



CALIFORNIA ISO

California Independent
System Operator

CALIFORNIA ISO
CORPORATION

**Report on 8/25/2005 Pacific DC Intertie Loss
with Subsequent Load Shedding Event**

November 10, 2005

EXECUTIVE SUMMARY

At 1547 PDT, on Thursday, August 25, 2005, one pole of the Pacific DC Intertie (PDCI) blocked, and within seven minutes the PDCI was taken out of service. As a result, 2,249 MW of generation tripping occurred automatically by a Remedial Action Scheme (RAS) in the Pacific Northwest. In addition, weather/load forecast errors in South of Path 26 (SP26)¹ resulted in under forecasting of load by as much as 2,937 MW.

As a result of both the forecast error and the PDCI going out of service, both interruptible and manual firm load shedding totaling approximately 1,750 MW was utilized in the CAISO Control Area to maintain reliability of the interconnected grid. Of the total load interrupted, firm load comprised about 950 MW and was restored after 40 minutes while the remaining 806 MW comprised of interruptible load and was restored after 77 minutes.

Path 66 (COI), Path 26, and Path 15 experienced path overloads following the loss of the PDCI, but path violations exceeding time requirements were not incurred.

Day-Ahead Analysis

At about 10 AM on August 24, the Day-Ahead (DA) Market closed for input for the load forecast and DA schedules for the following operating day, August 25. Temperature forecasts for August 25, and the corresponding load forecasts were similar to the load forecast and temperature actuals on August 24.

The CAISO ensures not only that there is sufficient generation capacity scheduled to serve load and meet local area generation requirements, but also that sufficient generation is available to maintain Operating Reserves for reliability reasons. The CAISO prepared for the August 25 operating day through a review and commitment of Reliability Must Run (RMR) generating units based on the forecasted DA load for Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric (SDGE). Scheduled load in the DA Market was essentially at the same level as the CAISO forecasted load for the CAISO Control Area.

For SP26 on August 25, based on the SCE forecasted peak load of 18,680 MW and SDGE forecasted peak load of 3,324 MW, the CAISO committed enough resources within SP26 in the DA Market and met the required Ancillary Service requirements established by the Western Electricity Coordinating Council (WECC) Minimum Operating Reliability Criteria (MORC). In order to meet transmission reliability requirements in the South of Lugo² area, the CAISO committed two additional generating units totaling 960 MW via the Must Offer Waiver process in the Los Angeles Basin.

¹ SP26 represents the combined service territories of SCE, SDGE, and southern municipal utilities.

² South of Lugo Area is defined by the transmission lines carrying power South of the Lugo 500 kV substation in the SCE area.

Hour-Ahead Analysis

On the morning of August 25, it became apparent that the actual loads and temperatures would be higher than forecasted. The CAISO called for quick-start generating units to come on-line and the Scheduling Coordinators (SCs), also seeing the increasing temperatures (up to 14 °F higher than the forecast), responded with additional scheduling of load and resources to balance their DA schedules in the Hour-Ahead (HA) Market. The SCs substantially supplemented their forward market schedules during the course of the day as actual temperatures and loads continued to increase. Ultimately, the SCs supplemented their schedules by adding approximately 2,000 MW of load and resources. However, even with the supplemental load and resources scheduled in the HA market by Hour Ending (HE) 16, schedules were still approximately 800 MW short for south of Path 26. As the CAISO continued to manage the system with the increasing load, SCE and the CAISO had a discussion on the amount of interruptible load in SCE, to which SCE reported it had about 806 MW.

Throughout the operating day and up to the event, the generating units were loaded accordingly to maintain appropriate transmission line flows and to remain within path and transmission element limits. The shift personnel were mitigating for South of Lugo congestion and facing several fires within the CAISO Control Area, one of which was close to major 230 kV lines in North of Path 26 (NP26)³. In anticipation of higher than forecasted temperatures and loads, the CAISO Shift Supervisor ordered the issuance of a Warning for Southern California from 1305 through 2000 in accordance with CAISO Operating Procedure E-508 (“Electrical System Emergency”).

Real-Time Analysis

Prior to the loss of the PDCI, during HE16, the CAISO Control Area load was about 41,893 MW, which was 2,491 MW higher than the August 24 peak of 39,402 MW. Similarly for SP26, SCE’s load was trending 2,495 MW higher than its August 24 peak of 18,442 MW and SDGE’s load was 559 MW higher than its August peak of 3,445 MW. The CAISO Control Area actual Operating Reserve was 2,479 MW, slightly higher than the required 2,447 MW based on the WECC MORC. In addition to the ISO Control Area Operating Reserve monitor, the ISO also utilizes a real-time regional reserve-monitoring tool for assisting the system operators in determining the available reserves in NP26 and SP26; however, the CAISO does not procure Operating Reserves on a regional basis. The CAISO regional reserve-monitoring tool indicated a reserve requirement of 1,444 MW for SP26 and an actual in-market reserve of only 651 MW.

The CAISO Shift Supervisor did not view this regional deficiency as a reliability concern because the reserve-monitoring tool also indicated unloaded generating capacity of approximately 1,203 MW (includes the 651 MW of in-market reserves) in SP26 that could have been converted to energy within 10-minutes. The Shift Supervisor also monitored the flows on Path 26, which was loaded below its Operating Transfer Capacity (OTC) limit by approximately 500 MW prior to the loss of the PDCI indicating that approximately 500 MW of reserves from NP26 could have been made available to SP26.

³ NP26 represents PG&E service territory and northern municipal utilities.

In addition, the Shift Supervisor had confirmed the availability of 806 MW of interruptible load in the SCE area. With this information at his disposal, the Shift Supervisor determined there was no need to initiate a Staged Emergency⁴ or shed interruptible load, but instead chose to diligently monitor the system and take necessary actions in response to a Transmission Emergency⁵.

At 1547, one pole of the Pacific DC Intertie (PDCI) blocked due to the loss of the Los Angeles Department of Water and Power (LADWP's) Sylmar Station Converter⁶ #1, and within seven minutes the second pole was taken out of service. Prior to the first pole block, the PDCI was carrying 2,608 MW of which 2,091 MW was scheduled for the CAISO. LADWP did not contact the CAISO or the Reliability Coordinator when the PDCI blocked or when the second pole was taken out of service. The CAISO attempted to contact LADWP but the calls were not answered. Upon losing the PDCI, 2,249 MW of generation tripping occurred automatically in the Pacific Northwest creating an Area Control Error (ACE⁷) deficiency of 1,202 MW within the CAISO necessitating the shedding of approximately 1,750 MW of load to maintain reliability of the interconnected grid. Had the CAISO been able to contact LADWP, the shedding of only interruptible load may have been sufficient to maintain reliability. Approximately 40 minutes after the event occurred, LADWP reported the PDCI was stable.

Conclusion

Actions taken by the CAISO shift personnel were appropriate in stabilizing the grid and prevented cascading events, which could have impacted neighboring control areas. The actions of the in-area load serving entities - specifically SCE and SDGE - were appropriate as they managed and responded to both the under-forecasted load due to the significant under-forecast in temperatures and the subsequent loss of the PDCI.

The failure of numerous weather forecasting agencies to accurately forecast the temperatures on August 25, resulted in both the SCs not procuring sufficient energy and the CAISO not initially requiring sufficient reliability-based generating units that in the end, based on actual load, would have been on-line. The under forecast of load represented a major and significant first factor in creating a situation that strained the area available and scheduled resources. Operating Reserves procured by the CAISO were in compliance with the WECC MORC requirement from a control area perspective.

In the area of communication between control areas, the CAISO believes there is an opportunity for improvement between the CAISO and LADWP. Had there been adequate communication between the two control areas, the need to interrupt firm load could have been avoided or minimized.

⁴ A Staged Emergency is typically called when Load Demand plus Operating Reserve Requirements exceed available generating resources.

⁵ A Transmission Emergency is declared for any event that threatens, harms, or limits capabilities of any element of the transmission grid and threatens grid reliability.

⁶ The PDCI requires converter stations at both ends to convert the DC current back to AC current and vice versa. The PDCI has converter stations at Celilo (within the Bonneville Power Authority service territory) and at Sylmar (within the LADWP territory.)

⁷ The CAISO's ACE is a measure of the generation required to restore frequency and net interchange to their desired values.

While CAISO shift personnel's swift actions maintained reliable operation and limited the impact to customers, there are always lessons to be learned from events such as this to enhance operating capabilities. It is recommended that CAISO and LADWP revisit joint operating procedures that ensure well-coordinated operations during emergencies and enhance communication protocols between the two organizations. Progress toward resolution of these issues is already noted, with the CAISO and LADWP taking step to strengthen their working relationship. There is a vital need to work together in the interest of consumers.