



HYDROPOWER PEAKING

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*Indus Waters Western Rivers Arbitration
(Pakistan v. India)
PCA Case No. 2023-01*

**Hearing for the Second Phase on the
Merits**

3 February 2026 (corrected)

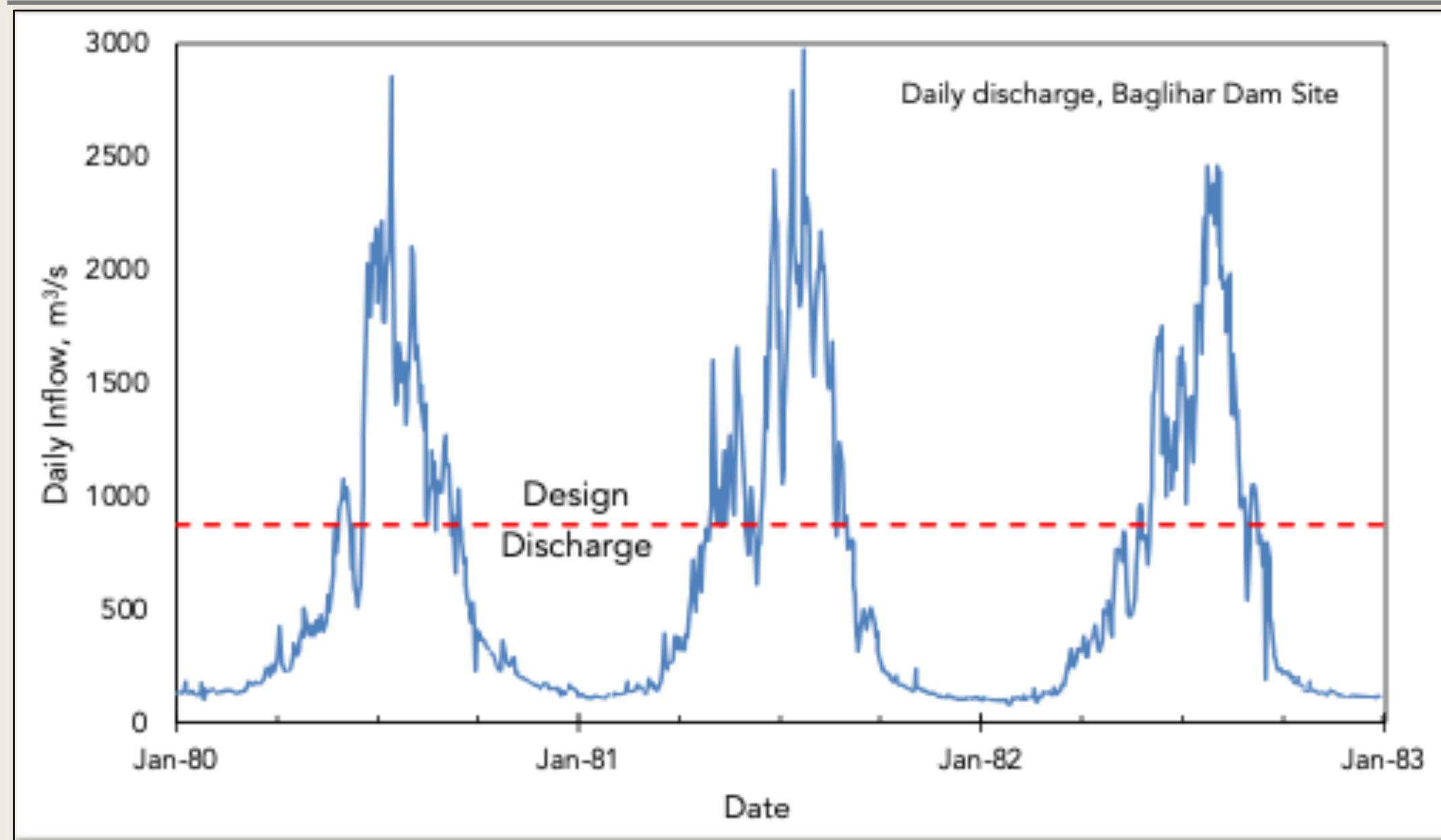


Part I

Peaking Potential of RoR HEP



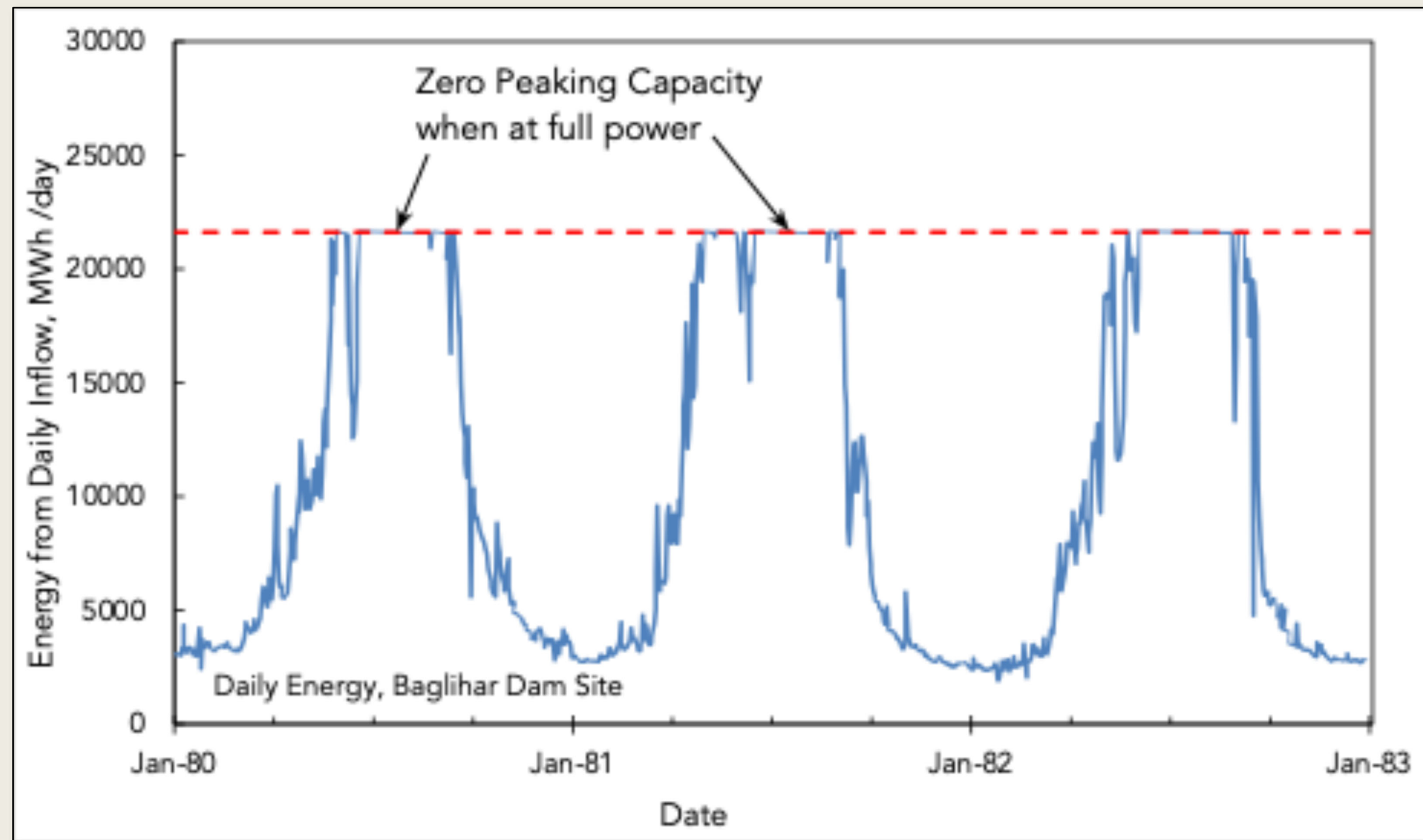
Baglihar Daily Flow and Design Capacity



Baglihar data from P-0585



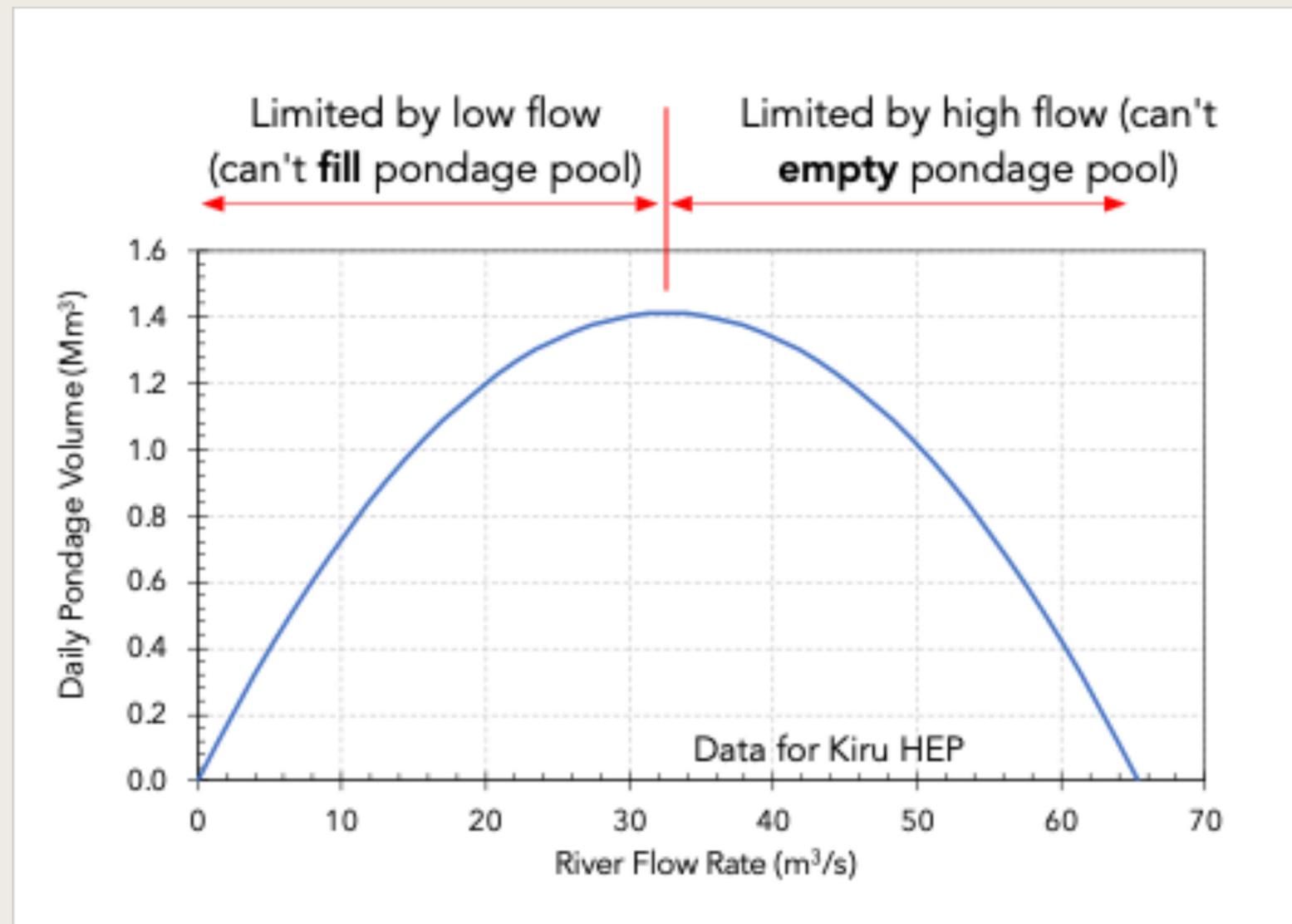
Daily Flow to Power Generation



Calculated using Baglihar data from P-0585



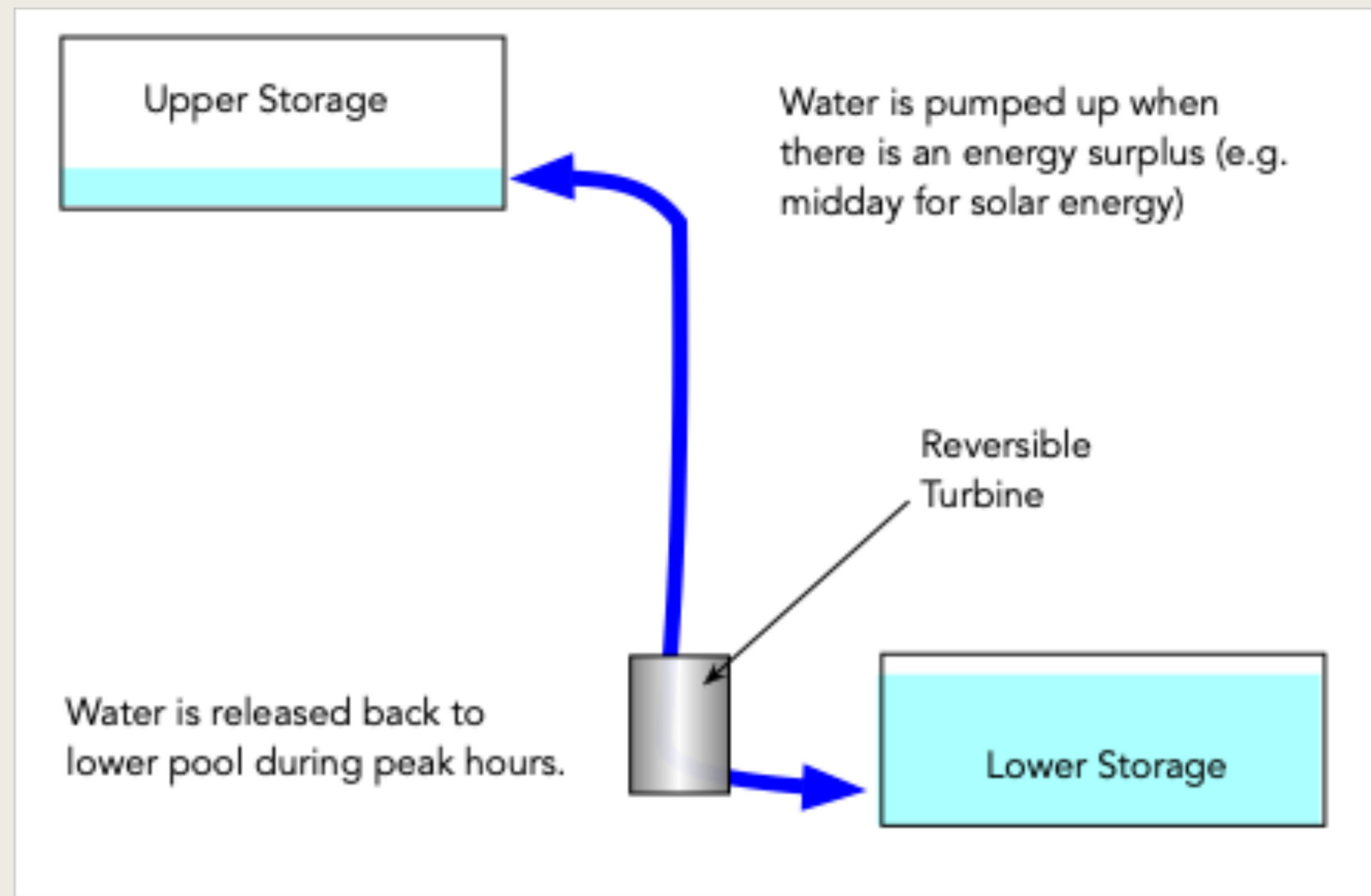
Peaking Energy Limitations



- Peaking power is generated by filling and emptying operational storage.
- At low river flow the ability to **FILL** the operational pool is limited by hydrology.
- At high river flow the ability to **EMPTY** the operational pool is limited by hydrology (too much flow, machines operating at full or near-full capacity)
- Thus, peaking capacity is limited by both low and high flows
- This dataset calculated for Kiru, but same pattern is inherent in all RoR HEPs.

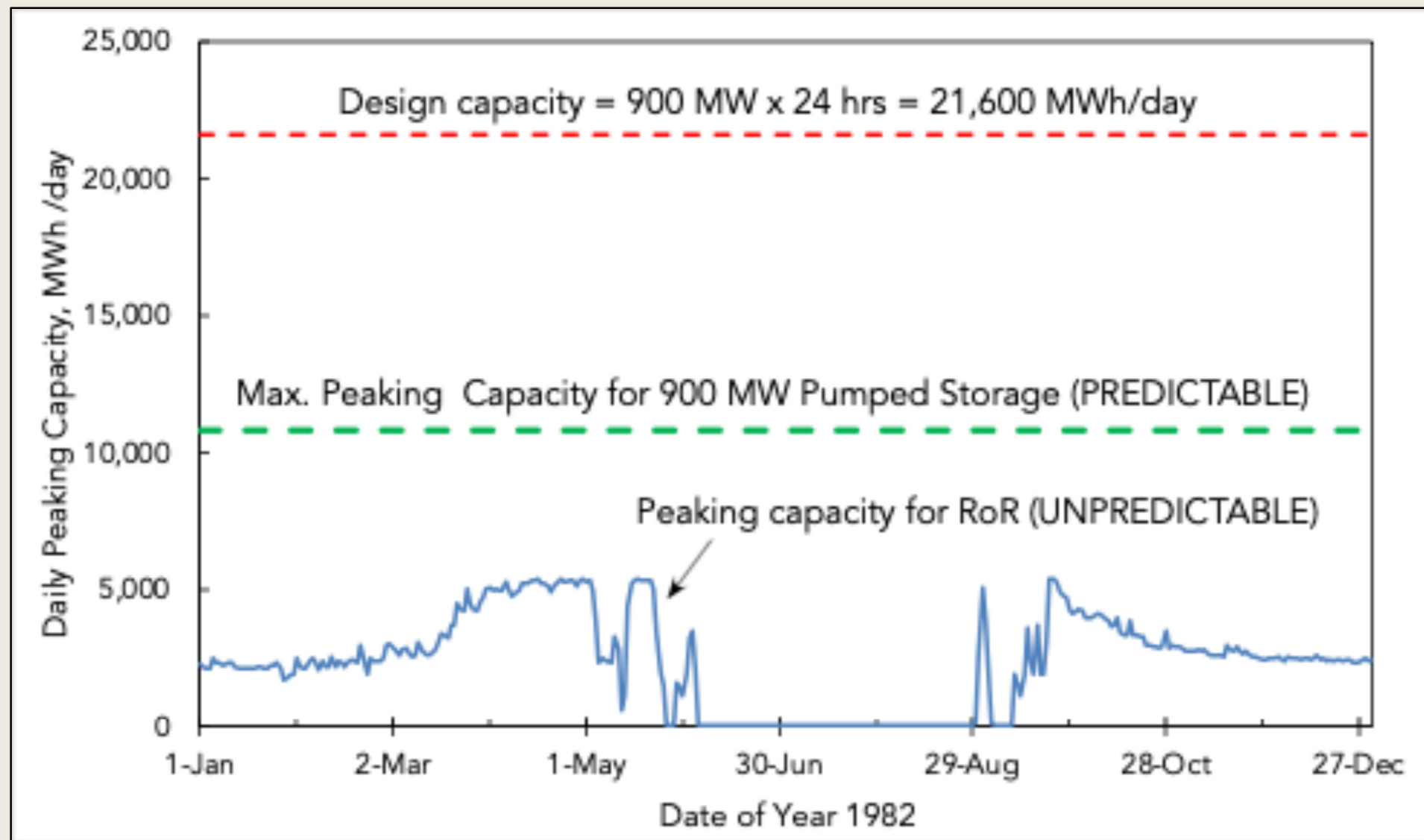


Pumped Storage Hydro: A Peaking Plant



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Daily Peaking Energy is Both Limited and Unpredictable



- Baglihar data showing that peaking energy from Himalayan RoR HEP is both limited and unpredictable.
- For every year the available RoR HEP peaking energy will be different both in magnitude and timing, making it inherently unpredictable.

Calculated using Baglihar data from P-0585



Part II

Longevity and Adaptability
of HEP's: An Example



Example of Hydropower Operational Flexibility



- La Oroya is a Peruvian HEP operating since 1914. It is the oldest plant I have visited.
- Originally designed as a mining supply, it now delivers to the grid **USING ORIGINAL EQUIPMENT**

- This provides an example of the inherent flexibility of hydro plants to adjust to changed load conditions by changing the operating rule, without changing the project's original physical infrastructure.



Conclusions

- Himalayan hydropower plants have limited capacity to produce peaking energy.
- The day-to-day peaking energy depends on daily hydrology, which is itself inherently unpredictable.
- Thus, the peaking energy available from a Himalayan RoR plant is inherently very small compared to the plant's design capacity, and is also unpredictable, representing a small and unreliable peaking supply for system planning.
- In contrast, storage hydropower, pumped storage hydropower and battery storage systems can all deliver design power in a reliable and predictable manner. For this reason operators rely on these reliable sources of power for power peaking.
- Hydropower plants are very long lived, and the **ORIGINAL EQUIPMENT** can operate for many decades, adjusting the **OPERATING RULE** to accommodate future (and unpredictable) changes in the market and load.

