An Environmentally Sustainable Solution for Energy Storage
Powater Corp. (MD2)

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Project Description

The project objective is to develop infrastructure to store hydroelectric energy at the Hoover Dam. When renewable energy production is abundant, water from the Colorado River is pumped into Lake Mead and during high energy demand periods, stored water from Lake Mead is used to generate hydroelectricity.

Our team will develop a preliminary design for the selected alternative.

Constraints and Parameters

- Hoover Dam generates 500 MW daily over 5 hours
- Pump cycle runs daily for 10 hours (returning daily volume of water used for power generation)
- Pump Station is 19 miles below Hoover Dam
- 15% maximum grade for pipeline alignment

Design Approach

- Establish vertical and horizontal alignments of the surface and tunnel pipeline alternatives
- Calculate friction loss, pump head, pressure, and required power
- Calculate costs and select preferred alternative for further evaluation

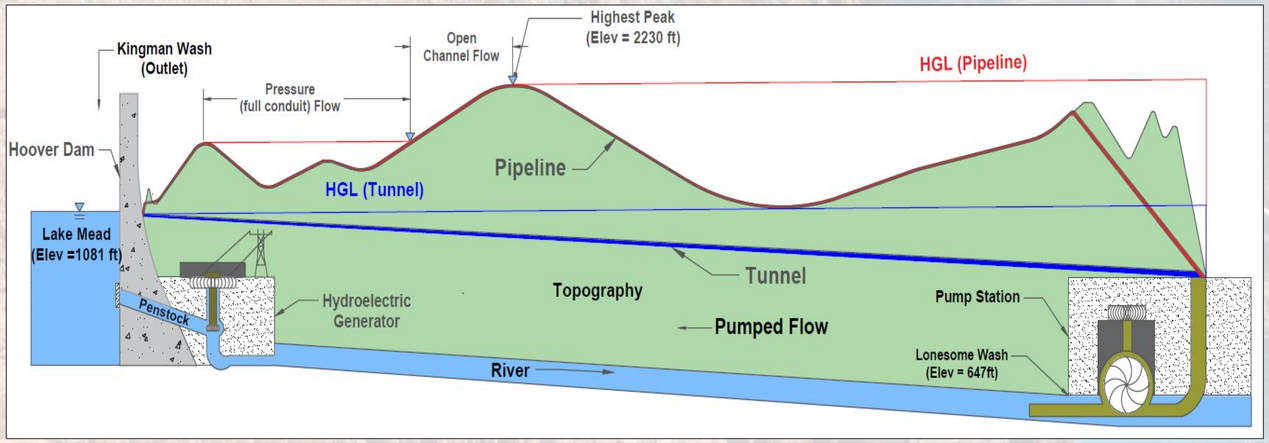

Figure 1. Hoover Dam Hydraulic Schematic

Figure 2. Profile of the surface pipeline (includes short sections of tunnel)

Figure 3. Profile of the tunnel pipeline

Acknowledgements

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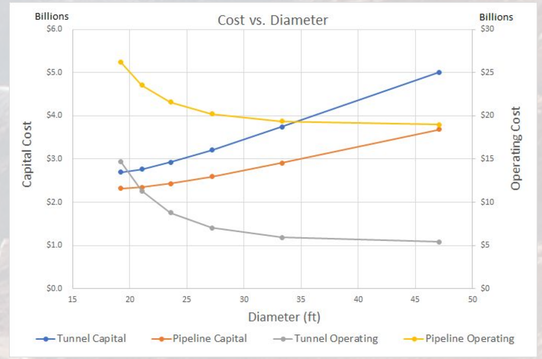

Figure 4. Cost vs. Diameter

Capital Costs - includes pump station, pipeline, and Lake Mead outlet
Operating Costs - present worth of 30 years of power and operating and maintenance costs

Table 1. Project Present Worth

	Tunnel Pipeline	Surface Pipeline	Tunnel Pipeline	Surface Pipeline	Tunnel Pipeline	Surface Pipeline	Tunnel Pipeline	Surface Pipeline	Tunnel Pipeline	Surface Pipeline	Tunnel Pipeline	Surface Pipeline
Diameter (ft)	19		21		24		27		33		47	
Total Capital Cost ($ Billion)	2.7	2.3	2.8	2.4	2.9	2.4	3.2	2.6	3.7	2.9	5.0	3.7
Operating Cost over 30 years ($ Billion)	14.7	26.2	11.3	23.6	8.8	21.6	7.0	20.2	5.9	19.4	5.4	19.0
Project Present Worth over 30 years ($ Billion)	17.4	28.5	14.1	26.0	11.7	24.0	10.2	22.8	9.6	22.3	10.4	22.7

Conclusion

The project present worth over 30 years for the tunnel pipeline is less than the surface pipeline. In addition, considering the lower environmental impacts associated with the tunnel, the tunnel pipeline is preferred.

Plan for Next Phase

- Conduct sensitivity analysis considering renewable energy costs
- Optimize the tunnel diameter
- Establish environmental impacts
- Prepare preliminary design of the pump station, tunnel, and outlet
- Prepare final costs estimate and project schedule