

Subject: RIRP Coordination	
Client: Alaska Energy Authority	
Project: Susitna Hydro Evaluation Project	Project No: 092756, Task 4
Meeting Date: May 7, 2009 (teleconference)	In Attendance: Jim Strandberg, Bryan Carey (AEA), Myron Rollins, Arlin Mire (B&V), Pat Burden (NE), Stephen Spain, David Elmore, Bob Butera (HDR)
Notes by: Butera/Spain	

Questions in black were provided prior to the meeting by B&V. Responses in red provided by HDR.

1. Alternatives to evaluate (Page 5)
  - a. Watana
  - b. Low Watana
  - c. Watana/Devil Canyon
  - d. Staged Watana/Devil Canyon
  - e. Devil Canyon
2. Other possible alternatives
  - a. Staged Watana
  - b. Staged Watana – Low Watana/High Watana/Devils Canyon
  - c. **Watana w/ Tunnel to Devil Canyon**
  - d. **Alternate Construction Methods for Devil Canyon Dam**
  - e. **Alternate Construction Methods for Watana Dam**

3. Potential to screen out alternatives to evaluate

**Devil Canyon does not have sufficient storage to provide substantial generation during the winter months. The Devil Canyon reservoir has approx 1,000,000 Acre-feet of total storage, while the Watana reservoir has approx 10,000,000 Acre-feet. Therefore, if substantial winter electric generation is a goal of the AEA, Devil Canyon alone can reasonably be excluded from further evaluation.**

4. CO<sub>2</sub> emissions from hydro projects (Page 3 and 28)

**Work is ongoing by The Intergovernmental Working Group on Climate Change to investigate greenhouse gas emissions from hydro-electric reservoirs. The range of greenhouse gas emissions measured from reservoirs in boreal (subarctic) regions has varied greatly throughout the literature. Variation in the impounded substrate (Huttunen 2002), the depth of the reservoir, and wind levels have all been reported to effect the rate of CO<sub>2</sub> production (Duchemin 1995). It has also been noted that while reservoirs in Northern climates may be frozen for a majority of the year higher levels of CO<sub>2</sub> production during the spring melt may raise the overall average CO<sub>2</sub> production (Huttunen 2002).**

5. Any problems with spilling water if there is not enough generation load

**This may have negative environmental impacts. Depending on the system load frequent spilling may cause large fluctuations in the river level that may be detrimental to aquatic resources. Large spills could also affect the dissolved oxygen level and temperature downstream, negatively impacting the environment. Whether spilling water is possible will depend on the ramping rates negotiated as part of the licensing process along with any maximum flow restrictions imposed on the project.**

6. Is monthly energy and maximum generation available for each alternative and incrementally for each stage.

Providing this data would extend the scope of the previous study. Data is available but has not been compiled (post-processed). B&V will provide HDR with a definition for firm capacity for analysis, based on discussions with local utilities and the AEA.

HDR Action Item: Provide B&V with monthly generation and firm capacity for each of the project alternatives.

7. Is 1.5 percent forced outage rate the appropriate forced outage rate. (Page 7)

For a new project with multiple units this might be an overly conservative estimate. To improve our estimate of the forced outage rate we would need to develop a more detailed maintenance schedule that could be incorporated into the CHEOPS model along with a failure modes and effects analysis. This would enable us to directly estimate the impact of the maintenance schedule on energy production and ensure that forced outages are minimized. HDR can prepare a more detailed maintenance schedule, incorporate it into the energy model and re-run and post-process the energy models for all the alternatives.  
For Example:

The highest average monthly generation for Full Watana and Devil Canyon is just over 1000MW. With four 170MW units at Devil Canyon and six 200MW units at Watana this level of generation is achievable with four of the ten units online. Assuming a 2% forced outage rate for each unit (equivalent to approx. 160 hours of forced outage a year) the probability of five units failing simultaneously is less than .1%. This indicates that our original estimate of a 1.5% forced outage rate for the entire system may be overly conservative.

HDR Action Item: Perform a statistical analysis of the forced outage rate using failure rates from existing hydroelectric projects.

8. Are the monthly energy values provided reduced by the forced outage rate. (Page 7)

Yes.

9. Are the monthly energy and capacity values reduced by the 2 percent transformer losses. (Page 7)

Yes.

10. Can we ignore sedimentation. (Page 7)

Yes. The reservoir rule curves from the 1985 FERC application, which were used for energy estimates, the minimum operating levels for the Devil Canyon and Watana Reservoirs are 1405' and 1850' respectively. This means that the Devil Canyon reservoir has approx. 700,000 Ac-ft of unused (dead) storage and the Watana reservoir has approx 1,950,000 Ac-ft of unused storage. The 1981 Acres feasibility study estimated the maximum sedimentation after 100 years to be 155,000 and 472,000 Ac-ft for the Devil Canyon and Watana reservoirs respectively. This means that after 100 years approx. 25% of the unused storage in the reservoir will be filled by sediment. Since this is not part of the active (live) storage of the reservoir sedimentation should not have an impact on energy production for the project.

11. What would be the maintenance schedule for the alternatives?

Base case maintenance schedule is attached, also see details of cost and schedule under item 12. The maintenance schedule for the alternatives would be similar to the base case but

the alternative schedules were not completed for this study. HDR could prepare maintenance schedules for the other alternatives.

## 12. O&M Costs (Pages 12 and 13)

The economic analysis for this project will require estimates of operations and maintenance costs (O&M) and capital expenditures. The annual costs for these items are based on the following assumptions:

-Annual operation and maintenance for the power facilities is estimated at \$10 million per year for each of the alternatives. This annual cost is based on other hydroelectric projects of comparable size and location. For the roads and other infrastructure, it is assumed that once the construction is completed, a portion of the maintenance would be subsidized by the project, equating to approximately \$5 million per year and is the same for each of the alternatives.

-A schedule of capital expenditures was developed for the first 50 years of the project. In order to provide a better estimate of capital expenditures over the first 100 years of the project this schedule should be extended.

HDR Action Item: Extend the capital expenditures schedule a further 50 years and estimate capital expenditures over the first 100 years of the project.

## 13. Generation of first power/Generation of Full Power (Page 15)

Generation of full power is delayed because the reservoirs take time to fill (1 season for Devil Canyon, 2 seasons for Watana).

## 14. Weekday/Weekend On-peak/Off-Peak

Electric rates in most of the United States vary depending on the time of day and time of week. Typically energy is more expensive Monday through Friday during the day, when demand is high. The CHEOPS model allows different electric rates to be prescribed for these "peak" and "off-peak" hours to investigate the effect of various rule curves on overall revenue. CHOEPS also has the ability to output energy production on an hourly basis for use in the B&V model.

## 15. Secondary MWh

Model toggle not used in this analysis.

## 16. Spinning Capacity MWh

Spinning capacity is a measure of the ability of a hydro-electric project to follow system load. Turbines can be run at speed no load such that power can be added to the grid on short notice in order to provide for increased demand. Spinning capacity is becoming a very important issue for grid stability with the increase in renewable energy generation from intermittent sources like wind and solar.

## 17. Storage versus generation plant

The Susitna project, as envisioned in the 1980s, uses a system of two reservoirs arranged in a cascade to store energy and generate electricity. The upper Watana reservoir has a storage capacity approx. 10 times greater than the Devil Canyon reservoir. The rule curves developed as part of the 1985 FERC application used the larger Watana reservoir to store water during the spring melt and then run that stored water through the Devil Canyon powerhouse continuously over the winter months. The Watana powerhouse was intended to

provide peaking power to enable load following during high demand periods. The Watana reservoir was also designed with a large amount of unused storage capacity to collect sediment that might otherwise fill the smaller Devil Canyon reservoir. B&V will provide HDR with their estimated electricity demand based on the results of their analysis. This data can then be used to optimize the rule curves used in the energy analysis.

HDR Action Item: Use electricity demand developed by B&V to optimize the rule curves for the reservoirs to match energy production to expected demand.

#### 18. Cost estimates

2008 cost estimates for each alternative were created based on quantities from the original 1982 estimate with a few modifications from the 1986 estimate. U.S. Cost, a company specializing in cost estimates for large projects, developed the unit prices for 2008. Cost estimates were developed using conservative assumptions; further review of existing infrastructure and industry practices may reduce costs.

#### 19. Schedules

The AEA expressed an interest in determining the cost impact of shortening the overall schedule for each alternative. The AEA expressed an interest in determining the cost impact of shortening the overall schedule for each alternative.

HDR Action Item: Investigate the feasibility of shortening the project schedule by increasing construction resources. Determine the cost of decreasing the overall construction time by 1-2 years for each alternative.

#### 20. Cash Flow

21. Any problems taking excerpts from Project Evaluation Interim Memorandum and using them in the RIRP report.

No.

22. Can we get a Word copy of report.

Yes.

23. Can we get the Tables in Excel

Yes, data only.

#### 24. Transmission

The cost of upgrading the existing transmission system to incorporate power from Susitna was included in the study. The total cost of transmission was estimated at approx. \$1,000,000,000. O&M costs for transmission were not included in this study.

HDR Action Item: Estimate the added cost of adding a second transmission line to improve the reliability of the transmission system. Work with B&V and the AEA to determine the best location for interconnection for the second transmission line.

#### Summary of HDR Action Items:

1. Provide B&V with monthly generation and firm capacity for each of the project alternatives.
2. Perform a statistical analysis of the forced outage rate using failure rates from existing hydroelectric projects.

3. Extend the capitol expenditures schedule a further 50 years and estimate capitol expenditures over the first 100 years of the project.
4. Use electricity demand developed by B&V to optimize the rule curves for the reservoirs to match energy production to expected demand.
5. Investigate the feasibility of shortening the project schedule by increasing construction resources. Determine the cost of decreasing the overall construction time by 1-2 years for each alternative.
6. Estimate the added cost of adding a second transmission line to improve the reliability of the transmission system. Work with B&V and the AEA to determine the best location for interconnection for the second transmission line.