



Case Study

Tohono O'odham Utility Authority

Energizing the Desert Nation

The federally recognized tribe of the Tohono O'odham Nation includes 28,000 members in the Southwestern region of Arizona. As the second largest reservation in Arizona, roughly the size of Connecticut, its four non-contiguous segments total 2.8 million acres, or 4,460 square miles, at an elevation of 2,674 feet.

For over 40 years, the nation remained energized by a 230kV substation with two 69kV feeds and four distribution substations under Papago Utility Authority- later changed to Tohono O'odham Utility Authority (TOUA). That is until June 2017, when a lightning strike caused catastrophic failure and left the entire reservation without power.



Lakeshore Substation pre-modernization



Background

In 1970, the Papago Utility Authority (PUA) assumed ownership of an existing 230kV substation at the Cypress Tohono Mine. During this time, electric service to the entire Tohono O'odham Nation was unreliable and non-existent in the more remote areas of the reservation. Therefore, as they expanded the Lakeshore substation at the Cypress Tohono Mine, PUA formed two 69kV feeds, one of which ran 40 miles to Sells, AZ, creating a metering point outside the mine and feeding three distribution substations:

- Santa Rosa Substation
- Quijotoa Substation
- Sells Substation

These three substations would be responsible for distribution circuits throughout the central reservation until 2016 when Darrold Hoobs, TOUA Operation Manager, requested EPS, who had been performing minor maintenance and testing services on the site batteries, bring in engineering support to the Lakeshore Substation.

As previously noted, EPS had been performing maintenance and testing services and providing batteries every 2-3 years due to high desert temperatures significantly reducing life expectancy at the substations. In addition, the electrical infrastructure had not experienced any major updating since 1980 and desperately needed modernization.

The Challenge

Having gone nearly 50 years without any grid modernization, TOUA and EPS began what would turn into a year-long journey to properly electrify the existing substation and distribution sites and bring power to homes throughout the reservation that previously had none.

In 2016, EPS representatives met with TOUA's Darrold Hobbs and Mike Betherum at the Lakeshore substation to assess and prioritize the upgrades. Initially, TOUA thought to place new relaying into existing control cabinets, but EPS representatives mapped out the long-term benefits of a more intensive phase-by-phase concept. The scope of work included new relaying placed in a new construction climate-controlled building and a utility-grade battery system to protect the equipment and provide long-term battery life- roughly 20 years.

When presented with the initial scope of work, TOUA determined it would be outside of their budget. However, EPS proposed a second estimate to provide engineering, procurement support, and testing for the ongoing upgrade. As a result, TOUA released EPS to perform the necessary engineering to add a control building and replace all secondary wiring within the substation.

In early 2017, TOUA experienced a setback when an oil circuit breaker feeding the West 230/69kV transformer failed, leaving the East transformer to feed the entire reservation. Luckily, EPS was able to locate a used 69kV gas circuit breaker to replace the failed existing one, which TOUA then purchased. This also opened the door for TOUA to greenlight the purchase of three more gas circuit breakers for the Lakeshore substation and integrate them into the ongoing Lakeshore design.

In June 2017, the Arizona weather wreaked havoc on TOUA, causing yet another setback in modernizing their grid. A lightning strike took out the reservations metering station, yielding a total blackout and leaving the Tohono Nation with a total loss of power. In addition, the existing relaying at the Lakeshore substation failed to open the 69kV breaker due to a mechanically frozen lockout relay, resulting in further catastrophic failure of the West transformer. At the request of TOUA, EPS was able to locate a viable replacement transformer, and with an approved insurance claim, TOUA hired EPS to ship, design, and install the replacement equipment. During this time, EPS also performed a complete protection sweep of the existing electro-mechanical relays and replaced equipment to ensure it was protected and operational.

Further adding to the challenges TOUA was experiencing on the reservation, the Lakeshore station experienced a catastrophic failure of a 230kV circuit switcher, which fed the East transformer. At this time, the entire Tohono Nation experienced a four-day blackout until the transformer in transit could be delivered and installed.

Once the replacement transformer was received, EPS crews immediately installed the equipment and were able to feed the 69kV system, once again providing power to the Tohono Nation. In addition, to further aid the much-needed progress on the Tohono electrical infrastructure, TOUA purchased two additional replacement transformers for the Lakeshore substation from EPS. The first piece of equipment was released for design, with the second

to be built and shipped after the previous installation.

During this time, TOUA replaced the interrupter element on the west 230kV circuit switcher and returned the East transformer to service. EPS also assisted TOUA with issuing an RFP for contractors to bid on the proposed work at the Lakeshore substation. The RFP was sent to five reputable construction companies within the area, none of which responded with bids for various reasons, most notably due to the complexity of such a large-scale remote project.

To expedite the project, EPS proposed TOUA hire a civil subcontractor to pour the foundations and utilize the TOUA in-house crews to erect the substation structures, performing all the work in the high voltage path. EPS would then purchase, install, and terminate the secondary wiring and perform the necessary testing at the Lakeshore substation.

In 2018 EPS completed the new control building and relay designs and hired a civil subcontractor to assist with the following tasks:

- Oversee the pouring of new foundations and installation of cable trench
- Receive and install new control building
- Oversee the TOUA crews during the installation of new circuit breakers and other high-voltage equipment
- Oversee EPS crews during the installation and termination of new/old cables
- Oversee testing and commissioning of the Lakeshore substation

Upon completion of the Lakeshore substation, EPS began rebuilding their metering facility, which sits East of Lakeshore. The rugged terrain and land constraints posed complications for building a new control shelter for the metering facility. This temporary roadblock highlighted a new path for EPS to design the replacement relays and Supervisory Control and Data Acquisition (SCADA) equipment into an existing enclosure with an HVAC system with insulation and new station batteries.

Once the new 69kV circuit breakers were delivered, TOUA and EPS worked together to install and

commission the three breakers at the Lakeshore substation. TOUA also modified the control cabinets at the metering station with HVAC and insulation and updated the relay and SCADA with an SEL-T400L time delay relay on the 69kV circuit breaker. These implemented changes successfully brought power back to this desert nation.

Conclusion

Throughout the years since the initial phases of the ongoing relationship with TOUA, EPS has also assisted with the following:

- Designing and implementing a remote operations center at the TOUA headquarters to enable remote monitoring and control of all TOUA facilities
- Installed new 69kV circuit breakers
- Installed new metering transformers at Metering
- Tested, commissioned, and placed Metering into service



Control House Installation

At this time, TOUA and EPS have an exclusive relationship for maintenance, testing, commissioning, SCADA, studies work and other consulting needs as the Tohono O’odham nation continues to evolve, grow, and modernize their electrical grid.