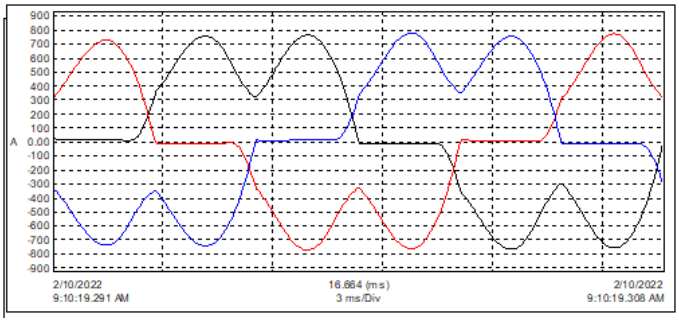
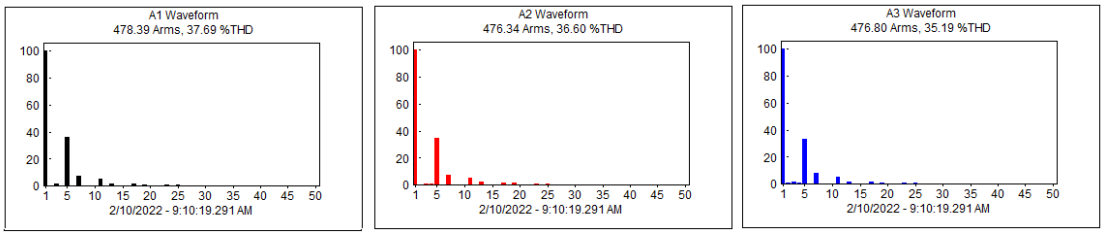
Case Study 700 HP project: Estis Compression – Permian Basin

A Gas Lift contractor Estis Compression located out of Kilgore; TX contacted us to help them resolve a potential harmonic challenge for a new install in the Permian Basin. The Utility had advised the Current Harmonic limit (Ithd) at their PME (Primary Metering Equipment) would be 8% or less, based on their interpretation of IEEE 519-2014, which was the version in effect at time of the project. The current version of IEEE-519 is dated 2022, but there were not changes to the target values over the previous version. Five Star Electric worked with Estis to develop a system harmonic model and specified the filter requirements. Estis purchased and installed two Mirus AUHF-ED 700HP Extreme Duty filters as part of the VFD driven electric compressor package. The critical measurements showing significant improvement in harmonic condition is noted below:

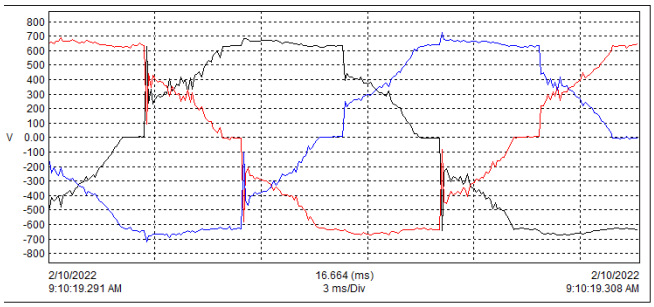
Unfiltered Harmonic Profile:

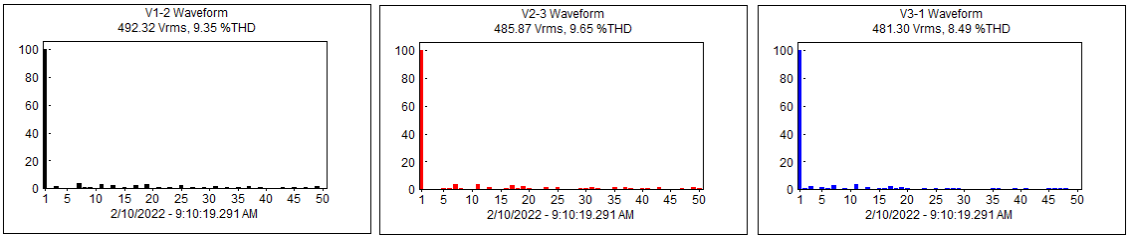




The VFD already had a line reactor installed which would account for the lower normal harmonic profile exhibited, but the untreated Current Harmonic injection (Ithd) still ranged from 35.19% to 37.69% with the dominate harmonic present on the 5th (300 Hz) with lower harmonic profiles on other higher frequencies. There is a typical double hump configuration with no errant harmonic frequencies. The current balance is excellent, so the drive was performing within the specification.

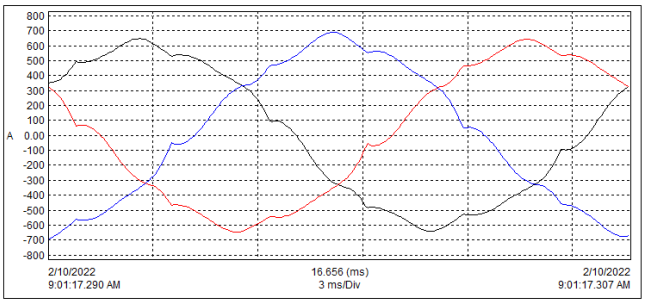
The voltage distortion was likewise measured above IEEE 519 limits. Per the standard, the Vthd should be limited to an 8% Vthd or less, but measurements showed a range of 8.49% to 9.65%.

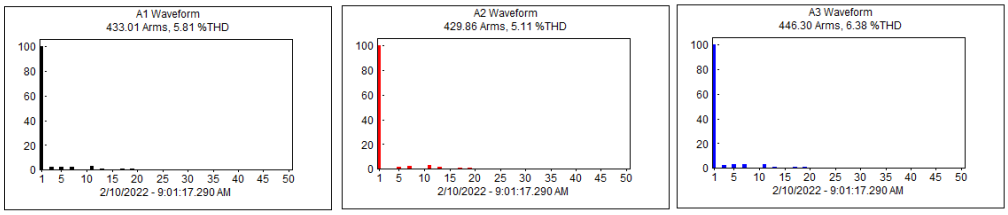




Filtered Harmonic Profile:

With the deployed FSE/Mirus Extreme Duty filter in service, the testing showed a dramatic improvement is both current harmonic levels and associated voltage distortion.



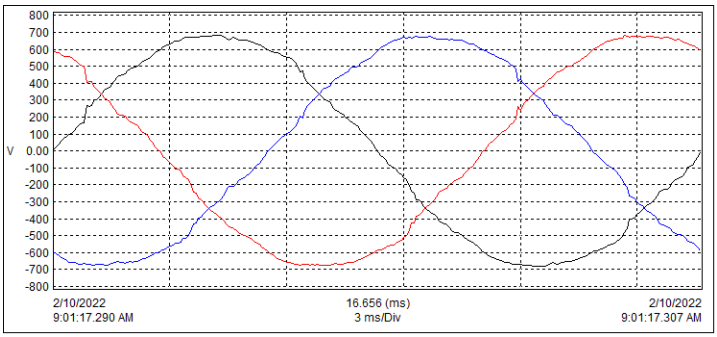


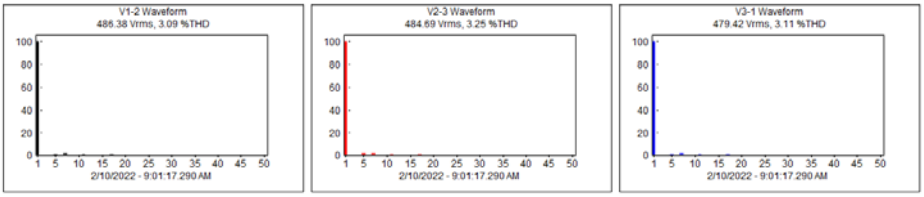
Ithd after filtration ranges at a very low 5.11% to 6.38%. Of note is the IEEE519-2022 compliance criteria would be 8.0% based on the SC ratio of the application. It should be noted that the testing was being conducted at a load profile of 52% of full load current, which would indicate the Ithd measured would be even lower at higher load profiles. The current harmonic witnessed significantly exceeded the IEEE requirements. Note the comparative of the power profiles below:

Power Readings	Unfiltered	Filtered	Improvement
W - Real Power	119.8k W	119.3k W	Functionally Unchanged
VAR - Reactive Power	51.12k W	9.485k W	81.40%
VA - Apparent Power	130.2k W	119.7k W	8.06%
Total Power Factor includes harmonics	0.92	0.99	8.32%
Displacement Power Factor (DPF) Cos Θ	0.99	1.0 Unity	1.00%

The deployment significantly improved the Total Power Factor which includes the harmonic kVAR from the operation. This can be witnessed by the 81.4% reduction in the Reactive Power being consumed by the load structure. The apparent power was likewise being reduced by the improvement in the power factor.

For Voltage Distortion (Vthd) performance was excellent. The Vthdbg as measured within the distribution system was around 3.0% so the addition of the two VFDs with filters had little effect on the systemic background Voltage Distortion.





A quick review of the Ithd and Vthd measurements adds insight to the harmonic condition improvement:

Power Readings	Unfiltered	Filtered	% Improvement
Current Harmonic Distortion (Ithd)	36.50%	5.76%	82.98%
Voltage Harmonic Distortion (Vthd)	9.16%	3.15%	65.61%
Total Power Factor (Tpf)	0.92	0.99	8.32%

The installation of the filters clearly showed a reduction in the harmonic contribution of the Compression Drive Package and a reduction of the reactive power consumption of the load structure as well as improvement of the Total/True Power Factor.

For more information and assistance in harmonic modeling, system design, and proposals, contact:

SALES – San Antonio TX	DIRECT DIAL	CELL	E-MAIL
Mark Hajda	210-568-8940	210-627-3023	mark@vfd.com
Shannon Lux	210-568-8928	210-870-0099	shannon@vfd.com
Mike McGraw (Application Engineering)	X	713-208-8534	mmcgraw@vfd.com
SALES – Austin TX			
Chuck Stewart	X	830-832-0525	chuck@vfd.com
SALES – Houston TX			
Patrick McGinty		281-467-9113	pmcginty@vfd.com
Jason McKinley	X	713-516-4078	jason@vfd.com
SALES – West Texas			
Tery Lewis	X	806-252-9700	tlewis@vfd.com
SALES – Dallas/Ft. Worth			
Jack Dolman	X	469-563-8943	jdolman@vfd.com