

AMSC[®] D-VAR VVO[®]

Case Study: Recovering Unserved Energy by Solving PQ Problems



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1. Introduction

The D-VAR VVO® STATCOM is a high-performance distribution-class voltage regulation solution. Utilities employing the D-VAR VVO STATCOM can eliminate common voltage constraints that occur on utility circuits and deliver an attractive stack of benefits to their end-customers. As a result of these benefits, the D-VAR VVO solution can offer justifiable capital deployment opportunities for utilities.

A summary of the value stack for utility applications of the D-VAR VVO STATCOM is provided in Figure 1.

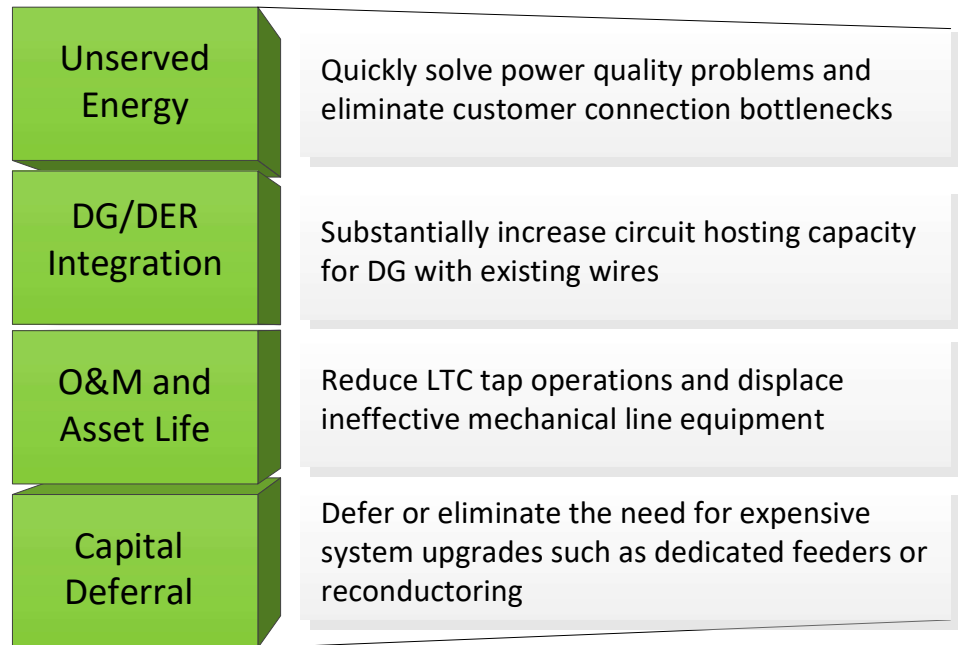


Figure 1. Value stack for D-VAR VVO applications.

While most D-VAR VVO applications provide multiple or all of the benefits within the value stack, this case study will highlight the *unserved energy* value of a specific installation.

2. The Problem

A utility customer operating a quarry was creating power quality problems including flicker and low voltages. These problems caused other utility customers on the circuit to experience poor equipment operation, as well as down-time due to tripping of certain loads.

Due to these problems, the quarry customer was forced to disconnect their main operating loads from the grid. The stop-gap solution was to run the operation with on-site back up generation. As a consequence, the following occurred:

- The utility lost 100's of MWhr's of served energy during this time
- The quarry operation electricity cost more than doubled due to fuel and maintenance costs
- A significant increase in carbon emissions due to the use of on-site generation

The blue trace in Figure 2 shows an actual low voltage event caused by the quarry operation, occurring up to two times per hour (less severe events also occurred more frequently). The red line indicates the

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level the voltage must stay above in order to comply with utility industry flicker standards, as well as to ensure that other utility customers are not experiencing unacceptable service quality.

The graph clearly illustrates why the customer was not able to remain connected to the utility grid.

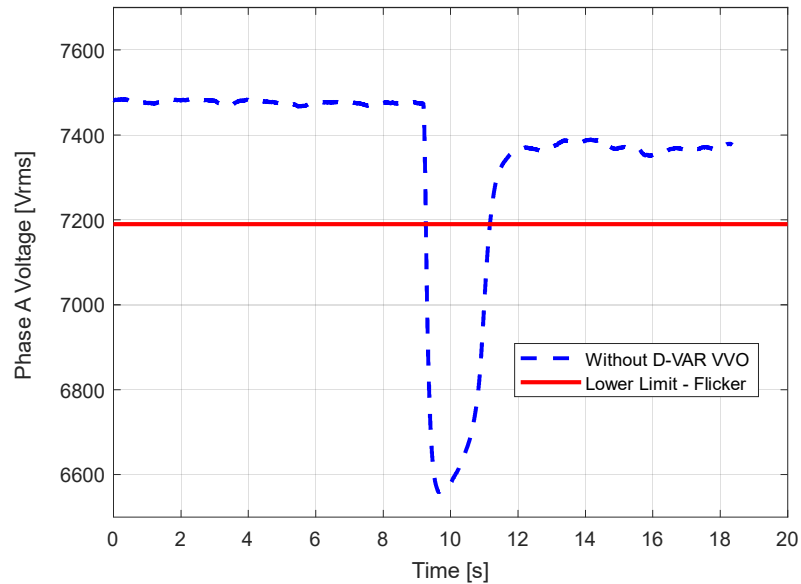


Figure 2. Recorded voltage event causing customer down time and flicker problems.

3. The D-VAR VVO Solution

The utility considered several options to address this problem and bring the customer back on the grid. After thorough investigation, the D-VAR VVO emerged as the most attractive solution. The following table summarizes the alternate solutions that were considered and why they were not viable.

| Considered Alternative | Reasons for elimination |
|---|---|
| Change customer operation and/or equipment | Utility cannot dictate customer choices; Customer was not sure how to make effective changes |
| Add a new line voltage regulator | Too slow to solve the problem |
| Reconductoring the feeder | Too expensive and marginally effective |
| Build a dedicated feeder to serve that customer | Far too expensive and time-consuming |

Table 1. Alternative solutions for improving quality of service and recovering unserved energy.

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The utility procured a D-VAR VVO solution and installed it on the existing 15kV class feeder near the quarry customer operation. A picture of a typical feeder installation of the D-VAR VVO equipment is shown on the title page of this case study. The figure below shows a similar event with the D-VAR VVO STATCOM now installed and compensating the circuit. The flicker and low voltage issues are clearly solved by the D-VAR VVO solution.

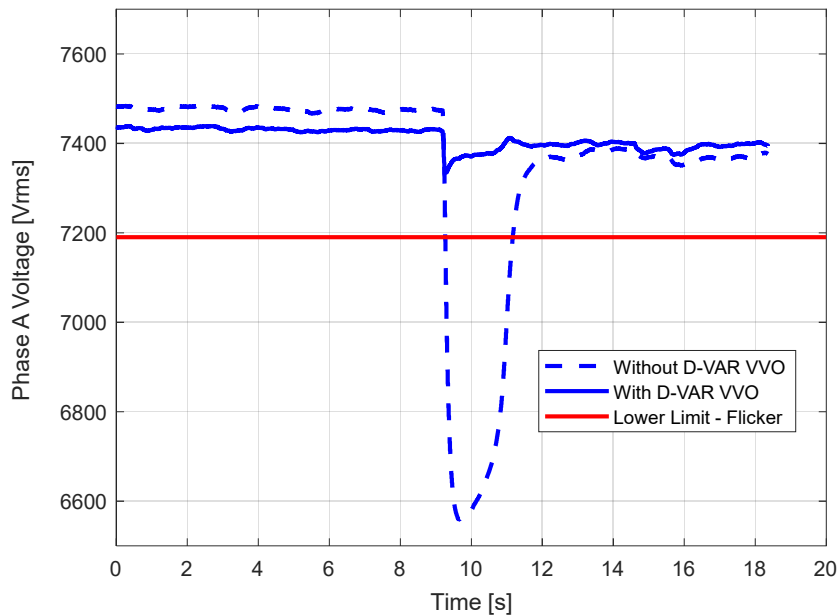


Figure 3. Line voltage during customer operation with the D-VAR VVO installed on the circuit (solid blue line).

The D-VAR VVO responds continuously and rapidly to correct voltage problems (by injecting or absorbing VARS). This performance is possible because the D-VAR VVO is a power electronics device that adjusts output *thousands of times per second*.

D-VAR VVO solutions typically require no special coordination with existing utility equipment. The existing line regulators and capacitor banks remained in place and the settings were unchanged. After observing the field performance, the utility chose to remove a nearby switched capacitor bank because the powerful D-VAR VVO solution alone provided superior volt/var compensation for the circuit.

The utility has placed additional D-VAR VVO solutions in order to continue to enhance the service quality of their distribution grid.

4. Summary

The D-VAR VVO solution in this case study achieved the following economic benefits:

- Reduced the quarry energy cost by nearly 50% by allowing utility grid connection
- Recovered the utility lost revenue due to the unserved energy of that customer
- Allowed the utility to serve additional customers on that feeder without wire upgrades
- Reduced O&M cost by allowing removal of an ineffective mechanically switched capacitor
- The D-VAR VVO solution *paid for itself in approximately one year*

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Power quality issues similar to those highlighted in this case study are most likely to occur on longer distribution feeders, and are commonly caused by loads such as:

- Medium duty industrial operations that involve crushing, chipping, conveyors, etc.
- Irrigation pumping
- Oil & gas well operations
- Line start Motors rated above 150 HP

D-VAR VVO®

Helping utilities enhance service quality at the:

- **Right time** – Systems typically in stock or 20 wk standard lead time
 - **Right size** - 1MVAR and 2MVAR sizes are tailored to distribution needs
 - **Right location** – Distribution-class apparatus can be installed anywhere that it needs to be
 - **Right certainty** – The performance certainty of utility-grade and utility-owned equipment
- =
- **Right value** – Multiple benefits enable attractive capital deployment

5. Other Recommended D-VAR VVO Case Studies

Website: <https://www.amsc.com/gridtec/distributed-generation-solutions/#dvarvvo>

D-VAR VVO Case Studies:

- Recovering unserved energy by solving power quality problems with D-VAR VVO solutions
- Serving modern energy users: Increasing DG and Solar Hosting Capacity with D-VAR VVO Solutions
- Connecting distribution solar and wind plants into existing feeders with D-VAR VVO solutions