



DVI has 7 primary patents covering our intellectual property. These patents have evolved as DVI has grown and advanced its technology. This summary aims to provide context and a summarized view of what each patent covers and how it supports the EDGE® solution.

1. CVR - Voltage conservation using advanced metering infrastructure and substation centralized voltage control

Patent # 8437883 – May 7, 2013

Inventors: Phillip W. Powell, Steven K. Parker, Melissa A. Bollbach, Mark L. Pruett

This patent makes 52 claims, but essentially the patented IP covers LTC and regulator control based on voltage input from a subset of voltage sensors for the sake of saving energy consumption. Key elements include defining the nature of bellwether meter set size as well as the concept of automatically adapting that subset. Smart meters are referenced.

2. Manager - Management of energy demand and energy efficiency savings from voltage optimization on electric power systems using AMI-based data analysis

Patent # 9325174 – April 26, 2016

Inventors: Stephen J. Tyler, Phillip W. Powell

This patent has relatively fewer claims but broadens the voltage control methodology to include the concept of Nodes, Zones, and Blocks. A major expansion of IP is the concept of how to control line capacitor banks as part of the voltage optimization system. This patent further emphasizes the use of AMI meters as well as including of focus on loss optimization modeling.

3. Planner – Electric power system control with planning of energy demand and energy efficiency using AMI-based data analysis

Patent # 9354641 – May 31, 2016

Inventors: Melissa A. Peskin, Phillip W. Powell

This patent makes 30 claims and lays out the use of AMI voltage data to identify outliers and understand the cause of voltage problems. In addition it addresses configuring bellwether meters and the feeder for voltage reduction control.



4. Stabilizer/High Variation Loading (HVL) – Maximizing of energy delivery system compatibility with voltage optimization using AMI-based data control and analysis

Patent # 9367075 – June 14, 2016

Inventors: Phillip W. Powell, Stephen J. Tyler, Melissa A. Peskin

This patent makes 28 claims focused on controlling voltage with a high and low band constraint.

5. Validator – Electric power system control with measurement of energy demand and energy efficiency using T-Distributions

Patent # 9563218 – February 7, 2017

Inventors: Edmund J. Hall, Stephen J. Tyler

This patent makes 68 claims focused on deriving CVR factors by comparing controlled pairing over 24, 4, or 1 hour timeframes. The Paired-T method is heavily referenced.

6. Unity – Systems and methods for Volt-Ampere Reactive control and optimization

Patent # 10367354 – July 30, 2019

Inventors: Stephen J. Tyler, Melissa A. Peskin

This patent makes 32 claims focused on achieving power factor correction on a broad system by optimizing based on local substation conditions. The methodology prioritizes fixing local power factor within the context of the system. The system power factor is categorized into one of 5 zones of performance from extremely lagging to extremely leading. The state of the system determines the aggressiveness of the local control.

7. Dynamic Impedance Mapping – Electric grid control systems and methods using dynamically mapped effective impedance

Patent # 11791655 – October 17, 2023

Inventors: Abhineet H. Parchure, Stephen J. Tyler

This patent makes 48 claims focused determining the effective impedance of a circuit from the substation to a variable set of downline sensors. Importantly it contemplates calculating this parameter utilizing power, reactive power, or current inputs from the source point. The patent also covers calculating this parameter over a time series to determine future predictions. Lastly, the patent considers goodness of prediction performance when projecting this parameter.

Family	Jurisdiction	Product	Patent Numbers					
CVR	US	Manager/Stabilizer	8437883	8577510				
Manager	US	Manager/Stabilizer	10476273	10784688	9325174	9553453		
Dynamic Impedance Mapping	US	Manager/Stabilizer	11791655	12176708				
Unity Power /factor	US	Manager/Stabilizer	12107422	11626735	10367354			
High Variable Loads	US	Stabilizer	11132012	11550352	10274985	10768655	9582020	9367075
Planner	US	Planner	10775815	9354641	9678520	10386872		
CVR Factor	US	Validator	9887541	10666048	9847639	9563218		

US Patents

Inventors	Topic	US Patent	Date Granted
Powell/Tyler/Peskin	HVL	11132012	9/28/2021
Powell/Tyler/Peskin	HVL	11550352	1/10/2023
Powell/Tyler/Peskin	HVL	10274985	4/30/2019
Powell/Tyler/Peskin	HVL	10768655	9/8/2020
Powell/Tyler/Peskin	HVL	9582020	2/28/2017
Powell/Tyler/Peskin	HVL	9367075	6/14/2016
Tyler/Hall	M&V	9887541	2/6/2018
Tyler/Hall	M&V	10666048	5/26/2020
Tyler/Hall	M&V	9847639	12/19/2017
Tyler/Hall	M&V	9563218	2/7/2017
Peskin/Powell	Planner	10775815	9/15/2020
Peskin/Powell	Planner	9354641	5/31/2016
Peskin/Powell	Planner	9678520	6/13/2017
Peskin/Powell	Planner	10386872	8/20/2019
Powell/Parker/Peskin/Pruett	CVR	8437883	5/7/2013
Powell/Parker/Peskin/Pruett	CVR	8577510	11/5/2013
Tyler/Powell	Manager	10476273	11/12/2019
Tyler/Powell	Manager	10784688	9/22/2020
Tyler/Powell	Manager	9325174	4/26/2016
Tyler/Powell	Manager	9553453	1/24/2017
Parchure/Tyler	Z Map	11791655	10/17/2023
Parchure/Tyler	Z Map	12176708	12/24/2024
Tyler/Peskin	Unity	12107422	10/1/2024
Tyler/Peskin	Unity	11626735	4/11/2023
Tyler/Peskin	Unity	10367354	7/30/2019

CA Patents

Inventors	Topic	CA Patent	Date Granted	CA Patent	Date Granted
Powell/Tyler/Peskin	HVL	CA2906025C	4/11/2023		
Tyler/Hall	M&V	CA2016521104A			
Peskin/Powell	Planner				
Powell/Parker/Peskin/Pruett	CVR	CA2758536C	7/5/2016	CA2929916C	3/12/2019
Tyler/Powell	Manager	CA2905076C	4/4/2023		
Parchure/Tyler	Z Map	CA3174426A1			
Tyler/Peskin	Unity				

MX Patents

Inventors	Topic	MX Patent	Date Granted	MX Patent	Date Granted	MX Patent	Date Granted
Powell/Tyler/Peskin	HVL	MX391242B		MX349421B		MX368041B	
Tyler/Hall	M&V						
Peskin/Powell	Planner	MX2015011547A					
Powell/Parker/Peskin/Pruett	CVR	MX2011009052A					
Tyler/Powell	Manager	MX349422B		MX391143B			
Parchure/Tyler	Z Map						
Tyler/Peskin	Unity						

AU Patents

Inventors	Topic	AU Patent	Date Granted	AU Patent	Date Granted	AU Patent	Date Granted
Powell/Tyler/Peskin	HVL	AU2014239691B2	10/26/2017				
Tyler/Hall	M&V						
Peskin/Powell	Planner						
Powell/Parker/Peskin/Pruett	CVR						
Tyler/Powell	Manager	AU2014239662B2	7/9/2017	AU2017272154B2	6/20/2019	AU2019232868B2	9/23/2021
Parchure/Tyler	Z Map						
Tyler/Peskin	Unity						

JP Patents

Inventors	Topic	JP Patent	Date Granted	JP Patent	Date Granted
Powell/Tyler/Peskin	HVL	JP2016516386A			
Tyler/Hall	M&V	JP2016521104A			
Peskin/Powell	Planner	JP2016517685A			
Powell/Parker/Peskin/Pruett	CVR	JP2013243925A			
Tyler/Powell	Manager	JP2016519916A			
Parchure/Tyler	Z Map				
Tyler/Peskin	Unity				

CN Patents

Inventors	Topic	CN Patent	Date Granted
Powell/Tyler/Peskin	HVL	CN105264735A	
Tyler/Hall	M&V	CN105052000A	
Peskin/Powell	Planner	CN105122169A	
Powell/Parker/Peskin/Pruett	CVR	CN105449681A	
Tyler/Powell	Manager	CN105190453A	
Parchure/Tyler	Z Map		
Tyler/Peskin	Unity		

DK Patents

Inventors	Topic	DK Patent	Date Granted	DK Patent	Date Granted
Powell/Tyler/Peskin	HVL	DK3641091T3	7/5/2021	DK2973924T3	3/30/2020
Tyler/Hall	M&V				
Peskin/Powell	Planner				
Powell/Parker/Peskin/Pruett	CVR	DK2427949T3	6/29/2020		
Tyler/Powell	Manager				
Parchure/Tyler	Z Map				
Tyler/Peskin	Unity				

WO Patents

Inventors	Topic	WO Patent	Date Granted
Powell/Tyler/Peskin	HVL	WO2014152458A2	
Tyler/Hall	M&V	WO2014152398A1	
Peskin/Powell	Planner	WO2014152408A2	
Powell/Parker/Peskin/Pruett	CVR	WO2010129691A2	
Tyler/Powell	Manager	WO2014152429A1	
Parchure/Tyler	Z Map	WO2021202909A1	
Tyler/Peskin	Unity	WO2016115067A1	