

## QUARTERLY REPORT

**PROJECT:** HVDC TRANSMISSION SYSTEM FOR RURAL ALASKAN APPLICATIONS, PHASE II – PROTOTYPING AND TESTING

**UAF CONTRACT:** UAF 10-0055

**CONTRACTOR:** POLARCONSULT ALASKA, INC.

**REPORTING PERIOD:** JULY 1, 2010 – SEPTEMBER 30, 2010

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### PROJECT OVERVIEW

- The project is progressing smoothly. No problems have been encountered.
- Billed expenses to date are \$562,525.83 (26% of the \$2,175,500 project budget). All costs are from Denali Commission funds.
- Polarconsult, with ACEP's approval, has let a subcontract to Manitoba Hydro International, LTD (Manitoba) of Winnipeg, Canada. Manitoba is an expert in cold regions design and HVDC systems design. It is expected that their involvement in the project can help increase the efficiency of the project effort and improve the final project deliverables. Manitoba's initial authorized budget of up to \$25,000 will come from Task 3.4 funds (testing). Manitoba also has HVDC testing capabilities and facilities that may be used if appropriate.

### PROJECT SCHEDULE AND MILESTONES

Polarconsult has worked with ACEP to revise the schedule for several project tasks. These revisions reflect project progress to date, and also provide additional time to consult with Manitoba on key task items. Major schedule changes are summarized below. A revised Gantt Chart for the project is attached to this report.

- Change Task 1.3 (electric code issues) completion from 11/19/10 to 3/31/11.
- Change Task 1.4 (phase III site selection) completion from 11/18/10 to 3/31/11.
- Change Task 2.1 (HVDC converter spec) completion from 9/4/10 to 10/15/10.
- Change Task 3.1 (cold region test site) completion from 6/28/10 to 5/1/11.
- Change Task 3.2 (overhead system conceptual design) completion from 10/5/10 to 12/1/10.
- Change Task 4.0 scope and budget proposal submittal date from 9/1/10 to 12/1/10.

### SUMMARY OF PROJECT ACTIVITIES, STATUS, ACCOMPLISHMENTS

#### *CURRENT PERIOD*

#### *Task 1 (Project Management, SAG, Code Issues, Phase III Site Selection)*

- On-going informal communication has occurred with SAG members on various aspects of project. Correspondence has occurred with AVEC, AEA, and AP&T on converter specifications and interface with village grids; with IPEC and AEL&P about technical details on the Hoonah-Green's Creek Intertie (potential phase III

project site); with Ingemar Mathiasson (Northwest Arctic Borough) on HVDC ground return experiences and practice in Sweden; with the North Slope Borough and ACEP/UAF on buried utility experience with regard to polygonal cracking issues; with GVEA on foundation experience on their Healy-Fairbanks intertie structures; and with USDA-RUS on transmission design standards.

- A white paper to the SAG soliciting candidate locations for the phase III demonstration project has been drafted and sent to ACEP for review and comment. This paper is expected to be finalized and distributed to SAG members in October.
- The second SAG meeting has been scheduled for the week of January 10, 2011.

#### ***Task 2 (HVDC Converter Development)***

- PPS has drafted a specification for the HVDC converter. Polarconsult is working with SAG members, ACEP/UAF, and Manitoba to prepare comments on the draft specification and is working with PPS to finalize the specification. Upon timely receipt of comments from Manitoba, the specification should be finalized in the next quarter.
- PPS has completed building the computer model of the HVDC converter. High frequency transformer design and power electronics topology have been finalized. Mechanical modeling and design is in progress. Thermal design is nearing completion. Purchase order for high frequency transformer manufacture has been issued, and AC fuse disconnects are on order. AC capacitors, AC contactors, high voltage IGBTs, high frequency transformer cores, and litz wire have been received and inspected.
- Development of HVDC converter test plan is in progress.
- No progress this quarter on converter testing and reporting.

#### ***Task 3 (Overhead Transmission System Design)***

- The overhead system conceptual design effort is on track to be completed by the revised schedule date of December 2010.
- Polarconsult continues to talk to manufacturers and vendors of overhead transmission system components (poles, insulators, breakers, surge arrestors, etc) to assess their suitability for use in a remote overhead HVDC intertie. The results of this effort are being integrated into the conceptual design.
- Polarconsult has identified specialists in key technical areas pertinent to the overhead system. Manitoba is one of these experts with regard to HVDC-specific hardware and transmission design in cold regions. Duane Miller, PE of Golder Associates (formerly of Duane Miller Associates) is another expert that we expect to engage on geotechnical conditions and foundation design aspects of the overhead system.

- Polarconsult is still working to identify a specialist on HVDC grounding grids. Manitoba has some expertise in this field, and we expect their industry contacts will lead us to other supplemental experts as needed to develop suitable conceptual designs and/or identify testing efforts that may be beneficial for the types of grounding grids proposed for this transmission system.

#### **Task 4 (Secondary Development Activities)**

Polarconsult is assessing the level of effort necessary to advance secondary project activities. Polarconsult will propose budget, scope, and schedule amendments to advance these secondary activities near the end of the 4<sup>th</sup> quarter 2010. Current status of the three major activities is summarized below:

- **4.1 – Construction and maintenance equipment.** Requirements of the construction and maintenance equipment will be driven by the conceptual overhead intertie design, which is still under development. Polarconsult is contacting various equipment manufacturers to identify the capabilities of their equipment and potential suitability for constructing and maintaining HVDC interties. Logistics and environmental factors remain key considerations in this effort. Due to the extended schedule for Task 3.2, this task is not expected to be completed by December 2010. Polarconsult will provide a detailed status report to ACEP in December advising of the status and expected completion of this task.
- **4.2 – Submarine cables.** Polarconsult has contacted submarine cable manufacturers and technical experts on submarine cable materials to identify key design elements of a cable suited to the technical and economic constraints of the proposed HVDC transmission system. This activity is on track to develop a conceptual cable specification and determine what testing, if any, is necessary for this submarine cable. Findings and recommendations will be issued to ACEP in December 2010.
- **4.3 – overland cables.** Polarconsult is continuing to collect data to better characterize and quantify the polygonal cracking problem. We are also gathering data on other utility systems that have been successfully used in crack-susceptible soils. These data will allow a better definition of the problem and potential solutions. This activity is on track to issue findings and recommendations for testing, if any, to ACEP in December 2010.

#### **Task 5 (Economic Analysis and Final Report)**

Cost data on various components are being collected as appropriate. No economic analyses have been started at this time.

#### ***NEXT PERIOD***

- Task 1.1: On-going management.
- Task 1.2: Finalize agenda and details of 2<sup>nd</sup> SAG meeting, distribute to SAG.
- Task 1.3: Start formal dialog with Al Nagel at Dept of Labor on electric code issues. Coordinate with ACEP and Denali Commission.
- Task 1.4: Finalize Phase III Site Selection White Paper, Issue to SAG for feedback.

- Task 2.1: Finalize HVDC converter specification with PPS.  
Task 2.2: Continue HVDC converter design and development (PPS).  
Task 2.3: Finalize HVDC converter test plan (PPS with Dr. Weis).  
Task 2.4: No activity planned for next quarter (scheduled to start Q1 2011).
- Task 3.1: Define test site requirements, identify test site as appropriate.  
Task 3.2: Finish conceptual design of overhead system.  
Task 3.3: Continue conceptual design of SWER grounding system.  
Task 3.4: Start field tests, if required (after ACEP's approval of test plans).
- Tasks 4.1-43: Issue reports describing work necessary on secondary design activities.  
Issue recommended scope, budget, and schedule amendments to allow for advancement of secondary design activities for ACEP's consideration.
- Task 5.1: No activity planned for next quarter.  
Task 5.2: No activity planned for next quarter.

HVDC TRANSMISSION SYSTEM FOR RURAL ALASKAN APPLICATIONS - PHASE II PROTOTYPING AND TESTING - SCHEDULE AMENDMENT #1 (9/22/10)

ID	Task Name	Start	Finish	Qtr 1, 2010			Qtr 2, 2010			Qtr 3, 2010			Qtr 4, 2010			Qtr 1, 2011			Qtr 2, 2011			Qtr 3, 2011			Qtr 4,
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	<b>1.0 PROJECT MGMT, SCOPING AND STAKEHOLDER PROCESS</b>	1/1/10	8/26/11																						
2	1.1 Project Management	1/1/10	8/26/11																						
3	<b>1.2 Stakeholders Advisory Group (SAG)</b>	1/1/10	7/15/11																						
4	Assist ACEP to Organize Group	1/1/10	4/23/10																						
5	Meeting #1	4/28/10	4/28/10	◆ 4/28																					
6	Meeting #2	1/11/11	1/11/11	◆ 1/11																					
7	Meeting #3	7/15/11	7/15/11	◆ 7/15																					
8	1.3 Address Electric Code Issues	5/3/10	2/28/11																						
9	1.4 Phase III Project Selection	3/1/10	3/1/11																						
10	<b>2.0 CONVERTER DEVELOPMENT</b>	4/8/10	6/16/11																						
11	2.1 Develop Converter Standards and Specifications	4/23/10	10/15/10																						
12	2.2 Converter Design / Development	4/8/10	12/22/10																						
13	<b>2.3 Converter Test Plan</b>	7/8/10	8/23/10																						
14	Develop Draft Test Plan	7/8/10	7/15/10																						
15	ACEP Comments	7/15/10	8/16/10																						
16	Finalize Test Plan	8/16/10	8/23/10																						
17	Issue Test Plan	8/23/10	8/23/10	◆ 8/23																					
18	<b>2.4 Converter Testing and Test Results</b>	12/23/10	6/16/11																						
19	Testing	12/23/10	5/27/11																						
20	Issue Test Report	5/27/11	6/16/11																						
21	<b>3.0 TRANSMISSION DEVELOPMENT</b>	5/3/10	6/8/11																						
22	3.1 Procure Cold Regions Test Site	11/1/10	5/1/11																						
23	<b>3.2 Overhead System Conceptual Design</b>	5/3/10	12/1/10																						
24	3.2.1 Foundations and Anchors	5/3/10	12/1/10																						
25	3.2.2 Poles	5/3/10	12/1/10																						
26	3.2.3 Hardware	5/3/10	12/1/10																						
27	3.3 Earth Return Grounding System	8/2/10	6/8/11																						
28	3.4 Overhead System Testing	12/2/10	4/5/11																						
29	<b>4.0 OPT. TRANSMISSION DEVELOPMENT</b>	11/1/10	7/8/11																						
30	Develop/Approve Work Plan for Task 4 Activities	11/1/10	12/1/10																						
31	4.1 Construction and Maintenance Equipment and Methods	12/3/10	7/8/11																						
32	4.2 Submarine Cable Development	12/3/10	7/8/11																						
33	4.3 Overland Cable System Development	12/3/10	7/8/11																						
34	<b>5.0 SYSTEM ECONOMICS AND REPORTING</b>	4/4/11	8/26/11																						
35	5.1 Economic Evaluations	5/2/11	6/27/11																						
36	<b>5.2 Draft Final Report</b>	4/4/11	8/26/11																						
37	Prepare Draft Final Report	4/4/11	6/27/11																						
38	ACEP/SAG Review and Comment	6/27/11	7/28/11																						
39	Finalize and Issue Final Report	7/29/11	8/26/11																						
40	<b>PROJECT MANAGEMENT</b>	4/1/10	10/3/11																						
41	Quarterly Report #1	4/1/10	4/1/10	◆ 4/1																					
42	Quarterly Report #2	7/1/10	7/1/10	◆ 7/1																					
43	Quarterly Report #3	10/1/10	10/1/10	◆ 10/1																					
44	Quarterly Report #4	1/3/11	1/3/11	◆ 1/3																					
45	Quarterly Report #5	4/1/11	4/1/11	◆ 4/1																					
46	Quarterly Report #6	7/1/11	7/1/11	◆ 7/1																					
47	Quarterly Report #7 - FINAL PROGRESS REPORT	10/3/11	10/3/11	◆ 10/3																					