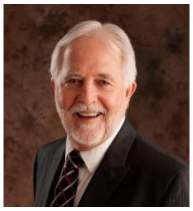
NOVEMBER 2024

GTTSi

Global Technical Training Services, Inc. Newsletter



The State of the Industry

Sid Crouch, GTTSi Chief Technical Consultant

Grid reliability refers to the ability of the electric grid to maintain power and avoid disruptions, even during unexpected conditions. It is essential for our economy and our national security. In the United States, we have grown accustomed to electricity being available to us at any time. In fact, the average U.S. customer loses power less than two times per year for a total of less than five hours, which represents 99.95% reliability.

FERC (***Federal Energy Regulatory Commission***) has warned this may soon change. They believe we are “heading for a very catastrophic situation in terms of grid reliability" due to market distortions, caused by subsidies for renewables, and public policies that have driven out many of our baseload power plants, causing a deterioration of grid reliability.

Replacing dependable power sources with intermittent ones without reliable backups or massive energy storage is a recipe for disaster, increasing the risk of prolonged blackouts. Some areas of the country have made significant gains in providing this support. (See Solar and BESS Helped to “Keep the Lights On” in Texas - Oct. Newsletter), but according to a Liberty Energy study, blackouts affecting 50,000 customers or more can be linked to areas where there is increasing solar and wind power. Data already shows that wind and solar renewables are causing rising power bills and not reducing our carbon footprint. We can achieve a clean, affordable, reliable, and resilient electric grid but without more work, adding renewables to the mix may take away the word affordable.

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

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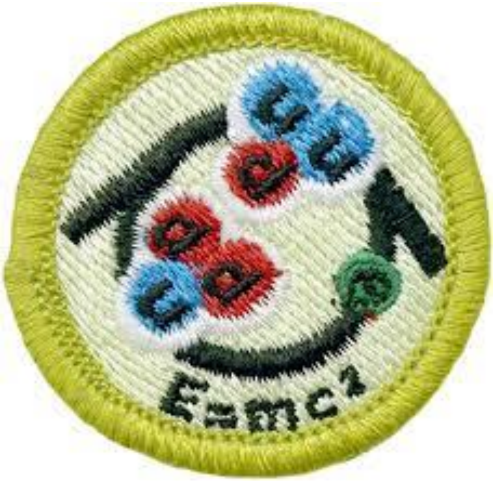
NUCLEAR SCIENCE CAMPOREE AT DAVIS-BESSE NUCLEAR POWER STATION

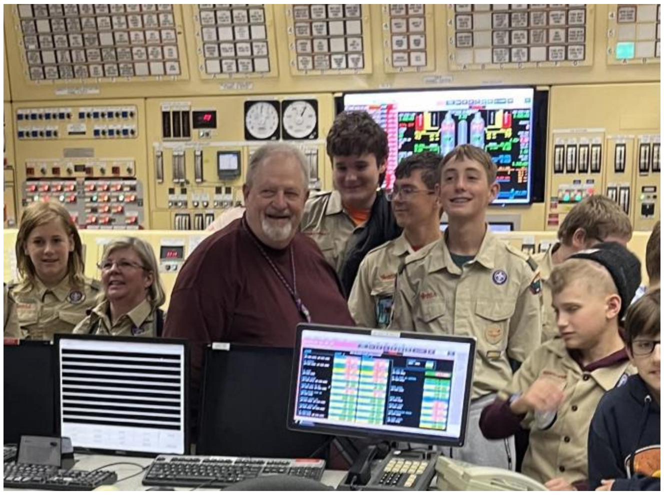
While many of us think “hunting” or “fishing” when we hear the words “Scout camporee”, the Davis-Besse Nuclear Power Plant recently hosted an *Atomic Energy* camporee. This gathering was designed to introduce scouts and scouters to the fascinating and sometimes misunderstood field of atomic energy.

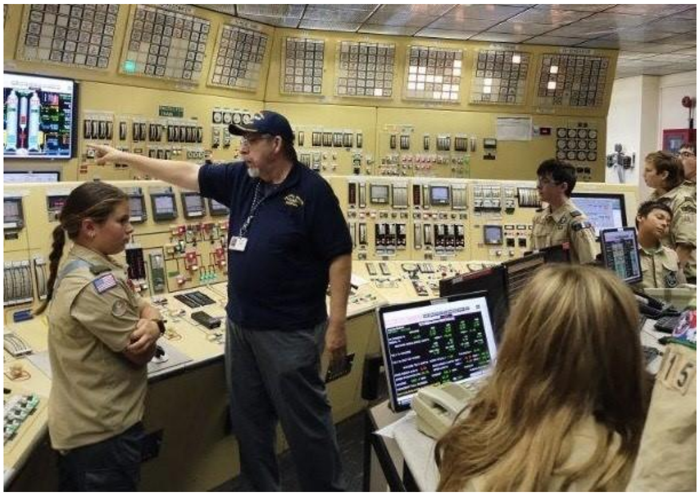
The camporee was held October 4-6 at the Davis-Besse Nuclear Power station in Oak Harbor, Ohio. Two GTTSi team members, Larry Gentry (below) and Steve Martin (right), Senior Training Consultants, working with many other volunteers, made the 2024 Annual Nuclear Science Camporee a big success. Hundreds of Scouts from all over Northern Ohio came to the Davis-Besse Nuclear Power Station to learn about nuclear power and gain knowledge to earn their Nuclear Science Merit Badge. The main day began with a flag ceremony at the Energy Education Center followed by classes and activities to help the campers take steps towards their Nuclear Science Merit Badge. Scouts and Scouters camped out at a local campground and spent all day at the Davis Besse Training Center.



The Nuclear Science Merit Badge, formerly called the Atomic Energy Badge

The Nuclear Science Merit Badge is a rare merit badge, being the 68th most earned badge out of 138 different badges. To earn it requires the scout to learn about nuclear science, including radiation, atomic structure, and nuclear reactions. This badge was previously known as the Atomic Energy Badge and like all other ***Scouting USA*** Merit Badges, it was designed to inspire curiosity, promote critical thinking, in addition to teaching scouts about the ethical and environmental implications of nuclear technology.





CAN THE NUCLEAR RENAISSANCE RESURRECT THE VC SUMMER PROJECT?

The VC Summer Nuclear Project was a highly ambitious plan to expand the V.C. Summer Nuclear Station in South Carolina by adding two new nuclear reactors. It was intended to be one of the first new nuclear power projects in the U.S. in decades, a major part of the push for clean, reliable energy. The project was canceled in 2017 after years of delays, cost overruns, and mismanagement.

V.C. Summer Site After Construction Halt
Photo Credit: Post and Courier

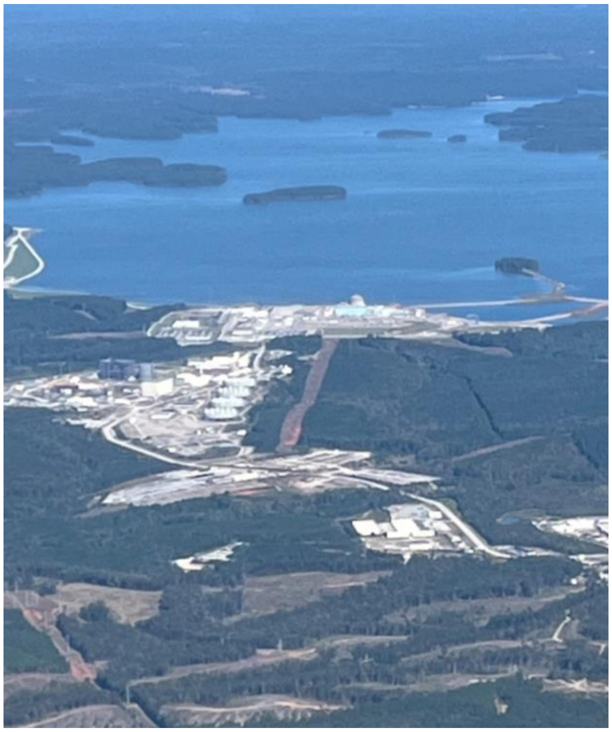
Now the question is, can the Nuclear Renaissance resurrect the VC Summer project and get construction activities restarted? The ***SC Nuclear Advisory Council*** created by the SC Legislature is pushing for a study into restarting the construction activities of the two AP1000 nuclear reactors abandoned just seven years ago by then SCE&G (***South Carolina Electric & Gas***) and Santee Cooper. The abandonment was later considered the biggest construction failure in South Carolina history.

A recent report by two members of the Governor's Nuclear Advisory Council said the partially completed buildings show no signs of degradation, corrosion, or chipped concrete. Among the buildings reviewed were the cooling towers, a turbine hall, and a containment building. Equipment includes a generator dome, reactor vessels, reactor cooling pumps, steam generators, and the diesel generators. They showed some surface rust, not unexpected nor a substantial problem. Components that were placed in storage are in excellent condition and the inventory of materials, assemblies, and electrical instrumentation systems have been well maintained and inventoried in a series of fourteen warehouses.

More study is needed to achieve a thorough understanding for construction restart feasibility, but the single most critical issue is finding how to pay for it. South Carolina customers of Santee Cooper and Dominion Energy, which acquired SCE&G after the abandonment, are still paying for the failed project as part of their monthly energy bills. $9 Billion was spent on the V.C. Summer project and as part of the 2020 settlement, Santee Cooper froze electric bill rates until the end of 2024 (***December 31, 2024***). The SC Dominion Energy ratepayers are still paying for the project as part of their monthly energy bills – Dominion did reduce their bills, but they're still paying on $2.3 billion worth of debt for the next 14 to 15 years. Therefore, it is imperative that a restart of construction activities be privately funded to gain acceptance for any restart of construction activities. *(continued)*

A spokesperson for Santee Cooper said they were not interested in the V.C. Summer project in any way, neither in owning any part of it nor operating it. Santee Cooper has sold $100 million worth of equipment, and they are still actively marketing the equipment for sale. Although Dominion and Santee Cooper jointly own the property, Santee Cooper and Westinghouse own the equipment.

Cranking up an abandoned nuclear site in not unprecedented. In 2015 Watts Bar Unit 2 was restarted more than 25 years after the project had halted. Today, Watts Bar Unit 2 is fully operational and is part of Tennessee Valley Authority's nuclear fleet of seven nuclear units at Browns Ferry, Sequoyah, and Watts Bar, generating 8,275 MW of electricity each day.



V.C. Summer Site on Lake Monticello

Key Details of the Halted VC Summer Project

- **Location**: Jenkinsville, South Carolina, at the existing V.C. Summer Nuclear Station.
- **Companies Involved**:
    - **SCANA Corporation** (owner of South Carolina Electric & Gas, or SCE&G)
    - **Santee Cooper** (a state-owned electric utility in South Carolina)
    - **Westinghouse Electric Company** (the primary contractor, responsible for designing and building the reactors).
- **Technology**: Reactors designed using the **AP1000 model**, a cutting-edge reactor developed by Westinghouse offering improved safety features and a more streamlined construction process.

Timeline

2008 The project was formally announced, and construction was expected to be completed by 2016 for Unit 2 and 2019 for Unit 3.

2013 Initial construction began, but the project soon faced delays due to licensing issues, material problems, and labor shortages.

2015-16 Costs ballooned. Initial estimates had put the project around **$9 billion**, but by 2017, the projected cost had soared to over **$25 billion**.

2017 Westinghouse, the contractor, filed for **bankruptcy**. This was a key turning point. Westinghouse's financial struggles left the project with significant uncertainties. Both SCE&G and Santee Cooper decided to halt construction, citing that completing the reactors would be too costly.

THE RACE TO FIND THE NEXT "MAGIC NUMBER" CONTINUES

U.S. Physicist Maria Goeppert Mayer (1906-1972)
Photo Credit: Atomic Heritage Foundation

The word "magic" is rarely used in science but in the early 1930s, scientists discovered that some atomic nuclei had specific numbers of protons or neutrons, or "***magic numbers",*** as physicist Eugene Wigner called them. They were magic because the nuclei with these specific numbers of protons or neutrons were more stable than the other elements. The question was, why?

The solution came about in 1949 by two scientists working independently of each other – U.S. physicist Maria Goeppert Mayer and German physicist Hans D. Jensen. Today, 75 years later, these magic numbers continue to play an important role in scientific research.

Earlier in 1913, Niels Bohr proposed a theory, based on quantum theory, that the electrons of an atom existed in a shell structure – circulating around the nucleus at particular energy levels, or orbits. Each of these orbits have specific energies and can only hold so many electrons. Using Bohr's model, we see that chemical reactions result from the interactions between the electrons of these associated atoms. If an electron orbit is not already filled, then it's easier for the atoms to exchange or share electrons – inducing a chemical reaction.

In 1949, Goeppert Mayer and Jensen, using Niels Bohr theory that electrons of an atom exist in a shell structure, developed the so-called shell model of the nucleus - like electrons, protons and neutrons occupy particular orbits within the nucleus, but they also have a property called spin, similar to a spinning top. Goeppert Mayer and Jensen found that when combining the two properties in their calculations, they were able to reproduce their experimental observations.

Through experiment, they found that nuclei with certain numbers of neutrons or protons are unusually stable and hold onto their nucleons more than researchers previously expected, just like noble gases. These certain numbers were called the "magic numbers" - 2, 8, 20, 28, 50, 82, and 126.

An element always has the same number of protons, but the number of neutrons can be different, even in atoms of the same element. Atoms of the same element that contain the same number of protons, but different numbers of neutrons, are known as isotopes. The element Tin (***atomic number 50***) is a good example as it has a magic number of protons - 50 protons, but also has 10 stable isotopes, whereas Indium (***atomic number 49***) and Antimony (***atomic number 51***) have only 2 stable isotopes apiece.

Helium, with two protons and two neutrons, is the lightest "doubly magic" nucleus. Both its neutron count and its proton count are a magic number. The forces that hold *(continued)*

Photo: Niels Bohr (1885-1962)
Photo Credit: Bettmann Archive/Getty Images

the helium-4 nucleus together are so strong that it's impossible to attach another proton or neutron. If you tried to add another proton or neutron, the resulting atom would fall apart instantaneously.

On the other hand, the heaviest stable nucleus in existence, Lead-208, is also a doubly magic nucleus. It has magic numbers of 82 protons and 126 neutrons.

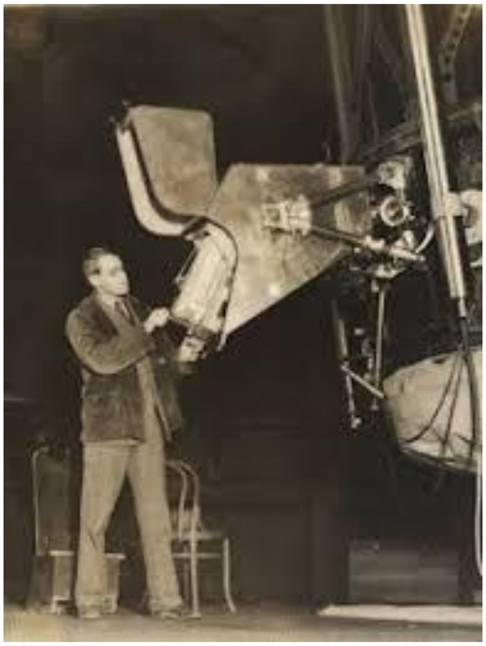
One of the most abundant elements on our planet and in the human body is Oxygen, in particular the isotope Oxygen-16. With eight protons and eight neutrons, Oxygen-16 is an extremely stable nucleus.

Maria Goeppert Mayer, in her Nobel Prize lecture, talked about the work she did with physicist Edward Teller. The two attempted to describe how these stable elements were formed in the stars, but in the 1930s, it was impossible for them to explain why certain elements and isotopes were more abundant in the stars. Later, Mayer found that the increased abundances corresponded to nuclei with something in common, as they all had the "magic numbers" of neutrons. Therefore, using the shell model and the explanation of "magic numbers", the production of elements within the stars seemed scientifically possible.

But it was not until May 2, 1952, when Paul W. Merrill's watching the sky, through a telescope at the Mount Wilson Observatory in Pasadena, CA, observed that within the light coming from a distant star, were the signatures of the element Technetium. This was completely unexpected, as Technetium has no stable forms – it is what physicists call an "artificial element".

Merrill reported his discovery in the journal *Science* and within the three interpretations he offered about his discovery, was the answer: ***Stars create heavy elements!***

Not only had Merrill explained a puzzling observation, but he had also opened the door to understanding our cosmic origins. Not many discoveries in science completely change our view of the world – but this one did. And the repercussions of this discovery are still driving nuclear science research today, as the race to determine the next "magic number" is still on.



Astronomer Paul W. Merrill (1887-1961) at Mount Wilson Observatory in California
Photo Credit: Huntington Digital Library

DID YOU KNOW?

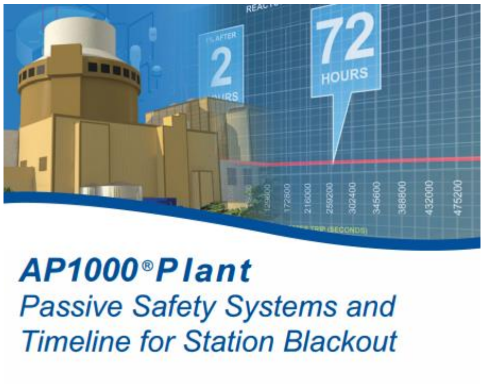
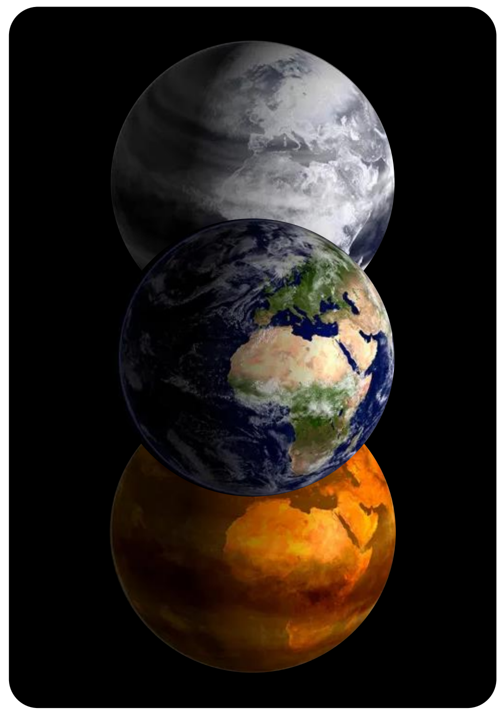


Image from the AP1000 Blackout Brochure at Westinghousenuclear.com

Westinghouse's AP1000, their cutting-edge nuclear reactor, is known for both it's safety and its modular design. In the event of a loss of power, the reactor's passive safety systems are designed to function for **up to 72 hours** without operator action, relying on water tanks, gravity-fed cooling systems, and heat exchangers to prevent overheating. It also features **modular construction**, allowing large sections of the plant to be built offsite and assembled more quickly, reducing costs and construction time. Westinghouse also estimates that it has about **50% fewer valves, 35% fewer pumps, and 80% less piping** than previous designs. The first **operational AP1000 reactors** were built in China followed by the success of two units at Vogtle, with multiple units being constructed around the globe.

Environmental scientists recently discovered that over the last 485 million years, Earth has been both a lot colder and a lot hotter than was once thought. A new temperature timeline has been developed that combines geologic data with computational simulations with the timeline showing that Earth's average temperature was as low as 11 °C (***~52 °F***) and as high as 36 °C (***~97 °F***). This temperature reconstruction adds context to Earth's current warming trend – currently at ~15° C (***59° F***), suggesting we are in a relative icehouse condition. However, this doesn't mean that current human-caused global warming isn't a dire concern, as it is the rate at which we are heating up that is so critical. The past five years have been the hottest on record and 9 of the 10 warmest years have occurred since 2005. Organisms can adapt to big, gradual change. But "when CO2 values and temperatures change rapidly, organisms cannot keep pace."



West County Energy Center in Palm Beach County is the largest U.S. natural gas power at 3,750 MW
Image Credit: FPL.com

There is an approximately 100-year supply of natural gas in the U.S. with an amazing pipeline infrastructure that can move the gas to where it's needed. Experts agree that since coal fired power plants are being eliminated, there are only three other distribution sources that can provide reliable baseload dispatchable power – nuclear, natural gas, and hydro. The immediate solution is natural gas, due to its reduced carbon emissions and its availability. According to S&P Global Market Intelligence, U.S. electric utilities and investors have announced development of 133 new natural gas-fired power plants. Today, the U.S. capacity for natural gas plants is ~530 GW.

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