California Energy Commission
Agricultural Peak Load Reduction Program

For Water Agencies
Administered by the Irrigation Training and Research Center

Case Study

Kaweah River Power Authority and Tulare ID

Site

Tulare Irrigation District (TID) is located on the east side of the Central San Joaquin Valley just south of Visalia, CA. The district receives water from Lake Kaweah through Terminus Dam as well as from the Friant-Kern Canal. TID is the single largest partner in the Kaweah River Power Authority (KRPA), which operates Terminus Dam and regulates the discharge from Lake Kaweah.

Opportunity

1. Releases from Terminus Dam are released based on irrigation demand from downstream irrigation districts such as Tulare ID. Historically, large flow rates were delivered from May through late July/August depending on the storage in Lake Kaweah. Irrigation districts made requests for releases in advance and the release flow rate was maintained throughout the day. Therefore, generation from this release water was based on irrigation water demand and the load generated was the same for each full 24 hour period. The maximum generating capacity at Terminus Dam was not being utilized to generate peak load because the downstream irrigation districts did not have the infrastructure to handle large flow rate fluctuations throughout the day.

2. The U.S. Army Corp of Engineers (USCOE) recently increased the spillway height on Terminus Dam so that additional storage could be maintained in Lake Kaweah. This project increased the water level in the lake, providing increased generating capacity at the dam. However, the current turbine design did not have the capability to utilize this increased water level to generate addition load. The operation of the turbine was limited by the various physical characteristics of its components, mainly the turbine, generator, power cables, transformer, switchgear and transmission line.

IRRIGATION TRAINING AND RESEARCH CENTER
California Polytechnic State University
San Luis Obispo, CA
(805) 756-2434

Solution #1

TID and KRPA, with the assistance of ITRC, proposed and designed a project that increased the generated peak load from Terminus Dam by 2,280 kW. Several structural, control, and SCADA investments were necessary to facilitate implementation of a California Energy Commission (CEC) Category 1 and 3 grant proposal by the district. The proposal was to fluctuate TID releases from Terminus Dam during the day so that the dam's generating turbine would be at maximum capacity during the peak period (Monday-Friday, 12-6 pm). During the off-peak period the releases would be reduced so that TID would receive the required daily volume of irrigation water. The excess releases occurring during the peak period would be stored in regulating reservoirs within TID boundaries so they could be used during the off-peak period when flows from Terminus are reduced.

Figure 1. Before (top) and after (bottom) photos showing new L~~l~~angemann gates at TID's entrance to the main canal at Rocky Ford. The Langemann gates are used for upstream water level control.

The project involved structural modification and automation of key sites in the distribution system. ITRC assisted the district in determining which structures to install as well as developing control algorithms for the computer-automated structures. In addition, ITRC provided recommendations on the equipment necessary for the SCADA system and a cost estimate so the district could budget appropriately.

As a second function of the project, TID plans to selectively choose the water sources tapped by the district in order to utilize the maximum amount of water from Lake Kaweah during hours of peak electrical demand. By selectively using the water from Lake Kaweah, the maximum output of the hydroelectric generating plant at the dam would coincide with peak electrical demand. This second function is not presently available to TID because the Friant-Kern Canal (TID's second surface irrigation water source) currently does not have the flexibility to make large flow rate changes multiple times during the day. In the future, the district expects to be able to utilize this function of the project, which

IRRIGATION TRAINING AND RESEARCH CENTER
California Polytechnic State University
San Luis Obispo, CA
(805) 756-2434

would maintain the water level in Lake Kaweah longer into the peak season, further increasing the peak generating capacity.

In general, the system improvements are used to facilitate the time-dependent use of water by accomplishing the following:

SCADA enclosure is open in the center of the photo.

- Providing a method for the Kaweah-Delta WCD (KDWCD) system operators to manage large fluctuations in flow on the Kaweah River, without interfering with the operation of the irrigation districts and canal turnouts.
- Providing a method for TID to control and monitor the variable flows as they enter the district boundaries and pass to the two key reservoirs.
- Controlling and monitoring the status of two key reservoirs in the district.

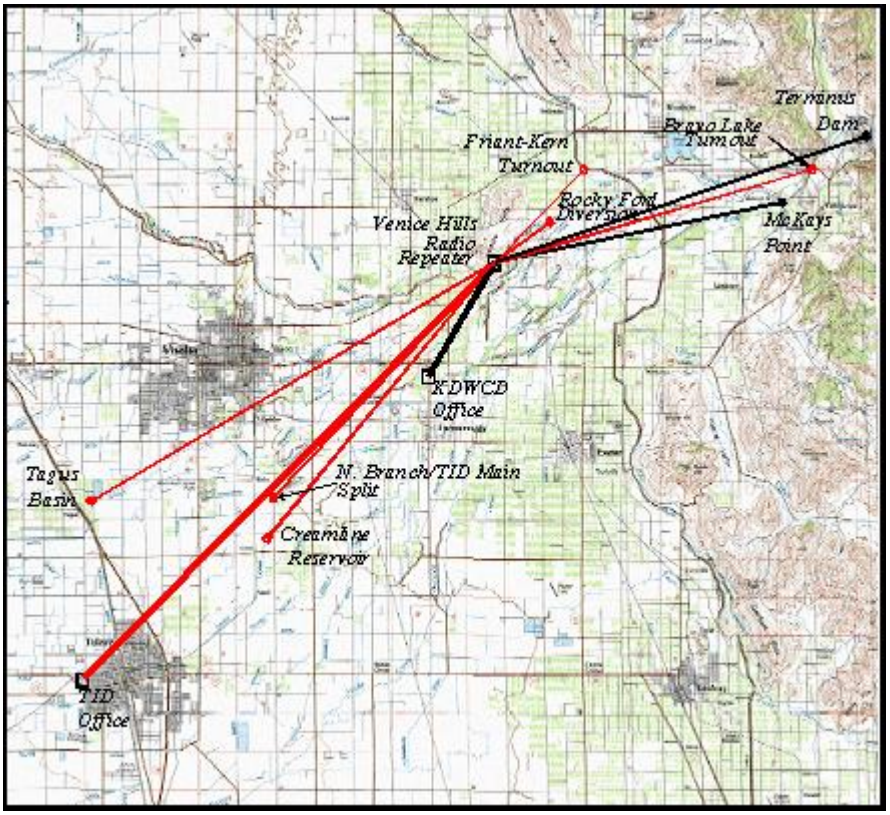

Figure 2. Tulare ID radio system layout and location of main SCADA sites.

IRRIGATION TRAINING AND RESEARCH CENTER
California Polytechnic State University
San Luis Obispo, CA
(805) 756-2434

Solution #2

KRPA proposed and designed a project that increased Terminus Dam's peak load generation by 1.18 MW. With the assistance of a CEC Agricultural Peak Load Reduction Program Category 1 grant, KRPA increased the generation during the peak period by modifying the existing turbine at Terminus Dam to take advantage of the increased water level that will be made available through a USCOE dam enhancement project. The maximum water level in Lake Kaweah was increased from 694 feet to 715 feet. The rotor was rewound and the excitation system was upgraded to increase the maximum generation of the facility from 18.5 to 20.5 MW.

Figure 3. Inlet from Lake Kaweah to the turbine at Terminus Dam

Benefits of Both Projects

- The State of California has benefited from the increased generation of nearly 3.47 MW to the electricity grid during the summer peak period.

- Increased peak generation increases the revenue to KRPA and its partners because Southern California Edison (SCE) pays a higher rate to energy providers for peak energy compared to partial or off-peak energy.

- The structural modifications and the addition of SCADA not only benefit the district through the generation of more peak load but also for overall operation of the irrigation distribution system. With regulating reservoirs and real time data and automatic control from key sites within the irrigation distribution system, the district is able to provide more flexibility to water users.

Summary Category	Results
Total Cost	$1,631,620
Total Grant	$805,191
Kilowatts (KW) Curtailed	3,470
Grant $ per kW Curtailed	$232.71

IRRIGATION TRAINING AND RESEARCH CENTER
California Polytechnic State University
San Luis Obispo, CA
(805) 756-2434

Further Information

- **California Energy Commission**
  Ricardo Amon
  (916) 654-4019
  Ramon@energy.state.ca.us

- **Irrigation Training and Research Center**
  California Polytechnic State University
  San Luis Obispo, CA 93407
  Dr. Charles Burt, APLRP Director
  (805) 756-2379, cburt@calpoly.edu
  Dan Howes, APLRP Administrator
  (805) 756-2347, djhowes@calpoly.edu
  www.itrc.org

IRRIGATION TRAINING AND RESEARCH CENTER
California Polytechnic State University
San Luis Obispo, CA
(805) 756-2434