Shredding is a critical aspect of the recycling business. And it's power-intensive.

If reducing one scrap bundle requires "X" amount of energy, then reducing 200 scrap bundles requires 200 times as much. But shredder profitability is production-oriented: savvy operators don't ask "How much energy will it take?", but rather "How fast can it go?" Profitable shredding is simple physics and depends directly on the amount of power a shredder motor can consistently generate and apply to the load. Shredder power depends upon motor torque and shaft speed. For example, a typical AC wound rotor motor-powered shedder rated at 4160 volt, 4,000 HP and 514 RPM generates about 105,000 ft-lbs of torque when operating at full ("nominal") voltage, and full speed.

When planning new installations, shredder operators often gravitate towards the largest motor they can afford to install at site. The motor sizes considered are often limited by the amount of power that the serving utility can supply. Frequently, the electric power supplier for the site has concerns about "voltage flicker" – how much the shredder operations will cause the voltage on its circuits to change rapidly, and to the utility, uncontrollably.

To avoid the possibility that the shredder will affect voltage stability on the power lines, some power companies limit the motor size allowed at the site. Other power companies offer expensive power construction projects such as new circuits, or new substations to ensure that other customers are not affected by shredder operations. Many power companies simply require the shredder operator to meet voltage stability or "flicker" requirements.

SVCs


Shredder with SVC

SVCs (static VAR compensators) are a proven way to meet utility flicker requirements. These systems are installed on the main power feed to the motor, or where the operation interfaces with the power company. With a properly-designed SVC, an operator can meet utility requirements, and simply run their business.

But using an SVC also effectively increases shredder motor horsepower. The increase occurs because, while mitigating flicker, the SVC also prevents the motor voltage from sagging as the shredder is operating.

An SVC analyzes the amount of power a "load" (in this case a shredder) is drawing, and adjusts 60 times a second, to keep the voltage stable. This is not just theory: the following illustrations are drawn from data collected at a 4,000 HP wound rotor shredder which has had an SVC in service for years. The charts cover four and one-half minutes of operation: during this time, the SVC makes 1,988 adjustments responding to shredder operations and maintaining voltage. (This is 210,000 adjustments per shift, or 1,050,000 adjustments over 40 hours of operation.)

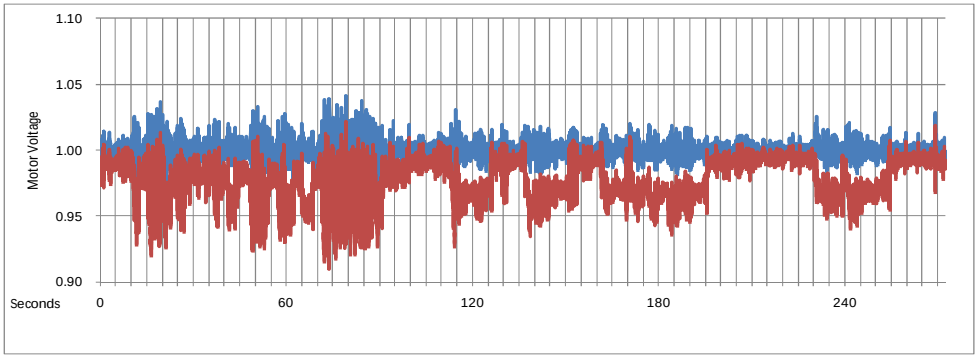
SVCs are used for new, existing, or expanding shredders including:

- **AC Wound Rotor.**
- **AC Squirrel Cage.**
- **VFD and DC Drive operations.**

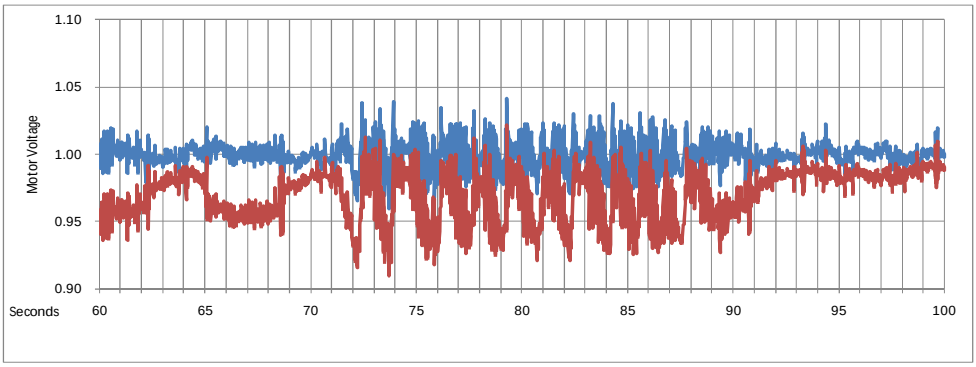
Voltage Stability

The **blue** shows the voltage each cycle with the SVC in operation over the entire interval. The **red** line is the voltage without the SVC in operation. In each case, 1.0 is "nominal". When voltage is measured at this rate, some variance (up to 1.5%) is normal. Over the period, the SVC holds voltage stable: otherwise it varies by up to 8% from nominal.

The voltage swings occur because the shredder is in use and the motor is being called upon to put out more power. When the motor is idling, the voltages are (almost) the same.



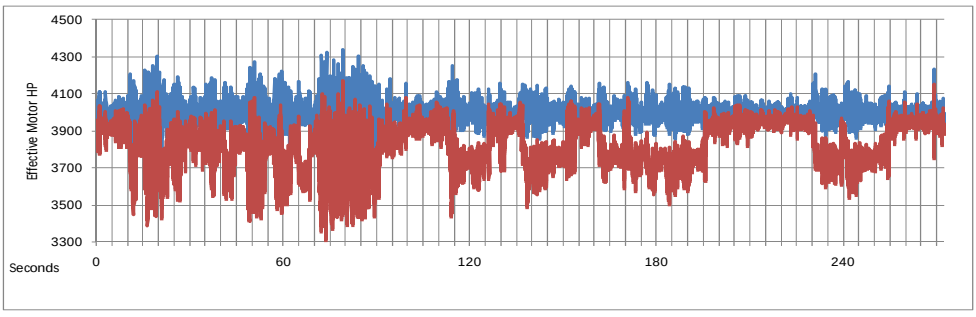
The more power the motor is called upon to put out, the greater the divergence. The period between 60 and 90 seconds shows the greatest power draw. Seen close-up, the "non-SVC" case shows twelve rapid voltage swings of up to 8% in one 15-second period. With the SVC, these swings are shorter, averaging less than 3%. The voltage swings with the SVC operating are not noticed by either the utility or neighboring power customers. Without the SVC both the utility and neighbors notice immediately.



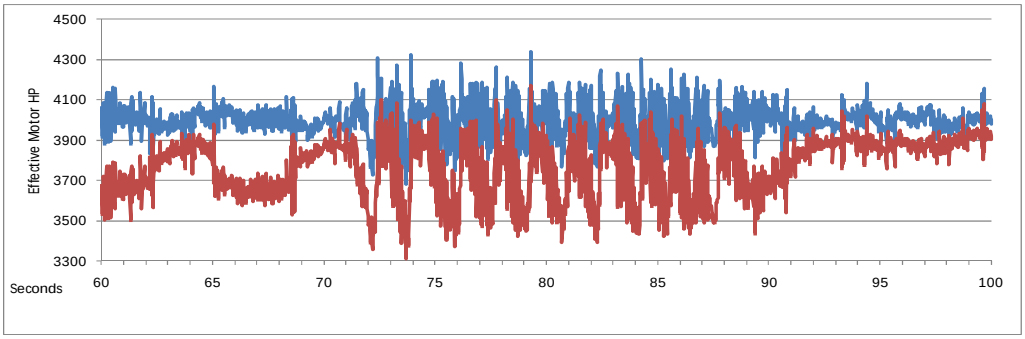
Motor Torque

It's important to be a good neighbor, but the operator also benefits . Here is a comparison of motor torque over the same period. Again, the shredder operating with the SVC is in **blue** while the uncompensated operation is in **red**.

During the 4 minute and 30 second period, the SVC provides the equivalent of about 200 *additional* HP on average, dropping to 15-20 HP as the motor idles.



But that's not the most important fact. Looking at the same heavy-loading interval again, the difference in effective HP during the heaviest loading period is about 400 HP, and the average over this interval is about 300 HP.



Summary

This client bought an SVC because it offered immediate capital savings over the new service offered by the utility. (It also allowed them to start-up in 22 weeks as opposed to 11 months.)
They got that. They also got 7.5-10% more horsepower from the same motor when it's needed most. When the SVC is not available, nearby utility customers know because of the flicker and the operator knows because production drops.

Power Considerations for Shredder Operations:

1. What electrical service is available at the site today (*voltage, fault current, X/R*)
2. What are the service provider flicker standards that must be met?
3. What's the largest allowable motor without utility changes or an SVC?
4. What are the utility changes, how much do they cost and how long would they take?
   After they are complete, what is the largest allowable motor?
   How much would the voltage sag when the motor is loaded?
5. What does an SVC cost (with 20 week delivery)?
   What is the largest allowable motor after SVC installation?
   How much would the voltage sag when the motor is loaded?

In addition to providing SVCs, T-Star can:

- Perform power system simulations to predict operating sags (with or without SVCs).
- Assist in negotiations with Power Delivery companies.
- Interpret flicker power contract standards.
- Prepare SVC controls status outputs for integration with plant PLC system.

WHY SVCs IMPROVE SHREDDER SITING AND PERFORMANCE

T-Star Engineering, based outside Pittsburgh, Pennsylvania specializes in helping both power grid operators and power customer clients who need to place large "problem" loads on to power grids. Often, this means designing, providing, commissioning, and maintaining a Medium Voltage Static VAR compensator.


SVC performing phase-independent con-

T-Star offers a family of SVC products, and provides SVC quotations in response to RFP/RFQs prepared by others. However, if clients want a single entity willing to take "end-to-end" responsibility beginning with a "needs analysis" and ending with an installed solution, T-Star is ready to meet all "end-to-end" requirements including power system analysis, solution development, manufacturing, commissioning, and training. Clients include power grid operators and end-user customers, as well as Architect/Engineering firms, and System Integrators among others.


SVC for single-phase welding operation.

Modern Medium-Voltage Static VAR compensation technology was developed in the 1990's. Since that time, over 100 Medium Voltage SVCs have been installed at customer sites throughout North America, and T-Star's principals have been involved in virtually all of those projects. Customers, grid operators, and power users alike benefit from the unique and extensive experience gained from dozens of installations and hundreds of application analyses.

The extensive experience of T-Star's personnel translates into constant reviews and improvements of SVC design, and underlies T-Star's unique capability to maintain, service, upgrade, and modify existing Medium Voltage SVCs whether manufactured by T-Star or others. T-Star can provide Clients with existing SVCs cost-effective means to: alter the size and use of their SVCs, take advantage of the latest in control and monitoring capability, or improve the performance of troublesome SVCs.


SVC for 5,000 HP auto shredder.

Compact, reliable, and affordable, SVCs operate large loads efficiently on electric grids, quickly and affordably.

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