FEBRUARY 2023

Global Technical Training Services, Inc. Newsletter

The State of the Industry

Sid Crouch, GTTSi Chief Technical Consultant

2022 was a year many of us would like to forget but let's reflect on it while we look forward to 2023.

In 2022, US electricity sales began to rise as recovery from the pandemic progressed. Sales increased by ~4% compared to 2021, but the costs spiked ~14%. This was largely due to natural gas prices; however, coal and renewables also contributed…their cost rose as demand surged for alternatives to natural gas, supply chain disruptions, inflation, and rising interest rates. Unfortunately, the cost for electricity is expected to remain elevated into 2023.

Extreme climate events – droughts, hurricanes, heat waves, and wildfires- tested our regional grids and these too, are expected for 2023. Our industry has responded with a focus on more flexible load options through energy storage, microgrids, and hardening the infrastructure (***boosting efforts to thwart cybersecurity threats***).

Due to passage of the Inflation Reduction Act and the Bipartisan Infrastructure Law, 47 of the largest US electric and gas utilities plan to spend a record-breaking $169.4 billion in 2023 to enhance reliability, security, and renewable integration. However, the increases in electricity costs will dramatically affect our customers as we venture into another recession. Despite these challenges, new technologies and supportive policies could provide opportunities in 2023 and help the industry achieve its goals.

I welcome your comments or questions - sid.crouch@gttsi.com

Highlights

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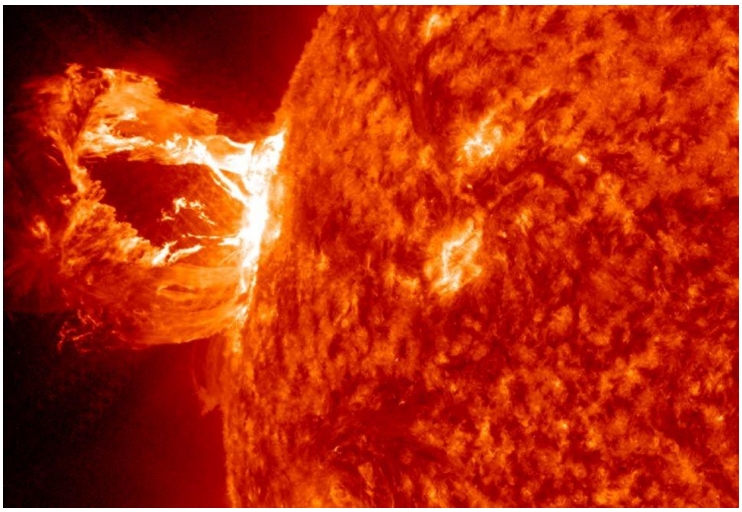
GTTSI
807 Bypass 123 – Suite 31
Seneca, SC 29678
864.882.3111
ginfo@gttsi.com
www.gttsi.com

SOLAR STORMS INCREASE – IS INTERNET APOCALYPSE IN OUR FUTURE?



Solar storms are becoming more frequent and powerful as the sun nears the peak of its 11-year solar activity cycle. In 2022 we had an abundance of solar storms – some surprises with massive sunspots and others producing vibrant aurora explosions and rare observable phenomena.

The U.S. National Oceanic and Atmospheric Administration rates solar storms from G1 to G5, where G1 is the weakest storm classification.

One storm in 2022, only a G1-class event, crashed into earth without warning causing many scientists to scratch their heads. Why? Because storms like these usually come from a coronal mass ejection (*CME*) - a burst of plasma with an embedded magnetic field that is belched out from a sunspot - but in this case researchers couldn't find any evidence that a CME occurred.

Even a G1-class event is significant because it is strong enough to create weak power grid fluctuations, cause minor impacts to satellite operation, disrupt navigational abilities of some migrating animals, and cause unusually strong auroras.

A particularly strong solar storm could have devastating effects on undersea internet cables, a crucial component of the world's internet infrastructure. Without stronger mitigation efforts against these effects, the study claims we could be headed towards an "internet apocalypse."

Massive solar tsunamis on the surface of the sun can send particularly strong CMEs hurtling towards Earth at speeds of up to several million miles per hour. While the Earth's atmosphere protects us against the radioactive effects of such storms, they can cause havoc to our electronics.

These solar superstorms have the potential to cause long blackouts, as solar winds batter the Earth's magnetosphere causing millions or even trillions of dollars of damage to electrical equipment including satellites. And it's not just a hypothetical scenario. In 1989, a solar storm was responsible for cutting off the electrical supply to over 6 million people for nine hours in and around Québec. It even halted the Toronto Stock Exchange for three hours by disrupting what was supposed to be a "fault-tolerant" computer.

Sangeetha Abdu Jyothi of the University of California, Irvine presents a hypothetical scenario in her paper, titled "Solar Superstorms: Planning for an Internet Apocalypse". She presents in her hypothetical scenario how an internet outage could persist for long periods after a strong solar storm, even lasting for prolonged periods after power returns to the grid.

Abdu Jyothi states that regional internet infrastructure is surprisingly *(continued)*

robust against solar storms because optical fiber isn't affected by the geomagnetically induced currents that are typical of solar storms. The electronic repeaters used to amplify the optical signals in long undersea cables; however, are very vulnerable to those currents, and a strong solar storm has the potential to cut worldwide connectivity by disrupting these cables.

Jyothi started thinking about the effects of solar storms on our internet infrastructure when she saw how unprepared the world was for the COVID-19 pandemic. "Our infrastructure is not prepared for a large-scale solar event. We have very limited understanding of what the extent of the damage would be," Abdu Jyothi explained.

Luckily for us, geomagnetic storms are relatively rare. We only have data from three large events in relatively recent times: the previously mentioned 1989 Québec outage, and events in 1921 and 1859. All of these occurred before the advent of the modern internet.

Not only are undersea cables vulnerable, but services such as SpaceX's Starlink satellite internet service would also be particularly vulnerable to a solar superstorm, as they orbit 340 miles above the Earth's surface. Currently, there are no models for how a strong solar storm would play out in today's internet-reliant environment. Jyothi hopes her study will lead to a renewed focus from global industries on the potentially destructive effects of solar storms on our world's connectivity.

Although the last strong solar storm occurred over three decades ago, we may be close to the next incident that could cause massive outages, potentially leading to trillions of dollars in damages to electronics and lost revenue from internet blackouts — according to *Forbes*, internet outages could cost $7.2 billion per day to the US economy. This is a number that will only rise, particularly as the world has increasingly turned to remote work. Scientists warn that we are overdue for a GMD (*geomagnetic disturbance*) that results in the induction of electrical currents throughout the planet. We first learned about this on September 1, 1859, when solar astronomer, Richard Carrington, witnessed sunspots that suddenly and briefly flashed brightly before they disappeared. Just before dawn, the very next day, auroras erupted over most of the Earth, as far south as the Caribbean and Hawaii, while the southern lights were seen as far north as Chile.

This event, named the "Carrington Event" not only produced a visible light show in areas where they had never appeared, it also caused electrical shock to telegraph operators, shooting sparks out of pylons, and causing paper fires.

Today, such an event could grind our technological infrastructure to a halt by overloading, disrupting, or destroying some of our modern technologies like satellites and cellphones, and threaten our electrical infrastructure and power grid due to grounding and digitalization of equipment and components. Because our electrical grids are grounded, they are susceptible to electrical currents induced from these storms, deep inside the Earth. Although the voltage is low - just one or two volts - our power transmission lines extend for miles, and some of these lines are hundreds of miles long, so the voltage can add up and become significant. This voltage is more like direct current, which can result in transformer coil heat up - frying the coils – resulting in a loss of that transformer. And, when power transformers go down, the damage is rarely isolated. Disruptions can ripple across the power grids and cause a major catastrophe, inflicting up to $2 trillion worth of damage and a recovery effort that could drag on for months or years – affecting the world.

"WHEN THE GOING GETS TOUGH, THE TOUGH GET GOING"

There are roughly 1,700 electric utilities in the United States. Upgrading their infrastructure to safely and reliably supply the electricity needed over the next decade will be quite a challenge and it will not be cheap. A conservative estimate is about $2 trillion over the next decade. Just "keeping the lights on" is especially challenging in some areas where demand is greater than supply. To provide the nation's needs and accomplish the nation's climate goals at the same time is difficult because this requires the elimination of coal-fired generation, and there is momentum in also eliminating natural gas-fired generation. As they say in New Hampshire… "you can't get there from here".

We can possibly meet the nation's needs without coal, but this will require our current nuclear fleet to remain in operation along with additional natural gas generation while we continue to add renewables and energy storage. Don't forget nuclear - the baseload generation supplied by nuclear has proven its value over and over again, during the past two years.

It's time the nation understands that despite continued investment in renewables, energy storage, and other carbon-free sources, we cannot make the transition to net-zero emission without the "bridge fuel" - natural gas. We have recently witnessed the consequences of premature closings of "bridge fuel" production facilities and pipeline infrastructure, resulting in unnecessary blackouts and economic upheaval both here in the U.S. and in Europe.

Today, 40% of the nation's electricity is generated from renewables and other carbon-free sources including nuclear, hydropower, wind, and solar. Therefore, natural gas and coal-fired generation make up the remainder - about 60%. With coal-fired generation being eliminated, the result is the need to increase gas-fired generation. But increasing gas-fired generation is also not easy – they need supply in order to be built and operated and the struggle for additional pipelines has been an unsurmountable problem thus far. This is evidenced, for example, by cancellation of the Atlantic Coast Pipeline – a 600-mile natural gas transmission project that would *(continued)*

Photo Credit: Crown Commercial Service

have provided much needed natural gas from West Virginia to South Carolina. Assuming we can increase gas-fired generation enough to offset the loss of coal-fired generation, how long will gas-fired generation be needed? This will be based on how fast we can replace its generation with other reliable, resilient sources. Many analysts say gas-fired generation will be required until the end of our current decade.

Today, electric utilities are struggling to clear record backlogs in the interconnection queues. Federal and state regulators and policymakers are working on policy reforms to alleviate the gridlock and accelerate the process of connecting renewable energy to the grid. However, gaining "right of way" rights or purchasing the land necessary for the infrastructure has become a stumbling block. In the future, offshore wind is expected to make a dramatic impact, but interconnection of these resources faces the same issues of "right of way" and/or land purchases.

Assuming all these issues can be resolved, we still have one more important hurdle to overcome – a secure wireless network. This is needed in order to reliably connect everything from the customers' residential meters and sensors to commercial heavy industrial equipment, grid applications that gather data from the grid assets, and workforce management applications. To date, this need has evolved and now most of the utilities are using private LTE providers to provide them with a secure, flexible, and reliable connectivity that their applications require. This too is an issue – will the utilities stick with this model or develop their own organization and infrastructure. Either way, this too could hamper our transition.

Photo Credit: Vox

Over the past two years, established private-sector capital and operating expense investment commitments to transmission and distribution upgrades have been increasing and are now at an all-time high. Compounding that investment, federal lawmakers recently injected billions of dollars into the industry just before the November elections. Therefore, the monetary resources needed to make the transition seem to be in place.

The future contains many new opportunities for growth and from this perspective it looks bright. The challenges ahead are many and some daunting, but they are doable. Reinforcing our high-volage networks, continuing to advance our goal to net-zero emissions, while providing reliable, resilient energy to our customers, and obtaining and maintaining a secure wireless network will no doubt be challenging. But, as the old saying goes, "When the going gets tough, the tough get going".

DUKE ENERGY OPENS NEW ENERGY EDUCATION CENTER AT BRUNSWICK

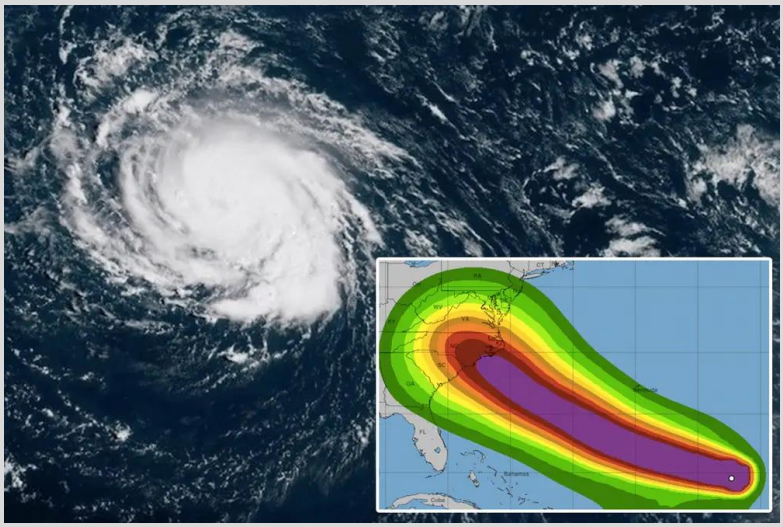
You may recall the September 14, 2018, Category 4 Hurricane Florence that wreaked havoc across North and South Carolina resulting in 42 fatalities and over $18 billion dollars of damage.

Duke Energy's Brunswick Nuclear Power Plant was right in the middle of it all and Florence destroyed their Visitor's Center. Today, construction workers are putting the finishing touches on their new Brunswick Energy and Education Center located at 8520 River Road SE, Southport, North Carolina.

Brunswick Energy and Education Center
Photo Credit: Renee Spencer/STARNEWS

Karen J. Williams, lead communications manager for Duke Energy's Brunswick Nuclear Plant, explained the building replaces commercial facilities destroyed by Hurricane Florence in 2018. It also includes a new education center with about 3,000 sq. ft. of exhibit space offering opportunities to learn about electricity, nuclear science, and the Brunswick Nuclear Plant.

The Brunswick Energy and Education Center will feature exhibits on nuclear science, electricity, carbon-free energy, and the operation of the Brunswick Nuclear Plant. Ideal for middle school-age and older students, it offers a unique look at how science intersects with daily life. Ms. Williams also noted that teachers would be able to reserve a time to bring their classes to the center and talk with staff about energy, and she added they are still exploring possible programming possibilities.



Hurricane Florence Over the Atlantic
Photo Credit: NOAA

Hurricane Florence, with maximum sustained winds of 130 mph, caused catastrophic damage across the Carolinas and destroyed Duke Energy's Brunswick Nuclear Power Plant Visitors Center. The Brunswick Energy and Education Center will replace the facilities destroyed by Florence.

DID YOU KNOW?

Photo Credit: Energy Education

Coal use across the world is at record highs. The Paris-based International Energy Agency said that while coal use grew by only 1.2% in 2022, the increase pushed it to an all-time high of more than 8 billion metric tons, beating the previous record set in 2013. They attributed higher prices for natural gas, due to Russia's war in the Ukraine, as cause for the increased reliance on coal for generating power. "The world's coal consumption will remain at similar levels in the following years in the absence of stronger efforts to accelerate the transition to clean energy and continue to be the global energy system's largest single source of carbon dioxide emissions, by far," the agency said.

The use of coal and other fossil fuels needs to be cut drastically to cap global warming at 1.5° C this century. Experts say the ambitious target, agreed upon in the 2015 Paris climate accord, will be hard to meet as the average temperatures worldwide have already risen by 1.2° C since pre-industrial times.

One of the two last coal-fired power plants in New Jersey has been imploded. The 225MW Logan Generating Plant, which has stood since 1994, was located near Swedesboro. Starwood Energy, owner, announced their plans to close it and the 245 MW Chamber Cogeneration Plant in Carneys Point, NJ in March 2022. They plan for a new $1 billion venture at the Logan Plant site, where batteries will be deployed to store power from renewable sources. The remaining Chamber Cogeneration Plant in Carneys Point has yet to be dismantled, but it too will soon be demolished. The company plans to transition the site "to a 21st century clean energy solutions, such as battery energy storage."

Logan Generating Plant Site
Photo Credit: Starwood Energy

NuScale Control Room Simulator
Photo Credit: Sid Crouch

NuScale Power, with partners Shell Global Solutions, Idaho National Laboratory, Utah Associated Municipal Power Systems, Fuel Cell Energy, FPoliSolutions, and GSE Solutions, are planning to produce hydrogen using electricity and process heat from their VOYGR small modular reactor. A NuScale control room simulator will be modified to evaluate the dynamics of the energy system and will include modeling for the solid oxide electrolysis system for hydrogen production, as well as a fuel cell for electricity production. Research will be conducted to determine the number of NuScale power modules needed for the solid oxide fuel cell hydrogen production and the amount of hydrogen that can be stored for subsequent electricity production. "Hydrogen has been identified as a pathway for global decarbonization and NuScale's SMR technology complements this goal through low carbon hydrogen production," said John Hopkins, NuScale Power President and CEO.

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GTTSI
807 Bypass 123 - Suite 31
Seneca, SC 29678
Phone: 864.882.3111
Fax: 864.882.1026
ginfo@gttsi.com

Marshalla Schile
President
Phone: 864.882.3111
marshalla.schile@gttsi.com

Clay Schile
Vice-President
Phone: 864.882.3111
clay.schile@gttsi.com

Chrissy Mulay
Technical Staffing Manager
Phone: 864.506.4647
chrissy.mulay@gttsi.com

Lisa Peach
Technical Staffing Specialist
Phone: 864.360.7554
lisa.peach@gttsi.com

Debbie Scott
Administration
Phone: 864.882.3111
debbie.scott@gttsi.com

Sid Crouch
Chief Technical Consultant
Phone: 843.861.0431
sid.crouch@gttsi.com

Ken Schaaf
NRC Exam Developer
Phone: 864.882.3111
kenneth.schaaf@gttsi.com

GTTSi Job Board

GTTSi has been providing professional services to the energy and nuclear industry since 1980. We are an MWBE (***minority woman-owned business enterprise***) and have served over 80% of the US commercial nuclear facilities, 8 Federal agencies and prime contractors, and one foreign government. If you are qualified and interested in any of the job opportunities listed below, please contact us at ginfo@gttsi.com or call **864.882.3111.**

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P.O. Box 307
Hartsville, SC 29550-0307

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