SS GRID SECURITY ESSAY writing

Resiliency is yet to be defined by regulatory entities mainly because stakeholder profiteers enjoy using this word as reason to push revenue in their direction.

I propose one portion of the solution can involve utilizing genuine closed networks with proprietary operation software for power grid control. Currently engineers access control for troubleshooting with “secure” wireless phones to operate switching control systems. With a closed network, nothing can enter the control software and operating system (o s) without a physical hardwire attachment of the device. In conjunction with a closed network, the networks used can have a unique proprietary o s, software, and hardware. which makes the entire control system incompatible without available known industrial system components. This would place the hacker is a similar position to the German attack force attempting to enter Russia by rail and finding the railroad tracks in Russia were several feet wider than the German supply trains wheel trucks. In this case, there is no easy way to enter and easily navigate about within the control system for the hacker.

When remote areas of Africa obtain electricity for the first time, users first remarks involve the ease to flip a switch and have light. So, as it has gone throughout history lighting is an important part of electricity usage. Personally, as of today LED lighting might be the single most contribution to electricity usage efficiency. How much % of electric use today is due to lighting? How much lighting is now LED

The invisible hand and freedom of capitalism in the economic power generation marketplace can be a large portion of the answer. Power generation diversity in itself can be grid security.

As the age old saying goes: The more the merrier. We have moved from a power generation system owned and controlled by (28 entities) in (1940) to (millions) of independantsources for power generation. These sources can be as small and simple as a homeowners rooftop mini microgrid to a large baseline power geothermal generation project. This isn’t your father’s power grid generation system anymore. The wide diversity in itself offers resiliency from natural threats while simultaneously providing more open doors for cyber sabotage entry points. Profiteers and politicians no longer retain complete control over who can enter the market to generate and sell electricity. The main ticket to entry today is to meet the specifications an d standards necessary for quality. Security known as grid resilience is becoming centered in development of microgrids.

In 1980 wind and solar were far too expensive. Even just 5 years ago, Government representatives scoffed at the possibility of today’s reality. Renewable energy is cheaper than ever. In fact, wind energy is the cheapest form of electrical production with a ( ) cost per kW according to( ) . There is one huge caveat to this explosive growth of renewables. We have to store the electricity renewables produce because demand spikes when the sun is down and demand drops when the sun is shining bright. Meeting electric demand is all about an ability to meet peak demand. (Operators) work tirelessly project usage needs and to stay ahead of minute to minute demand. We do this by continuously covering a baseload and turning on more generation during demand spikes. We must focus on electricity storage devices. This is where the race to develop grid battery efficient technology explodes. Can we become cost efficient with battery storage technology soon enough?

When will the EV penetrate 10% market share. Will that cause grid disruption through massive demand ? Maybe yes if we don’t prepare. However, think about all those batteries and their potential to both create demand and be small widely distributed storage devices. These millions of EV batteries can also be used to balance the grid and add to grid diversity.

Can government investment in new technology grid infrastructure projects pay dividends?

Recently, Texas experienced a weather anomaly. Temperatures dropped 30 degrees below normal for several weeks. ERCOT Texas power whatever they are… failed as millions of Texans froze in their homes without running water or heat.

California government dreaming of ending nuclear power generation recently decided to order nuclear plants shut down. The infrastructure for replacing nuclear generation is not in place. This bold move is spurring California to lead the way in developing energy storage technology but the move also caused unnecessary brown outs to multiply.

Threats to our power grid can be classified as known or unknown and natural or intended sabotage.

Proactive/ reactive

The invisible hand and freedom of capitalism in the economic power generation marketplace can be a large portion of the answer.

Supervisory Control and Data Acquisition (SCADA) is the interactive control at the heart of the smart grid. Is there too much demand during a 15 minute period near noon on a sunny day? SCADA can leave thousands of air conditioners off, and turn them on as demand subsides or more peak power generation comes gently online. This is accomplished by sacrificing individual unit control to a region wide control system. What could possibly go wrong? Examples of SCADA in action

<https://www.sciencedirect.com/topics/engineering/supervisory-control-and-data-acquisition-system>

“All SCADA systems collect real-time and historical information and then provide operational personnel with a wide range of modes in which this information can be displayed and accessed.”

“SCADA systems generally cover large geographic areas with the controller application housed in the appropriate terminal that is controlled by an operator working centrally. “

One Flaw too Many: Vulnerabilities in SCADA Systems

<https://www.trendmicro.com/vinfo/us/security/news/vulnerabilities-and-exploits/one-flaw-too-many-vulnerabilities-in-scada-systems>

https://www.infosecurity-magazine.com/scada-security/

Outline

Abstract

Introduction

Security

A, Threats

B. Risks Vulnerability

C Answers to avoid

D. Microgrids

Flexibility and diversity = freedom

E. Diversity is a double edge sword

F. Efficiency projected usage needs (LEDmarket penetration)

Resilience

1. Still not defined
2. An attempt at definition
3. Lessons learned Texas
4. California dreaming

Recent grid events demonstrate potential disaster and massive economic capital loss

Why do we need to improve grid security and Why this struggle still exists?

1. History of grid control
2. The plan
3. Grid in flux
4. Strength of diversity

Now and Forward (The future)

1. EV effect and projected market share
2. SCADA

Grid security involves so much more than protection from sabotage. Diversity of generation and the rise of micro grids are essential keys to grid security / reliability. Some discussion of California and Texas (why blackouts and how to avoid their mistakes which caused them) will be involved. System vulnerability verses flexibility, interconnectivity, transmission, generation diversity and decentralization, SCADA are some of the areas that can be discussed. Mention of ways to use less electricity by using efficient devices like LED lighting and how much market penetration something that groundbreaking has made so far. What about EV? When will EV penetrate 10% market share and will all those charging EV batteries actually help the grid by storing as well as charging? what is going on there.

I will need flexibility as I research the main theme of security. I hope to break out with a focus on at least 4 main areas involving grid reliability and security. I might want to have one of the four areas include the recently discovered software breach that put the grid and many other things at risk. What could happen, how could it happen, what do we do to avoid or stop it if it does happen, etc. I will be doing much current research to see what is going to be in this essay. I need to find out more by researching before I can put together a decent outline.

“The main reason why **Scada systems** are so **prone** to vulnerabilities is a lack of monitoring. As most **Scada systems** lack an active network **system**, they often fail to detect suspicious activities or to provide a proper reaction when a **cyber** attack does happen.”

“To ensure the highest degree of **security** of SCADA systems, isolate the SCADA network from other network connections to as great a degree as possible. Any connection to another network introduces **security** risks, partic- ularly if the connection creates a pathway from or to the Internet.”

<https://www.youtube.com/watch?v=_LAuDTNW5dw&t=348s> STANFORD OPENING TREND CHARTS HUGE

complex system

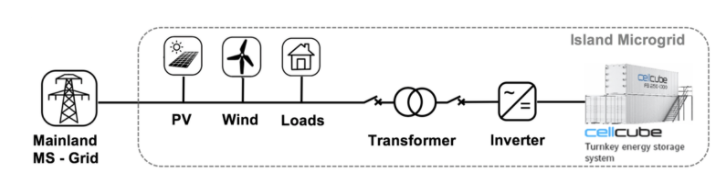
**utility of storage is directly relative to capacity of storage How long do we need to store electricity**

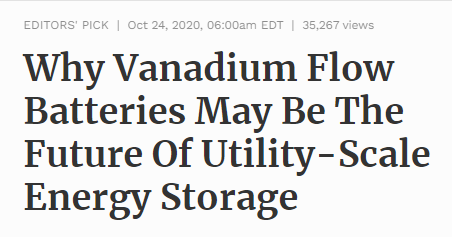
**peak shaving**

**curtailment**

**cant use it all…..dump it or store it**

**solar output shifts seasonally but demand is relatively static curtail wind and solar during low demand and ramp up during high demand**

****

****

If we build an efficient grid everyone will benefit. Society will progress exponentially. Our economy gains the means to flourish.

Does the current grid architecture have Effective load carrying capacity ELCC for tomorrows demand?

Intervention must be accompanied by measurement and oversight.

We hear much about “Greening the grid” and looking both forward and back we see consistent controversy about renewable energy sources. In fact, the rise of renewables is presenting tremendous challenges for grid security and control. Frankly, the growth of renewables as a source of power generation is driving the need for energy storage because when solar power is producing at highest levels for the day, electricity demand is low. The short term key to this storage dilemma is to study and understand exactly how many hours of short term energy storage is needed to balance supply with demand. Long term, seasonal storage solutions come into play.

There is a debate ongoing concerning Green energy. The entrenched status quo stakeholders in the energy want to protect their gravy train. The power needs of the nation, our future, and our leadership position in the world depend on the resiliency of our power grid.

Peak load sharing distribution between base load generation and batteries is an initial way to think about what we need in grid batteries in order to make renewables an efficient contributor and help eliminate gas peakers. Natural Gas generation plants are currently most cost efficient peak power producers which are switched on during peak cycle demand.

Load balancing

Our electrical energy grid traverses the entire country. This is a just in time system which means that at the precise second in which electricity is demanded that amount of electricity must be generated and supplied. Electricity demand is cyclical throughout the 24- hour day and seasons.

Harmony and smooth flow transition is key to proper grid operation. Contingency expected failure/outage contingency reserves Curtailment, a reduction in output below supply ability

Energy grids do not want to be required to have a “Black start” caused by fault and failure. A black start is starting up supply systems from dead stop. When customers arrives home from work and turn up their climate control, begin cooking dinner, and enjoy their leisure technologies the demand for energy ramps up drastically. Power frequency and voltage are maintained. They cannot be too high or too low. because if they were not kept in a tight range, brown outs would ramp into blackouts. So, our service providers maintain a continuous base load level of power generation and ramp up power generation during periods of increased demand. This is not a simple supply and demand equation as voltage and frequency must be maintained also. currently, a large part of peak load power generation comes from intermittent sources. Gas fired peaker plants are a typical generation source for peak demand. Pump hydro is the main type of battery currently utilized throughout the grid. More than 90% of the peak load adjustment comes from local sources through distribution system operators (DSO) 35% of energy produced comes from intermittent sources which destabilize the balance of power, voltage, and frequency. That is why local load balancing is critical to managing the power grid. (Barancourt, 2021)

The Energy Information Administration (EIA) Has shifted it’s focus from cost effective capacity resources to “load shaping.” Load shaping is partially done through SCADA where by smart timing control of load demand. (Electric, 2021)

Future grid architecture will increasingly involve diversity, storage batteries, and smart control to define the complex interactions of generation supply.

Microgrids Minigrids and milligrids provide diversity to our grid generation supply. Microgrids are directly connected to the main power grid and supply power from local sources Minigrids are used for remote locations and may or may not be connected to the main grid. Milligrids can be maintained to supply power for specific operations such as large stores, mines, or manufacturing plants and may not be directly connected to the main power grid. (Haun, 2019)

Managing electricity supply is not simple because our nation’s power grid is a diverse assortment of Interconnected networks.

Power Producers can be as unique as the end consumers.

We hear much about “Greening the grid” and looking both forward and back we see consistent controversy about renewable energy sources. In fact, the rise of renewables is presenting tremendous challenges for grid security and control. Frankly, the growth of renewables as a source of power generation is driving the need for energy storage because when solar power is producing at highest levels for the day, electricity demand is low. The short term key to this storage dilemma is to study and understand exactly how many hours of short term energy storage is needed to balance supply with demand. Long term, seasonal storage solutions come into play.

Capacity

Contingency expected failure/outage contingency reserves

Curtailment reduction in output below ability

Demand response voluntary and compensated load

Reduction system reliability resource

Demand Side Management DSM

Economic dispatch

Effective load carrying capacity ELCC

Electric energy storage

Fault= failure

Flexibility

Integration of electric energy storage as peak demand load sharing is an essential consideration of how grid batteries will be implemented

Abstract

Affected utility

Phase angle shift

Baseload

Low voltage brownout

Capability

Contingency

Failed to converge to a solution

Critical energy infrastructure info ceii

Demand

Dispatch = turn off/on

Auto dispatch

Kilowatt hour kWh

Load shedding

Nta non transmission alternative

Out of angle phase shifter

Phase shifting transformer

Adjusts amt of power and/or voltage has angle capacity

Reactive reinforcement = reactive compensation and capacitors

Reliability deficiency

Renewable power source

Steady state

Voltage instability

Voltage collapse Texas