

Reading Report 3

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Summary

During the day of September 8th 2011, 2.7 million customers in the US Southwest and Mexican Northwest were left without power for up to 12 hours after an 11 minute disturbance caused by the loss of one 500kV transmission line owned and operated by Arizona Public Services. Though only one line was lost, many users were impacted - in a well designed and maintained power system, the loss of one line should never have such a large impact. This particular line oddly had tripped off before without causing this level of loss if any at all. However, on this particular day, there happened to be abnormally low levels of power generation and the redistribution of power when the line tripped caused overloads on several key transformers. The initial trip of the 500kV line caused a cascade of trips, which is why the event had such a large impact.

After the 500kV line known as Hassayampa - North Gila tripped, the second phase of the cascade was the trip of 230/92kV transformers in the Coachella valley. This Coachella valley trip caused phase three, the trip of another 230/92kV transformer, in Ramon. Then, the fourth phase, the trip of some smaller 161/69kV transformers in Gila, took Yuma cogeneration offline, Fifth was the trip of Pilot Knob 161/92kV and Yucca 161/69kV transformers. Sixth was the trip of the Pilot Knob-El Centro 161kV line, causing the seventh phase in the cascade of the South of SONGS Separation, meaning that the 8,000 amp trip setting on the SONGS separation scheme was exceeded. 30 seconds later, the blackout was seen.

At least five separate organizations (SDG&E, CFE, IID, APS, and WALC) had customers without power, and shortly after the blackout occurred they each began initiating restoration plans. Each party was able to use borrowed power from neighboring entities.

Similarly to both the blackout in Europe in the US Northeast and Canada, the blackout had a big impact and seems to be caused mostly by poor planning and lack of foresight, and the extent of the blackout in all three cases seems to have been prolonged and worsened by communication and coordination difficulty. The main difference the report on the September 8th event shows is that the entities involved did have pre-existing plans to cope with this scale of blackout, but the coordination and communication issues made these plans less effective than they could have been.

What Was Handled Well

The fact that many organizations were quick to jump to initialization of restoration plans shows that though they may not have been expecting to encounter this exact situation, they were at least somewhat prepared to respond to unforeseen emergencies. Based on the conclusions found in the report, if all parties simply had had a little more time before the trips occurred, the blackout likely could have been stopped.

Additionally, having access to power from neighboring systems shows that though there may have been some communication and coordination issues between different groups, the need for supplemental power was well established and overall the borrowing of power was a "process [that] was generally effective." Due to this, none of the groups had to use their black start generators, as off-site power was available.

And though some of the beneficial actions that occurred are routine, such as the next-day studies, they were performed to establish operation solutions and help determine steps to be taken the next day. Though APS and IID failed to perform their studies, the other TOPs involved did perform their next day studies as they should. In the future, more importance should be placed on these though, as none of the TOPs next day studies actually resulted in helpful information.

What Needs Improvement

Some main issues described in the report were that:

1. The system was not being operated according to the N-1 security rule
2. The system suffered from poor operations planning
3. There was inadequate situational awareness
4. Failure to identify and study impacts on BPS (Bulk Power System)
5. Unrecognized IROLs (Interconnection Reliability Operating Limits)
6. Uncoordinated/unstudied RASs (Remedial Action Schemes)
7. Lack of tools and instructions in regards to reclosing

Interestingly, these issues all seem rooted in the facts that overall, there is not enough information about how the system runs as a whole, and not enough communication occurs between different entities operating in the WECC region.

However, it can be extremely difficult to pinpoint weaknesses in a system; for example one small part of the cascading shutdown was that the IID group had several transformers taken offline too quickly, as the relay trip setting was too close to the maximum emergency operation level. Perhaps in some situations, this conservative trip level is necessary, but on this particular day, more time before disconnection could have given operators a chance to mitigate the issues first. There are guidelines on the selection of settings, which were not exactly followed by IID, but there is no guarantee that the guideline would have worked in this situation either. No matter what there will always be some crazy situation that nobody can predict - and even the most robust power system won't be able to handle every possible condition.

There were of course other parts of the situation that could have been executed better, for example during phase 6 had SG&E been informed early enough, they could have shed significant amounts of load to help, but this was never communicated.

Additionally, it seemed that the WECC RC did not provide enough support for any of the companies involved. As a coordination council, WECC RC can act as a third party mediator between different entities especially since they have higher visibility of the systems. They also could have helped clarify responsibilities during restoration.

Some aspects of the blackout don't seem specific to this situation, either. For example, seasonal planning done by involved TOPs did not include all facilities, which led to plans too narrow in scope. Lack of studies done at multiple load levels and scope gaps in longterm plans also led to similar issues. Another big issue was unawareness about the SONGS separation; since this was the first time it went into action, some effects that were not necessarily planned occurred.

Overall, though this was a highly impactful event, the result seems like it was not as bad as it could have been. Most customers out of power regained power again in less than a day. Lots of weaknesses in the system and the coordination about the system were revealed - about 30 of them, with remediation steps - which should help entities with making sure a similar event does not have such big impacts in the future.