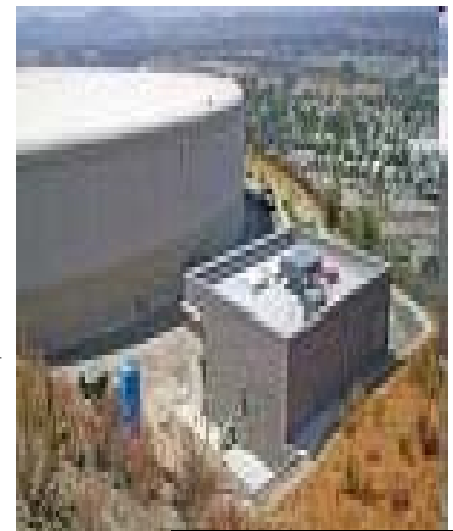


# Water Storage as Energy Storage Opportunities in California



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Workshop on Energy Storage for Renewables Integration

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Sacramento, CA

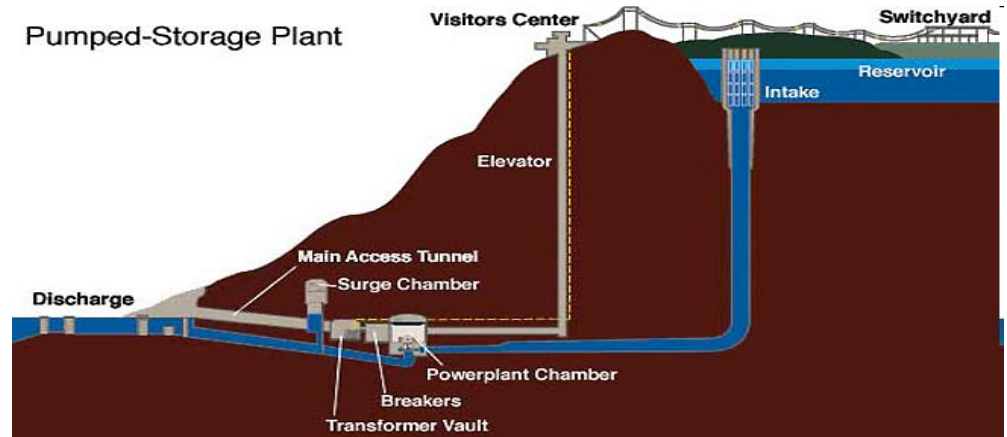
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# Subject of this Testimony



- Water stored at elevation is stored energy.
- There are large water pumped storage facilities in operation within water agencies (e.g., San Diego County Water Authority) and others being planned (e.g., Lake Elsinore, Olivenhain)
- Testimony today is not about those, but about smaller (<10 MW each) opportunities available in most water districts

# Water Agency Storage



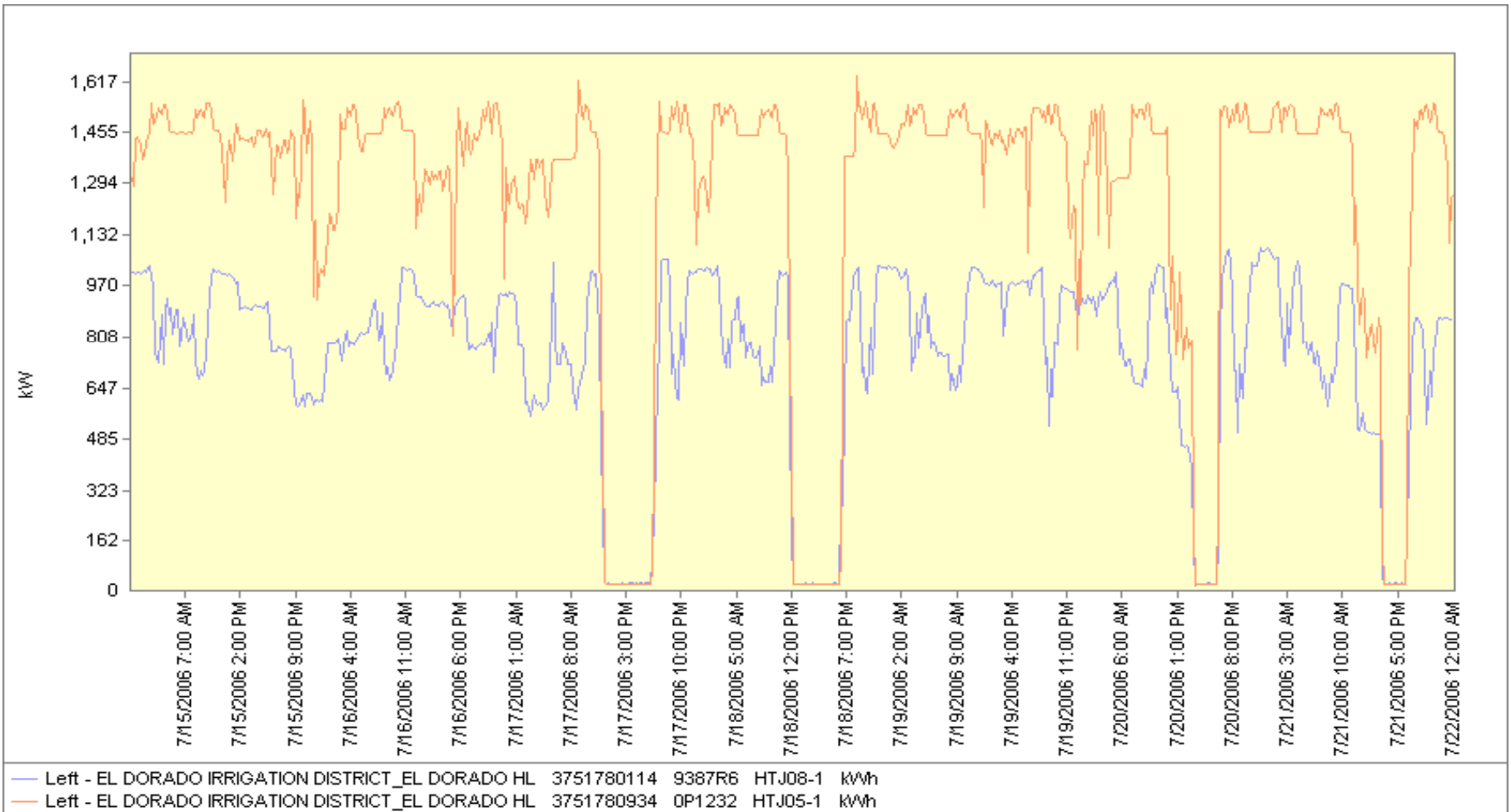
- All water agencies that supply treated water have some storage
- Storage added to optimize water system - not for electrical generation or demand reduction
- Water storage is at elevation if possible - provides pressure to system
- Existing storage is used to meet bimodal daily peak water deliveries and smooth out treatment plant production
- However, it can be used to “store” energy by using energy to fill storage, or releasing energy when storage drained

# Examples of Types of Water Storage Opportunities



- Water storage with hydroelectric generation  
- e.g., Calleguas MWD
- Water storage with treatment plant and pumps - e.g., El Dorado Irrigation District
- Groundwater storage can work very similarly - e.g., Semitropic, Arvin Edison

# EID El Dorado Hills Raw Water and Treatment Plant - July 15-21, 2006



# Potential for Smaller Water Storage as Energy Storage



- Currently approximately 400-600 MW of electric load is dropped during on-peak period by water agencies in the state
- Existing facilities reoperation
  - + 250 MW
    - vagaries/instability of demand response programs have not encouraged reoperation of water storage facilities
- New storage facilities and retrofit of existing facilities with reversible pump turbines
  - +500 to 750 MW
    - economics uncertain.
    - integration with current water system operation needs to be evaluated

# Water Storage as Energy Storage Facilities



- Advantages
  - Proven technology
  - Less expensive than other storage technologies (upper storage already available)
  - Easy to site - multiple locations already reserved for additional water storage
  - Locations close to load centers
  - Provides dual advantages - improves water and energy infrastructure efficiency
- Disadvantages
  - Smaller size (2-10 MW typical)
  - Existing storage integral to water system operations, will need modified operation protocols
  - Current economics and information discouraging development

# Additional Information Needed

- System enhancements needed
  - Reversible pump turbines instead of pumps and pressure reduction valves
  - Lower storage requirements
- How quickly can water storage respond
  - shift from pumping to draining/generating
- What water agency operational protocols need to be changed and how
- Economics of operation for energy rather than for water use
  - Water storage response to ISO needs





# Conclusions



- Exotic energy storage technologies are nice, but don't ignore simple, readily available existing technology
- Water agencies storage opportunities could add 1,000 MW of additional energy storage
  - Proven technology, least expensive storage option, locations readily available in urban load centers, improve water as well as energy infrastructure
- Needed -
  - information on water system operation changes necessary for use as energy storage facility
  - economics of replacing pumps with reversible pump turbines
  - economics of new lower storage construction for energy use

Submitted for the Association of California Water  
Agencies

by:

A black and white photograph of a handwritten signature in cursive script, which reads "Lon W. House". The signature is written on a light-colored surface and is centered horizontally.

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