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Global Technical Training Services, Inc. Newsletter

The State of the Industry

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We are seeing a lot of discussion these days around the use of hydrogen as a replacement for fossil fuels. Did you know there are three ways to produce hydrogen without releasing CO2 to the atmosphere: from electrolysis using renewable energy sources (***green H2***), from natural gas supported by carbon capture & storage (***blue H2***), and from electrolysis using electricity from a nuclear power plant (***pink H2***)?

Although the thought of using hydrogen in place of fossil fuels might seem like a great idea, obstacles abound. We have no nationwide network of hydrogen pipelines and no overall regulations for them. We have only a 1,600-mile pipeline, primarily serving refineries and ammonia plants along the Gulf Coast with limited regulation provided by several federal agencies, state, and local authorities.

To make hydrogen work, we will need a nationwide network with manageable regulations. According to the Energy Bar Association, the Federal Energy Regulatory Commission (***FERC***) is the best-suited agency to regulate hydrogen pipelines. FERC and its predecessor, the Federal Power Commission, have been regulating the nation's interstate natural gas pipelines under the NGA (***National Gas Act***) since 1938.

How will FERC apply decades-old statutes to meet our decarbonization goals? Hydrogen seems to be poised to play an important role as an alternative fuel, but the ball is in FERC's court. They need to seize the opportunity to assert their jurisdiction, offer regulatory certainty, and unleash the opportunity for hydrogen development as an alternative fuel.

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

Highlights

Minority and Woman-Owned MWBE Business Enterprise

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VISTRA ENERGY'S MOSS LANDING ENERGY STORAGE FACILITY NOW THE LARGEST OF ITS KIND

Phase III expansion at Vistra's Moss Landing Energy Storage Facility has been completed. Moss Landing now has a total capacity of 750 MW / 3,000 MWh (***megawatt /megawatt hour***) making this facility the world's largest of its kind.

The facility supports the California grid and operates under a 15-year resource adequacy agreement with Pacific Gas and Electric Co.

Jim Burke, Vistra president and CEO said, "As we navigate this energy transition to cleaner fuel sources, the ability to balance that shift with both reliability and affordability is paramount. Continued investment in energy storage, like our Moss Landing site, allows us to harness and store a substantial and growing amount of power from intermittent renewables and then deliver that electricity when customers need it most. We appreciate the continued partnership with PG&E, which allows us to bring our expertise in energy storage to bolster the reliability of California's growing renewable portfolio and provide much-needed power to its residents."

The Phase III expansion was made up of 122 individual containers that together house more than 110,000 battery modules. The project was completed on schedule and within budget in just 16 months, despite a challenging supply chain environment and tremendous rainfall.

Moss Landing Energy Storage Facility is co-located on the site of Vistra's existing natural gas-fueled Moss Landing Power Plant in Monterey County – a site that has provided critical electricity to Californians since 1950.

Vistra Energy Moss Landing Power Plant in Monterey County, California
Photo Credit: Vistra Energy

"Like our other energy storage projects, we've been able to locate this project at a site that has historically been used for electricity production, enabling the reuse of a site with existing industrial zoning and infrastructure and with the physical space for potential growth. In addition, revitalizing existing sites ensures the local communities continue to benefit from ongoing operations while we provide affordable electricity to consumers", said Burke.

Completion of this project elevated Vistra to the second-most energy storage capacity in the country. In addition to its California assets, Vistra owns and operates two solar facilities, one solar-plus-storage facility, and a 260-MW storage facility in Texas. In addition, Vistra also has four solar installations and 10 other storage and solar-plus-storage facilities in development, at various stages, in Illinois and Texas.

Just recently, Vistra announced their plans to acquire Energy Harbor's 4,000-MW nuclear fleet to further grow its zero-carbon portfolio. Once this transaction closes, expected to occur later this year, Vistra will own and operate the second-largest competitive nuclear fleet in the country, with 6,400 MW of carbon-free nuclear power (***Comanche Peak in Texas & Davis-Besse in Ohio***). The company also continues to operate a large, dispatchable power fleet that brings flexibility and reliability while the country continues to transition to low-carbon resources.

IS CENTRUS ENERGY THE ANSWER FOR HALEU AND THE NEXT GENERATION

Fifty years ago, the U.S. was the dominant force in uranium enrichment, but over the last three decades, it went from the world's largest exporter of nuclear fuel to the world's largest importer, totally dependent on Russia and Europe to fuel our existing fleet of reactors (***See July's State of the Industry.***)

The vast majority of the world's fleet of existing nuclear reactors are light water reactors. Their fuel is enriched 3-5% U-235, classified as low-enriched uranium. However, most of the next generation nuclear reactors are designed to run on enrichments of 5-20% U-235, classified as HALEU (high-assay low-enriched uranium). This higher energy density fuel allows smaller reactor designs, longer-lasting cores, and less waste, according to the Department of Energy (DOE).

The process of increasing the higher concentrations of U-235 is accomplished in a centrifuge, which takes advantage of the slight difference in weight between the naturally occurring uranium isotope and the 235 isotope.

Recently a company based out of Piketon, Ohio – Centrus Energy – cleared an operational readiness review by the Nuclear Regulatory Commission, which means that they can handle the materials needed to produce HALEU fuel. That makes Centrus Energy the only facility in the US licensed to produce HALEU. They plan to start production by the end of this year.

Although Centrus cleared one significant hurdle with this approval, the road ahead is uncertain, as they still need to wade through a number of regulatory and economic challenges before they can begin commercial production of HALEU.

Photo Credit: centrus.com

Several next-generation plants are scheduled for operation in 2028. Nine of the 10 reactors selected for the DOE's Advanced Reactor Demo Program will require HALEU fuel. The DOE predicts that more than 40,000 kilograms will be needed before 2030. It would take 120 centrifuges to produce 6.000 kilograms per year of HALEU fuel. Centrus hopes to produce 900 kg/yr starting in 2024

According to Patrick White of the Nuclear Innovation Alliance, to have a HALEU fueled reactor online by 2027 or 2028, we need to be producing fuel in 2025 or 2026.

The DOE has indicated it will attempt to serve as an anchor customer for HALEU fuel by being the first buyer, which should help capital investments flow in from private industry. There's an earlier historical parallel for this approach when in 1956 President Eisenhower made one billion dollars (***$11 billion in today's dollars***) worth of enriched uranium available to utilities in the United States and around the world in exchange for meeting nonproliferation standards. The program was a major success – enabling the commercial nuclear plants built in the 60's, 70's, and 80's.

Today, nearly seven decades later, this approach might just be what is needed to get things moving with building our next generation nuclear plants.

THERE SHE IS…MISS NUCLEAR

Miss America, Grace Stanke
Photo credit: Powermag.com

As the first new commercial nuclear reactor in three decades came online and achieved 100% power at Vogtle, Miss America, Grace Stanke, wrote that she was "skipping" after the news broke.

Ms. Stanke is 2023's Miss America, and the first ever nuclear engineer not only to compete for the title, but to win it. She studied nuclear engineering at the University of Wisconsin-Madison, which likely contributed to her initiative as Miss America, called "Clean Energy, Cleaner Future". Ms. Stanke said that her biggest goals are centered around changing public perception of the word NUCLEAR. She is working with today's youth to educate them on how nuclear technology is all around us and is advocating for nuclear policies that allow for the advancement of the technology and for nuclear power plants to stay open and continue to supply a zero-carbon baseload source of power for our energy grid.

Miss Stanke recently spoke at the second annual American Conservation Coalition Summit which brought together nearly 300 young activists as well as other environmental and energy leaders for a weekend of programming and training. In her talk, she spoke about how she initially asked her father, "Aerospace or Nuclear?", to which her father (a civil engineer) said, "Grace, don't go into Nuclear. There's no future there." Grace went on to say, "Well, now here I am…"

In an opinion piece in Newsweek, Ms. Stanke wrote, "Supporting nuclear energy, after all, is a no-brainer. Whether you're concerned about fighting climate change or energy security, nuclear energy must be a part of our energy portfolio moving forward...We each have a voice, and it's our responsibility to use our voices to enact meaningful change. Gen Z could be the generation that champions nuclear energy and fights back against climate change. In fact, we have to. It's time to seize this valuable opportunity to hold politicians accountable and take action to create reliable and zero-carbon energy."

Miss America, Grace Stanke, speaks at the ACC Summit in Salt Lake City, Utah in June 2023.
Photo credit: American Conservation Coalition

TESTING CONTAINMENT OF NUCLEAR WASTE

While fear of storing or transporting spent fuel continues to be one of the obstacles to nuclear energy, the Office of Nuclear Energy reports that it is nearly impossible for a spent nuclear fuel container to accidentally release its contents. Spent nuclear fuel (SNF) containers have undergone rigorous testing to ensure their strength and integrity. These tests are designed to simulate different conditions that the containers might encounter over their intended lifespan. Here are some tests conducted to assess the strength of SNFs:

Structural Integrity Testing: This involves subjecting the container to various mechanical stresses, such as pressure, tension, compression, and bending. The container's response to these stresses is monitored to ensure that it remains intact and maintains its structural integrity.

Impact Testing: Containers are tested to determine their ability to withstand impact during transportation or handling. These tests can involve dropping heavy objects onto the container or simulating collisions.

Fire Testing: Containers have been tested to assess their resistance to high temperatures. This is important to ensure that the container's contents are not compromised even in the event of a fire.

Vibration Testing: Vibration tests simulate the effects of transportation or seismic activity. Containers are exposed to vibrations of various frequencies and intensities to ensure they can withstand such conditions.

Temperature Testing: Containers are subjected to extreme temperature variations to assess how they respond to thermal stress. This includes both cold and hot temperature simulations.

Radiation Testing: Containers are tested to determine their response to radiation exposure. This can include gamma radiation tests to assess how the container's material and seals hold up under radiation.

Sealing and Leakage Testing: The effectiveness of seals and closures is tested to ensure that the container remains tightly sealed and doesn't leak radioactive materials.

Long-Term Aging Testing: Containers may be subjected to accelerated aging tests, simulating the effects of long-term storage, to assess how the materials degrade over time.

Environmental / Corrosion Testing: Containers might be exposed to environmental conditions such as water, humidity, salt spray, and chemical exposure to evaluate resistance to environmental degradation.

To read more and watch archival footage of SNF container testing, go to https://www.energy.gov/ne/articles/5-common-myths-about-transporting-spent-nuclear-fuel

Photo credit: NuclearNewsWire

SMR STAGING & PLANNING HAS BEGUN IN THE U.S.

The NRC (***Nuclear Regulatory Commission***) accepted NuScale's SMR design certification application back in March 2018 and issued its final technical review in August 2020. On July 29, 2022, the NRC voted to certify their 50 MWe (***fifty megawatt electric***) design making it the first SMR approved by the NRC for use in the United States. In 2023 the NRC officially certified their design, making it the first and only SMR to achieve either milestone.

Now NuScale is seeking approval of their VOYGR-6 plant design which features an uprated power rating from 50 MWe to 77 MWe. Their application has been docketed after the NRC began technical review of their March 2023 application. The uprated design, under review, includes the same fundamental safety case the NRC approved in 2020. NuScale is cautiously confident that their uprated design will be approved and have requested the NRC provide a 24-month review schedule for the approval process - aligning their timing needs for their U.S. customers.

Power ratings for small modular reactors (***SMRs***) has migrated toward the IAEA SMR design threshold of 300 MWe – evidenced by the rollout of the BWRX-300 (***boiling water reactor with significant commitments from Ontario Power Generation and the Tennessee Valley Authority***) and the AP300 MW SMR design from Westinghouse.

NuScale's 'six-pack' power package (***462 MWe***) compares closely with the Rolls-Royce 470 MWe mid-range PWR but it significantly exceeds the IAEA standard of 300 MWe.

Looking at advanced reactors - X-Energy has an agreement to build four 80 MW HTGRs (***high temperature gas reactors***) for Dow to provide process heat at a Texas chemical plant (***320 MW***). And TerraPower's Natrium, sodium cooled design is intended to replace coal-fired power plants comes in at 345 MW.

In Canada and the UK, Moltex is developing a 300 MW molten salt reactor for power generation and process heat applications. Also in Canada, Terrestrial Energy plans to offer customers their 195 MW molten salt reactor in pairs for a total of 390 MW.

All these reactor developers claim their designs are "modular" and "transportable." The "modules," when fabricated by the vendor or its suppliers, will be transported by truck, rail, or barge to the reactor site where they will be assembled into a finished nuclear plant.

There are, however, other issues to consider. In NuScale's case, the site for their first customer UAMPS (***Utah Associated Municipal Power Systems***) is inside the Idaho National Laboratory boundary on the Arco desert - about 50 miles due west of Idaho Falls, ID. There is a rail connection via a Union Pacific (***UP***) spur, but it doesn't terminate near the site. Therefore, additional trackage will be needed, or they will have to offload and deliver the modules by truck.

All the 300 MW range SMRs will face similar challenges in getting their components delivered to the customer sites. Transportation by truck will require these oversize loads to fit beneath the clearances of both major highway and rural roadway overpasses. Another factor is bridge load ratings for the combined weight of the truck, trailer, and its load.

Undoubtedly, SMR vendors are working on management of their transportation logistics and making decisions on just how many modules of the reactor plant will need to be shipped in separate loads.

DUKE ENERGY ANNOUNCES SMR PLANS WITH FIRST AT BELEWS CREEK SITE

Belews Creek Steam Station is a coal-fired power plant located in Belews Creek, North Carolina. Owned and operated by Duke Energy, it has been a prominent source of electricity generation for the region. In 2018, it was the #1 most efficient coal-fired power plant in the U.S. with a 37.1% conversion efficiency.

In 2020 and 2021, natural gas was added to the station to allow up to 50% natural gas co-firing on both units. Co-firing allows the units to produce energy using either coal or natural gas, or a combination of these fuels, benefiting customers and the environment. For every pound of coal displaced with natural gas, sulfur dioxide is reduced by an estimated 99% and carbon dioxide emissions are reduced by about 40% per megawatt-hour.

Belews Creek Steam is located on Belews Lake in Stokes County, North Carolina northwest of Greensboro.
Photo credit: Duke Energy

Despite these changes and an historical record of reliable service, however, Duke Energy plans to permanently shutdown Belews Creek by 2036. This action along with other plant retirements is a result of a ***2021 North Carolina law that requires NC utilities to reduce their carbon dioxide emissions by 70% by 2030, compared with 2005 levels, and achieve net-zero emissions by 2050.***

Based on Duke Energy's newly updated integrated resource plan, they have offered three scenarios that would get the company to 70% by 2030, 2033 or 2035; they prefer the 2035 scenario. This timeline would allow the addition of 600 MW from two small modular reactor (***SMR***) sites – one of which would be the Belews Creek Steam Station site.

“Advanced nuclear will provide significant operational flexibility that will be needed to support increased deployment of renewable energy resources,” said the utility in its latest filings. Duke plans to choose the SMR design for the Belews Creek site between 2023 and 2025 and apply for an early site permit from the U.S. Nuclear Regulatory Commission (***NRC***) in mid-2025.

The projected in-service date for the Belews Creek SMR would be the first quarter of 2034, with the SMR at the second site coming online the first quarter of 2035.

Duke Energy said it is also in the process of seeking 20-year license extensions for its eleven nuclear units operating at six plants (***Brunswick, Catawba, Harris, McGuire, Oconee, Robinson***) in the Carolinas.

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