Ultimate answer for greener power

Hoteam HTSVG STATCOM (Static Synchronous Compensator)

SHANDONG HOTEAM ELECTRIC CO., LTD

ABOUT US

Hoteam Electric is the leading company specializing in providing power quality solutions for utility and industry customers to ensure efficient and reliable operation of electrical systems. The company's broad range of products includes active power filters (APFs), STATCOMs (also known as SVG), capacitor banks, MCRs and many other customized power quality solutions.

In order to solve the power quality problems related to fast growing new energy installations such as rooftop solar farms as well as traditional industrial applications, Hoteam Electric offers a wide range of STATCOMs available in different voltage levels, kvar ratings and dimensions. The whole Hoteam STATCOM family includes floor standing HTQF STATCOMs with voltage level ranging from 400V to 35kV, and rack-mount/wall-mount STATCOMs for flexible installation.

LEADING PROVIDER OF POWER QUALITY TECHNOLOGY

Our company will always adhere to the "Technology leads the future" business philosophy and currently owns over dozens of patents and software copyrights

STANDARDIZED MANUFACTURING PROCESS & COMPLETE QUALITY ASSURANCE SYSTEM

As a high-tech company aiming at global power qulality market, Hoteam Electric are acquired ISO9001 certification, ISO14001certification and our products has passed CE certifications and SGS inspections successfully, in order to regulate our manufacturing. All our products are fully tested before delivery to minimize the time needed for assembly and commissioning.

Product Selection Tables

Hoteam HTSVG -0.4 400V module type SVG					
Model	Capacity (kvar)	Reference dimensions			Installation Methods
		Width (mm)	Depth (mm)	Height (mm)	
HTSVG - 0.4 / 30	30	440	445	150	Rack or Wall-mount
HTSVG - 0.4 / 50	50	440	575	177	Rack or Wall-mount
HTSVG - 0.4 / 100	100	500	580	270	Rack or Wall-mount



Hoteam HTSVG -0.4 400V cabinet type SVG					
Model	Capacity (kvar)	Reference dimensions			Installation Methods
		Width (mm)	Depth (mm)	Height (mm)	
HTSVG - 0.4 / 100	100	800	800	2200	Floor-standing
HTSVG - 0.4 / 150	150	800	800	2200	Floor-standing
HTSVG - 0.4 / 200	200	800	800	2200	Floor-standing
HTSVG - 0.4 / 250	250	800	1000	2200	Floor-standing
HTSVG - 0.4 / 300	300	800	1000	2200	Floor-standing
HTSVG - 0.4 / 350	350	1000	1000	2200	Floor-standing
HTSVG - 0.4 / 400	400	1000	1000	2200	Floor-standing

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Specifications

Model name	HTSVG STATCOM (SVG)
General electrical parameters	
Nominal voltage	0.4/0.69 kV ±15%[1]
Nominal frequency	50/60 Hz ±2%
Performance specifications	
Rated capacity	20kvar ~ 400kvar per unit
Var compensation range	100% of rated capacity, from capacitive to inductive continuously adjustable
Functionality	Power factor correction, flicker mitigation, harmonic mitigation[2], load balancing
Response time	Instantaneous response time < 0.1ms Full response time < 10ms
Inverter topology	Patented interleaved inverter topology for ripple current cancellation
Overload protection	Automatic limitation of 100% of rated capacity
Power loss	3% when at the full load
Harmonic mitigation performance for the H model of HTSVG STATCOM	
Harmonic spectrum	2^{nd} to 50^{th} harmonics
Harmonic selective compensation	2^{nd} to 31^{st} harmonics all can be selected individually, 32^{nd} to 50^{th} harmonics can be selected simultaneously
Compensation capacity	30% of rated current capacity [3]
HMI & communication	
Display	7-inch English language menu-based touch screen (10-inch version available on request)
Communication interface	RS-232, RS-485, TCP/IP
Communication protocol	MODBUS-RTU
Digital I/O	4 digital inputs, 2 digital outputs
Operation configuration	
Parallel operation	Up to 10 units
CT requirement	3 CTs required (class 0.2 or better) Secondary rating: 5A
CT location	Supply side or load side, please specify when placing order
Color	RAL 7035, other color on request
Environmental conditions	
Operation environment	Indoor
Protection class	IP3X (higher protection classes available on request)
Operation temperature	-10 ~ 40°C (higher operation temperature allowed with derating)
Storage temperature	-25 ~ 70°C
Cooling type	Forced air cooling
Humidity	Maximum 95% non-condensation
Altitude	1000m (higher operation altitude allowed with derating)

(1) Other nominal voltages available on request. For medium voltage applications a step-up transformer is required.
(2) Harmonic mitigation function only applies to H model.
(3) And the rated current capacity of the HTSVG STATCOM equals to 1.5 times of the rated capacity based on kvar.

CASE STUDY

HTSVG : dynamic PFC solution in facility with grid-tie roof-top solar farm

Suth Africa project background

Voestalpine VAE SA (Pty) Ltd is a leading partner for complete turnout systems in Republic of South Africa (RSA), including drive and safety technology, as well as for diagnostic and hazard notification systems for all railway applications – ranging from high speed to heavy haul, urban traffic and mining.

The manufacturing processes at the heavy-engineering VAE Plant in Isando, Gauteng, creates an electrical demand from the local supply authority that is very dynamic in nature, with processes switching on and off throughout the day. VAE is purchasing the electricity from the supplier against a two-part electricity tariff, which is basically a kWh real energy consumption part and a kVA Maximum Demand part.

In a drive to reduce the annual electrical energy purchases from the local supply authority, the VAE plant in Isando, Gauteng, has installed a 314kW Rooftop Solar PV Plant in 2014. This plant was commissioned in August 2014, and since then there was a reduction in kWh real energy purchases from the supply authority.

To reduce the monthly kVA Maximum Demand cost on the electricity bill, Power Factor Correction (PFC) is the most general solution to realise this. However, the low voltage (LV) PFC system of the switched-capacitor type was not functional at this plant due to failed components. These failed components could be attributed to higher than normal switching frequency of the capacitor steps as a result of the high dynamic nature of the plant's electrical load, and due to resonant over-voltages in the capacitors caused by harmonic currents and voltages present on the LV network.

On the other hand, the connection of the Solar PV Grid-tie Inverters on the plant's LV electrical network in August 2014 introduced another dynamic to the electrical load of the plant as seen from the supply utility's side. The Grid-tie inverters were configured to generate power directly into the AC grid at unity Power Factor (PF), meaning that only real power (kW) is injected into the grid from the Solar Plant. The result of this is that during daytime when the sun shines, the Solar PV Plant will reduce the instantaneous kW real power demand from the supply utility, while the instantaneous kVAr reactive power demand will remain unchanged at that instant, and will only be determined by the electrical load of the manufacturing plant itself. While the kW demand from the supply utility drops when the sun shines, the kVAr demand stays the same – the result is that the PF of the plant as a whole as seen by the supply utility decreases

How grid-tied roof-top solar farms can cause low power factor problems

National regulations requires inverters to operate at a high power factor. Further, most modern inverters operate at unity power factor. As such, the inverter itself does not constitute a problematic load with regard to power factor. However, one side effect of inverters operating at unity power factor is that solar PV systems may reduce power factor at distribution transformers. This is due to the fact that active load current is generated locally by the inverters while the upstream grid must supply all reactive load current. This results in a higher proportion of reactive to active load currents passing through distribution transformer resulting in reduction of the power factor at the transformer. However, this in itself does not present any operational problems for the network. In fact, local generation of active current reduces network losses as power does not need to be transported as far. Figure 3 illustrates graphically the mechanism by which power factor may be reduced at distribution transformers due to the interaction of PV systems.

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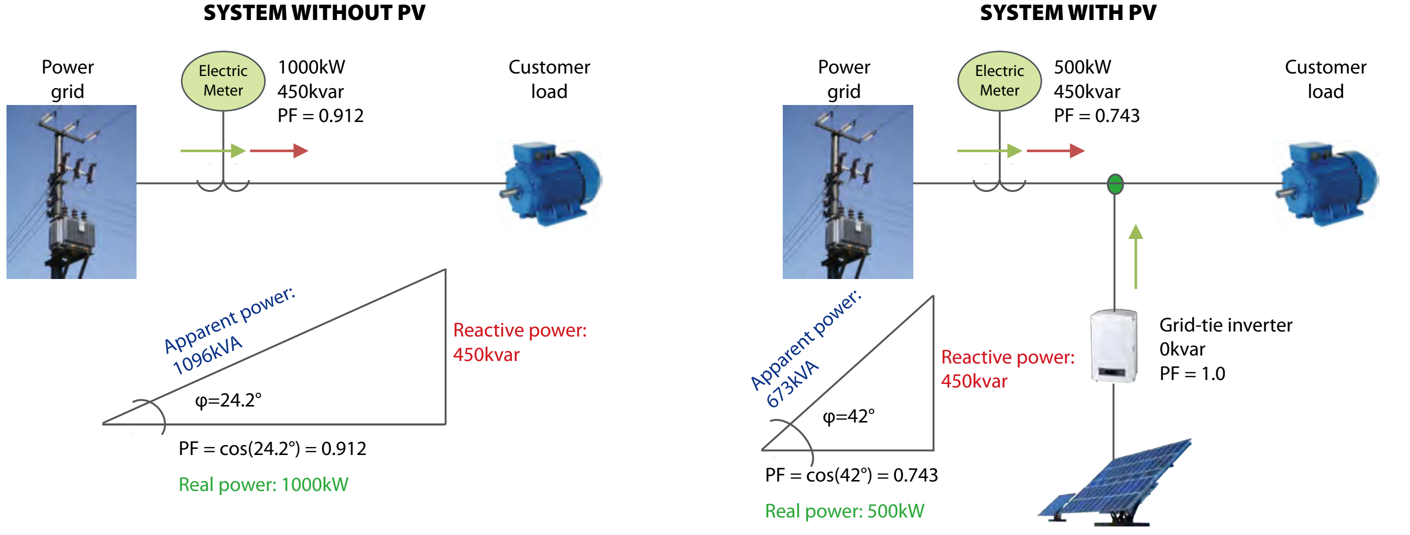

Fig.3: How PV Systems can Impact on Distribution Substation Power Factor

Solution

So VAE SA required a new PFC solution to control the PF of the plant continuously at a target level better than 0.96 (lagging) under dynamic load conditions and dynamic power generation conditions from the Solar PV plant.

A LV STATCOM solution was designed and implemented at the VAE SA plant in Isando in April 2015. The rating of this STATCOM is 266kVAr @ 400V.The single line below shows the Solar PV Plant feeding into the LV (400V) plant network, while the STATCOM is also connected on the same 400V Bus. The STATCOM uses measured current of the Main LV Incomer to calculate the correct amount of instantaneous reactive power to be injected into the network. This amount of reactive power required is determined by the plant's instantaneous electrical load and by the instantaneous real power generated by the Solar PV Plant.

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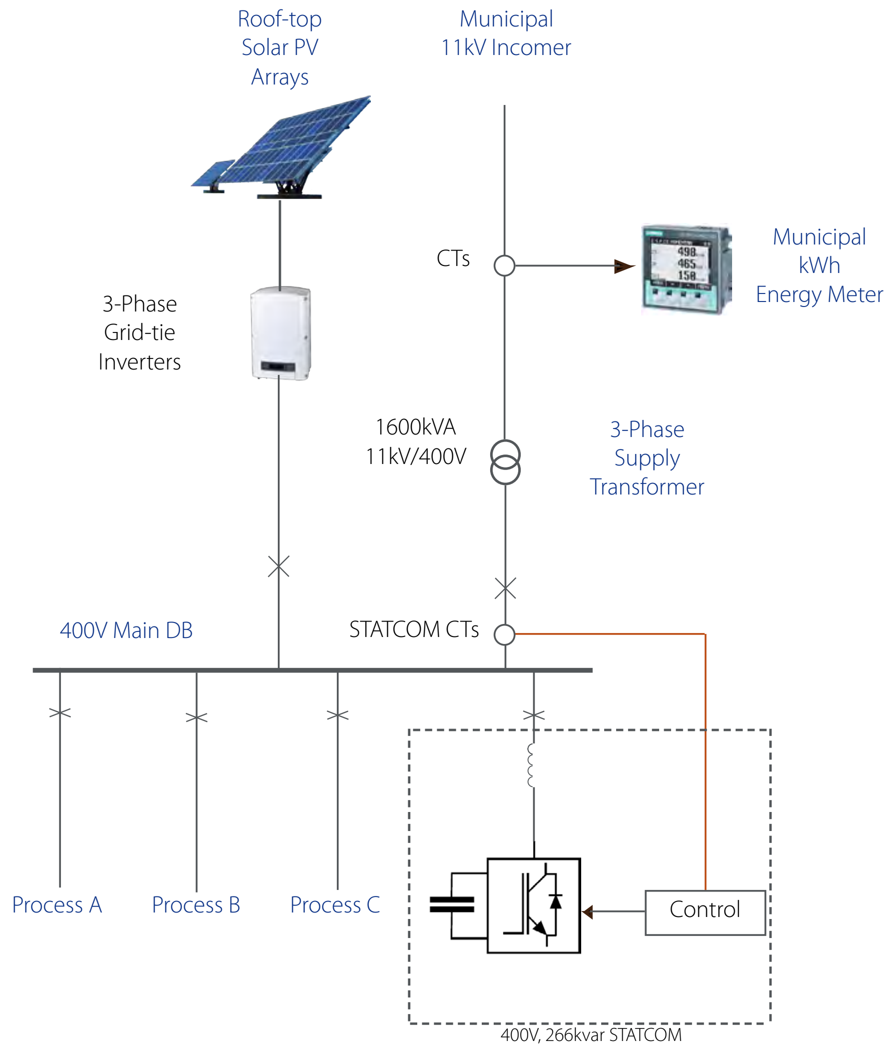
The STATCOM dynamically varies the amount of reactive power that it injects into the 400V Bus in order to keep the instantaneous PF on the Main LV Incomer better than 0.96. The transient response time of the STATCOM is 0.1ms, meaning that it will follow very fast step changes in the electrical load of the plant. In this application the PF on the LV Incomer is controlled on 0.98 (lagging), while the PF on the 11kV Input of the Transformer follows that on a constant 0.97 (lagging).



The picture below show the 266kVAr LV STATCOM installed at the VAE SA plant in Isando, Gauteng.

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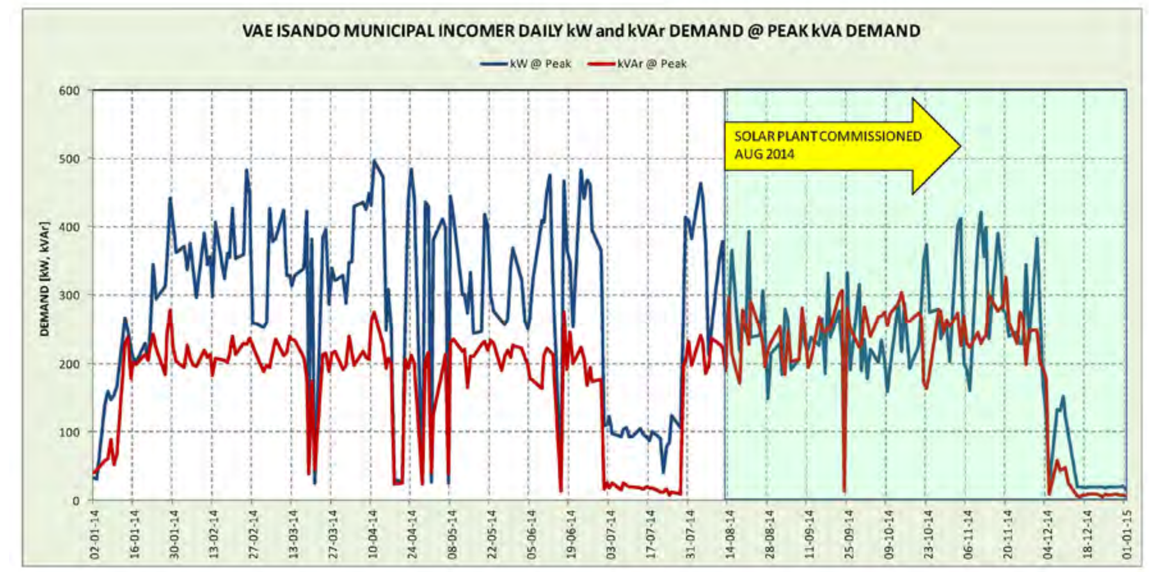
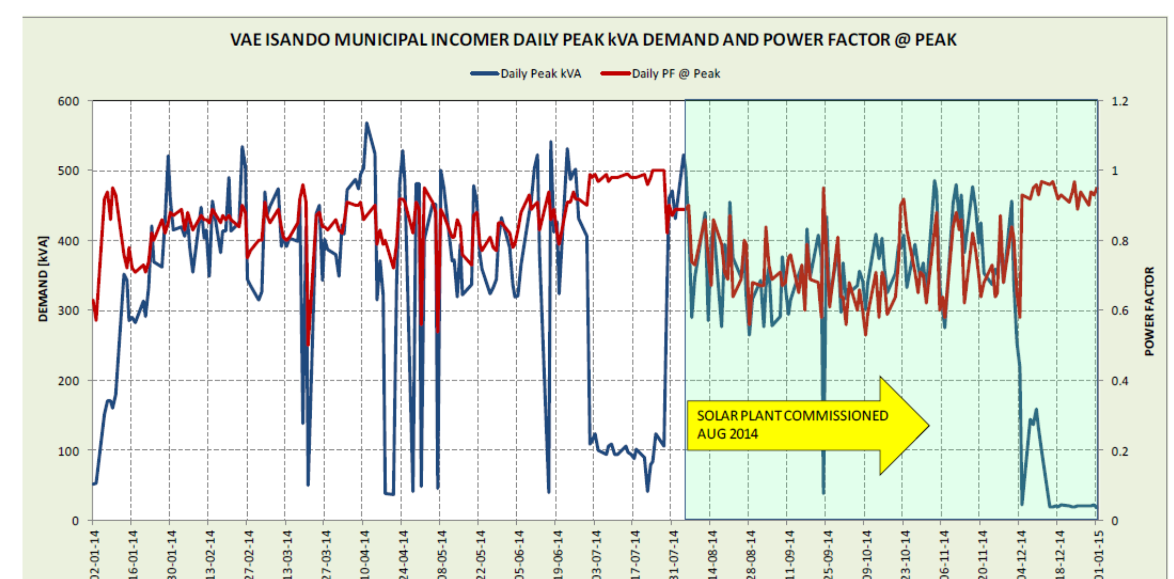
Results

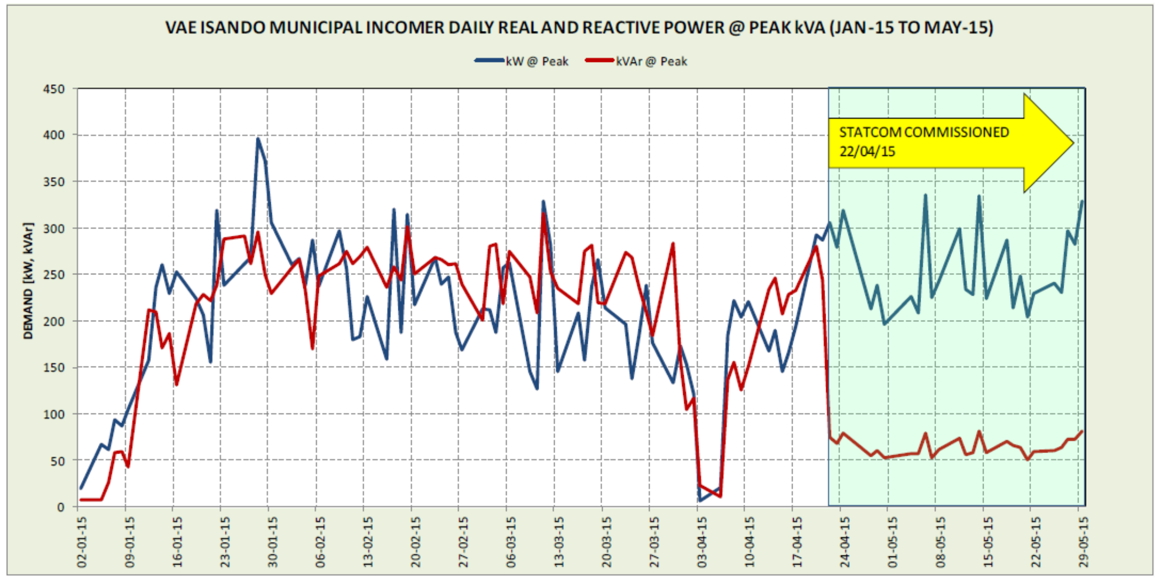
Just to give some background, the effect of the Solar PV Plant at VAE SA in Isando that was commissioned in August 2014 is shown below. The first graph below shows the weekday daily kW real power and kVAr reactive power profiles taken at daily kVA peak demand, as measured on the 11kV Municipal Incomer, for 2014. The reduction in kW real power demand (blue line) is evident since the commissioning of the Solar PV Plant. The peak kW values dropped from about 500kW to about 400kW.



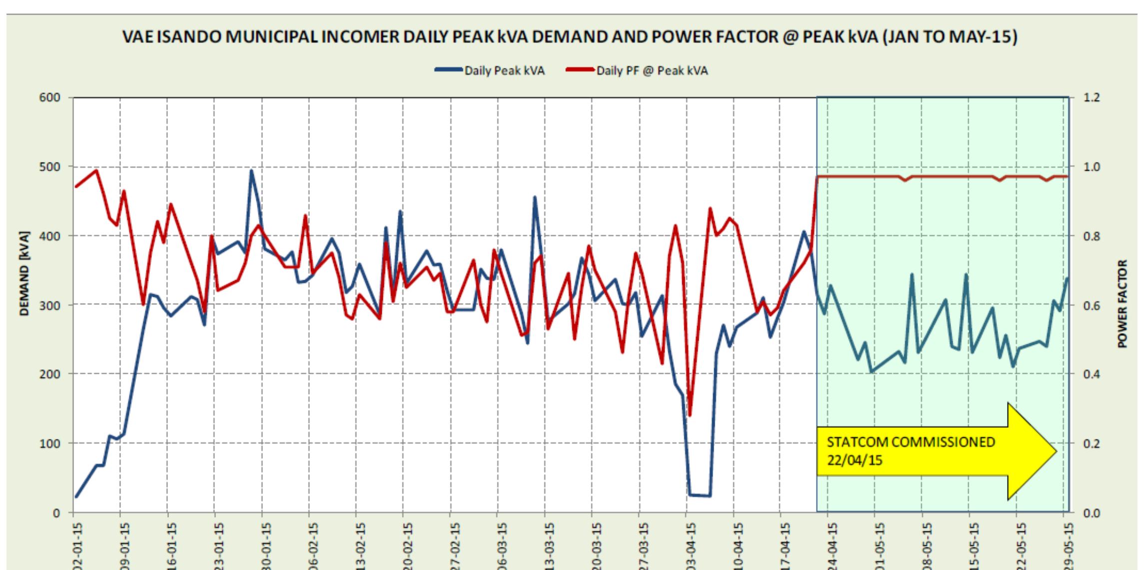
The graph below shows the weekday daily Peak kVA demand and the Power Factor @Peak. The reduction in daily kVA Peak demand as well as the reduction in Power Factor @ Peak is evident since the commissioning of the Solar PV Plant.



The effect of the STATCOM is shown in the graphs below. The first graph shows the weekday daily kW real power and kVAr reactive power profiles taken at daily kVA peak demand, as measured on the 11kV Municipal Incomer, for 2015 until the end of May 2015. The reduction in the kVAr reactive power demand (red line) is evident since the commissioning of the STATCOM in April 2015.



The graph below shows the weekday daily Peak kVA demand and the Power Factor @ Peak for 2015 until the end of May 2015. The reduction in daily kVA Peak demand as well as the increase in Power Factor @ Peak is evident since the commissioning of the STATCOM in April 2015. The Power Factor @ Peak as measured on the Municipal Incomer is constant on 0.97 since commissioning of the STATCOM. The kVA Peak demand dropped from about 500kVA in earlier months to 350kVA in May 2015.



Conclusion

The LV STATCOM that was implemented at the VAE SA manufacturing plant in Isando proves to be a very efficient and successful solution to control the Power Factor of the plant, as measured on the Municipal Incomer, on an excellent 0.97 (lagging) under dynamic plant and solar conditions.

Since commissioning of the STATCOM, the monthly kVA Maximum Demand is reduced by about 50 - 150kVA, which will result in monthly cost savings on VAE SA's electricity bill.

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