceptual diagram of what this transmission line would
look like. So you have essentially power converters on each end of the transmission line. The line itself can be 50 kilovolts DC, and Joel and Polarconsult can explain why that’s a good thing and why that matters, and the power converters essentially condition the power that comes off of that line into the standard power that you’d normally get out of a diesel generator. Actually it’ll probably be a little bit better since these power converters are pretty good at cleaning up the power quality, making sure the harmonics are very good and kind of adjusting as needed depending on what the loads are.

So these are a couple shots of these prototype units being built in phase two in our lab in Princeton. And essentially the components, there are really two components of the power converter as a system that we’re building and that’s a low voltage enclosure which connects to the 480 volt AC power and converts that power into an internal high frequency AC bus and then there’s a high voltage component which is essentially this nanocrystalline core transformer with high voltage switches and bolting those two cabinets together you end up with a power converter that takes in 480 volts AC and puts out 50 kilovolts DC and can do it in a bidirectional way where power can flow in both directions. So there is an AC transformer in there, but it’s a very small single phase, very, very efficient transformer. They operate on the order of 99.8 percent efficiency, that transformer component itself. And this is
essentially dipped in oil and immersed in the high voltage tank. And I have a couple more pictures I’ll show you later to show you more what’s inside of these. But this one on the left is the low voltage enclosure and then that tank being worked on on the right is the high voltage enclosure and then on the lower right side we have both of them together in the test setup.

MS. MEERA KOHLER: Darren, could I ask a quick question?

MR. DARREN HAMMELL: Sure.

MS. MEERA KOHLER: This is probably for Joel too. Why did you choose to go 480 to 50KV, why didn’t you use 7,200 distribution voltages so you didn’t have to transform it yet again?

MR. JOEL GROVES: Yeah, we looked at the -- that. There’s a number of reasons for it. This is Joel. Yeah, we looked at that and one of the visions here is that these would probably be at the power plant integrated to the 480 volt bus and so that’s why it was logical to bring it in at 480.

MS. MEERA KOHLER: At one end, but at the other end it would go into the distribution system.

MR. JOEL GROVES: Yeah, that’s true, at the other end it would go into the distribution system. We did look at modifying the converter so you could have it at a 7-2-12-4 (ph) output and it was about the same cost of just having a transformer there, a conventional 60 cycle transformer to go
ahead and step that back up. So we decided leave it at 480 and
just use a transformer when needed to bring it up.

MS. MEERA KOHLER: I mean I was just thinking about
the line loss or the transformer core losses because you’re
going to another stage of transformation and so it just.....

MR. JOEL GROVES: Yeah, no, absolutely. And, you
know, we looked at that and I believe even the efficiency of the
AC transformer was going to be comparable to some of the
efficiencies incurred, you know, putting that voltage
transformation inside of this unit. So when we looked at the
totality of it this looked a little bit more flexible.....

MS. MEERA KOHLER: Okay.

MR. JOEL GROVES: .....and the benefits were -- didn’t
-- weren’t really there.

MS. MEERA KOHLER: Okay. I was just curious.

MR. JOEL GROVES: Yeah, that’s a good question.

MR. DAVID LOCKARD: There might be some cost savings
with the enclosure as well because a medium voltage
enclosure.....

MS. MEERA KOHLER: Yeah.

MR. DAVID LOCKARD: .....would probably have to incur
significant costs.....

MR. JOEL GROVES: Yeah.

MR. DAVID LOCKARD: .....over low voltage.

MR. JOEL GROVES: I mean, you know, at higher energy
levels you might go to 4160.....

MS. MEERA KOHLER: Yeah.

MR. JOEL GROVES: .....you know, as a generation voltage, a bus, a higher bus voltage if you -- like a five megawatt converter or something like that. But one step at a time.

MR. DARREN HAMMELL: And part of the benefit of this design, having that low voltage enclosure, it’s really using what we call off the shelf components, you know, semiconductors that are used and industrial variable speed drives, solar inverters, they all use kind of the same switches. So it’s a little bit of a unique circuit configuration, but if we wanted to bump that up to 4160 we’d pretty much just select a different.....

MS. MEERA KOHLER: Right.

MR. DARREN HAMMELL: .....part out of a catalog and be able to do that.

Okay. So in -- phase one started in really early 2008, late 2007. We ran through some validation testing on a bench scale in lab concept and feasibility unit. In phrase two we’ve been doing a full design of the full power converters, then building two 500 kilowatt prototypes and those modules, we call them module one and module two, they operate at 500 kilowatts and they can also be paralleled. So two 500 kilowatt converters can be one, one megawatt converter basically. And we
can parallel those up to higher power levels also.

So we plan to do testing through December this year to get both of our 500 kilowatt modules working individually up to full power and full voltage and then working together, sort of a simulated transmission line. We have a high voltage test lab in our facility in Princeton that can run the voltages up to 50 kilovolts. So that work will be going through December and we have a technology demonstration coming up in November. We’ll be able to show much of that operation with everybody on site.

This one I will breeze through pretty quickly. It’s more for your records, just a picture of what the controls block diagram looks like for the system. So there are some control pieces in the high voltage enclosure and those are basically trigger signals and a couple status readers that tell us what’s happening inside of that tank. Those control signals all come out. The rest of the controls are all in that low voltage enclosure. So there’s a whole lot of monitoring components and there’s access to a lot of that information that can be transmitted over Ethernet or to remote locations or accessed on the front of a converter. There’s a touch panel screen that they can get information off of.

Okay. So, status summary. This is from our project manager, just a list of the tasks that we had in phase two and the status of those tasks. We’ve completed much of the early work and the remaining two months we’ll be essentially testing
those prototypes that are now constructed and have done some of
the functional and operational testing and now we’re bringing
them all up to full power and full voltage.

So a more detailed list of some of the tests that we
went through. Again, there’s two modules and each module
consists of the low voltage enclosure and then the transformer
enclosure. So each of those four pieces is sort of at a
different stage of testing. The first transformer we had
identified a couple issues, the types of things that normally
come up when you’re building a prototype unit. We corrected
those issues, were able to get high potential tests done in air
up to 20 kilovolts. After we take that transformer and we do
these tests in air then we immerse it in oil in order to get up
to the full voltage. So we were able to run that transformer
one with those modifications up to 70 kilovolts on the Hi-Pot
test and that was awhile ago, a month or two ago. So now we’ve
incorporated those changes into the second transformer and
that’s undergoing -- or it’s passed the air testing, it’s now
getting immersed in oil and will run up to full voltage with the
in oil testing. The low voltage enclosure for number one has
been run through operational testing and is now being integrated
with the high voltage enclosure and that will run through full
power, full voltage testing within the next probably two weeks.
And then the second enclosure will follow closely behind that
and then we’ll put both of them together in the early November,
mid-November timeframe.

So here are a couple pictures to help you visualize what we’re talking about. This is the high voltage enclosure that we’re looking at with all the walls off. The bright orange piece in the center is the nanocrystalline core transformer with wires wrapped around it. So the orange part is actually the wires that are wrapped around the transformer. You can just catch a glimpse of the really shiny metal that kind of sticks out the top.

UNIDENTIFIED MALE: (Indiscernible).

MR. DARREN HAMMELL: Yeah, sure. Looks kind of like a missile. Okay. So this is the nanocrystalline transformer. This is the core right here, the nanocrystalline core. It’s really just a big chunk of metal. They’ve been making these things for a long, long time, they just used to be very expensive. And we’ve been working -- I think we built our first transformer probably in 2004, a 75 kilowatt transformer. And the material itself runs very, very efficiently, as I was saying, about 99.8 percent conversion efficiency. And what’s happened is the cost of this has gone down quite a bit in the past few years so we’re able to build these cores for a materials cost that’s actually much, much lower than a standard transformer since the price of copper and iron and shipping has really increased.

So on the side of this transformer are the high
voltage switching stacks and those are built out of IGBT switches which is a very common semiconductor device basically used -- and every industrial motor drive uses these things. Ours are sort of high power and high voltage depending on who you talk to, but, again, it’s really a standard off the shelf product. The way we put them together onto these boards is really the technology piece, being able to have all these devices stacked together, get to high voltage, the triggering systems that operate all these devices and then the safety systems that make sure that the switching is happening at the right time and the whole system is basically operating correctly. So in air we can test this up to about 20 kilovolts, all of these components, before the air starts -- air insulation starts to become the problem. And so then we immerse this entire assembly in oil and it’s just to get the insulation a little bit higher so we can run up to 50, 70 kilovolts.

So just some pictures of the section going out, getting immersed in oil and coming back with the heat sink fins on the sides.

These are a few more pictures of sub-assembly tests that we do on each of the control components. There are fiber optic triggers going to each of the switching devices and monitoring signals coming back so we can test all of the control functions before we actually get it on the high power system. So that lets us get all the algorithms developed and all this
work is essentially done and we’re now -- we’ve integrated all
of this together into the high power converters and we’re
running through some of the same tests, just at full power.

A couple more shots of the testing setups. And this
is actually a pretty good shot of the transformer itself. So
this is a 500 kilowatt transformer which, you know, if you’ve
seen a normal 500 kilowatt transformer it’s about 10, 20 or more
times smaller. It’s actually relatively light. It’s pretty
dense, but compared to a normal transformer it’s very, very
small.

MS. MEERA KOHLER: About how much does it weigh?

MR. DARREN HAMMELL: This one right here -- I know our
75 kilowatt transformer weighs about 45 pounds. So my guess is
it scales -- yeah, so this one is going to be, you know, 10
times, maybe eight times that. And a lot of the design work,
actually the core is pretty straightforward, the winding design
is pretty straightforward, the transformer design really ends up
being about getting heat out of the windings. So the heat is
generated at places where it’s not necessarily that easy to get
out of the core and into the outside so you can run it through
the heating fins and cool it. So a lot of the design that we
did in phase one and then the testing that we did in the early
phases of stage two was to run this transformer with these
designs and modify it to make sure we could get heat out of the
center part of those windings. And the oil helps with that also
since it naturally heats up and convects out and tends to go to
the outside of the enclosure where the heat can be exchanged
with the air.

MR. ERIC MARCHEGIANI: You’re not doing anything
mechanical inside the transformer to move the oil around at all?

MR. DARREN HAMMELL: I think we have a small
circulating fan in the enclosure.

MS. MEERA KOHLER: Natural convection usually does it.

MR. DARREN HAMMELL: Yeah.

MR. ERIC MARCHEGIANI: Outside though, but not inside.

MR. DARREN HAMMELL: The -- I know in the initial
designs there was a small circulating fan inside just to move
the oil, but the goal is always to get rid of it. That was more
for prototyping purposes to make sure it works but, as you know,
fans are -- tend to be a reliability issue. So the -- this
final tank design I believe doesn’t have a fan in there. Yeah,
the convection really handles that.

MR. ERIC MARCHEGIANI: Sure. Okay.

MR. DARREN HAMMELL: Okay. So really a few more
pictures. And just the -- module one, again, is completed and
that consists of both the low voltage enclosure and the high
voltage enclosure undergoing full power testing in our high
voltage lab. And then module two is basically following closely
behind with a couple modifications based on things we found in
the first module. And that will begin in air testing this week.
and then that will be brought up to speed and then both systems working together prior to the end of the project. And then we have a testing plan just to measure really efficiencies and temperature rise of both systems working together.

This one I won’t go over in detail, but just for your records this is just the project schedule and the milestones coming up.

And another just set of the next steps that we’ll be going through to kind of give you an idea of what we should have to show on the 14th at the demonstration also. We’ll have module one running at full power and full voltage. Module two will be operational but probably not quite at full power yet and so we’ll be able to run our simulated transmission line probably at a lower voltage and lower power level until the second module is fully up to speed.

These are pictures of the process that we went through with the first module. And again, these are prototype units, we’d sort of call them alpha units. We did a concept study in phrase one, built these alpha units, so they’re functional and they operate correctly. We’re still learning some things about the manufacturing process and how we can get them to be lower costs, more based on commercial components. There are still some tweaks that we would do. When we field deploy these or go to build the next set of systems we’d incorporate some of those changes, we’d call those beta units and usually the beta unit
would be pretty close to what would end up in production. So with the beta units we’d end up designing, assembly books and assembly procedures that we can build these things very efficiently and high quality. While these first modules there’s -- you know, a lot of engineers around them so there’s a lot more labor and manpower involved.

A couple more shots of controls testing. I think this is probably our engineers just bragging about how many oscilloscopes we have.

Okay. So once we get both modules running together in tandem these are the set of tests that we plan to run in probably late November, early December. And it’s essentially both converters running at full power and then measuring the actual efficiency of those systems operating and then measuring temperature rises. So with power electronics field failures are almost always directly correlated to temperature issues or temperature changes. So measuring the components and where the heat’s all coming from is usually a really, really good way to assess your design, make some tweaks and stretch out the reliability. We have a nice high voltage thermal camera that we use when we start running tests that lets us really quickly identify where the heat’s coming from. Sometimes it’s just a loose wire, sometimes it’s induction from some interactions between components and then other times there are things we can do to redesign certain components, put a little more copper or
material in to get the efficiency up. So that’s part of what we hope to do in the late November, December timeframe is really assess this is the measured efficiency, this is where we’re losing heat and then address those issues and it’ll both get the efficiency up and also make sure that we can hit our reliability targets.

This is a -- just a brief picture of the high voltage lab that we have in Princeton and we just fitted this out a couple of months ago. And we’ll actually -- we’ll have the two enclosures so these two together would make up one converter and then this is the other converter. It’s all caged off with a control room here and a lot of this is automated. Like the high voltage thermal camera we have on an automated setup so it can be running the system at full power, full voltage, and move that camera around and look at different things while the system’s running. So obviously you can’t have anybody inside of there while it’s going so some of the measurement systems have to be pretty well designed. But we have a lot of power in here. We have a set of loads that we can use to simulate the grid inductive loads, resistive loads on the outside part of the building. We even have a water tank to simulate pumping loads and we can run a number of different scenarios with this test setup.

And this is a picture of the facility that we had used for the in air testing. This is the high voltage transformer.
tank back here but with no walls and obviously not in oil. This is the low voltage enclosure. This, again, was only running up to about 20 kilovolts so a little bit easier spacing requirements and testing requirements. And this was all done actually at our old facility and all this is now moved into the high voltage lab.

Okay. So the -- I’d say the main things we were trying to meet are essentially low costs, high efficiency and high reliability. Those are sort of like the holy grails for all power electronics, but in this case we were trying to show that we could do lower power high voltage DC conversion at cost targets that had really not been touched before. I’m not sure many people even had looked at this because it was just assumed that it wouldn’t be possible. So we initially had a cost target of $250.00 per kilowatt based on existing technology. And based on what we know now this is essentially very achievable and things change and some of the trends are changing, but they’re all generally in the right direction. One of the large reasons for being able to achieve this is the materials costs of the nanocrystalline core inductor have gone down quite a bit and one of the benefits of using that is we can use much less copper and steel by having a much smaller size and smaller enclosure requirements. So as those costs have generally gone up quite a bit, our costs have either stabilized or gone down based on that nanocrystalline.
The other major trend is in these IGBT semiconductors. They’re essentially leveraging the advances in the semiconductor community which, you know, have just been exponential for the past several years. So we’re able to incorporate those new switches in here. As they come out they tend to get less expensive and more efficient on an almost annual basis. So I think the trend is actually pretty positive and we were pretty happy to be able to achieve this number based on these alpha prototype units.

There is work to be done to, again, turn these into what we would call commercial units, ready for production. A lot of that has to do with taking a power converter that today takes a team of five engineers eight weeks to build and run through all of its testing and we need to get that to a point where we can have assembly people, technicians, build these things, build them and test them in two weeks and ship them out the door. So there’s some -- it’s not really development work but more manufacturing documentation, assembly books, supply chain qualification, things like that in order to be able to get these things built by ideally non-engineers so that the labor cost goes way down and you end up with products that are all the same and not, you know, engineered units for each one.

Okay. Efficiency numbers and these are not quite as good as we’d like them. We’re looking at a peak efficiency just over 96, 96 and a half. And again, this is estimated based on
the current designs that we have now and we will actually be measuring these over the next several weeks in the lab. And we also -- the main reason for doing this exercise was to identify where we expected the losses to come from so that we can correlate this up with the testing and know which areas to focus on. And if you look at this table, it becomes very apparent that the low voltage AC bridge is really driving the majority of losses and that -- to us that’s a relatively good sign because that bridge is actually an off the shelf component that we buy in and by over rating that, bumping up the current ratings on that, we can most likely get that efficiency quite a bit better with a small marginal cost.

So in power converters we’re always looking at the tradeoff between cost, efficiency, size and right now I’d say we’re doing very well in the cost number and we can probably boost that efficiency number by spending a little bit of extra money. And that’s essentially what we’ll be looking at after we run these baseline tests on the alpha prototype units.

So we had thrown this together as sort of an estimated this is what one of these systems could look like once we implement it. And we got some numbers from Polarconsult about the likely power loads at a couple of villages and this is just really a conceptual diagram of how this might work where you have a main power converter at the front of the village, you have one common DC line and these power converters are
essentially able to communicate with each other and share power in whatever way in appropriate. So they’re bidirectional, the power can either be generated out of one village and sent to the others or consumed by that same village depending on time of day or whatever the resources happen to be. And that’s -- it’s essentially all programmable too. So there are a lot of brains built into these power converters so they can help with shedding loads, turning generators on and off, coordinating different energy sources.

MR. DAVID LOCKARD: Those numbers there are quite a bit higher than the peak loads in those communities. How much higher should they be than the peak loads?

MR. JOEL GROVES: The -- thank you. The 500 kilowatt is the size of the converter and that’s why they’re that small. We don’t have a 250 or 100 kilowatt unit right now.

MR. ERIC MARCHEGIANI: So it steps down without any problem.....

MR. DARREN HAMMELL: Yeah.

MR. ERIC MARCHEGIANI: .....to that size?

MR. DARREN HAMMELL: Yeah, it can run at a -- you know, lower duty cycles tend to be even easier because, you know less power generates less heat.

MR. ERIC MARCHEGIANI: Better efficiency?

MS. MEERA KOHLER: Yeah, I was going to ask if you’re going to be charting the efficiencies at different levels of
MR. DARREN HAMMELL: Yes, absolutely. That’s part of the testing that we’ll do. And the way this system is designed it’s -- it will likely max out in the sort of 30 to 60 percent power range.

MS. MEERA KOHLER: And then scale down?

MR. DARREN HAMMELL: Yeah, it’ll have a tail off when it gets to full power and then there’s usually, you know, a ramp-up at low power. So part of the debate here is obviously, you know, if you could match the power level to the specific communities it would ultimately be maybe the best thing, but from a commercial standpoint having one module size is also very, very beneficial from a cost and manufacturing standpoint. So there is a tradeoff there and, you know, in our discussions we thought 500 kilowatts seemed like a good place to start, easy to parallel up to larger sizes and then as we move forward there may be some opportunities to scale that down. Or up. You know, scaling a single module up to one megawatt will make it less expensive, more efficient too most likely.

Okay. And we put together some thoughts on what we’d like to see beyond these alpha unit prototype tests essentially. This will all be tests that are done in our lab at full power, at full voltage, at kind of normal operating conditions and then the next logical steps will be to try and get those systems in the field somewhere working and between then running more tests
in the lab essentially trying to look at some of the edge
conditions on the converters, what happens in unique situations,
what are all the failure modes, cataloging all of those and then
also looking at some of the commercialization steps, like the
assembly books and the manufacturing process, the other things
that we’d want to do before we start deploying lots of these
things in the field.

MR. DAVID LOCKARD: Do you mind if I ask another
question on the previous slide?

MR. DARREN HAMMELL: Yeah, sure.

THE REPORTER: Can you pull your microphone.....

MR. DAVID LOCKARD: Sure.

THE REPORTER: .....over towards you so I get a good
recording?

MS. DENALI DANIELS: And state your name, sir.

THE REPORTER: That’s all right, I know his name.

MS. DENALI DANIELS: Okay. I just had to say it once
today.

MR. DAVID LOCKARD: Does anybody not know my name?

This is David Lockard. Those examples may be, you know,
somewhat arbitrary, but it raises an interesting question
because of those communities there the INN system is the biggest
and they get over 90 percent of their power from hydro
currently. Kokhanok has got a $1.5 million high penetration
wind system. Egegik is considering experimenting with a hydro
kinetic technology. So one of the challenges of this concept is going to be dealing with places that have a very significant investment in renewable energy in them already. Pedro Bay has hydro potential as well. So, actually every one of those has either got or a candidate for some renewable energy as an alternative.

MR. DARREN HAMMELL: Yeah, sure.

MR. JOEL GROVES: Yeah, this is Joel. Yeah, that’s an excellent point. I mean this particular example is sort of an outgrowth of the TERRA project that GCI did. This is sort of the first leg of TERRA until it hits the overland system. I don’t think Levelock is on there. You know, and is this a good application for DC. Like you said, every single community on here has various local energy options. If a system like this was actually going to go forward you’d probably go ahead and continue it out to some of the larger population centers out in Bristol Bay and then you might start to make sense. But yeah, it’s a good point. As you think about the implementation of this technology where are you really going to get the biggest benefit out of the technology and the costs.

MR. DARREN HAMMELL: So I think I’m about out of my allotted time. I was going to hopefully leave it open to everybody for more questions. And this -- I guess everybody has the presentation. There’s obviously a lot more technical detail behind a lot of this for anybody that’s interested. And also a
lot smarter people than me to talk to about it. So if you have
any real hard questions I know who to bug back home, so.

MS. DENALI DANIELS: Well, thank you. That was an
excellent presentation, Darren. We are actually pretty close to
on schedule. I guess one way we could go about this is we could
open it up to questions just specifically to the converter
presentation that we just heard or we could let Joel finish up
his presentation, which of course probably talks a little bit
about transmission and next steps. What do you think?

MR. JASON MEYER: Maybe if there’s any converter
specific questions.....

MS. DENALI DANIELS: Yeah, if we could just focus.
Because I think that, you know, there are a couple of different
issues here and the converter, you know, technology is in my
mind -- you know, we’re real lucky to have you here, so thanks
for coming up. Meera, it looks like you have a question.

MS. MEERA KOHLER: I do. Obviously, you know, the DC
transmission technology is not new, it exists. How do your
converters compare with conventional AC/DC converters that are
currently used, for example, in Texas?

MR. DARREN HAMMELL: Gotcha. The biggest difference
will generally be that those converters tend to be much higher
power levels.

MS. MEERA KOHLER: Right.

MR. DARREN HAMMELL: And because of that they use a
different switching device technology. So they’ll typically use
maybe an SCR base.....

MS. MEERA KOHLER: Okay.

MR. DARREN HAMMELL: .....thyristor based, and then
there are all the host of consequences that come because of that
so they’ll end up being much larger generally. Usually pretty
efficient, but again, at really, really high power levels and
the whole construction method ends up being pretty different.
So a lot of times they’ll be -- they’ll look more like a utility
substation where you’ll have some outdoor components.....

MS. MEERA KOHLER: Right.

MR. DARREN HAMMELL: .....you’ll have multiple
enclosures and long distances between different sections.
Versus this is more of -- it ends up being more of a pre-
engineered solution where you can do your testing in the
factory, put it all in an enclosure and then ship it out in a
form factor that’s easier to kind of, you know, drop in place
and have it work. And a lot of that is just because they -- the
larger power systems use those different types of switching
devices and they actually -- they really don’t make that type of
thyristor for systems this small. They used to and we actually
used to use those in some of our Navy products. We had a 100
kilowatt system based on thyristors since our technology works
really well with thyristors. But the IGBT technology, the
alternate switching technology has gotten so much better over
the last decade essentially that manufacturers have all stopped making those thyristors at low power levels. So the -- really the smallest systems that you can get readily available thyristors for are in the 10, 20, 50 megawatt range and it gets higher every year, you know, they’re really phasing out those products.

MS. DENALI DANIELS: Jason.

MR. JASON MEYER: Yeah, a quick question. So I know you guys talked a lot about the type of application in Alaska. Specific to like these alpha units and maybe looking at a beta unit, what are some of those arctic issues you’ve looked at in particular for like rural applications, harsh, you know, cold climates and weather?

MR. DARREN HAMMELL: Sure. The nice part about power converters in these climates, which is not nice, and any other climate is that they generate their own heat. So as long as they’re in a -- you know, it’s sort of a, quote, weatherproof container keeping them at temperature is generally going to be pretty easy as long as they’re always on. And that’s really the issue is it comes down to reliability, do you want to have.....

MS. MEERA KOHLER: Right.

MR. DARREN HAMMELL: .....these systems always on, and the way the grid architecture works that’s also, you know, pretty key. So I think we originally thought about, you know, you could co-locate these near a generator and these are sort of
fail safe systems. You know, if the converter goes out, the line goes out, you can always go back to running the system off of your generator. So having it in a location where there’s some heat available which can almost always be self-generated tends to be the -- really the biggest issue. You know, it will need to be -- I think these are rated for maybe zero or negative 20 for normal operation, but they’ll -- you know, a 500 kilowatt system at 97 percent efficiency is going to be throwing off a lot of kilowatt hours under normal operation. So they’ll pretty quickly be able to get the ambient temperature up to normal.

So then I think really the major thing is reliability. It’s just if these are in places where they’re not easy to service, you know, the brute force method is you keep a lot of spares around. But these are really designed to be able to operate maintenance free for a long, long time. And actually the heat helps with that too, so operating them at lower ambient temperatures tends to extend the lifetime.

We’ve done reliability analyses on these. You know, there’s a lot of software you can use and kind of metrics that you can do and it tends to come down to the capacitor components. If there are fans, the fans are terrible, but as long as you can limit the fans or limit their operation then a lot of it is the lifetime of the capacitors. And actually a lot of times it’s the capacitors on the control board that tend to have the worst lifetimes since they’re all commercial
components, you know, made by Texas Instruments or somebody intended for use in computers that don’t generally need to last for more than five years. The -- so we’ve focused on those and actually we have all of our control boards military certified, so they use all military grade or industrial grade components. It’s actually the same control board that runs these as the one that’s in those aircraft carrier units and those are certified for, you know, 20 year plus lifetimes. And then if there are issues we try to make it easy to swap in and out the control boards. So there’s going to be some level of spares that would be good to have and then we try to make it pretty easy to be able to replace those components that are more prone to failure.

UNIDENTIFIED MALE: Thank you.

MS. MEERA KOHLER: What type of oil are you using for insulation?

MR. DARREN HAMMELL: That is a good question that I don’t know the answer to. It’s standard transformer oil, like biodegradable transformer oil. I know early tests they were just using vegetable oil. But there is sort of a standard oil product that was used and it was -- the oil emersion was actually done by a transformer company that we work with kind of next door. So I know it’s nothing fancy and nothing, you know, unique to the design.

MS. MEERA KOHLER: Well, there actually is a move afoot, you know, nationally to go to biograde oils, mineral
oils, vegetable oils and so forth. And so I was curious to know because I'm a little unsure about what the propagation life is likely to be on those types of oils. And that is, you know, the single basic issue that causes more transformer failures than anything else is the quality of the oil and so that has to be paid really, really close attention to. But you're right, I mean our ambient temperatures actually are very conducive to much longer life of transformers of all kinds. It's the hot ambient conditions that cause issues so interior Alaska in the summer could be an issue. But given, you know, the ratings that you're looking at that covers, you know, quite the range of rating possibilities. So.....

MR. JOEL GROVES: Yeah, and I -- I'm trying to remember what the oil was too. But one of the points I should clarify is when we framed out some of the specifications for the converter it has an operating window of I think plus 100 at Fahrenheit to minus 30 Fahrenheit and that minus 30 is dictated by the oil.....

MS. MEERA KOHLER: Right.

MR. JOEL GROVES: .....the gelling points and so on of the oil. And I believe that the converters if they're non-functioning I think that they can do a cold soak to colder than that, but I -- I want to say minus 50 but I'm not sure if that's correct or not. And then the concerns there become, you know, the thermal stresses on the boards and so on. If you're
bringing -- if you're changing the temperature too quickly you
can start to really damage things. Correct me if I'm wrong
there, but.....

MR. DARREN HAMMELL: Yeah. Yeah, even our commercial
products are down to negative 50 for storage.

MR. JOEL GROVES: Yeah. Okay. Yeah, and then in
terms of reliability and so on, you know, going back to the
overall design of this, those two modules are designed so that
if you do have a failure in a village of one or the other
component, be it the low voltage enclosure, the high voltage
tank, those are configured so that you can fit them and fly them
-- you know, unplug -- turn it off, unplug it, fly it out, fly a
new one in and do a rapid replacement that way. And then you
can, you know, diagnose the actual failure, replace the cards,
whatever, with more skilled technicians in a hub or in Anchorage
or whatever.

MR. DAVID LOCKARD: Are there any ramp rate issues as
far as rate of power change going through the devices?

MR. DARREN HAMMELL: Not issues that we’ve encountered
in sort of normal scenarios. It operates like a voltage source
machine on the AC side, so it’s really -- you know, it’s more
limited by maybe the control system’s ability to respond, but
the controls are operating at, you know, a couple of megahertz
so they’re super fast generally. When we’re looking at things
like solar ramp rates or wind ramp rates they’re generally much
slower than the kinds of limitations that it might see. You know, loads turning on and off are generally pretty easy since it is a voltage source so it tends -- the voltage responds sort of instantly and then it just has to, you know, make sure that it’s getting enough current through. But yeah, we haven’t come across any real response time ramp rate type issues.

MR. JASON MEYER: Darren, one other question. So the site visit planned in -- on November 14th, what are some of the testings that’ll be going on or what will maybe people that are attending expect to see?

MR. DARREN HAMMELL: Sure. Well, what we’ll do is we’ll bring you to the actual high voltage lab and we’ll have both modules assembled and sitting there ready to run tests. So what we’d like to do is show a full range of operational testing on one of the modules, including running it up to full power and full voltage, and we’ll be able to show the power quality really coming out of the units is generally one of the most interesting pieces. We’ll have efficiency results. We may not run some of the tests at the time since we try to control temperature and things like that, but we’ll be able to run a lot of the functional tests on that unit. And then we will have the second module also connected up in sort of a simulated transmission grid and we’d like to be able to show some functional tests of those units both running together. Probably not at full power and full voltage, but enough to show that the functionality is
there and they’re both operating. And the kind of concept of that high voltage DC transmission we can show really to the limits of our capability in that small space, you know, the high voltage lab. So we’ll basically be able to show all the electrical functionality of both converters working together and then the full operational capabilities in terms of power and voltage of at least one of those units. And at the same time we can also show some demonstrations of some of the other products that we have there for microgrid type applications that might be of interest.

MS. DENALI DANIELS: Should we check in with folks online? For those of you online, if you’re still with us, we’re still working on questions specific to the converter portion of this project.

DR. RICH WIES: This is Rich here. I have a lot of questions but they’re -- this is probably the wrong forum for them.

MS. DENALI DANIELS: Pick one.

DR. RICH WIES: They’re really technical. Actually there’s one concern that I’ve had kind of all along with this and that’s the -- you know, I realize you can program these things and they’re versatile, but, you know, some of these systems where you have -- start to put, you know, kind of medium to high penetration wind and just wondering about kind of the stability side with regards to the -- you know, the power.
MR. DARREN HAMMELL: Right. We’ve -- yeah, you know, we’re generally more familiar with solar control, kind of high penetration solar, since we -- we’ve been involved in a program with the Department of Energy for high penetration solar systems and we have some operational experience operating microgrids with solar and batteries and the converters. But yeah, I think you’re right that there would almost certainly be a stage of sort of adapting and programming the converters to operate in a high wind penetration regime. I think they are -- they’re capable of doing it and almost uniquely capable. I think they do have fast enough response times and basically have the ability to clean up the power quality in a way that they can respond to frequency variations and things like that. But there would almost certainly be during this kind of beyond stage two phase some programming that would have to be done to get them to be compatible in a high wind penetration regime or maybe other potential applications.

DR. RICH WIES: Yeah, and particularly one concern is like if you literally had a system where you could shut off diesel, not that we’re really there yet but, you know, that -- there’s a whole laundry list of issues that come up when you start shutting -- you know, shutting off your, quote, unquote, stable generation source.

MR. DAVID LOCKARD: Could I comment?
MR. DARREN HAMMELL: Yeah.

MR. DAVID LOCKARD: Rich, this is David Lockard. One of the trends, more very recent trends in high penetration wind and even run of river hydro in the State is the incorporation of dispatchable electric boilers which would address some of those issues you’re talking about with regards to frequency control.

DR. RICH WIES: And in fact we’re actually working on -- up here on a separate project, you know, looking at that on that front.

MS. MEERA KOHLER: And I think that there’s an awful lot going on also with battery storage that I think is going to help flatten out a lot of those issues.

MS. DENALI DANIELS: Gwen or Bob, do you have anything to add?

MR. BOB GRIMM: I’m good. This is Bob, I’m good.

MS. DENALI DANIELS: Okay. I trust Gwen will pipe in if she wants to. Okay.

MR. DAVID LOCKARD: Maybe one more question.....

MS. DENALI DANIELS: David.

MR. DAVID LOCKARD: .....for Darren.

MR. DARREN HAMMELL: Yeah, sure.

MR. DAVID LOCKARD: You made reference to I think it was a military installation with solar and battery and diesel backup and you -- I think you said that you could improve your performance by using the diesels primarily to charge the
batteries. In my experience battery roundtrip efficiency is a barrier to that kind of thing and with lead acid, even valve controlled lead acid batteries the roundtrip efficiency is on the order of 50 or 60 percent. So any benefits you might get on diesel efficiency are offset and wiped out by the losses in the battery system. Could you speak to that?

MR. DARREN HAMMELL: Yeah, sure. The specific system that we’re doing for the Army, they’re -- it was sort of solving a number of issues. One of the things they’re looking at is if we -- if they have a normal load that’s 30 kilowatts and they have a 30 kilowatt generator and then the load grows and they want to put another 30 kilowatt their generators aren’t compatible with each other so they have to stick a 60 kilowatt on there whereas the system that we deliver is basically an AC coupled grid. So we could put a 100 kilowatt battery system on the side so even with just the 30 kilowatt generator we could serve a 60 kilowatt load, so they essentially got rid of a whole generator. And then the -- since it was AC coupled you could leave the generator running kind of whenever you needed it to, but you also had the option of maybe running it at full power and charging all the batteries and then shutting it off for nighttime loads.

Unfortunately we’re not actually able to get all the operating results out. We’ve tried many times and they keep telling us we’re not allowed to see them. But from what we hear
it’s going well and we’ve been to Army presentations where they started quoting these numbers back to us without, of course, attributing it to the specific site.

The batteries, the Army’s using a number of different kinds. The ones I think in that installation were these AGM lead acid like telecom batteries I guess. And we’ve also been using lithium iron phosphate batteries which have had better efficiencies. You know, they’re looking at high 80s, maybe 90 percent roundtrip on some of those batteries. A lot more expensive generally, but coming down pretty fast too. And a lot of the work that we’re doing is trying to leverage developments being done in other industries like electric vehicles. So as these car manufacturers are all seeming to standardize on these lithium iron phosphate batteries we’ve seen the cost come down. We were paying maybe $1.20 per watt hour about a year ago and we’re getting quotes now for 50 cents a watt hour.....

MS. MEERA KOHLER: Wow.

MR. DARREN HAMMELL: .....for the same batteries and we’re -- as long as that trend continues we’ll very rapidly be approaching lead acid battery costs for these -- on a per kilowatt hour basis for deep cycling, daily cycling operations.

So I don’t have the specific numbers from the Army but I know they are talking about 30, 40 percent fuel savings based on their configuration that they’re using these in. And, you know, most systems that we’ve seen the way they would integrate
the batteries is they’d have a generator charge the batteries
and then the batteries supply power through the inverter to the
grid. So anytime you’re running that generator you’re always
getting double losses from charges and discharging. What our
system did a little bit uniquely for them was putting the
generator on the AC side. So if the generator’s powering the
load it’s just going directly to the loads and you’re only --
you’re losing efficiency when you’re charging the batteries but
you’re not doing it all the time, you’re only doing it when you
decide to run the generator at full power. So in their
configuration I think that helped with the efficiency too.

MR. DAVID LOCKARD: Thank you.

MS. DENALI DANIELS: Good discussion. Any other
questions or comments regarding the converter portion of this
project? And has anyone new joined us online?

MS. JODI MITCHELL: Yes, it’s me, Jodi Mitchell.

Sorry I’m late.

MS. DENALI DANIELS: Hi, Jodi.

MS. JODI MITCHELL: Hi. Is this Denali?

MS. DENALI DANIELS: It is.

MS. JODI MITCHELL: Hi.

MS. DENALI DANIELS: Thanks for joining us. So I
don’t know how long you’ve been on and I don’t -- if you’re at
your computer I know that Jason sent out a couple of PowerPoints
so we’re just going through those. On the agenda we are pretty
much at the ready to go ahead and move into the Polarconsult final report which Jason and Joel are going to do jointly? No.
Okay.

MS. LESLI WALLS: And also, by the way, this is Lesli at ACEP. I joined in as well.


MS. JODI MITCHELL: Denali, I haven’t been on very long, this is.....

MS. DENALI DANIELS: Okay.

MS. JODI MITCHELL: .....Jodi again, and I don’t have the handout or the PowerPoint.

MS. DENALI DANIELS: Are you at your computer?

MS. JODI MITCHELL: Yes.

MR. JASON MEYER: Jodi, what’s your email?

MS. JODI MITCHELL: jmitchell@alaska.com.

MR. JASON MEYER: All right. I’ll send those to you right now.

MS. JODI MITCHELL: Thank you.

MS. DENALI DANIELS: Okay. So moving right along, I guess it’s just Joel?

MR. JOEL GROVES: Yeah.

MS. DENALI DANIELS: Not Jason? It says Jason and Joel on the agenda.

MR. JASON MEYER: I just wanted credit. Yeah, just -- I think my name just got.....
MS. DENALI DANIELS: It’s like auto-insert?
MR. JASON MEYER: Yeah, it somehow.....
MS. DENALI DANIELS: It’s everywhere. So the rest of your presentation here, Joel, is there a page number that we’re on? Are we still working on the same PowerPoint here?
MR. JOEL GROVES: It’s the one that I started with, yeah.
MS. DENALI DANIELS: Okay. So I think you ended up on page three? No.
MR. JASON MEYER: It’s going onto page four I think.
MS. MEERA KOHLER: Uh-huh (affirmative), PPS presentation.
UNIDENTIFIED MALE: Yeah.
MS. MEERA KOHLER: The blank slide and then we go to the next one.
UNIDENTIFIED MALE: Page four.
MS. DENALI DANIELS: So just anecdotally, from the Denali Commission’s perspective those of you may recall at the last meeting we spent quite a great deal of time really just brainstorming on, you know, what the best strategy might be for next steps. The Commission does not have funding available for a future phase of this particular project. So really we spent a lot of energy discussing options and, you know, we’re kind of at a point here where the Denali Commission will be, you know, finalizing its financial role in the project and there will need
to be some decisions made about ownership of the converter, for example, and then, you know, future undertakings regarding the actual ground testing in the event we get to the point where it’s commercially viable. You know, we’ll continue to be part of that dialogue, but we’re really at a point here where we’re winding down on our grant relationship and we’ll be working closely with ACEP on lessons learned. And, you know, so the feedback from this group is really critical at this meeting today because the future of this potential technology is really going to be, you know, dependent on where this goes next. So with that, go ahead, Joel.

MR. JOEL GROVES: Okay. Thank you. So there’s a lot of information to cover in the rest of the project, far more than we have time for today, so what I thought I would do is sort of go through a high level where are we on the major deliverables and tasks of the rest of the project, sort of describe very briefly how that’s going to be structured into the final report and then to the extent that folks on the SAG and online and whatnot have questions please ask me what your questions are and we’ll make sure that we answer those. So there’s not a lot of pictures and content in the rest of the presentation just because we’d be here for the rest of the day and into tomorrow probably to really cover it and I didn’t think anyone really wanted to go there.

MS. MEERA KOHLER: Unh-unh (negative).
MR. JOEL GROVES: But absolutely.....

MS. DENALI DANIELS: Oh, Meera, you -- I know.

MR. JOEL GROVES: .....as we go through this please feel to interrupt, ask me questions on things and if we can’t answer them right here on the spot we’ll certainly follow up on it.

So just to start with, the structure of the final report. What we’re looking at doing is having a fairly succinct document at least at the front end where people might actually read. So a couple page executive summary that’s going to hit the highlights, you know, what did we do, what did we set out to do, what did we accomplish, where do we go from here. And then a also fairly succinct 30 -- you know, I’m shooting for a 30 page narrative of the actual report document, the main body, something that someone -- you know, someone around the table or whoever can actually sit down and get through in a reasonable amount of time, walk away with the answers. And then there’s going to be some very voluminous appendices that go into all the technical details, the backup, the minutes of these SAG meetings, just a whole host of data that may actually go into a second volume, that if and when folks want to drill down into the phase two work the data will be there. So that’s going to be the structure of the final report deliverable of this project.

You know, so just going through some of the high level
work items in the project. The Stakeholders Advisory Group meeting, we’ll have a fairly succinct description, the main narrative of what the SAG did, the input, the feedback, the relationship. In the appendices, the transcripts, a lot of the correspondence that we’ve had with SAG members over the course of the project and that kind of information.

On Code issues, this is something that we’ve talked about quite a bit at the previous SAG meetings. Main body of the report we’re going to -- you know, basically the end product of the Code allowance for single wire earth return is that you can get a Department of Labor waiver for these on a project specific basis, it’s a fairly straightforward process. We have had the Department of Labor’s technical people talking with Manitoba Hydro on some of the technical concerns that they had of when would it be okay, why would it be appropriate to grant those waivers, why is single wire ground return not allowed in the Code. So those issues have been answered and that kind of more detailed discussion will be -- you know, the correspondence record, the answers and so on will be in the appendices. But the net result of that is the waiver’s a viable path forward, it’s not prohibitive for a project to get permitted.

MS. DENALI DANIELS: That was easy.

MR. JOEL GROVES: Yeah, so far so good. The demonstration site selection or the phase -- I guess, you know, the going forward, the phase three site selection. We talked
about this quite a bit in January, going through some of the
candidate sites. Polarconsult has not identified a final site
for deployment at this time. So the main narrative is really
going to talk about the list of the goals, the criteria, the
sites, future actions needed to get this technology deployed as
quickly as possible and then a lot of those -- the detail on
those various sites will be in the appendices.

And maybe just a -- because we were just talking about
this a little bit. You know, at the end of the current phase
we’re going to have two alpha units that are probably not ready
for deployment into the Bush, but they are functional once --
and, you know, once we get them fully validated and so on. What
we’d like to do is get those into Alaska, get them in an
appropriate place and get them operational and that’s sort of
our goal and do that as soon as possible. Obviously the longer
we wait on getting this technology deployed the more AC
interties are being built to the extent that -- you know, that
we have the resources to afford those and this technology is not
really bringing in benefits. So we want to get the technology
demonstrated with the two converters that we do have as quickly
as possible and continue working with stakeholders to identify a
phase three project so we can engage in those in the permitting
and the design phases so that instead of building AC lines they
can start to look at the DC lines. And I’ll talk about that a
little bit later on in more detail.
System integration. This is obviously a pretty key piece. We have a functional converter, we have overhead power lines or under -- or buried power lines or submarine cables. How are we going to make it all work together? The main narrative is going to have a pretty high level discussion of that. We haven’t identified any really prohibitive aspects of that. It’s going to be a project specific, you know, control and electrical design issue. The appendix will go into a lot more detail on it. We have -- we’ve tasked Manitoba with developing this. They’ve got some white papers that discuss multi-terminal direct current transmission which has very limited implementation globally, but there’s actually a lot of work and a lot of renewed interest right now in multi-terminal DC networks which -- maybe need to step back one step, but multi-terminal DC network is instead of a point to point DC communication or DC power transmission, which is what most DC power systems in the world are today, it’s having several DC converters on a common bus and you can be moving power in or out of those based on a whole algorithm of -- basically of economics, where is your cheapest power, where are the loads and it may or may not be from a hub or from the railbelt out to villages, it might be that plus when you have hydro you’re putting that in, when you have wind you’re putting that in and that type of more complicated system. So there are no technical barriers to that. The biggest thing is you do need a SCADA
system to tell who -- you know, tell all the converters what
they’re going to be doing, who’s taking power off the DC grid,
who’s putting power on the DC grid, which requires reliable
communications but it’s all doable. There’s algorithms, there’s
been research on how do you develop those SCADA systems and so
on and that’s -- there are no real barriers there. It’s all
routine engineering for a specific project when it comes. Are
there any questions on that piece of it or -- Jason.

MR. JASON MEYER: I know you’ve been working with
Manitoba on this question. Are there any Canadian applications
or is this more like an international concept?

MR. JOEL GROVES: Let’s see, there’s -- I mean Canada
-- the -- Manitoba Hydro specifically is also interested in this
technology. They have four remote villages that are currently
on diesel systems similar to Alaska villages up in the northern
part of the province. Yukon Territory has a few and Northwest
Territories, getting into Nunavik, they have quite a few more.
And we’ve been talking to -- we’ve been also talking to some
people at Northwest Territories about the technology. So
there’s a fair amount of interest in Canada with it.

With regard to the multi-terminal DC networks, I’m not
familiar enough with their systems or their needs to know if
they would go to that or if they would just have a point to
point transmission system. I know there’s been some work that
-- Manitoba’s -- in their consulting role they’ve done in
Britain looking at multi-terminal DC networks as well.

So, Earle.

MR. EARLE AUSMAN: There’s multi-terminal work being done in Africa right now and there’s multi-terminal work being done in India at this current time and they’re just coming into fruition, they’ve done the studies and things and the one in Africa has actually been absolved and is operating at this time. Manitoba was involved, if I remember correctly, in part in the Africa operation.

MR. JOEL GROVES: Yeah, Manitoba or Teshmont.

MR. EARLE AUSMAN: Yeah, Teshmont was there too.

MR. JOEL GROVES: Yeah. Yeah, and the one in Africa, it’s Namibia and some other countries, I forget where all it’s going. That’s a large scale conventional DC line, but it has three or four terminals on it and power sharing between those.

David.

MR. DAVID LOCKARD: Joel, somebody mentioned Texas and I believe one of the primary benefits of the ERCOT system DC lines is that they avoid FERC jurisdiction. Is there any potential for that on any -- at any sites in Alaska where it would be significant? Maybe Meera should answer.

MS. MEERA KOHLER: We’re non-FERC jurisdictional in this state because we’re not connected to the lower 48, so that’s a non-issue. But yeah, within Texas because it’s all within Texas, it’s not exported outside of the boundaries, there
are -- but, you know, FERC, what FERC is doing now in the lower 48 I think that that exemption is going to go away.

MR. DAVID LOCKARD: I guess there’s been discussion of selling power to Canada or getting power from Canada, so there may be at one site.

MS. MEERA KOHLER: That could be a problem.

MR. JOEL GROVES: Yeah, I don’t have a definitive answer on that. ERCOT was in the process when I looked at it in -- sometime in the past year of building an intertie into Mexico which as far as I know did not pierce that FERC exemption because of the DC connections. So that would perhaps be a precedent.

MS. MEERA KOHLER: Well, yeah, but the problem is that FERC jurisdiction is coming in through NERC because of reliability issues.....

MR. JOEL GROVES: Okay.

MS. MEERA KOHLER: .....and so that becomes -- you know, the lines blur at that point.

MR. JOEL GROVES: Okay. Yeah, it’s above my knowledge, so I’ll offer what I can.

MS. DENALI DANIELS: That won’t be in your report in other words.

MR. JOEL GROVES: Probably not.

MS. DENALI DANIELS: Okay. Back to the screen. Or you have a question, Meera. Go ahead.
MS. MEERA KOHLER: This is also low enough voltage that I really do think it falls under the barrier of FERC. FERC triggers about 135 KV and there’s debate about whether even that is too low and it should be higher.

MS. DENALI DANIELS: Right.

MS. MEERA KOHLER: So I think we’re okay.

MR. ERIC MARCHEGIANI: And from my experience when I worked for the State.....

THE REPORTER: Can I hear you on (indiscernible)?

MR. ERIC MARCHEGIANI: Yes, I will try.

THE REPORTER: Thank you.

MR. ERIC MARCHEGIANI: Okay. From my work when I worked in the State at AEA we looked at the Johnny Mountain intertie to Canada. There’s an awful lot that you have to do with the Department of State. The chances of us having an intertie to Canada to be very frank.....

MS. MEERA KOHLER: Major (indiscernible).

MR. ERIC MARCHEGIANI: .....is pretty slim. Unless the administration and -- when I say administration, both federal and state, get together and make it a priority. So I don’t think you have to worry about us connecting to Canada or wheeling power to or from Canada for a very long time.

MR. EARLE AUSMAN: You might ask Bob Grimm how he’s going to do it.

MS. DENALI DANIELS: Bob, are you online still?
MR. BOB GRIMM: Yeah, I’m still online.

MS. DENALI DANIELS: Are you working up business?

MR. BOB GRIMM: Yeah, there is -- it’s mostly a federal decision. There’s a presidential permit that’s required and there’s also a export authorization that is required from the Department of Energy and, you know, those are routinely being granted now. If you go onto the Department of Energy’s website they have a catalog of all the international connections that they have permitted and all the export authorizations that they have issued and there’s quite a few of them. But it’s not a state question, it’s strictly a federal question.

MS. DENALI DANIELS: Okay. Back to Joel.

MR. JOEL GROVES: Okay.

MS. DENALI DANIELS: Thanks everyone.

MR. JOEL GROVES: So converter development, we’re still talking about the final report structure here and the highlight, the major deliverables. Converter development, main narrative is going to have sort of the information that Darren had towards the end of his presentation there, you know, the headline functionality, footprint, cost, efficiency, test results and so on. The appendix, we have a fairly exhaustive final report, draft final report from Princeton and that will be the primary content in the appendix and that goes through the detailed converter specifications and on and on and on, you know, more detailed test data, narrative of the entire design
process and so on.

And then for each of -- you know, the overhead
transmission system, submarine cable transmission system and
buried cable transmission system which are sort of the very high
level three.....

MS. MEERA KOHLER: Those are the options.

MR. JOEL GROVES: Yeah, those are the options. I’m
not sure how else you would go about connecting two places with
a wire. For each of those what we’re going to look at is the --
in the main narrative the conceptual design methodology, the
conceptual designs and the applications and then the cost will
be in the cost section. And then the -- in the appendices we’re
going to have much more information on the designs, the
loadings, the assumptions that we’ve made, you know, more
detailed prints and so on and a lot of the technical reports
from the sub-consultants coming up with thermal analysis,
structural loadings and so on. And that’ll be applicable for
each of those three systems. And there’s a whole mountain of
data there but I’m just going to skip over that for the time
being unless someone has any questions on it.

MR. DAVID LOCKARD: So this is going to address your
ground return concept as well. Is that correct?

MR. JOEL GROVES: Yes, yes.

MR. DAVID LOCKARD: I actually know nothing about
electricity, but I am a bulk fuel project manager and we bury
pipelines routinely on projects. I was wondering if you’ve had any opportunity to look at how the cathodic protection systems on a buried fuel pipeline might be impacted by the ground return aspect of this technology.

MR. JOEL GROVES: Yeah, it’s going to be very much a project specific issue and it’s going to really depend on the proximity of the grounding grids to the bulk fuel operations. Most -- I mean what you would see if is you had a -- you know, an adverse voltage gradient applied onto the bulk fuel system you would -- depending on the type of the ca -- if it’s an active cathodic protection or a passive with, you know, sacrificial anodes and so on you’re either going to increase the power -- you know, overload the rectifiers, increase the power draw on the system or simply drastically shorten the life of the anodes, none of which are necessarily acceptable. I mean if the -- if you had an active system and it could -- if the rectifiers and so on were sized to deal with it, it would actually be a fairly manageable issue.

Generally speaking the voltage gradients that you’re going to see across that field are going to -- if it’s reasonably -- you know, properly separated from the grounding grid are not going to impact the system. And that’s something that in the project specific design you’d need to look at that where you do have varied metallic infrastructure to avoid those problems and so you’d really want to identify and avoid those in
the design phase.

So, Earle, did you have anything to add to that or.....

MR. EARLE AUSMAN: Yeah. Well, generally we will be too far away and most of these don’t extend over a long enough distance. So we pick up the voltage differentials and cause a problem with corrosion. So they’re relatively small and then for the -- they are probably not going to be relevant and certainly something we can measure if we did have such a problem.

MR. JOEL GROVES: Yeah, we’re -- with the ground return application where we get concerned is if you have long, you know, linear buried metallic infrastructure like the Alaska pipeline or longer things like that you’d find in southcentral and Fairbanks you start to get concerned. Where those will actually start to pick up the return current they become a preferential return current pathway and one or the other end of those will become -- will experience accelerated corrosion.

MR. DAVID LOCKARD: The longest buried fuel line I’m aware of is about a mile long and we typically install magnesium sacrificial anodes on those systems. So I think your response is -- it makes a lot of sense. You’d have to address it in design at a site.

MR. JOEL GROVES: Yeah. And that mile long one, wherever that is, that is something that you absolutely want to
identify in the design phase and address. If you’re talking about buried pipelines within the vicinity of a fairly compact bulk fuel facility it’s not a huge cause for concern. Something you’d want to look at absolutely, but not a huge cause for concern.

Any other questions on this one?

MS. DENALI DANIELS: Is this your last slide?

MR. JOEL GROVES: I don’t think so.

MS. DENALI DANIELS: Oh, okay.

UNIDENTIFIED MALE: Let’s find out tomorrow.

MS. MEERA KOHLER: Wishful thinking.

DR. RICH WIES: Hey, Joel?

MR. JOEL GROVES: Yes, Rich.

DR. RICH WIES: Yeah, this is Rich. Yeah, I know that I’ve worked before with you guys the whole step potential issue and that’s I mean certainly something that -- you know, that’s going to have to be addressed. So I don’t know if you have a plan for that or what’s on the table in that regard.

MR. JOEL GROVES: Yeah, it’s a good point. You know, step potential is something that is basically if you have a voltage gradient on the ground that is a steep enough or -- yeah, steep enough I guess where it becomes a safety issue for people walking around you’re going to -- and that is a very potential thing to have in the immediate vicinity of the grounding grid. That’s something that standard practice for
substations can address be it a, you know, special walking
surface in the substation that reduces that or, you know,
fencing off the immediate vicinity of the grounding electrodes
are all measures that will address that issue. And that is
something that’s limited to the immediate vicinity of the
electrodes.

MS. DENALI DANIELS: Next slide.

MR. JOEL GROVES: Next slide. Well, I’m actually
already at the next slide. Next slide is construction and
maintenance methods. The main narrative’s going to basically
talk about the design objective and the results from our studies
and our work up in Fairbanks. And one of the key things here
with regard to the overhead system is to I guess increase the
flexibility of how you can go ahead and build these systems.

Yeah, right now the generally speaking it’s heavy
equipment in the wintertime has been the way that these things
have been built. That may very well still be the best way to
build these systems with the reduced sizes of the foundations
and of the equipment capabilities that you need to build these
new systems. But one of the key things that we’ve done is we’ve
developed these systems so you can build these in the wintertime
-- or I’m sorry, in the summertime with helicopters. There’s
equipment small enough, the components are small enough you can
sling load these with helicopters quite easily and it provides
more opportunity for flexibility and construction methods where
you don’t necessarily have to mobilize heavy equipment out into
the field in a barge season the year before, have that equipment
on site for an entire year building in the wintertime, de-
mobbing the next summer, where you can start to employ more
commonly locally available equipment, summertime or wintertime
construction methods, and bring down some of those costs
dramatically. And a lot of that more detailed data will be in
the appendix. Meera, you’re looking.....

MS. MEERA KOHLER: Am I looking skeptical?

MR. JOEL GROVES: A little bit.

MS. MEERA GROVES: Yeah, I’m very skeptical.

Helicopter deployment and utilization in Bush Alaska is
horrendously expensive. So I just fail to conceive how
conventional construction isn’t going to beat helicopter
construction hands down every single time.

MR. JOEL GROVES: Well, that -- and that is very
possibly an answer for most projects. But it’s an option -- I
mean another aspect of this is for repair of the systems when
you do have a structure that goes down. If you can deploy
something via helicopter out there to put in new foundations or
something that’s more -- it’s a more flexible option for
solutions.

UNIDENTIFIED MALE: There’s not a lot of helicopters
based out there.

MS. MEERA KOHLER: I still have a skeptical look.
MR. JOEL GROVES: Yeah. Yeah, you do. Well, what we’re looking at is a 3000 pound sling load for a helicopter, so readily available helicopter equipment that is available out in the Bush. And.....

MS. MEERA KOHLER: Yeah, chartered out of Anchorage.
MS. ELAINE BROWN: Uh-huh (affirmative), or Fairbanks.
MS. MEERA KOHLER: It’s not available in the Bush.
MR. JOEL GROVES: Huey’s (ph) aren’t.....
UNIDENTIFIED MALE: (Indiscernible).
MR. JASON MEYER: Yes, Bob?
MR. BOB GRIMM: Yeah, down in southeast Alaska we’re fighting a roadless rule which we might lose.....
MS. MEERA KOHLER: Yeah.
MR. BOB GRIMM: .....which means future transmission lines are going to have to be built without roads.
MS. MEERA KOHLER: Yep.
MR. BOB GRIMM: So having the option of putting these types of lines in with a helicopter is -- might be a creative solution to that if that rule stays in place.
MS. MEERA KOHLER: I reserve judgment.
MR. JOEL GROVES: Thank you, Bob.
MS. ELAINE BROWN: That’s the southeast.
MR. JOEL GROVES: Yeah, and the -- yeah, for southeast. And that’s something where, you know, the poles are a 900 pound sling, the equipment would be a 3,000 pound sling.
So we’re trying to get -- you know, I mean the southeast intertie that was built a few years ago was using heavy lift helicopters to get the towers in place.

MR. DAVID LOCKARD: Swan Tyee.

MR. JOEL GROVES: Yeah, thank you. Thank you, Dave.

UNIDENTIFIED MALE: At $2 million a mile.

MS. MEERA KOHLER: Yeah, uh-huh (affirmative).

MR. JOEL GROVES: Yes, which was what.....

UNIDENTIFIED MALE: A little expensive.

UNIDENTIFIED MALE: It was cheap.

MR. JOEL GROVES: Yeah, extraordinarily so. Cheap at any price. Earle.

MR. EARLE AUSMAN: One of the things about helicopters. I think we just had an example of a line that was mostly built with helicopters and that’s the line between Tyee and Ketchikan.

UNIDENTIFIED MALE: Right.

MR. EARLE AUSMAN: And that was almost 100 percent helicopter show. Is that not right, Robert?

MR. ROBERT VENABLES: That -- and that’s what we were talking about, the $2 million a mile.

MR. EARLE AUSMAN: Yeah. Well, that was then. That was big heavy stuff they were moving.

MR. ROBERT VENABLES: We might have a better data point. Kent is looking at a line with fiberglass poles. It’s
an AC line. Correct me if I’m wrong, but from -- the North Slope Borough is looking at that from Barrow to Atqasuk. So a similar technology as far as the poles go.

UNIDENTIFIED MALE: Right.

MR. JOEL GROVES: Yeah, and I imagine with the soil temperatures up there you’re just doing cantilever poles on that or have you decided yet?

MR. KENT GRINAGE: No, just single poles with that fiberglass.

MR. JOEL GROVES: Well, will they be supported by guy wires or just.....

MR. KENT GRINAGE: No.

MR. JOEL GROVES: .....just in the -- stuck in the ground?

MR. KENT GRINAGE: There’ll be a few of the guy -- the least amount of guy wires the better off we are.

MR. JOEL GROVES: Sure, sure.

MR. KENT GRINAGE: The st -- the Fish and Game, they just hate them.

MS. MEERA KOHLER: They do.

MR. KENT GRINAGE: Yeah.

MS. MEERA KOHLER: Fish and Wildlife.

MR. KENT GRINAGE: We’ll stick the poles in 10, 13 feet and that’ll be fine.

MR. DAVID LOCKARD: But there are some sites up there
even in that region along the rivers where you will have.....

MR. KENT GRINAGE: Yeah, we’ll.....

MR. DAVID LOCKARD: .....marginal permafrost or no permafrost. Is that correct?

MR. KENT GRINAGE: Well, it’s -- there we’ll do the double poles and we’ll have -- we’ll expand -- well, the span will be about 1,200 feet and that’ll cross any river we’ve got up there easily. But yeah, we’ve got to make sure we’re in the permafrost.

MR. JOEL GROVES: What kind of pole height are you looking at?

MR. KENT GRINAGE: The what?

MR. JOEL GROVES: The pole height.

MR. KENT GRINAGE: Right now it’s 65 feet.


MS. MEERA KOHLER: And span lengths, Kent?

MR. KENT GRINAGE: Seven hundred.

MR. JOEL GROVES: And so that’s a -- obviously a three phase AC so you’ve just got the tripod up on top or the.....

MS. MEERA KOHLER: Cross arms.

MR. JOEL GROVES: .....two side.....

MR. KENT GRINAGE: No, no cross arms.

MR. JOEL GROVES: .....cross arm or.....

MS. MEERA KOHLER: No cross arms?

MR. JOEL GROVES: .....just two side arms and a.....
MR. KENT GRINAGE: Yeah.

MR. JOEL GROVES: .....post top?

MR. KENT GRINAGE: Right.

MR. JOEL GROVES: Okay.

MS. MEERA KOHLER: What voltage?

MR. KENT GRINAGE: Thirty-five.

MR. ROBERT VENABLES: Mostly been talking about construction. Will the report have some good estimates on what the maintenance and renewals and replacements life span cost might be? Because even if you can get the technology worked out and the construction fully funded there are many communities that can’t handle, you know, within the rate structure very much O and M or, you know, R and R costs. So it’d be good to have that in the final report detailed out so that they can grapple with that.

MR. JOEL GROVES: Yeah, we will break all that out, you know, looking at a life cycle cost over a 50 year life for the intertie. And that’ll be the converter OM, RR as well as the tie line as well.

MR. ROBERT VENABLES: Fifty year life cycle on the converters?

MR. DARREN HAMMELL: Fifty year lifetime with maintenance.

MS. MEERA KOHLER: That’s what I thought.

MR. DARREN HAMMELL: With major replacements.
MR. JOEL GROVES: Yeah.

MR. DARREN HAMMELL: You can get 20 years.....

MR. ROBERT VENABLES: How’s that skeptical look come
-- how do you do that?

MS. MEERA KOHLER: Radiate it.

MR. JOEL GROVES: Yeah, and -- yeah, on the converter
I mean there’s a -- you know, there would be a maintenance
schedule. The -- I think that the controls were probably one of
the things that you’d regularly switch out because those have a
shorter life.

MR. DARREN HAMMELL: Yeah, the -- they’re generally
designed for 10 year little or no maintenance lifetime and then
some replacements at 10, a few major replacements at 20 and
then, you know, extension to 40 ish.

MR. ROBERT VENABLES: That sounds more realistic.

MR. DARREN HAMMELL: Yeah.

MR. ROBERT VENABLES: Thank you.

MR. DARREN HAMMELL: It’s -- you know, they call it --
the word lifetime is so loaded in the power electronics
industry. But the systems we did on the aircraft carrier are 50
year lifetime. It just means they’re upgradeable, you know,
and.....

MR. ROBERT VENABLES: Well, that’s where the R and R,
you know, issue comes into play because, you know, anything
that’s cooking at that temperature and speed is not going to
MR. DARREN HAMMELL: Right, right.

MS. MEERA KOHLER: Conventional transformers, 30, 35 years.

MR. DAVID LOCKARD: What is your estimate for some of the interties that you’ve installed recently, Meera?

MS. MEERA KOHLER: We are doing a 30 year life. We expect them to last 30 plus.

MR. DAVID LOCKARD: Do you have a O and M and R and R cost per KWH or anything like that?

MS. MEERA KOHLER: Well, you really can’t do it per KWH. I mean you can do it potentially per mile of line or per pole span or something like that. But overhead transmission is really relatively low maintenance because -- unless you have a telecom attached to it because those telecom guys are up and down those poles so much that they wear them out.

MR. ROBERT VENABLES: Well, unless you’re in southeast where there’s a rain forest. It’s a significant.....

MS. MEERA KOHLER: I’m telling you, it’s a real problem.

MR. ROBERT VENABLES: Yeah. Significant O and M on the overhead lines in southeast.

MS. MEERA KOHLER: Yeah. Well, but in southeast you also have weather conditions that are different.....

MR. ROBERT VENABLES: Right.
MS. MEERA KOHLER: .....than we have in northern Alaska and western Alaska. We don’t -- we flat don’t get wood rot so that’s a big plus.

MR. DAVID LOCKARD: Have you got any information on the availability of contractors to do maintenance on these lines? We recently did a job in southeast and we had a really tough time finding a contractor with the proper certificates to do medium voltage work.

MR. JOEL GROVES: No, we haven’t looked into that -- those sorts of issues in detail. You know, we are talking -- for the costing we are talking to STG and some other contractors to help us out with real world costing so you don’t have, you know, here’s what the engineer said for this report. But we haven’t gone into detail at that level.

MS. DENALI DANIELS: Good questions, guys. Anymore on this slide? David.

MR. DAVID LOCKARD: What about climbing these poles, the fiberglass poles? It’s......

MS. MEERA KOHLER: That’s a challenge.

MR. JOEL GROVES: Yeah, we’re looking at.....

MS. MEERA KOHLER: Pocketful of pigs.

MR. JOEL GROVES: .....I mean obviously spikes don’t work very well.

MS. MEERA KOHLER: No.

MR. JOEL GROVES: And so we’re looking at clip-on
ladders would be a proven solution for them.

MR. DAVID LOCKARD: Is there any temperature dependency and.....

MR. JOEL GROVES: Not that I’m aware of, no. Aside from what the person climbing the pole can tolerate.

MS. MEERA KOHLER: Sort of what we’re doing here is we’re talking about two different innovative concepts. We’re talking about the converters and then we’re talking about a new construction style, if you will. You know, my personal preference would be to do them as separate issues, to do the converters with conventional transmission construction and then try your avant garde transmission construction with conventional transformer conversion and then marry the two together in a third stage.

MR. JOEL GROVES: Yeah, when we talk about the demonstration project, you know, one of the things that we do want to do is design the demonstration for success. We don’t want to try every single new thing under the sun.....

MS. MEERA KOHLER: Right.

MR. JOEL GROVES: .....have one of them fail and then the entire thing is perceived as a failure.

MS. MEERA KOHLER: Exactly.

MR. JOEL GROVES: So, you know, for the demonstration we’re really going to focus on the converter technology because that’s -- that is the lynchpin to what we’re talking about. A
lot of this other stuff is -- you know, there’s a lot of ways to build overhead transmission lines and all that we’re talking about here is an identified, you know, higher cost and a lot of ways that are not really optimal to be doing what’s happening out in like the YK Delta and so on. We’re trying to focus on that. But this is another tool in the toolbox.

MS. MEERA KOHLER: The other thing, the constraint that you have to overcome is the fact that many of us in rural Alaska are RUS borrowers and the RUS has pretty, you know, definite and strict construction guidelines that we have to go with. So they -- their approval would have to be sought for any non-conventional construction style.

MR. JOEL GROVES: Okay. That’s an excellent point.

MS. MEERA KOHLER: Including the converters.


MR. ERIC MARCHEGIANI: Our material list is online. You know, you can turn around and take a look at it. And, you know, the.....

MS. MEERA KOHLER: It’s (indiscernible).

MR. ERIC MARCHEGIANI: .....and the specifications are out there also. I mean it’s pretty straightforward.

MR. JOEL GROVES: Yeah, yeah.

MR. ERIC MARCHEGIANI: Now, you know, we’re trying to look outside the box, I understand. From the standpoint of the
converter versus let’s say transmission or distribution, the
converter would be more or less in the power plant which would
more or less be considered like transmission or generation and
you more than likely would get a waiver or an exception to that
fairly easily. The transmission or distribution line would be
another case entirely.

MR. JOEL GROVES: Yeah.

MR. ERIC MARCHEGIANI: I think you’re.....

MS. MEERA KOHLER: Yeah.

MR. ERIC MARCHEGIANI: .....you’re running -- it’s
going to take some uphill battle I guess is the best way to put
it.

MR. JOEL GROVES: Yeah. Well, I mean one of -- you
know, I’ll toss this out for consideration. This is the kind of
detail that I didn’t put in the slides because it wasn’t one of
the million things that could have come up that I knew about.
Is, you know, as we’ve looked at the final design of this
overhead system where we’re going with a 19 number 10 alumaweld
wire as the conductor tensioned at I think about 35 percent, the
final tension is about 35 percent of design. And when you look
at the SAG data at 1,000 foot span, you know, we had originally
been looking at a 60 foot pole and a four foot insulator with a
-- like I think a 19 foot out of the NESC, a 19 foot ground
 clearance with a five foot terrain margin. Looking at the final
design of that at a conceptual level there’s actually an
enormous amount of margin in that, about 25 feet of margin that
we can actually shorten those poles down. So you can actually
-- and this is going to be a, you know, what is your terrain
allowance and a whole bunch of other project specific issues,
but if you’re in flat terrain you can actually go -- bring the
-- drop those poles down to about 45 feet with that four foot
post top insulator and still maintain that 1,000 foot span and
your ground clearances. And that starts getting into the
question of do you need to stick with fiberglass poles, does it
make sense to go back to wood poles if you’re going to a
different construction method. I mean these are all project
specific questions that you’re going to look at and if -- you
know, so there’s a lot of flexibility. When I say there’s a lot
of flexibility in that overhead conceptual design that’s sort of
what I’m talking about. So I mean if you’re up in the Fairbanks
area and you need that -- you know, there’s rolling hills and
you need a larger terrain allowance it’s certainly there with
that system.

MS. MEERA KOHLER: Well, the other thing that you have
over there is you have such a huge variation of ambient
temperatures in the interior, you know, from 90 to 100 degrees
in the summer down to minus 60 in the winter, your SAG is going
to change very, very dramatically.

MR. JOEL GROVES: Absolutely.

MS. MEERA KOHLER: You know, you’d be swinging on that
SAG in the summer.

MR. JOEL GROVES: Yeah. And then also when you look at unbalanced loadings and so on.....

MS. MEERA KOHLER: Yeah. Yeah.

MR. JOEL GROVES: .....that gets into it too. But yeah. So there’s a lot of -- you know, these are conceptual designs. We’re trying to solve some of the most beleaguering problems that have been out there in terms of driving up these costs. But every specific project is going to have specific solutions and the engineers will look at the totality of what’s available out there and come up with the best -- hopefully come up with the best solution. We’re trying to expand that palette, so. Yeah, Jason.

MR. JASON MEYER: Joel, one question maybe just kind of related to this. The report’s going to have your own economic review of the project. I know before you’ve looked at almost like a sensitivity analysis, like at what length theoretically do these systems make sense or they pay back better than traditional AC systems. Are you going to revisit that and then specifically focus on converters married with traditional HVDC trans -- or traditional transmission as opposed to single wire earth return or, you know, the bi-polar systems? Is that going to be part of that Polarconsult analysis?

MR. JOEL GROVES: Yeah, and we’ll also look at, you know, the overhead, buried cable and submarine cable options,
you know, so we'll start to break out some of those costs. They
won't necessarily have AC analogs for the other two because you
don't generally run long distance AC in cable settings. But we
will have that direct comparison to the AC, overhead AC system.

MR. JASON MEYER: And correct me if I'm wrong. I
think your -- the first SAG meeting we were talking about like
nine miles ish being the breakeven point for single wire earth
return with converter systems. Do you have any -- have you
revisited that number and have you thought about that number in
terms of traditional transmission with converter technology?

MR. JOEL GROVES: I -- yeah, the phase one report --
yeah, seven to nine miles was the breakeven for the mono-polar
systems. I haven't revisited those numbers yet so I don't have
an updated estimate of what that is. But that, again, will --
you know, we'll have a conceptual number and then that analysis
would be a project specific analysis to figure out if it -- you
know, if DC is a logical technology for any given intertie.

MS. MEERA KOHLER: And actually, Jason, we had looked
at that at AVEC and we're looking at something closer to
conventional construction with two wire with a tower pole
allowing us to do a longer span. Because right now we build to
a 250 foot span, maybe we can go to 400 foot or 450 foot which
would be a big plus for us.

MR. JOEL GROVES: Absolutely.

MS. MEERA KOHLER: But there the breakeven was about
20 to 25 miles and I’m not sure we threw in the factor on line
losses because that’s one of the big advantages that DC does
bring is that when you’re spanning longer distances you really
reduce your line losses with DC as compared with AC and that
could be a major factor in connecting villages.

MR. JOEL GROVES: Sure. Would you be willing to -- I
don’t want to put you on the spot, share that information with
us? We could fold it into the final report or.....

MS. MEERA KOHLER: You know, it was back of the
envelope stuff that we did.....

MR. JOEL GROVES: Okay.

MS. MEERA KOHLER: ......three years ago when we first
got into this and so that was.....

MR. JOEL GROVES: Okay.

MS. MEERA KOHLER: .....what we used as a starting
point.

MR. JOEL GROVES: Okay, okay. But yeah, I mean that’s
something, you know, in addition to the mono-polar we’ll look at
bi-polar as well and develop those costs, so.

MR. DAVID LOCKARD: Joel, there’s a bit of a trend
lately of AC actually being more competitive with HV -- with
traditional HVDC. In Kent’s analysis for his project they
looked at HVDC and they found the AC was economically more
attractive and there was an analysis done as part of the
integrated resource plan for southeast Alaska. The submarine
cable between Kake and Takatz Lake on the east side of Baranof Island and they found that -- they looked hard at HVDC and they found that traditional -- that AC was more attractive. Is that dynamic, does that affect this work or is this fundamentally different because of the more attractive cost of the -- this converter?

MR. JOEL GROVES: Yeah, I’m not familiar with the work that Kent’s done, but I am familiar with the draft report that came out on the Kake Takatz Sitka intertie and that did not look at this technology which was a -- I thought a major -- I’m not going to call it a shortcoming, but just a major limitation of that report. Because they were looking at HVDC light which starts at I think 50 megawatts and the ABB and Siemens simply are not interested in the bottom of the market. And that was one of the conclusions in that report is they -- you know, ABB and Siemens, I guess they were kind of like, well, yeah, I guess we could do that, but why don’t you just do it AC, you know, it’s simpler. And this technology is ideally suited to that because 50 megawatts is -- I mean Takatz I think is 25 megawatts, they just don’t need that much capacity down there. And when you look at the dollar per kilowatt of the converters I think this technology would very possibly come up with a different outcome of that report’s conclusions where DC is better.

MR. JASON MEYER: And just to clarify, Joel. So HVDC
light, that technology, is that similar to what Darren was
talking about with the thyristor or the different design of the
HV -- the converter technology?

MR. DARREN HAMMELL: Yeah, it’s basically exactly what
I was talking about. It would look sort of like a substation,
you know, using larger thyristor based devices.

MS. MEERA KOHLER: And I’m actually really excited
about what you’re projecting as the cost of the converters at,
you know, $217,000.00 for, you know, 500 KVA. That’s pretty
competitive.

MR. JOEL GROVES: Yeah, and actually I just wanted to
follow up on the other end of that. Kent, can you speak to the
study that you guys did for the Barrow Atqasuk on HV ver -- H --
DC versus AC?

MR. KENT GRINAGE: Yeah, I’m guilty. I’ll speak to
it. We just couldn’t find any of the technology in our range.
The closest thing we found was something out of Teeter (ph)
Technologies and that wasn’t even really developed. So what we
did come up with really economically it just wasn’t feasible to
follow the HVDC, but the real problem was the maturity of the
technology.

MR. JOEL GROVES: Sure. And the schedule of that
intertie is not compatible with the maturation schedule of this
technology then?

MR. KENT GRINAGE: I can’t tell you what the technol
-- our schedule will be because it’s going to be tough building
any power line on the Slope, just through regulations and that’s
going to be a hurdle.

MR. JOEL GROVES: Just the environmental issues, the
birds.

MR. KENT GRINAGE: Just environmental issues, yeah.

MR. JOEL GROVES: Is it birds are the primary concern
or.....

MR. KENT GRINAGE: Birds, yeah.

MR. JOEL GROVES: Okay. That’s too bad.

MR. KENT GRINAGE: Yeah, I know.

MR. DAVID LOCKARD: Joel, Alaska’s got some world
class battery storage systems. Is there any reason to think
about this technology particularly with respect to those? I
guess the BESS system at Golden Valley has already got some
major interties, but the proposed intertie to Metlakatla is not
built and not funded, not designed and there’s a large battery
system there.

MR. ROBERT VENABLES: It’s a pretty short span though.

MR. DAVID LOCKARD: How far is it?

MR. ROBERT VENABLES: It’s only about a mile, mile and
a half.

MR. JOEL GROVES: Yeah, it’s doubtful that an intertie
that short the -- any kind of savings you could achieve with the
lower line cost would absorb the cost of the converters. That’s
-- when we talk.....

MS. ELAINE BROWN: Right.

MR. JOEL GROVES: .....about that breakeven you need
about seven miles -- you know, the phase one study identified
you need about seven miles of savings on the per mile line
construction cost to pay for the converters. So interties that
are shorter than seven miles generally DC is not a good
solution. But longer than that -- and the longer you go the
more savings you start to reap both in the construction cost of
the power line itself and the efficiency gains of the power line
are both pluses.

MR. DAVID LOCKARD: The Metlakatla one would include a
submarine crossing. I don’t know if that makes a difference or
not.

MR. JOEL GROVES: It can. At a mile I think you can
generally deal with the cable capacitance pretty easily. It’s
-- as you get out farther that becomes more of a challenge.
More generally to answer your -- or to address your question,
with battery storage integration with the DC transmission, it’s
an interesting question. I don’t have an answer off the top of
my head as to whether or not that would have a major benefit to
it. I mean would you build a transmission line with -- you
know, with capacities so close to the load in the village where
you needed a battery system to, you know, deal with peaking and
so on. I wouldn’t think so. You know, the incremental cost of
building it at a little bit more capacity where you don’t need
the battery system is I think almost de minimis. But that’s
just.....

MS. MEERA KOHLER: Just add to that question. My
recolletion, David, is that that battery at Metlakatla was
installed over 20 years ago.

MR. DAVID LOCKARD: It was recently replaced.

MS. MEERA KOHLER: It was recently replaced. Okay.

MR. DAVID LOCKARD: I think. Wasn’t it, Robert?

MS. MEERA KOHLER: Because I was thinking, gee, that’s
got to be at the end of its practical life. And I remember that
they did it because of the harmonic imbalance from the sawmill
coming on and off and.....

MR. DAVID LOCKARD: Just a big load, big motor.

MS. MEERA KOHLER: And right after they built it the
sawmill shut down?

MR. DAVID LOCKARD: It’s Alaska.

MR. ROBERT VENABLES: No, it’s a new beautiful
facility.


UNIDENTIFIED MALE: And they still owe us.

MS. MEERA KOHLER: That was a big bill too.

UNIDENTIFIED MALE: Five million.

MS. DENALI DANIELS: So, Joel, I see you’ve got
several slides still.
MR. JOEL GROVES: Yeah, those -- pretty quick here I’m going to get into some optional slides that I didn’t really intend to go through.....

MS. DENALI DANIELS: Okay.

MR. JOEL GROVES: .....that.....

MS. DENALI DANIELS: So -- because there’s several slides on, you know, it looks like.....

MR. JOEL GROVES: Yeah, the thermal modeling and.....

MS. DENALI DANIELS: Yeah.

MR. JOEL GROVES: .....so on that I tossed in, in case we wanted to go there.

MS. DENALI DANIELS: So maybe you could just ki -- I really like the way this discussion is going because.....

MR. JOEL GROVES: Yeah.

MS. DENALI DANIELS: .....I really feel like this is the kind of feedback we’re after and, you know, I kind of feel like we’ve already gotten into the feedback from the SAG. So maybe you can just kind of wrap up and then let’s really start getting some pen to paper here on some of the points that have been brought up if that’s okay.

MR. JOEL GROVES: Yeah, absolutely.

MS. DENALI DANIELS: Is that good, Jason?

MR. JASON MEYER: Yeah, that’s perfect. One thing maybe just for the benefit of the group is last ti -- the previous SAG meeting we talked a lot about options and proposals
for phase three. I was wondering if you could update the SAG on the actions that you guys took for that -- those recommendations, where that’s at and then more specifically getting into like what you were mentioning, bringing the converters up for phase three testing, what your guys’ thoughts and goals and concepts are, just for more feedback from the SAG specific to kind of the future next steps, the technology of the project.

MR. JOEL GROVES: Yeah, absolutely. And I do have some slides a little bit later on to that effect, at the other end of all those technical slides, that I can speak to that in some detail.

MS. DENALI DANIELS: How about 10 minutes to finish up your PowerPoint? Can you do that?

MR. JOEL GROVES: Yeah, that sounds good.

MS. DENALI DANIELS: Okay. Go.

MR. JOEL GROVES: On that note, I’ll go to the next slide.

MS. MEERA KOHLER: No more questions.

MR. JOEL GROVES: Yeah, well we’ve actually already covered, you know, economic analysis pretty well so I’ll just keep on going. Okay. Well, here we go.

MS. DENALI DANIELS: Good job.

UNIDENTIFIED MALE: There we are.

MR. JOEL GROVES: Hey, how about that. Yeah, so I
guess I’ll answer Jason’s question first.

MS. DENALI DANIELS: Very nice pictures.

MR. JOEL GROVES: Yeah. The future of the project and the technology. And like Jason said, we -- in January we did go through an extensive review of potential phase three demonstration sites. And Princeton and Polarconsult also applied for funding under the Emerging Energy Technology grant program that started up back in, what, February or March or so and we’re watching that as that program works through its kinks and moves forward.

This is just a recap of the -- you know, some of the interties that we looked at in detail. One that we didn’t discuss in January is Kodiak to Ouzinkie. There’s another potential for an intertie there that we’ve talked to Ouzinkie a little bit about. They’re looking at an intertie from Kodiak. It’s about 11 miles or so. They do have a underwater cable crossing about a mile and a half or so and the -- they have some conceptual costs for that and the concern was the mobilization cost to get the cable across that over to Spruce Island from Kodiak Island was prohibitive. And so the question came up, well gee, why not -- if -- once you’ve got the cabling and ship onsite and everything else why not just go cable the whole way and maybe it makes sense that way instead. So that’s another site that’s out there.

But some of the lessons that we learned from going
through that exercise of reviewing all those sites is, like
Meera spoke to a few moments ago, we really need to focus on a
converter -- a successful converter demonstration. You know,
some of these other innovations that we’re looking at are
potential distractions and potential liabilities if anything
does go wrong and we really want to focus on making sure that
that converter is perceived and is a success in the
demonstration. We don’t really want to wait for a rural
intertie that is just a line on a map right now because that’s
probably about a five year process before that would get built.
We’d really like to demonstrate these converters as quickly as
possible to keep the momentum on this project up and to expedite
the deployment of the technology as quickly as possible.

We looked at a number of railbelt feeder lines,
distribution lines, as a potential conversion to a DC
application for a demonstration. Those really wouldn’t have
demonstrated very much in hindsight and they were not very cost
effective. There were a lot of sunk costs into stepping down
voltages, transforming voltages, you know, switching over the
insulators on the poles and then putting everything back. So a
lot of the money for the demonstration was not really -- it’s
just not very cost effective and wasn’t a very good
demonstration.

We -- you know, I’d have to acknowledge a lot of the
railbelt utilities did help us on that. We had a lot of staff
time from Golden Valley Electric, Copper Valley Electric, Chugach Electric and Homer. They all -- you know, we looked pretty hard at a lot of different sites out there, but they just didn’t really make sense for the technology and the project.

And so what we’re really focusing on now is a useful demonstration of the converter with a rapid deployment schedule. We don’t have a final answer on what that is yet, but that is sort of one of the key things that we’re working on as we wrap up this project and move beyond to keep this technology moving forward.

There’s sort of a three part plan to that. As Darren spoke to, you know, there’s going to be more testing needed to be done in Princeton, sort of the final commercialization work before the converter is really ready for primetime, moving from the alpha to the beta to, you know, serial number 1 through infinity. Part two is, you know, getting that near term Alaska demonstration installation and trying to figure out where that’s going to happen and how that’s going to be structured. And then part three is continuing to work with the utilities in the rural communities to find those HVDC projects that’ll be sort of the stage four I guess, the full scale commercial implementation of the technology. We do need to be working with people like Meera, people like Kent to try and -- as these interties are working through the permitting and early design phases be plugged into this technology and be ready for it so that you
guys can plan for the technology’s availability and we can plan to get it into those projects because there are substantial benefits to be reaped. And then, yeah, forge those partnerships.

So, there.

SENATOR LYMAN HOFFMAN: I have a question.

MR. JOEL GROVES: Yeah, Senator.

SENATOR LYMAN HOFFMAN: Is there any discussion about conversion to use electric heat in any of these demonstration projects?

MR. JOEL GROVES: That is some -- you know, the 500 kilowatt converter for a lot of the smaller utilities or communities like David spoke to near the beginning of the meeting, 500 kilowatts is a lot more than a lot of these communities need. So just by having a 500 kilowatt power intertie, if the economics of heating fuel on one side versus electricity on the other side were such that it made sense to switch to electric heat you absolutely could.

SENATOR LYMAN HOFFMAN: Especially given the transportation cost to many of the communities given the fact that they have to have additional storage capacity for the diesel. And I guess my question is are you looking at at least some demonstration of this in any of the projects that are under consideration so that some numbers can be looked at.

MR. JOEL GROVES: We haven’t looked at it
specifically. I know Barrow Atqasuk would be a prime candidate for that where you’re going from natural gas to.....

SENATOR LYMAN HOFFMAN: Yeah.

MR. JOEL GROVES: .....yeah, to heating fuel and I don’t know if you’ve looked at that there.

MR. KENT GRINAGE: We’ve looked at it and it proves out favorably but it jacks up the kilowatt hours.....

MR. JOEL GROVES: Sure.

MR. KENT GRINAGE: .....from about 500 to 2,000.

MS. MEERA KOHLER: Average residential use you mean?

UNIDENTIFIED MALE: (Indiscernible).

MR. KENT GRINAGE: No, no, no, the overall demand would go from.....

MR. DAVID LOCKARD: The KW.

MR. KENT GRINAGE: KW, about 500 to 2,000.

SENATOR LYMAN HOFFMAN: The problem with high cost of living in rural Alaska, you know, is not the cost of electricity, it’s the cost of heating a home.

MS. ELAINE BROWN: Yeah.

MR. KENT GRINAGE: Yeah. So it does work out.

MR. JOEL GROVES: Yeah, I mean another metric that might be useful on that, let’s see if I can do my numbers right, is if you’re looking at 12 cent a kilowatt hour energy on the railbelt that’s roughly analogous to $4.00 a gallon heating fuel out in the villages. So right there you can see.....
MR. KENT GRINAGE: Yeah.

MR. JOEL GROVES: .....you’d have to factor in the transmission cost of the intertie and what that ends up -- you know, what the retail cost of that energy on the far end of the line is, but that’s a pretty strong differential between what a lot of the prevailing costs are out in the villages. So that would absolutely be -- you know, I don’t know of many villages, maybe some in southeast, where they’re currently seeing $4.00 a gallon for heating fuel. Out in the west and stuff you’ve already got a significant savings potential there.

UNIDENTIFIED MALE: (Indiscernible) you’re seeing $7.00 a gallon.

MS. ELAINE BROWN: $7.00.

MR. JOEL GROVES: Yeah.

MS. ELAINE BROWN: $7.00 to $10.00.

MR. ERIC MARCHEGIANI: But if you’re generating electricity with diesel there’s no benefit. If you’re dealing with gas like he is.....

MS. MEERA KOHLER: Right. I think what you’re talking about is displacing.....

UNIDENTIFIED MALE: The storage capacity.

MS. MEERA KOHLER: .....diesel electric with natural gas powered electricity and that there could be a significant difference there. But the challenge is that, you know, the wheeling cost, the transmission cost over long distances is
going to be at least three or four cents a kilowatt hour over
the long term. But.....

UNIDENTIFIED MALE: (Indiscernible) diesel electric.

MS. MEERA KOHLER: Yeah. But if you’re just basing
$10.00 a gallon fuel oil there’s a lot of incentive there.

MS. ELAINE BROWN: Yeah.

MS. MEERA KOHLER: But now in Barrow or in the
villages, for example, you subsidize the cost of diesel fuel
for.....

MR. KENT GRINAGE: Yeah.

MS. MEERA KOHLER: .....the homes.....

MR. KENT GRINAGE: Yeah.

MS. MEERA KOHLER: .....don’t you? So, you know, for
them there would be no incentive to switch.

MR. KENT GRINAGE: Well, they still would.....

MS. MEERA KOHLER: Although there would be for you.

MR. JOEL GROVES: Someone’s paying.

MR. KENT GRINAGE: No, it’s still a benefit.

MS. MEERA KOHLER: Yeah.

MR. KENT GRINAGE: Because UC generates power about 10
cents a kilowatt. Fuel oil in Atqasuk’s about $6.00. The
Borough does subsidize that, but there still would be some
advantage.

MS. MEERA KOHLER: Be still -- uh-huh (affirmative).

MR. JOEL GROVES: The $6.00 is a subsidized cost?
MR. KENT GRINAGE: No. The Borough will subsidize the fuel going in which is around $4.40.

SENATOR LYMAN HOFFMAN: See, because Donlin Creek is planning on building their 12 inch line within the next six or seven years at a cost of $8 billion to the customer. So if you have a plant up there, distribution system, it seems as though we need to be looking at is it feasible to build something along those lines and see if the technology is going to work, the conversion from diesel heat to electric heat.

MR. JOEL GROVES: Well, and that’s even a question is it better for Donlin to build a gas line or a power line out there, you know. Because I believe at the scale of power that they need you’re almost into conventional converter technology where you have ABB or Siemens does the trunk of the tree that goes from the railbelt out to Donlin and then this technology becomes the branches and the twigs that go out to the villages is one possibility.

MR. EARLE AUSMAN: Another factor on the Donlin issue is also the fuel that’s necessary to run the heavy equipment and if they switch over to gas fuel for their heavy equipment they could run it on that with a small amount of diesel pilot fuel and that would change things significantly. So there’s some other factors that may weigh into this particular situation to cause them to make this decision. But they are talking about possibly running the line further on, but who’s going to pay for
it. That’s the other question.

MR. ERIC MARCHEGIANI: Can we go back to the slide before and I guess I sort of disagree on -- actually two slides back I think. Based on some of what Meera brought up and what we talked about as far as segregating things as far as -- in my mind the converter technology is the most important part of this. We can deal with the -- how we transmit it, you know, separately, we can argue about it, we can do whatever we want. The converter technology and demonstrating that’s very important. And so I don’t see how -- there isn’t very much to gain by using something in the railbelt. A, you have easy transportation, you can prove it out, if there’s a problem you’ve got easy ways to fix it, easy way to get in and out. It’s just a matter of picking a line and it doesn’t even have to be long, it’s just a matter of having some load on either end to turn around and make it work and prove the technology. It’s not going to be very cost effective but the purpose is to prove the technology. Once you prove the technology and you can say that it’s reliable then you can move it anywhere you want. You can put it in a village, you can put it in Aleknagik or, you know, Emmonak, wherever you want and then start actually implementing it and then we can start looking at, you know, whether you use conventional construction for the tie line or you use fiberglass poles, 60 feet, 45 feet, whatever. So I don’t agree with I guess bullet three. That’s just my own opinion.
MS. DENALI DANIELS: So let me just -- I think what I’m hearing Eric say is he doesn’t agree, but what I thought I heard Joel say is that in discussions with each of the utilities it was prohibitive just from a logistical standpoint?

MR. JOEL GROVES: Yeah, not a logistical standpoint.

When we were looking at putting together the application for the Emerging Energy Technology program we ended up spending a lot of money on just hardware that -- you know, transformers and whatnot that -- basically we would spend a lot of that $750,000.00 grant budget on stuff that isn’t really doing anything but just making that demonstration project work.

Whereas if you were in a different setting -- you know, if you were at a 480 volt bus at a power plant you don’t need to step up transfer, you don’t need this, you don’t need that, all this, you know, switching and stuff that you have to put out on a distribution line somewhere. You have to find a footprint for this stuff, you have to operate this line, you have to re-insulate the line and all -- you know, just all these things that were just sort of these ancillary distracting nonproductive costs. And another -- you know, another one of the concerns is that now you’re on a large stable grid as opposed to on these very small less stable grids, are you really demonstrating the functionality that the utilities are going to want to see. And that’s where, you know, we’d like to find -- and maybe it’s even, you know, we set up our own similar to what Princeton has
for their test -- you know, their testing apparatus. We actually set up a back to back circulating system where you have diesel generators, you have loads and you simulate the entire thing. That might actually be a lot more cost effective than going out on a physical piece of line on someone’s -- on a utility somewhere and just being a pain in the ass to the utility to demonstrate not very much. You know, that’s sort of where we got to.

SENATOR LYMAN HOFFMAN: Where does the restraint in the $750,000.00?

MR. JOEL GROVES: Those are the program rules for the Emerging Energy Technology grant program.

UNIDENTIFIED MALE: Is it -- never mind.

MR. DAVID LOCKARD: Yeah, one of the potential sites that you had listed was Pilgrim Hot Springs to Nome. To my mind that seems like it would be a very interesting one to analyze partly because there’s some potential and ACEP is doing some very interesting work out at the geothermal site at Pilgrim, but also I think it’s in -- it’s the right order, it’s the right sizes of things. It’s 50 or 60 miles of transmission and five to 10 megawatts of load. Is that about right?

MR. JOEL GROVES: Yeah.

MS. MEERA KOHLER: That’s right, five megawatts.

MR. DAVID LOCKARD: So -- and who knows if Pilgrim will ever prove out as a geothermal resource. I hope it does,
but it would be very interesting to model this technology and do the -- go through the -- all of the economic analysis with that particular example to see what the benefits are.

MR. JOEL GROVES: Yeah. We can certainly -- you know, when we look at our case studies we can look at that as one of them. And we’ve talked to ACEP a fair amount about the Pilgrim resource and their schedule and ours because it is a very intriguing possibility because that power line will very lar -- will very possibly dictate whether or not that project is ever economically viable. Similar issue with Lake Elva and Lake Grant out of Dillingham where they have, you know, some more difficult terrain for the power lines as well down there.

MS. MEERA KOHLER: But they don’t have funding for the transmission line right now. That’s the big issue and they need a lot of money to fund a transmission line between Pilgrim and Nome or Lake Elva and Dillingham, I mean either way.

MR. DAVID LOCKARD: Actually we did an analysis on the Pilgrim Nome concept as part of a larger analysis of all kinds of power generation resources for Nome and we -- everybody involved was stunned because the geothermal at Pilgrim and the transmission line was more economic than a lot -- than all the other options, including, you know, a small co-fire plant on a barge and methane gas and wind and all the other things we looked at. That particular example of the geothermal with the transmission line was more cost effective.
MS. MEERA KOHLER: Except that they just invested $30 million in their new diesel power plant.

MR. DAVID LOCKARD: It’s a good backup system.

MS. MEERA KOHLER: You know, you spoke of Dillingham, Joel, and there’s a line between Dillingham and Aleknagik, there’s about 25 miles. Would that be potentially, you know, a good demonstration site? Dillingham is relatively accessible, there’s a road between them, the load at Aleknagik is small. I think it’s got potential.

MR. JOEL GROVES: Possibly. I’m not familiar with it in detail. I mean when you look at doing a demonstration on something like that I imagine that the load is less than 500 kilowatts so these converters would be suitable for that if we can get them to a point where they’re, you know, ready to go out in the middle of nowhere.

MS. MEERA KOHLER: Yeah.

MR. JOEL GROVES: The next question is going to be you have to look at the cost of recon -- or re-insulating the line, top right fifth into KVDC.

MS. MEERA KOHLER: Yeah. I mean I’m not sure what it’s insulated at right now, but I’m sure it’s at least 35 KV. It’s not operated at 35 KV, but.....

MR. JOEL GROVES: Okay.

MS. MEERA KOHLER: .....I think it’s insulated at a higher level. But nonetheless, yeah, I mean it’s.....
MR. JOEL GROVES: Yeah.

MS. MEERA KOHLER: .....it’s a finite easily accessible line.

MR. JOEL GROVES: Well, and that’s an interesting question. You know, it gets into what kind of allowances do you have for contamination of the insulators because DC is more prone to accumulation of contamination than AC is. And on the other side of that, as you’re doing low voltage testing on the converters could you actually operate the converters that you have now at 40 KV or 30 KV. It will produce power through it but, you know, then -- I mean if you could avoid having to re-insulate that line that’d be a huge cost savings.


MR. JOEL GROVES So that could have legs.

MR. DAVID LOCKARD: The downside is you’re intertying diesel and diesel and you lose the heat recovery at Aleknagik.

MS. MEERA KOHLER: Aleknagik doesn’t have diesel generation, they’re on a line.

MR. DAVID LOCKARD: They don’t have.....

MS. MEERA KOHLER: They don’t even have a backup.

MR. DAVID LOCKARD: They don’t have any backup.

MS. DENALI DANIELS: Really?

MS. MEERA KOHLER: Not that I’m aware of.

MR. DAVID LOCKARD: Oh, really.

MS. MEERA KOHLER: Never have. I mean they’ve been
one of Dillingham’s original served communities. I don’t even think they have a backup in north Dill -- in north Aleknagik across the lake.

MR. DAVID LOCKARD: Wow.

MS. MEERA KOHLER: All they have is 7,200.

MR. JOEL GROVES: Well, that’s just the 480 to 7,200 step-up transformer.

MS. MEERA KOHLER: Yeah, that’s true.

UNIDENTIFIED MALE: Yeah.

MR. JOEL GROVES: And problem solved.

UNIDENTIFIED MALE: (Indiscernible). Minimal cost.....

MS. MEERA KOHLER: Yeah, that’s.....

UNIDENTIFIED MALE: .....compared to.....

MS. MEERA KOHLER: .....that’s modest.

MR. JOEL GROVES: Yeah, yeah, certainly doable.

MS. MEERA KOHLER: I think it has potential.

MR. JOEL GROVES: Yeah, I like it. It sounds like it has a very good potential. What’s the line construction, just wood poles?

MS. MEERA KOHLER: Conventional RUS.....

MR. JOEL GROVES: Okay.

MS. MEERA KOHLER: .....wood pole, uh-huh (affirmative), three phase.

MR. JOEL GROVES: Okay.
UNIDENTIFIED MALE: They’re a borrower of ours.

MR. JOEL GROVES: I’m sorry?

UNIDENTIFIED MALE: Nushagak’s (ph) a borrower of ours.

MR. JOEL GROVES: Okay, okay.

UNIDENTIFIED MALE: So standard.

MS. MEERA KOHLER: My husband built it.

UNIDENTIFIED MALE: It’s all in the family.

MS. MEERA KOHLER: It’s all in the family.

MS. DENALI DANIELS: Yes, it is.

MR. DAVID LOCKARD: This is kind of a stretch but I want to throw the idea out. One of the things we’ve been noodling around with is the idea of a low load diesel and the concept we’ve been knocking around is using a variable speed engine to drive -- an electronic drive similar to what’s used in the variable speed wind turbines that takes wild AC, converts it to DC and then produces grid formed AC. But I’m just wondering if there might be an opportunity to use a system like that with a variable speed diesel that produces wild AC, convert it to DC and then put it on an intertie that might also have wind turbines that are similarly configured to producing DC on the same intertie, maybe even a battery system, DC again. So it’s -- the intertie becomes almost a bus in some ways and the DC would connect to everything. Does it sound like there would be any benefit to that concept? And I guess what I’m really after
and what we’re most interested in with the low diesel idea is that the constant speed diesels operated at low loads are inefficient and they also if you operate them too low you run the risk of shortening the life of the diesel. So there’s some benefits to the variable speed engine concept.

MR. JOEL GROVES: Yeah. Well, one -- correct me if I’m wrong, but these converters could to some degree take a wild AC input and output directly as DC. And I don’t know what that frequency range that they could accept would be. I mean that’s something we’ve looked at on hydro plants, same sort of idea where all of a sudden you don’t have to maintain a 60 cycle, you know, at the turbine or through a belt drive or whatever and, you know, you can -- if you design that from the outset you can actually let the -- you can reduce the pen stock size and get peak power at much higher head losses and save some money on the pipe if you were putting out a wild AC.

MS. MEERA KOHLER: I just have to wonder though what’s going to bring you your grid stability, I mean how are you going to be able to put, you know, the blinkers on the cycles. The battery?

MR. JOEL GROVES: Well, the -- no, the.....

MS. MEERA KOHLER: The converter?

MR. JOEL GROVES: .....the converters on the.....

MS. ELAINE BROWN: Converter.

MR. JOEL GROVES: .....on the DC to AC side the
converters will form that A -- that 60 cycle grid. They’ll
black start the grid or whatever.

    UNIDENTIFIED MALE: Frequency voltage.

    MR. JOEL GROVES: Yeah.

    UNIDENTIFIED MALE: Take all the bumps out of it.

    MS. MEERA KOHLER: You’d make Mark Teitzel go
completely crazy.

    MR. DAVID LOCKARD: That’s my goal.

    MS. MEERA KOHLER: That’s what I thought.

    MR. JOEL GROVES: Yeah, I mean you would have this
wild AC bus that obviously couldn’t serve anyone because it’s
at, you know, whatever the load of the system is. So how that
would fit in on the generating village side I’m not sure.

    MS. MEERA KOHLER: I think that’s another tweak to
this whole -- I mean I just think that’s exciting stuff that has
the potential to be proven out and, you know, this could provide
the catalyst for some of your wild ideas.

    MR. DAVID LOCKARD: Well, at least nobody said, well,
that’s stupid.

    MR. JOEL GROVES: Well, there -- you know, it’s a.....

    MS. MEERA KOHLER: You couldn’t read my mind?

    MR. JOEL GROVES: It’s a little bit tangential, but
one of the other projects we -- or products we’ve actually
talked to Princeton about is they have this grid tied inverter
that does -- well, I guess it’s a system in Yemen or similar to
it that, you know, takes in wind, solar, battery, diesel and out
-- well, up to four I guess and outputs grid. And it will be
programmed with algorithms that optimizes that and gives you a
clean grid which, you know, seems to me like it has some pretty
profound potential for a lot of these village situations where
you do have batteries, you do have, you know, wind, whatever,
and you can start to optimize the operation of the diesels and
go diesels off for a lot of -- you know, significant period of
the time. When you do have the diesels on you have them
optimally loaded at 80 percent or whatever their sweet spot is
and you start to achieve some significant efficiencies that way.
And that’s an existing -- I mean there’s engineering to be done
to put this product into a village, but it’s an existing
commercial product.

MR. EARLE AUSMAN: One of the things you were talking
about, a wild AC bus. Doesn’t DC -- AC link, can’t that change
between frequencies?

MR. DARREN HAMMELL: Yeah, the -- and the inverters
that we have, the commercial ones can do that.....

MR. EARLE AUSMAN: Right.

MR. DARREN HAMMELL: .....conversion too.

MR. EARLE AUSMAN: So that’ll allow you to take these
variable frequencies and convert it back into AC which you
convert to DC if you want to. You don’t have to go through the
DC step at all. That was my mistake when I first talked to
Darren and that he was discussing wind turbines back at AWEA (ph) in about 19 -- what was it, 2004?


MR. EARLE AUSMAN: Somewhere around there. And that's where he came up and he said I can build that DC system for you if you want and I went, oh, great. So there is a possibility to do it that way if you guys want to do it that way. And it might be fairly simple.

MS. DENALI DANIELS: Well, thank you everyone. I'd like to go ahead and move us into kind of our final discussion here. As I mentioned at the beginning, one of the walk aways that I would like is -- and I think Jason would like it as well, is some specific feedback on the independent review that will be taking place as a follow-up to the good work that Polarconsult has done. And Jason and I are in the process of early discussions I suppose. Next step after this meeting is for us to work up a scope on what that independent review will involve. So before we open it up I guess why don't I turn it over to Jason to kind of talk about the role that ACEP is playing and how this is all going to work.

MR. JASON MEYER: Sure. So ACEP's involved, one, in managing the grant and the project on behalf of the Commission, but on the other hand providing supplementary independent review and analysis of the project. Dr. Wies on the phone here has been really instrumental in those efforts, providing
professional review comments and feedback on the project. We’d like to -- as part of the scope with the Denali Commission we’re providing an executive level summary report at the end of the project summarizing the efforts and our -- kind of our findings and thoughts. But the critical element I think is feedback from the SAG, you guys, in terms of what specific questions you still have on the project, if there’s anything specifically we can incorporate into this scope of work. One of the key elements I think and one of our main areas of focus is going to be an economic review. We have a joint partnership with ISER, a joint ISER ACEP position, Sohrab, and Sohrab’s going to be working with us really closely on the economics of the project, in fact perhaps even looking at something like a really in depth case study on Pilgrim Hot Springs is a -- kind of an example project since we do have a lot of joint work there on some of our other works. We have a lot of the numbers and other information that we could plug right in. So I guess I just wanted to kind of lay that out there in terms of what our role is and our kind of future deliverable and see if you guys had any at this point thoughts or items that, you know, you still feel like should be addressed or would be important in your mind to be included in the scope. We could also take comments after the meeting via email if you think about anything afterwards. But more just a time to maybe hear back from you guys what you think is kind of important elements on this review of the project.
MS. DENALI DANIELS: Thanks, Jason. And so this is Denali again. If I could just kick it off. And we only have a few minutes left. Something that I’m gathering from the discussion here is a strong sense of maybe decoupling or handling separately the converter technology versus the transmission development. And so I don’t know, I’m getting some nods here but I think that’s the sense I’m getting from folks around this table. And anyone online, just jump in, whatever, if you have anything to say. So that’s kind of the first thing on my list that I think is illuminating.

(Pause)

MS. DENALI DANIELS: We heard some comments about electric heat and I don’t know if that’s something that could be dealt with, but I do think that that’s a big issue and appreciate you bringing that up, Senator. So....

SENATOR LYMAN HOFFMAN: Another issue that was discussed was the emerging technology and, you know, I helped foster that legislation along with a lot of other energy projects in the senate. But, you know, I think that it would be shortsighted if we’re just going to say that we’re going to limit to whatever kind of demonstration project to that number. I think this is probably more farther along in viability than many of the emerging technology proposals that are going to come forward so I’d like to see the potential of a larger obligation by the State to this technology. And I’m also -- I would also
want, as you said, to get the technology proven in either this
case or one in the valley or both or several of them in
different areas of the State. If you have one in the valley
that, you know, we could -- the State could potentially
subsidize it and we convince the utilities out there that that
is -- you know, this is leading edge and something in western
Alaska, maybe something in southeast. You know, I think that
the report could be more encompassing in identifying those. You
know, I think you said you’re looking at several of them, but if
it was scattered throughout the State I would say that there is
a higher possibility of not limiting the proving up of this
technology just to the emerging technology fund, it could be
much broader. And I think the legislature has been
concentrating very heavily on energy projects. This last year
alone I put in over half a billion dollars worth of energy
related projects that the Governor had signed. Not projects,
but funding sources, including the -- you know, the
(indiscernible) equalization fund of 400 and the other $100
million toward weatherization along with several hundred --
hundreds of millions of dollars in hydro projects and others.
So the legislature is ready to continue to march forward to
address energy issues in the State and I would hope that the
report wasn’t shortsighted and just trying to look at the
emerging technology source of funding as its only source.

MS. DENALI DANIELS: Thank you.
MR. JASON MEYER: And maybe just a comment from my end too. A couple other key elements that have come up continually with the project of course has been the goals. Polarconsult’s going to be doing their demonstration in Fairbanks so a review of some of the results of that. The -- trying to think. I just spaced some of the other just kind of main issues that have been continually mentioned. But some of that for sure will be included. Dr. Wies has done a lot of the technical review so looking at that, some of the Alaska application issues, et cetera.

MS. DENALI DANIELS: This is Denali. I guess maybe I need to sit down with Joel and Jason, but I’m having a tough time wrapping my head around what the economic analysis, what the parameters of that will actually be. Because it seems like there’s so many and, you know, many of them are site specific. I really like the concept of maybe having a few different sites that have their own variables. But I think, you know, to the degree that we can manage that section of your report so that it flows right into what the University does. That way it’s not, you know.....

MR. JOEL GROVES: Yeah, I mean I think we can certainly structure this so we do have those case studies. And if nothing -- I mean the -- you know, so the framework will be there that ACEP can then receive and, you know, scrutinize and do an independent review of those estimates and so on so we can
look at, you know, these specific case studies around the State of what would this technology look like compared to, you know, what you can do with AC. That’s doable.

MR. DAVID LOCKARD: Are you interested in a couple more potential sites?

MR. JOEL GROVES: Always.

MR. DAVID LOCKARD: In southeast, Gustavus, the utility there is trying to intertie to the Park Service at Bartlett Cove. It’s 10 or 11 miles and I don’t know, 100 KW average. So they could certainly -- if -- particularly if they incorporated any electric heating, which they would want to do, it could easily be 500 KW peak. And then this might be somewhat theoretical, but the renewable energy fund has funded the completion of the Pelican hydro project at one point $8 million and they’re going to have about two or three times as much energy as they can use in Pelican, at least in the short term. This is all -- this is in the Tongass so the helicopter construction of the line might be relevant. At least from a theoretical basis it’d be interesting to do an analysis and see what it would take to take the power from Pelican to Hoonah which is developing a small hydro but it’ll only meet maybe 25 percent of the load there. So Hoonah is going to need more power. I would be interested in seeing the analysis anyway.

MR. JOEL GROVES: Yeah.

MR. JOEL GROVES: Okay.

MS. MEERA KOHLER: Another option.

MR. JOEL GROVES: Yeah.

MS. MEERA KOHLER: You know, we just took over Ekwok this year and we want to connect Ekwok and New Stuyahok and that’s going to be about a 10 mile line. And actually the terrain is pretty decent. We don’t have permafrost issues so that’s obviously got some possibilities. And I got my senator right here to work on potential funding and this could be really a pretty cool little demonstration project.

MS. DENALI DANIELS: You know, I obviously can’t -- don’t have the authority to commit future appropriations, but I think that that might fit into the Denali Commission’s legacy program.....

MS. MEERA KOHLER: Yeah.

MS. DENALI DANIELS: .....as well.

MS. MEERA KOHLER: Yeah, it would.

MS. DENALI DANIELS: Where it’s not as much like stepping on the toes of some of the other programs.

MS. MEERA KOHLER: Right.

MS. DENALI DANIELS: Anyway, I like that option.

MR. ERIC MARCHEGIANI: I would think that -- given the Senator’s recommendations I would think that your report should come out with -- number one, he suggested geographic distribution that provides support throughout legislatively.
Secondarily I think you want to pick let’s say like he said, three. And, you know, I don’t want to tell you which ones to pick, but I think you want to pick three and do a pretty good job of putting the numbers together so that maybe not the Denali Commission, but somebody can take that document or that information to the legislature and then they can turn around back on it or whoever’s the proponents that wish to move it along. But it’s -- obviously there’s going to be support. It’s definitely something that can provide a lot of benefits to rural Alaska if we can turn around and make it happen, to interconnect more communities. But I think it’s pretty obvious that we have something really good here. The question is, is we just got to prove it up. And so we need to give them the best information we can for let’s say three sites geographically distributed, maybe four sites, I don’t know. But I would concentrate on at least three, maybe four, and give that report and that information to the legislature and let them run with it. That’s my suggestion.

MS. DENALI DANIELS: I think that was well summarized, Eric. In terms of project selection criteria, I’m really interested in knowing, you know, absent, you know, picking some of these sites that we’ve been talking about what if we took a step back and said, you know, well, what are the questions that we have.

MR. ERIC MARCHEGIANI: The biggest question we have is
proving up the technology. We have to prove it up because if we can prove it up and show that it really works we really have a new wheel for all intensive purposes that will extend instead of let’s say 15 or 20 miles that we can extend to connect to it which we may be able to extend it to 30, maybe 40 miles, which all of a sudden means that we now have a power plant that we can extend out to a really -- a large number of communities (indiscernible) basically DC. I mean the potential is incredible and it will potentially mean the survivability of a lot of communities.

SENATOR LYMAN HOFFMAN: And if the comments that were made, you know, the longer the line the more savings, you know, that we should have a seven to 10 mile one and maybe a longer one.

MR. ERIC MARCHEGIANI: That’s a good idea. Yeah.

SENATOR LYMAN HOFFMAN: (Indiscernible) check those out.

MR. JASON MEYER: One question I had maybe related. Where does multi-nodal testing come in? Is that a priority up front, is that something you’d look at further down the road? Because it seems like that’s a real opportunity, especially with like networks of small communities in concentrated areas.

MR. JOEL GROVES: Yeah, it’s not something we would do on the first -- you know, the first demonstration, but it is going to be key to the ultimate success of the technology in
Alaska. I mean if this technology is going to have a big
difference, make a big difference for Alaska, it’s going to be
with multi-terminal systems. I mean there’s no question of
that.

MR. ERIC MARCHEGIANI: Fewer power plants you shut --
or more power plants you shut down the larger power plant higher
efficiency with whatever power plant, be it hydro, be it wind,
be it diesel, or integration of all of those into one.

MS. MEERA KOHLER: There is one word of caution I do
want to throw out though and that is that it is difficult to tap
into a DC line at a midpoint.....

MR. JOEL GROVES: Absolutely.

MS. MEERA KOHLER: .....because you have to have a
converter over there too. So feeding in of renewables midpoint
along a line can be a challenge. You know, either end is
not.....

UNIDENTIFIED MALE: Sure.

MS. MEERA KOHLER: .....an issue.....

MR. JOEL GROVES: Yeah. And it’s a.....

MS. MEERA KOHLER: .....but in the middle it could be
an issue.

MR. JOEL KOHLER: Yeah. And it’s strictly an economic
challenge.

MS. MEERA KOHLER: Yeah.

MR. JOEL GROVES: You know, you’ve got a quarter of a
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million dollar converter, whatever -- yeah, I think that’s right, you know, for a 500 kilowatt.....

MS. MEERA KOHLER: That’s close.

MR. JOEL GROVES: .....unit to tap into a line.

MS. MEERA KOHLER: Yep.

MR. JOEL GROVES: So there’s a barrier there.

MR. ERIC MARCHEGIANI: Anchorage Fairbanks intertie, the drop at Cantwell.....

MR. JOEL GROVES: Yeah.

MR. ERIC MARCHEGIANI: .....cost us I don’t know how many millions, $50 million probably for.....

MS. MEERA KOHLER: That’s true.

MR. ERIC MARCHEGIANI: .....that drop.

MR. JOEL GROVES: Yeah.

MR. ERIC MARCHEGIANI: You know, I mean yeah, it provided power to the Cantwell area, but it’s a lot of money. So.

MR. JOEL GROVES: Yeah. But yeah, so Jason, I mean to answer your question. Not in this phase. I think, you know, once we’re past the demonstration, the multi-terminal systems, it’s just -- it’s going to be you come up with the plan, you engineer it and you build it. And we’re going to be past demonstration and just into -- that’s going to be part of the implementation of the technology, so.

SENATOR LYMAN HOFFMAN: Another thing that’d really
sell it to the legislature is the potential long-term costs. You know, if you have a system and you look at -- I’ve seen some of the maps on the YK Delta, Bristol Bay and up north. If you had one system and then you built those and how much savings are you going to have in operational costs and how many gallons you’re going to save. So big picture long-term on a big dollar amount in savings really sells with the legislature.

MS. DENALI DANIELS: Jason, would that be outside of the scope of work that we’re talking about here?

MR. JASON MEYER: I’m not sure. I guess a lot of it would have to be conversations with ISER.....

MS. DENALI DANIELS: Okay.

MR. JASON MEYER: .....just in terms of what they feel like the effort and work would be.....

MS. DENALI DANIELS: Okay.

MR. JASON MEYER: .....for that type of analysis.

MS. DENALI DANIELS: My guess is that the information’s out there, it would just be a matter of having the right.....

SENATOR LYMAN HOFFMAN: Just use one region, say this is how much it’s going to be saving, not do the calculations for all of them, you know. You could have one region and then just fully implement the (indiscernible).

MS. DENALI DANIELS: Okay. So we are beyond 5:00 o’clock.
UNIDENTIFIED MALE: We’ve got one more minute.

MS. DENALI DANIELS: Do we? Oh, that clock is slow.

I’ve got.....

UNIDENTIFIED MALE: It is, it’s 5:01.

MS. DENALI DANIELS: .....I’ve got 5:01.

UNIDENTIFIED MALE: (Indiscernible) one more minute.

MS. DENALI DANIELS: All right. If you want another minute.....

UNIDENTIFIED MALE: No, that’s it.

MS. DENALI DANIELS: .....we could do it. No, in all honesty are there other comments before we wrap this up? Okay.

MR. JASON MEYER: Well, I had just two closing notes. One is our SAG visit to Princeton Power, November 14th. I think you’ve all seen the invite. If you haven’t let me know. I think we’re actually going to have about 10 people I think from Alaska currently. So if there’s any last minute participants just let me know and we can make sure we’re coordinated on travel schedules and events. We’re going to be doing a lot of review of testing. Princeton Power’s facility is on site so it should be a pretty good event. I believe the NRECA is going to be there.

MS. MEERA KOHLER: Yeah, CRN, Cooperative.....

MR. JASON MEYER: Yeah.

MS. MEERA KOHLER: .....Research Network. Actually we have a new -- you haven’t met him yet, Doug Danley (ph), did he
-- or did you meet him in Juneau?

MR. JASON MEYER: I wasn’t there.

MS. MEERA KOHLER: But somebody with very, very solid battery experience, storage experience. So we’ll be very well represented there. I think that.....

MS. DENALI DANIELS: Great.

MS. MEERA KOHLER: .....he’s going to be a great ally.

MS. DENALI DANIELS: Great.

MR. JASON MEYER: Yeah, that should be great. Thanks to Darren for traveling.....

MS. DENALI DANIELS: Absolutely.

MR. JASON MEYER: .....it was really great. I think a lot of people it’s -- you know, this project’s been several years in the making and there’s been a lot of questions, what are these converters, it’s -- and I think the presentation was really helpful I think for people to visualize and understand more that end of the project.

Final note, kind of a shameless self-promotion. But we have a hydro kinetic technical conference tomorrow so.....

MS. DENALI DANIELS: Yes.

MR. JASON MEYER: .....if you don’t know about it or you’re still interested in registering just grab one of these registration. There’s still slots available. It’s 8:00 to 6:00 tomorrow at the Dena’ina Center, so.

MS. DENALI DANIELS: 8:00 to 6:00.
MR. JASON MEYER: Yeah, should be good.

MS. MEERA KOHLER: That’s a long day.

MS. ELAINE BROWNE: That’s a long day.

MR. JASON MEYER: Should be good.

MS. DENALI DANIELS: Such is government. Okay. Well, thanks, Jason, for all your work and really looking forward to scoping out this review. I’d like to give a real special thanks to Polarconsult for sitting in the hot seat as we ask all of these difficult questions and looking forward to our trip to Princeton. And then, you know, most importantly thanks to all the advisory committee members. This is the third and final meeting of this particular group and I can’t promise you that you won’t hear from us again asking for input. But this was really an important piece to the puzzle in order for us to move things forward. So we recognize we have not compensated any of you, you’ve been volunteers. Some of you I think have even traveled to these meetings. So on behalf of the Denali Commission I just really would like to thank you for your public service and looking forward to moving this to the next stage.

So thanks again, I hope -- and thanks to the Senator for joining us today. That was really a treat. That meant a lot to us, so. Okay. Meeting’s adjourned.

THE REPORTER: We’re off the record at 5:04.

(Off record at 5:04 p.m.)
TRANSCRIBER’S CERTIFICATE

I, Nicolette Hernandez, hereby certify that the foregoing pages numbered 2 through 129 are a true, accurate and complete transcript of the proceedings of The Stakeholder Advisory Group meeting held October 25, 2011, transcribed by me from a copy of the electronic sound recording to the best of my knowledge and ability.

Date

Nicolette Hernandez