

RECLAMATION

Managing Water in the West

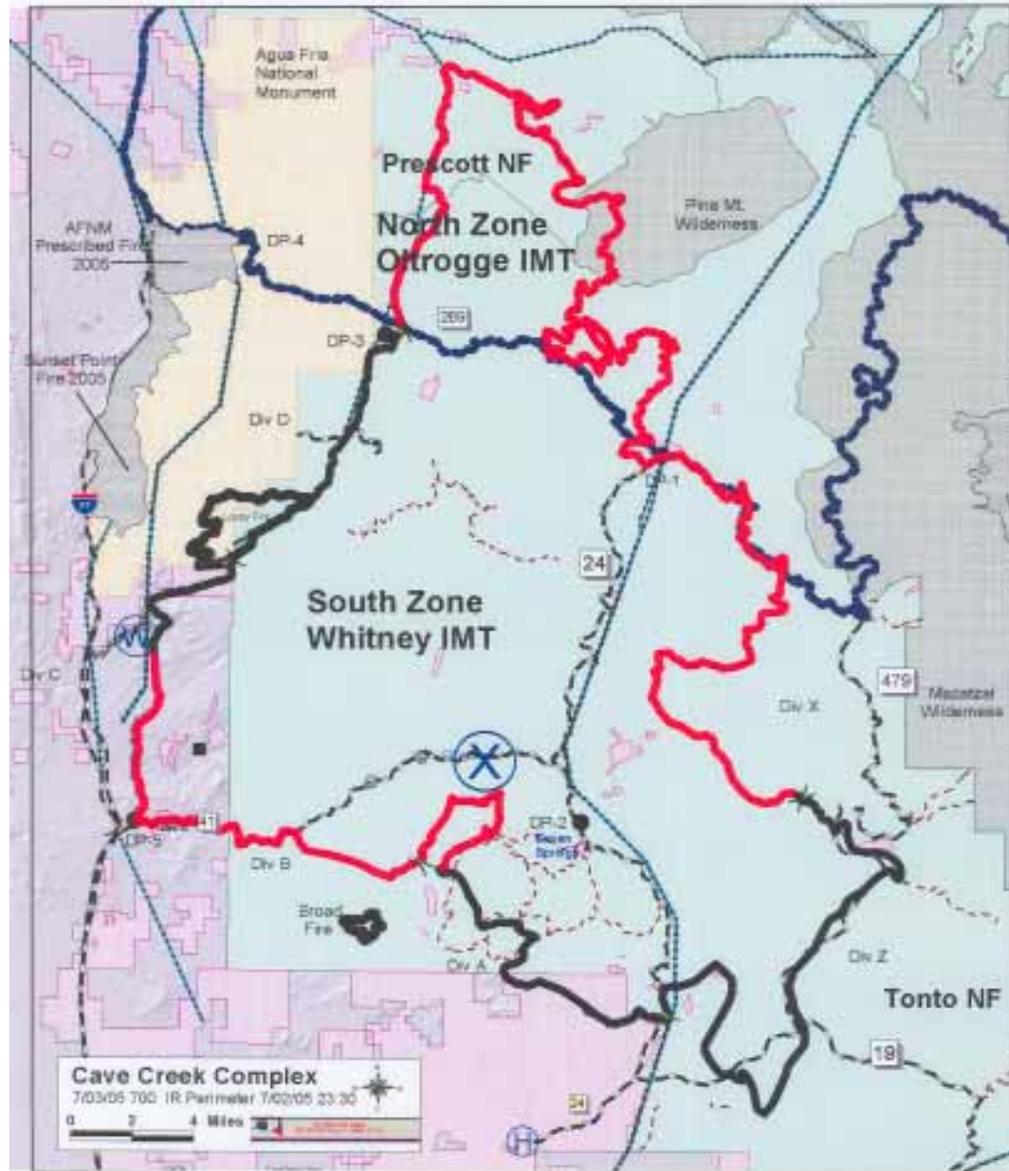
CAVE CREEK COMPLEX FIRE FLAGSTAFF TRANSMISSION LINE TRIP EFFECTS AT GLEN CANYON POWER PLANT

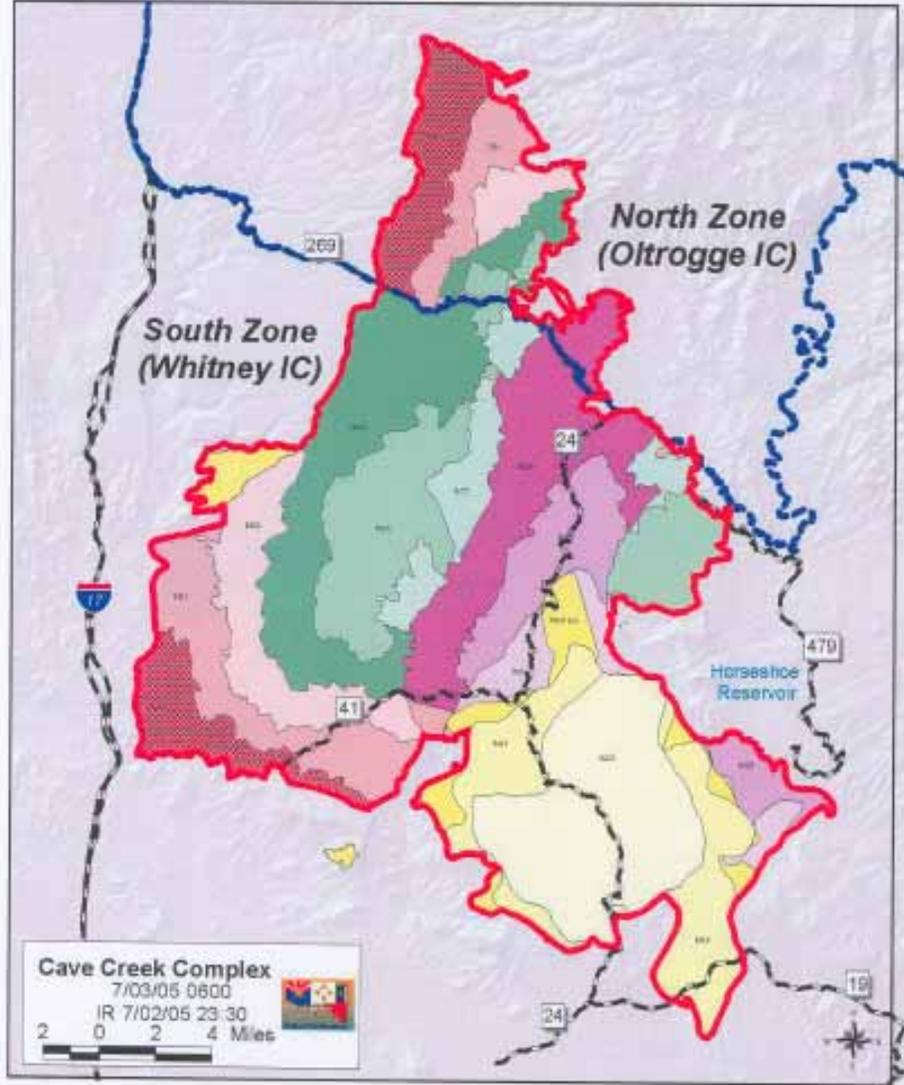


U.S. Department of the Interior
Bureau of Reclamation

Cave Creek Complex Fire

- The Cave Creek Complex Fire was started by a lightning strike on June 21, 2005.
- The 345 KV transmission lines between the Glen Canyon switchyard and the Pinnacle Peak switchyard near Phoenix were located in or near the fire zones from June 22 to June 26.
- The fires proximity to the transmission lines caused the main transmission pathways to be simultaneously interrupted ten times over a five day period.





Cave Creek Complex
7/03/05 0600
IR 7/02/05 23:30
2 0 2 4 Miles

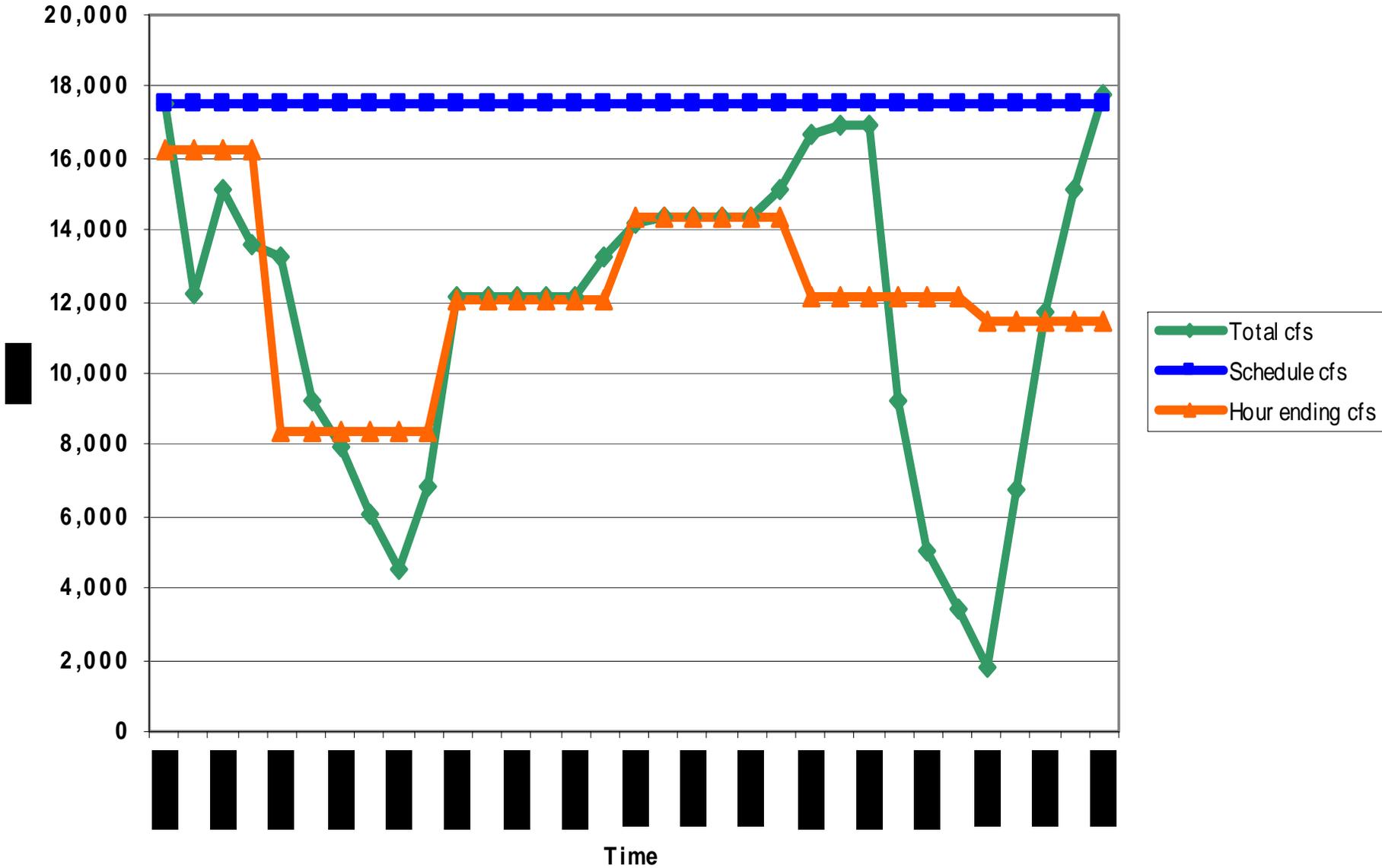
Cave Creek Complex Fire

- The transmission system that carries power generated at the Glen Canyon Power Plant relies primarily on the two 345 KV transmission lines.
 - When both of these lines are intact the transmission system is thermally rated to transmit upwards of 1,500 MVA of power.
 - The line are divided up into four sections on two parallel flow paths.
 - Transmission system protections are required to prevent overload damage to the much lower rated 230 KV line in the event of a individual or dual 345 KV line trip event.

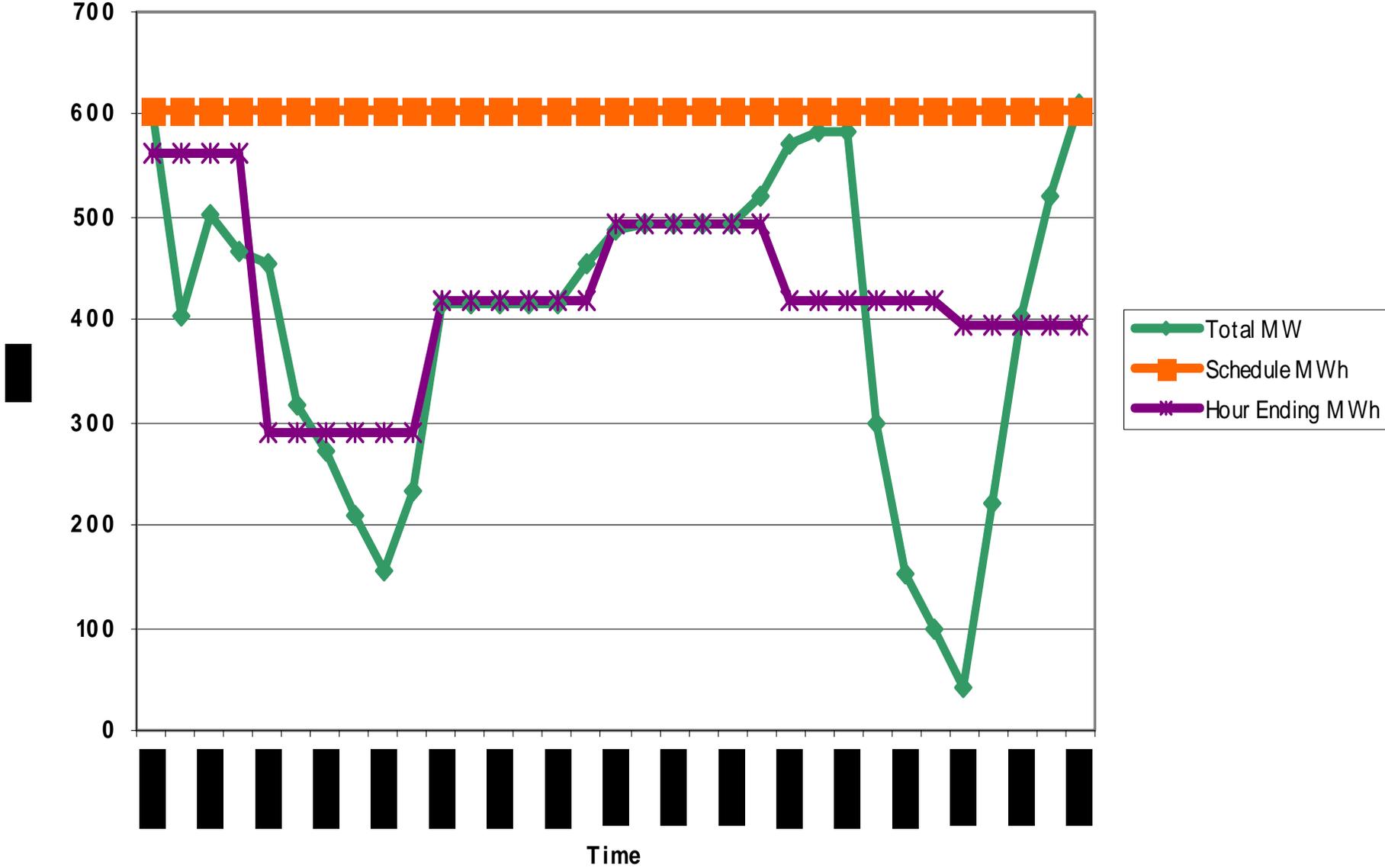
Cave Creek Complex Fire

- **June 22, 2005**
 - The fire is burning directly under the two parallel 345 KV lines from Glen Canyon Switchyard to Pinnacle Peak Switchyard.
 - Both lines are tripped out twice
 - 12:39 p.m. to 1:52 p.m.
 - 4:34 p.m. to 5:53 p.m.
 - Dispatchers have little difficulty restoring lines, but due to large phase angles, request the operators to reduce generation at Glen Canyon below 100 MW during the restorations.

June 22, 2005 Line Trip Effects on cfs



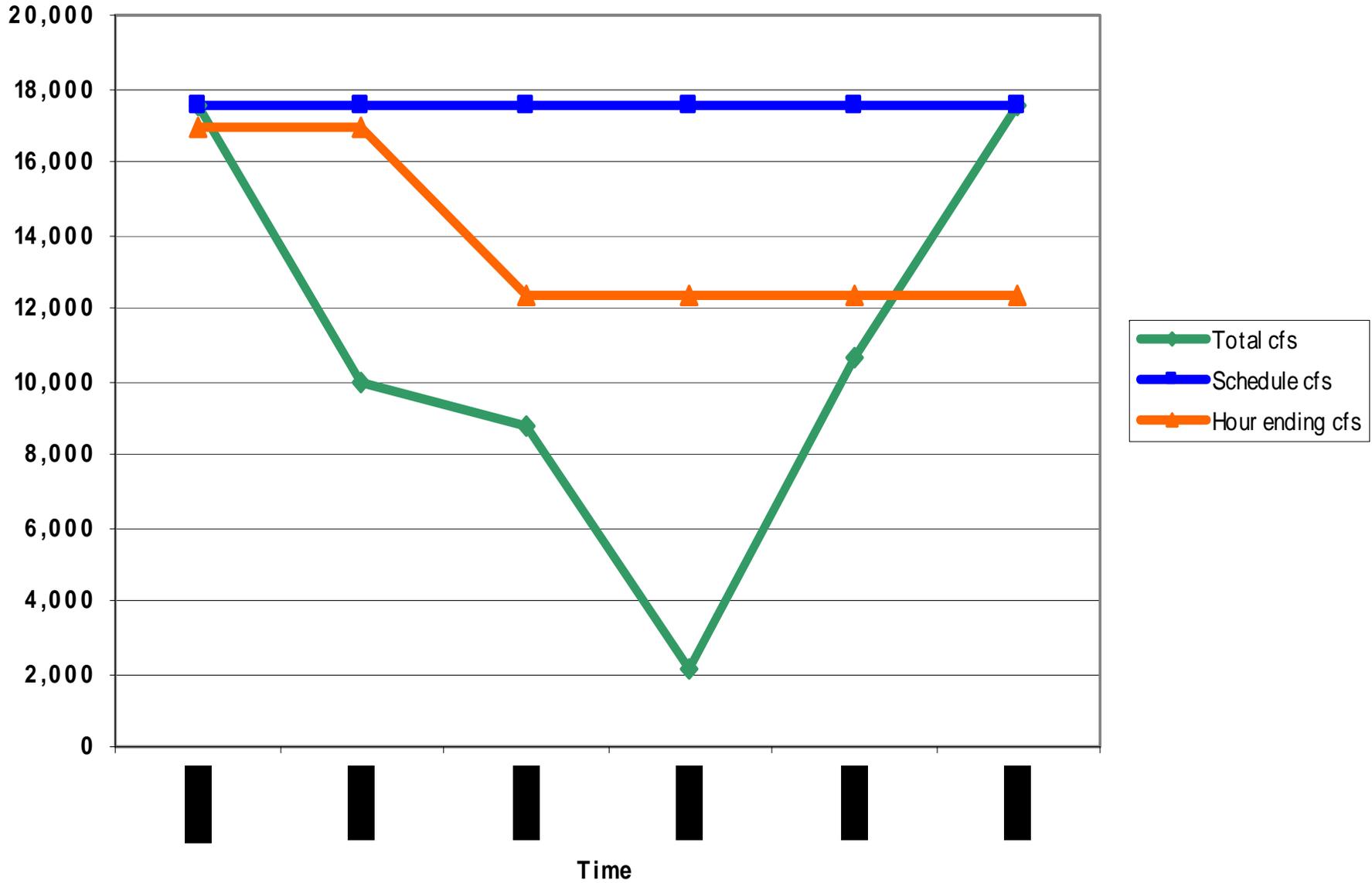
June 22, 2005 Line Trip Effects on MW



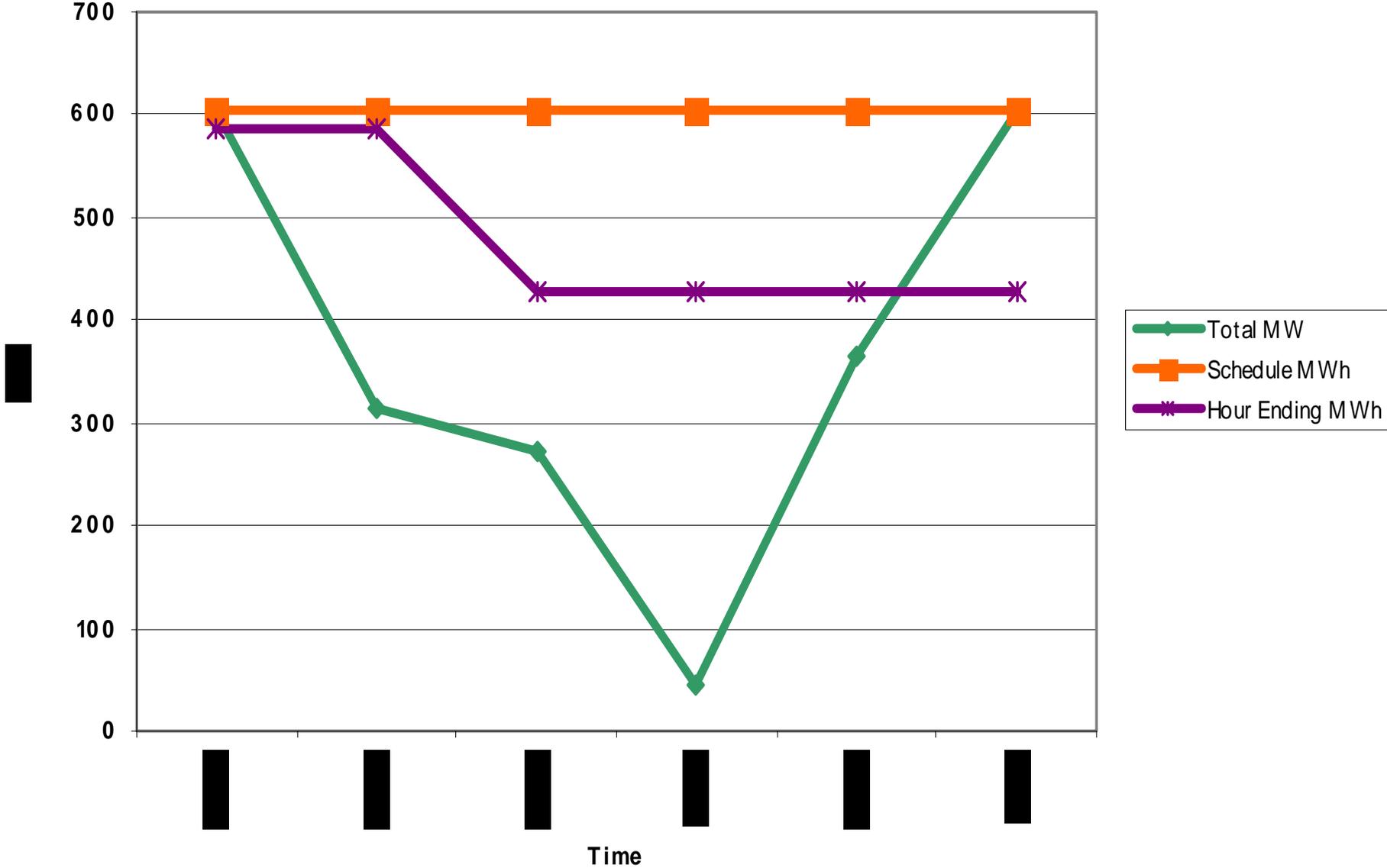
Cave Creek Complex Fire

- **June 23, 2005**
 - The fire burns in the corridor directly under the two parallel 345 KV lines.
 - Both lines are tripped out once.
 - 1:55 p.m. to 2:18 p.m.
 - Dispatchers have little difficulty restoring lines, but due to large phase angles, request the operators to reduce generation at Glen Canyon below 100 MW during the restorations.

June 23, 2005 Line Trip Effects on cfs



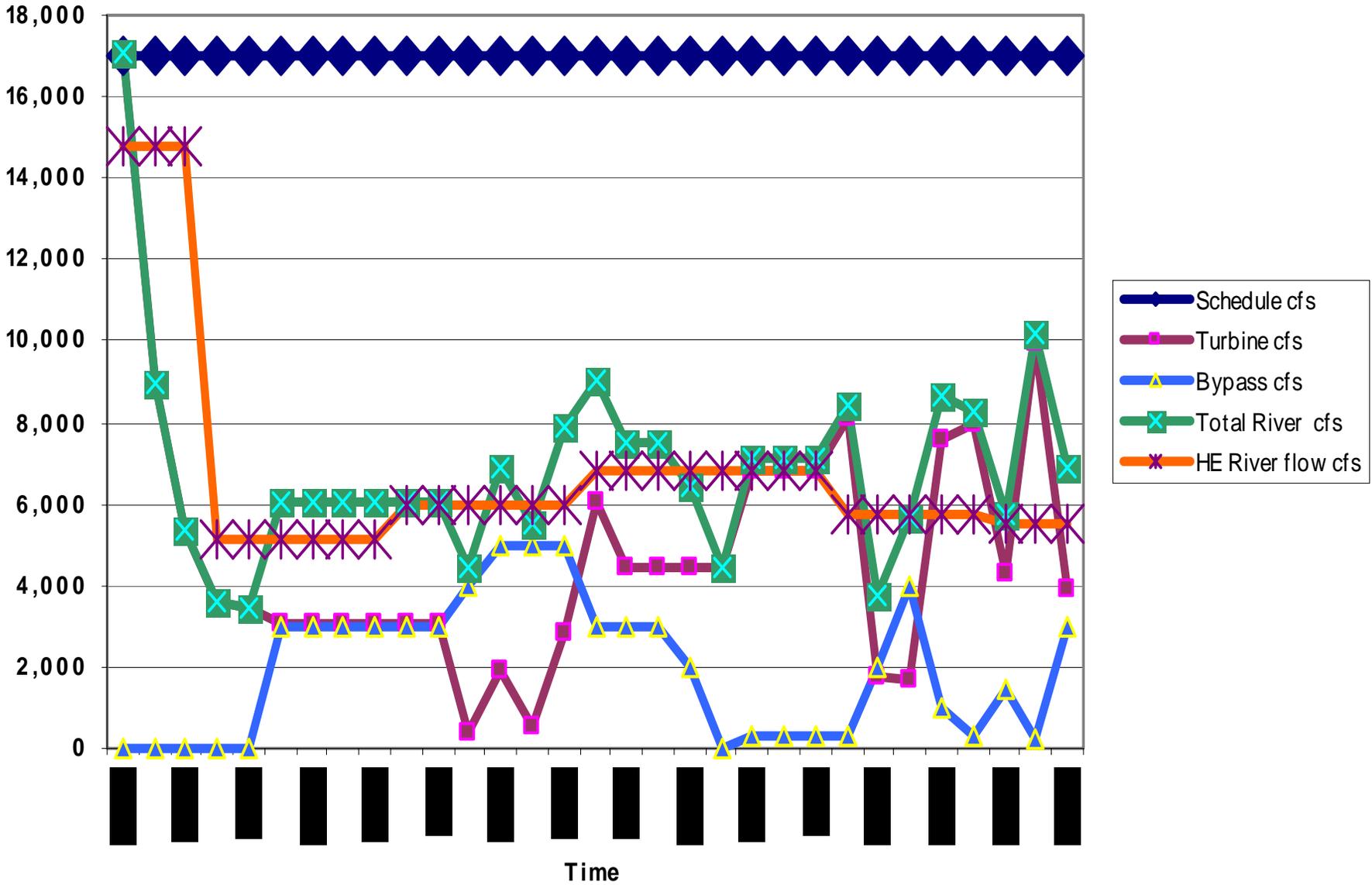
June 23, 2005 Line Trip Effects on MW



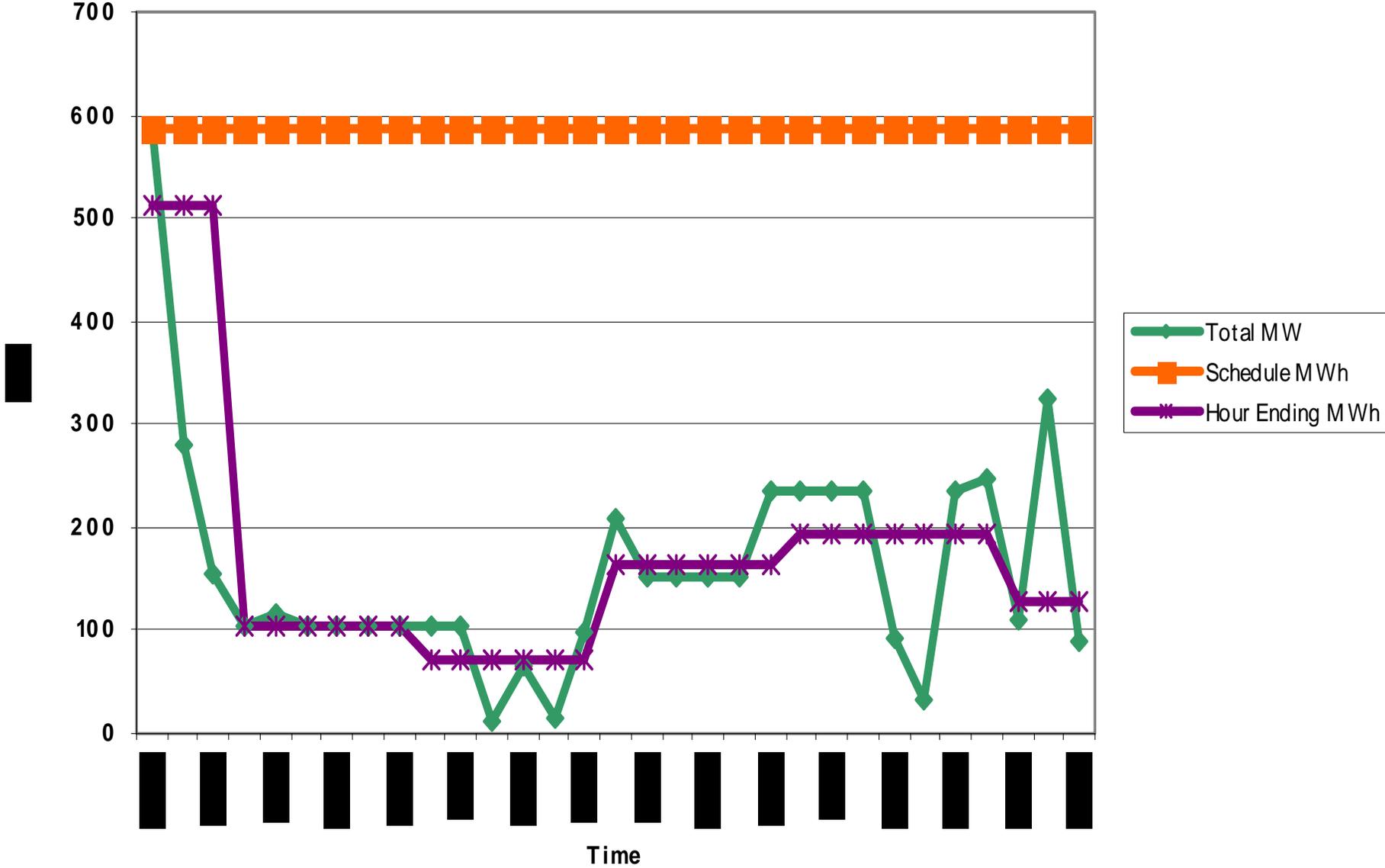
Cave Creek Complex Fire

- **June 24, 2005**
 - The fire burns in the corridor directly under the two parallel 345 KV lines.
 - Both lines are tripped out on four separate occasions.
 - 1:47 p.m. to 3:50 p.m.
 - Dispatchers have difficulty restoring lines, generation cfs is held low for so long that the decision is made to bypass water to attempt to get flows up.
 - River concessionaire is returning rafts up river when the decision is made to boost river cfs through bypass operations.
 - 5:18 p.m. to 5:37 p.m.
 - Bypass operations supplement river flows
 - 5:55 p.m. to 6:08 p.m.
 - Bypass operations continue to supplement river flows
 - 6:16 p.m. to 11:00 p.m.
 - Bypass closed when power levels sustain 5,000 cfs

June 24, 2005 Line Trip Effects on cfs



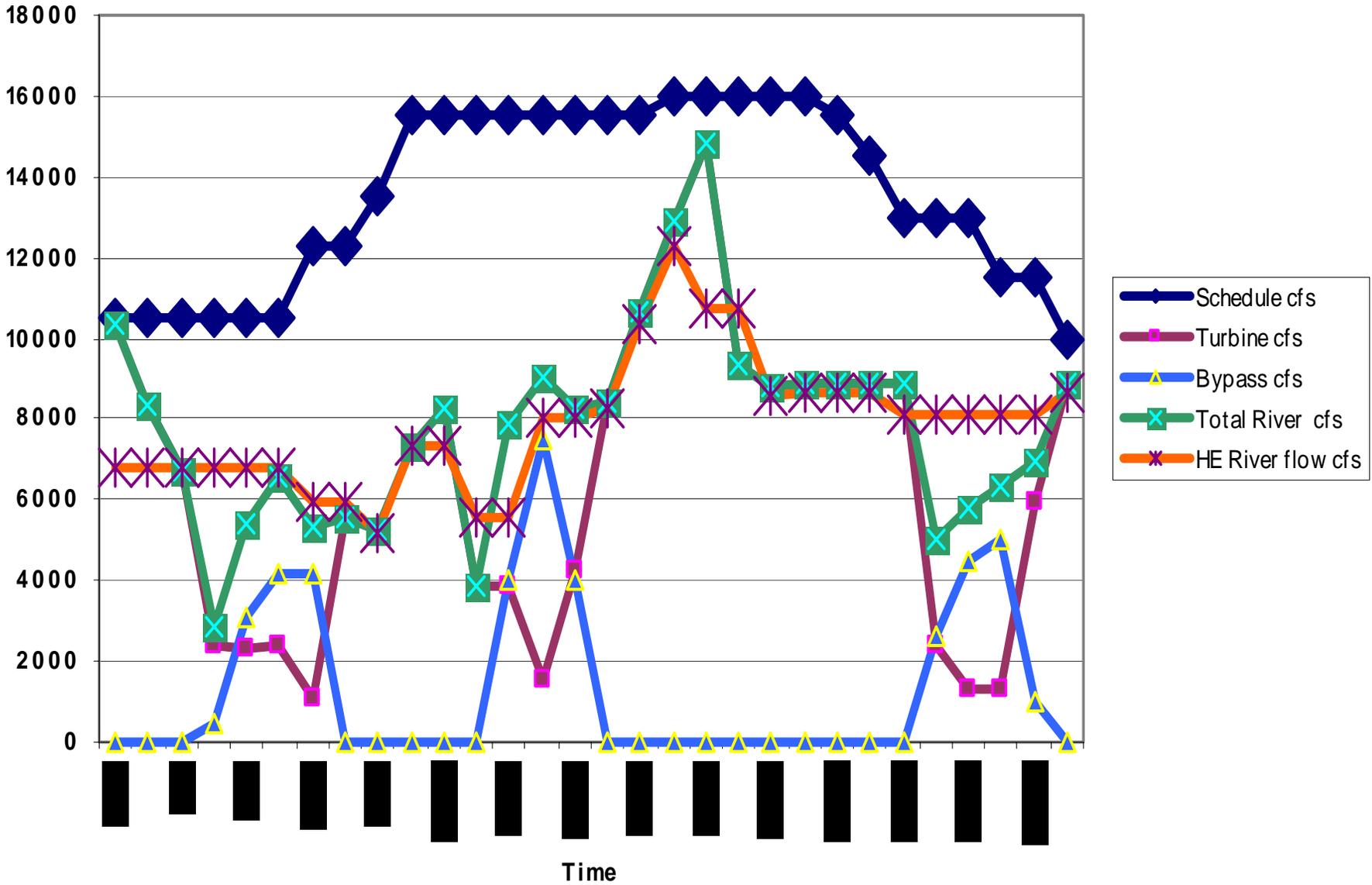
June 24, 2005 Line Trip Effects on MW



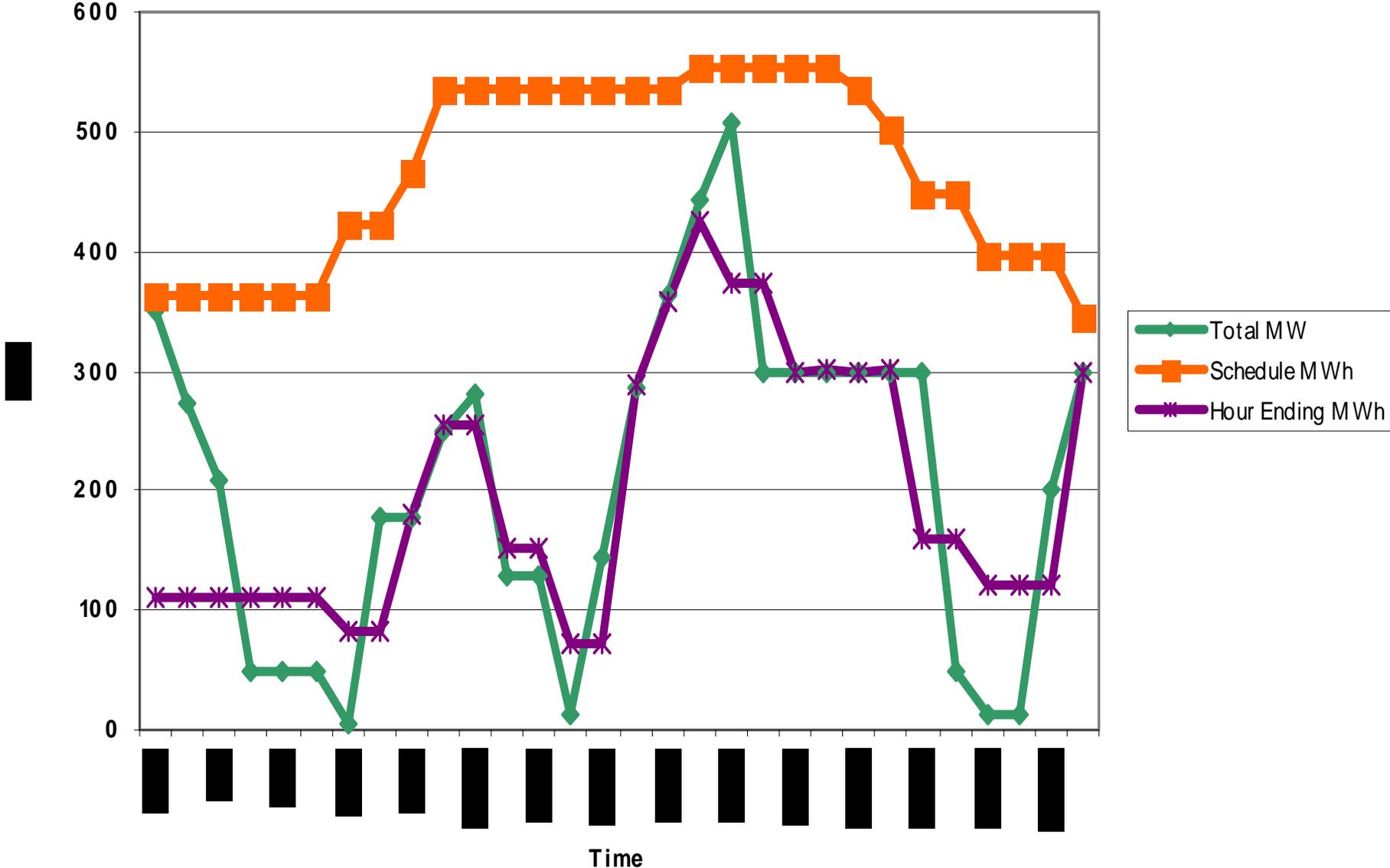
Cave Creek Complex Fire

- **June 25, 2005**
 - The fire burns in the corridor directly under the two parallel 345 KV lines.
 - Both lines are tripped out on two separate occasions.
 - 07:01 a.m. to 12:56 p.m.
 - Dispatchers have difficulty restoring lines, generation cfs is held low for so long that the decision is made to bypass water to attempt to get flows up.
 - River concessionaire is preparing rafts for tour operations.
 - River concessionaire cancels tour operations, moves raft down stream.
 - 4:20 p.m. to 10:55 p.m.
 - Dispatchers have difficulty restoring lines, generation cfs is held low for so long that the decision is made to bypass water to attempt to get flows up.

June 25, 2005 Line Trip Effects on cfs



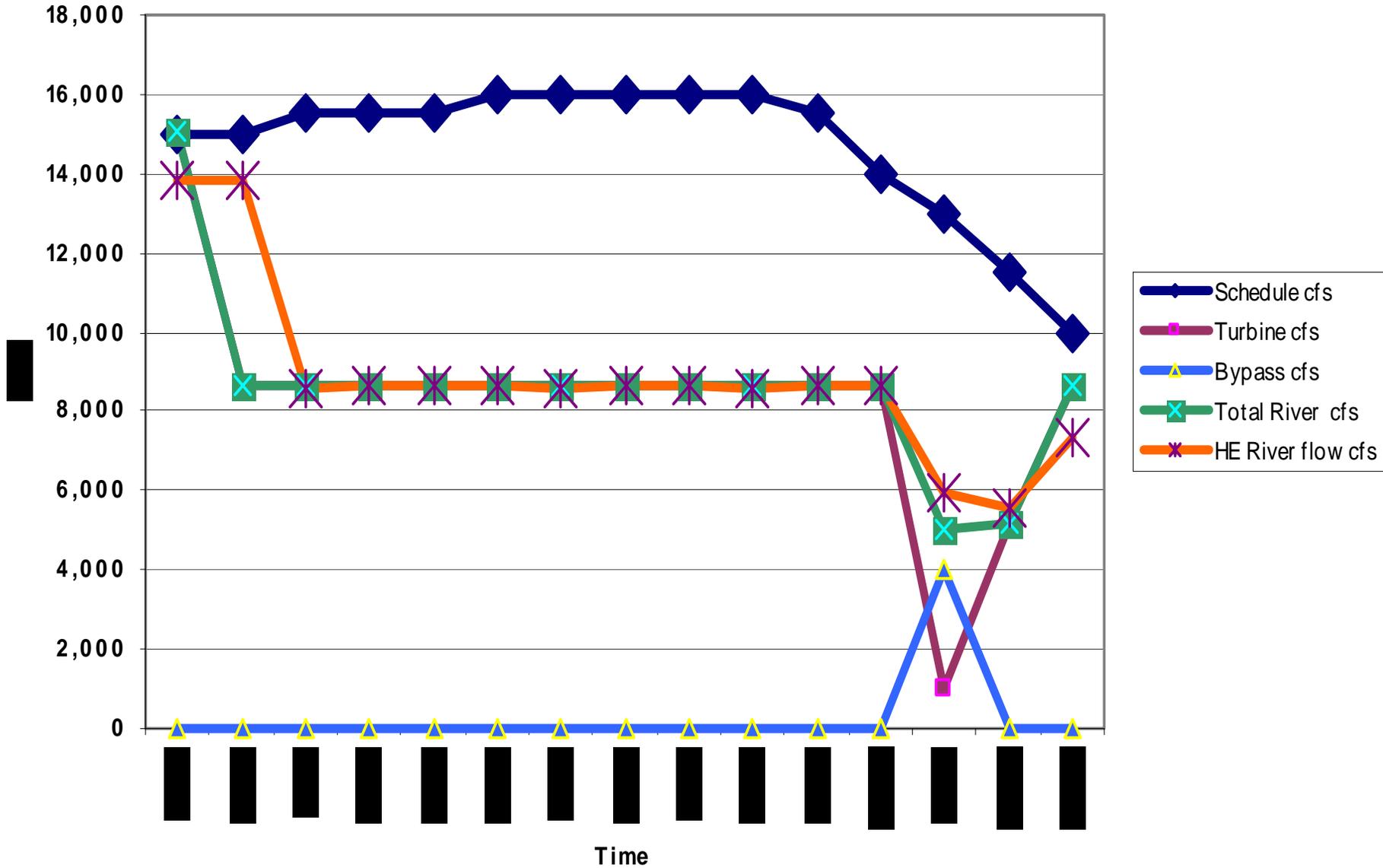
June 25, 2005 Line Trip Effects on MW



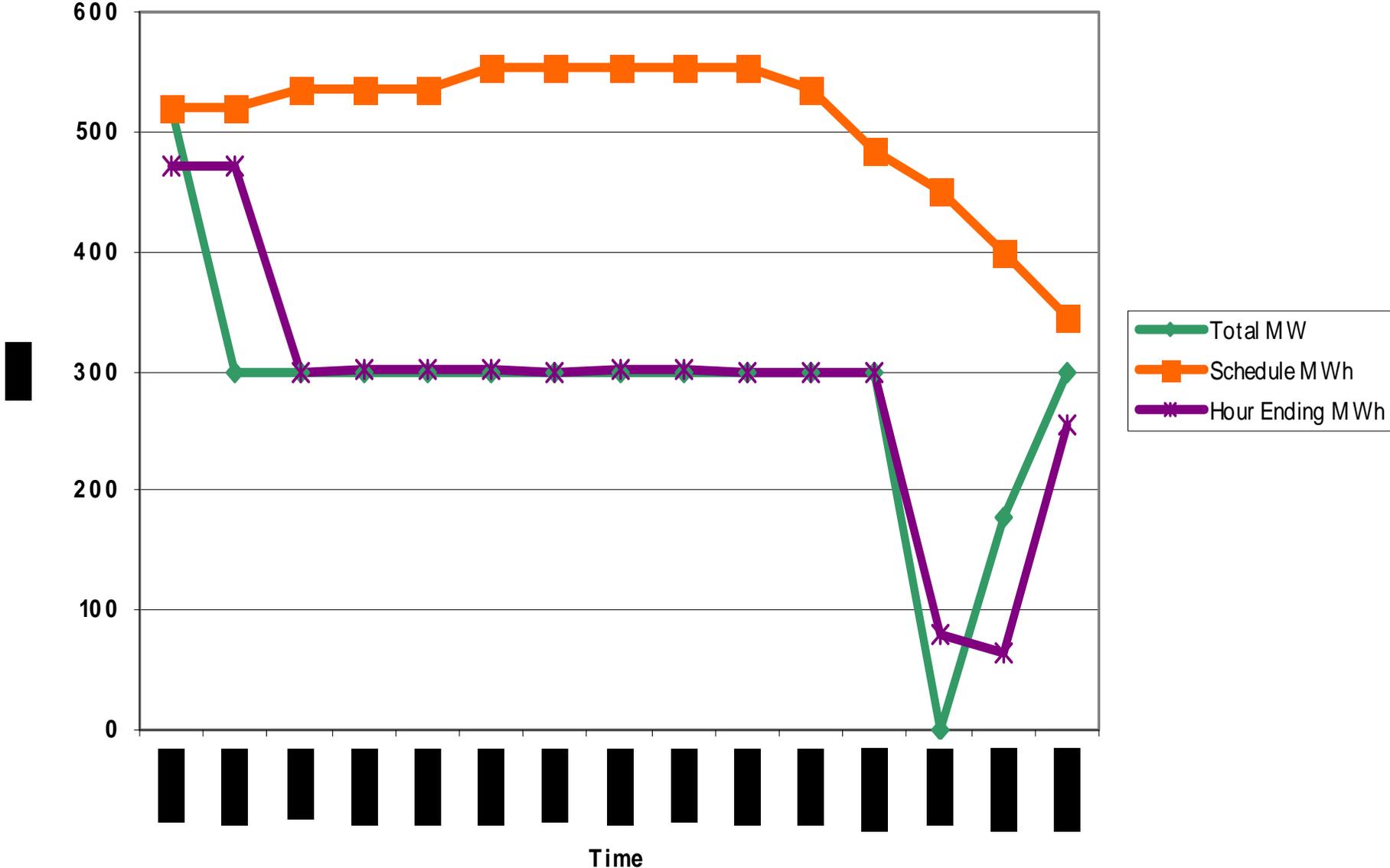
Cave Creek Complex Fire

- **June 26, 2005**
 - Dispatchers open both Flagstaff lines to support fire crews doing controlled burns in vicinity of fire, to divert fire out of the transmission line corridor.
 - Both lines are out for 12 hours.
 - 11:00 a.m. to 10:31 p.m.
 - Dispatchers have difficulty restoring lines, generation cfs is held low for so long that the decision is made to bypass water to attempt to get flows up.
 - Bypass operations start at 9:12 p.m., to raise river flows above 5,000 cfs while generation is held low by the dispatchers during line energization difficulties.
 - Bypass is secured at 10:47 when generation restores river above 5,000 cfs.

June 26, 2005 Line Open for controlled burn effects on cfs



June 26, 2005 Line Trip Effects on MW



Date	Schedule MWh	Produced MWh	Shortage MWh	MW Schedule Acre-Ft.	MW Acre-Ft	Bypass Acre-Ft	Shortage Acre-Ft
6/22	11,890	10,818	1,072	28,492	25,866	0	2,626
6/23	11,902	11,675	227	28,492	27,882	0	610
6/24	11,587	7,879	3,708	27,707	18,797	1,260	7,650
6/25	10,706	6,404	4,302	25,599	17,115	1,860	8,484
6/26	10,728	7,477	3,251	25,620	17,784	608	7,228

RECLAMATION