APRIL 2023

Global Technical Training Services, Inc. Newsletter

The State of the Industry

Sid Crouch, GTTSi Chief Technical Consultant

Our electric grid's aging equipment coupled with our increase in demand for power makes our grid vulnerable to physical and cyber attacks and the forces of nature. Reducing its vulnerability and fortifying the grid has become an urgent need. The Building a Better Grid Initiative calls for the Department of Energy (***DOE***) to invest over $20 billion in federal funding to expand and modernize transmission capabilities through public and private partnerships; however, we must also focus on cybersecurity. U.S. Power companies use Supervisory Control and Data Acquisition (***SCADA***) networks and many of them need to be updated and hardened to meet the growing cybersecurity threats. Physical attacks are another major concern. Our substations are an easy target with more than 55,000 connected to the grid. The cost and effort to protect these stations from physical threats is significant. Existential threats come from a variety of angles. Solar storms and weather events are the top two, but other factors, such as squirrels, rats, and snakes can also cause power outages. Over the past 150 years, the earth has been struck by more than 100 solar storms and a major storm could cause $2 trillion in economic damage with a full recovery ranging up to 10 years.

We have 18 critical infrastructures including food, water, medical care, electric grid, and telecommunications. Seventeen of them depend on the electric grid. If our grid went down for months or years it would move us back not into the 1980s, pre-Web, but into the 1880s, pre-electric grid. The clock is ticking.

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

Highlights

Minority and Woman-Owned MWBE Business Enterprise

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2012 MERCURY AND AIR TOXICS STANDARDS ARE RETURNED TO SERVICE

The U.S. Environmental Protection Agency (***EPA***) has reversed actions taken by the previous administration concerning the 2012 Mercury and Air Toxics Standards (***MATS***) for power plants.

The 1990 Clean Air Act gave the EPA the authority, working in coordination with state, local, and tribal governments, to address three major concerns of that era - acid rain, urban air pollution, and toxic air emissions.

In 2000, the EPA announced that it was "appropriate and necessary" to regulate coal and oil-fired electric utilities under section 112 of the Clean Air Act. This finding, known as the Utility Air Toxics Determination, triggered a requirement for the EPA to propose regulations to control air toxics emissions, including mercury, from these facilities by December 15, 2003.

On January 30, 2004, the EPA proposed a rule with two basic approaches for controlling mercury from power plants.

1) Require power plants to meet emissions standards reflecting the application of the "maximum achievable control technology" (***MACT)*** as set forth in section 112(d) of the Clean Air Act. If implemented, it would reduce nationwide mercury by 14 tons or about 30% by early 2008.

2) Create a market-based "cap and trade" program that, if implemented, would reduce nationwide utility emissions of mercury in two phases. If fully implemented, mercury emissions would be reduced by 33 tons (~70%).

Photo Credit: www.epa.gov

The EPA decided to pursue the “cap and trade “approach either under Section 111 or Section 112 of the Clean Air Act. Many other proposals, amendments, and finally a Clean Air Mercury Rule was established in 2005 via the “cap and trade” approach in two phases.

In 2008, however, the D.C. Circuit Court vacated the EPA’s rule removing power plants from the Clean Air Act list of sources of hazardous air pollutants. At the same time, the Court vacated the Clean Air Mercury Rule. Based on this ruling, the EPA announced plans to propose air toxic standards for coal and oil-fired electric generating plants by March 16, 2011, and present a finalized rule by November 16, 2011.

On March 16, 2011, the EPA proposed a rule that would reduce emissions from new and existing coal and oil-fired electric generating and replace the court-vacated Clean Air Act. In 2012, the Obama administration finalized the MATS rule, which required utilities to meet a 90% reduction in mercury emissions. MATS also required a 50% reduction in other air toxic emissions. *(continued)*

In 2016, the EPA confirmed that it was appropriate and necessary to regulate air toxins, including mercury, from power plants, even after consideration of the costs. They found that power plants were the nation's largest industrial source of mercury pollution, emitting more than half of the range of air toxins as well as sulfur dioxide and particulates. Reducing mercury emissions would reduce risks of neurological impacts in children and reduce emissions of other toxic air pollutants, thereby decreasing risks of cancer and other serious health effects. Reducing particle pollution would also mean fewer premature deaths, asthma attacks, and heart attacks.

In 2017, the EPA estimated that mercury emissions from power plants had been reduced by 86%, acid gas emissions by 96%, and non-mercury metal emissions by 81%.

In 2020, President Trump's EPA head, Andrew Wheeler, claimed the reduction of power plant toxic emissions was not worth the cost to the electric generating industry. He used a cost-benefit analysis that determined the health benefits of MATS were only $4 million, compared to $6 million in cost to the industry.

In 2021, not long after President Biden was elected, the President issued Executive Order 13990 that directed the EPA to review EPA Wheeler's finding and consider an action to rescind it. In response, the EPA found that the 2020 action was based on a "fundamentally flawed" interpretation of the Clean Air Act that "improperly ignored or undervalued" the health benefits from reducing hazardous air pollution from power plants. The EPA then reaffirmed that it is "appropriate and necessary" to regulate emissions of hazardous air pollutants from coal and oil-fired power plants.

This final ruling, leaves the 2012 MATS rule unchanged and ensures the continuation of public health protections provided by these requirements. When weighing the substantial burden that hazardous air pollutants, including mercury, impose on public health against the reasonable costs of controlling these emissions, the EPA finds that it is appropriate and necessary to regulate emissions of air toxics from power plants under the Clean Air Act. The Agency is also continuing to consider the MATS Risk and Technology Review, as directed by Executive Order 13990, to determine whether more stringent protections for hazardous air pollution from power plants are feasible and warranted and expects to address that review in a separate action. In January 2022, Senator Caper, Chairman of the Senate Committee on Environment and Public Works, praised the EPA's proposed rule to reinstate the 2012 MATS rule.

The recommended airborne exposure limit (***REL***) is 0.05 mg/m3 (***as Mercury vapor***) averaged over a 10-hour work shift and 0.1 mg/m3 (***as Mercury***), not to be exceeded at any time. Blood mercury levels above 100 ng/mL have been reported to be associated with clear signs of mercury poisoning in some individuals. Health effects with exposure to mercury include irritation to the eyes, skin, and stomach; cough, chest pain, or difficulty breathing, insomnia, irritability, indecision, headache, weakness or exhaustion, and weight loss.

Mercury toxicity mechanisms have the potential to induce DNA damage and disrupt cellular processes, like mitochondrial function. Proper mitochondrial function is important for cellular bioenergetics and immune signaling and function.

GTTSi TEAM MEMBER HIGHLIGHT: JACK HAROLD

Meet GTTSi employee, Jack Harold, as he works on the Niyol Wind Farm project in Colorado for NextEra. This project is still ongoing, but the wind turbines that are already in place began commercial operation in December 2021.

Jack's 30 years of experience with industrial construction in oil and gas refineries, wind farms, offshore oil platforms, combined cycle power plants, nuclear construction, and solar fields is a positive asset to this project.

His dedication to doing the job right the first time, every time, fits the GTTSi mantra. He loves to take on challenging projects and he left the warmth of Port Lucie, Florida to take on this project for GTTSi, at times in frigid conditions (pictured below).

Pictured right is part of Jack's project: the ***380-cubic foot mushroom-shaped concrete foundation and tower pedestal.*** The foundation is huge – it takes 38 truckloads of concrete to create this foundation. When the pit is filled and packed (***using bulldozers and a sheep's-foot roller***), only the top few inches of the pedestal will be visible, sloped away at a 2% grade to allow adequate drainage.

Niyol Wind Farm – February 2023
Photo Credit: Jack Harold

Foundation / Pedestal / Core Drilling – Niyol Wind Farm
Photo Credit: Jack Harold

There are copper cables, the size of a man's thumb, attached to steel spikes driven into the ground as ground wires, and buried under tons of backfill. When the wind turbines are in operation, a substation collects their electrical power and sends it on to another substation located in Yuma County. From there it is distributed across the Tri-State Generation's 42 cooperative and public power district members.

Each turbine, supplied by GE Renewable Energy, is rated at 2.75 MW with 3 rotor blades and a rotor diameter of 120 meters. The tower hub height is about 310 feet (***hub height is the distance from the ground to the middle of the turbine's rotor***).

Ultimately 74 wind turbines will make up the Niyol Wind Farm. Located about 10 miles south and west of Fleming, Colorado. When completed the wind farm will have a capacity of more than 205 megawatts and supply power to Tri-State Generation and Transmission for distribution to its 42 cooperative and public power district members.

Jack proves that no job is too big or too small for GTTSi - check us out at www.gttsi.com or on LinkedIn.

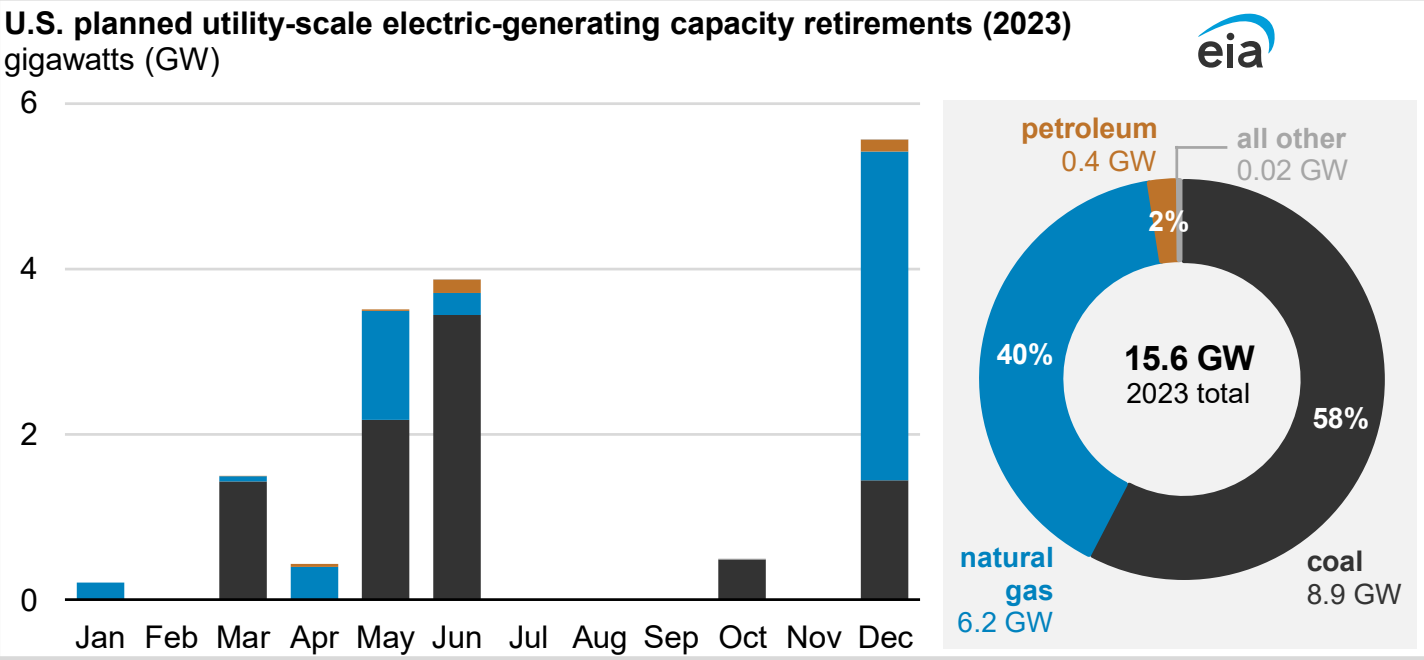
Coal-Fired Power Plant Retirements Reach 92 GW in 2023

Power plant operators plan to retire 15.6 GW of electric-generating capacity in the United States during 2023. 6.2 GW with the retirement of natural gas-fired power plants and 8.9 GW of coal-fired power plants. Over the past decade, more than 83 GW of coal-fired power plants have been retired.

Energy Harbor plans to shutdown two of its coal-fired power plants this year. The largest is the 1,490 MW W.H. Sammis Power Plant in Ohio – four of its seven coal-fired units were retired in 2020 and this year the last three units will be shutdown, along with the plant's five petroleum-fired units (13 MW of combined capacity). The second largest is the 1,278 MW

The natural gas-fired power plants slated for retirement this year are made up of older steam and combustion turbine units. Three of these are in California (Alamitos, Huntington Beach, and Redondo Beach), with a combined 2.2 GW. They were originally slated to retire in 2020 but were granted a three-year extension to maintain grid reliability.

Petroleum-fired power plants, slated for retirement, make up a small portion of our generating capacity at around 2.2% or about 0.4 GW. Most of these plants seldom run and serve as peaker plants and are located in Connecticut.



Data source: EIA, Preliminary Monthly Electric Generator Inventory, December 2022

A HISTORY OF NUSCALE AND THEIR VOYGR DESIGN

NuScale began in 2000, based on a research grant funded by the US Department of Energy (***DOE***) and conducted by Oregon State University, Idaho National Laboratory (***INL***), and other colleges. When the research grant ended in 2003, a group of scientists at Oregon State University continued to work on the design and built a test lab at one-third actual scale and eventually inherited its related patents from the university in 2007, in exchange for a small equity in the company. NuScale was founded that same year.

NuScale sought certification with the NRC (***Nuclear Regulatory Commission***) in February 2008; and by 2011 they had raised $35 million in financing with 100 employees in three cities: Tigard, Oregon; Richland, Washington; and Corvallis, Oregon.

October 2011: Fluor Corporation acquired a majority interest in the company for $3.5M (***million***) and promised almost $30M in working capital. Later, in a separate agreement, Fluor gained the rights to construct NuScale-based power plants.

December 2012: Co-founder and CEO Paul G. Lorenzini was succeeded by current CEO John Hopkins.

December 2013: NuScale won up to $226M in "cost-sharing" funding to share the expense of pursuing government approval, through the SMR (***small modular reactor***) Licensing Technical Support program. This was followed by an agreement in May 2014 for up to $217M in funding over a five-year period, whereby the DOE would match private funding.

March 2012: NuScale signed an agreement with the DOE allowing NuScale and two partners to build and operate a NuScale-based

Photo Credit: World Nuclear News

nuclear power plant at the SRS (***Savannah River Site***). In April, Energy Northwest said it didn't have any immediate plans to construct a nuclear power plant but had evaluated all the available SMR technologies and identified NuScale as the best available option at the time.

July 2013: NuScale announced an effort to study and demonstrate NuScale reactors in the western United States, called Program WIN (***Western Initiative for Nuclear***), with plans to build the first NuScale-based power plant in the western United States by 2024.

November 2014: NuScale announced it was building the first SMR in the US in Idaho. The plant is for the Carbon Free Power Project with Utah Associated Municipal Power Systems (***UAMPS***).

NuScale Power submitted its designs to the NRC in January 2017, and if approved, they hoped to complete its first plant in 2026.

January 2018: The NRC agreed that the NuScale SMR does not need back-up power.

August 2020: The NRC issued a final safety evaluation report for NuScale's SMR design, certifying the design as having met the NRC's safety requirements. They planned to apply for a standard design approval of a 60 MW per-module version of the design in 2022, and if accepted will allow the company *(continued)*

to pursue its first reactor deployment in the mid-2020s. Also in 2020, NuScale received approval of its SMR design by the NRC - the first design approval for a small commercial nuclear reactor.

2021: NuScale received investments from two Japanese companies, JGC Corporation and IHI Corporation, which together formed JNI (***Japan NuScale Innovation***). JNI became the second-largest investor in NuScale Power (***~9 percent***). In November, NuScale announced plans to build with Nuclearelectrica, its first SMR reactors outside the US, in Romania, as early as 2028. In December, NuScale Power and Spring Valley Acquisition Corporation reached a merger agreement with an estimated enterprise value of $1.9 billion. NuScale said it expected no additional capital requirements between closing and achieving positive free cash flow. Following the merger Fluor was projected to be a 69% owner of the company.

2022: In February, NuScale and a large mining conglomerate KGHM announced signing of a contract to construct their first operational reactor in Poland by 2029. In April, JNI and Japan Bank for International Corp. (***JBIC***) bought $110 million in NuScale Power equity from Fluor Corporation. However, Fluor still remains majority owner of NuScale and will continue to provide NuScale with engineering, procurement, project management, and construction of its energy projects. Also in April, Doosan Enerbility contracted for the manufacturing of Power Module components for NuScale. They expects to reach full-scale production at their plant in Changwon, South Korea, in the second half of 2023. In May, NuScale completed a merger with the SPAC (**special-purpose acquisition company**) Spring Valley Acquisition Corp, raising $380M as a “publicly traded company”. In July, the NRC announced it would certify NuScale's small modular reactor. In December, Romanian company RoPower Nuclear contracted for Front-End Engineering and Design at a location in Doicesti, Romania. RoPower is a joint venture between Nuclearelectrica and Nove Power & Gas. In December, NuScale Power announced their SMR design would be named ***VOYGR.***

2023: In January, the Carbon Free Power Project (***CFPP)*** approved a new Budget and Plan of Finance, establishing a target price of $89/MWh (***8.9¢ / kWh***) after an estimated $30/MWh generation subsidy from the Inflation Reduction Act. Also in January, the NRC certified NuScale's design for use in the US.

VOYGR does not rely on powered water pumps or circulatory equipment. It can shutdown and continue cooling itself indefinitely during most accidents. Its devices are intended to be kept in a below-ground pool, to absorb the shock of earthquakes, with a concrete lid over the pool. In the event that AC power is lost for its normal cooling systems, the pool water in the pool will absorb the heat and boil.

Levelized Cost of Electricity (***LCOE)***.is a figure that makes it possible to compare the electricity production costs of different systems – includes the cost of construction, maintenance over the estimated life span, and use efficiency. For total electricity generation in the U.S., this figure was $61/MWh in 2019. In the United Kingdom, it was approximately $210/MWh.

NuScale estimates its figure, as they do not yet have a complete system on the actual grid, but only test reactors. The LCOE of their system is said to be $40/MWh to $65/MWh. This would make VOYGR power generation cheaper than coal, offshore wind, and some of our current nuclear power plants. However, it would be more expensive than onshore wind or solar. But due to their fluctuating power generation, these systems always need stable supporting systems to keep the power grid reliable.

APRIL 2023

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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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- Engineer -Solar Farm Design & Construction, Juno Beach, FL

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