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August 2022

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Transportation of Spent Nuclear Fuel – Dispelling the Myths



“Spent nuclear fuel has been safely transported in the U.S. for more than half a century - by road, rail, and waterway - shipped in durable containers (pictured above) designed to withstand extreme transportation accidents. The DOE is working with the U.S. Navy to design and test a new transportation cask – Atlas Railcar – design to minimize the possibility of train derailment. The DOE expects to receive the Association of American Railroads’ (AAR) approval for the Atlas railcar design in 2022.”

The number of nuclear power reactors has been decreasing since 1990, when it peaked at 112 units. Today we are down to 54 commercially operating nuclear power plants - 92 nuclear power reactors in 28 states. While our nation's reactors create massive amounts of clean energy - 778.15 terawatt hours in 2021 - they also produce spent or used nuclear fuel that is securely stored at 76 reactor and storage sites across the country.

Did you know that spent nuclear fuel has been safely transported in the United States for more than half a century? Many believe that spent nuclear fuel (SNF) is too dangerous to transport. But in reality, it's a well-coordinated process with a great track record ... and we have the facts to prove it.

Here are 5 common myths about transporting spent nuclear fuel.

Myth: SNF can't be safely transported

SNF is transported in the United States ALL the time – by road, rail, and waterway - shipped in durable containers (pictured above) that are designed to withstand extreme transportation accidents. In fact more than 2,500 SNF shipments have been transported around the country without any radiological incidents over the past 55 years. The

Department of Energy (DOE) requires detailed preparations for any SNF shipment –containers, crew, drivers, travel routes, and coordinates with states and tribes along the travel route(s).

Myth: SNF container will explode in an accident

It's virtually impossible for a SNF transportation container to explode. Transportation containers (**also known as a transportation casks**) are designed to protect against all possible releases of radioactive material - walls are made of steel, lead, and other shielding materials 5 to 15 inches thick – and the ends are encased in structures called impact limiters that absorb impact forces and protect the container from damage. Transportation containers must pass a sequence of impact, puncture, fire, and water immersion tests that cover more than 99.9% of all travel-related accidents.

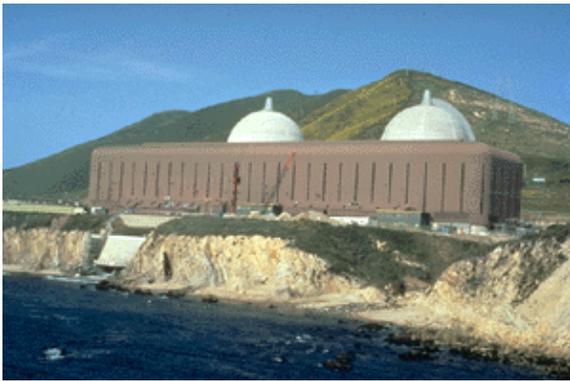
First of all, the chances of a SNF container releasing radioactive material in a transportation accident is less than 1 in 1 billion. Despite these odds, the DOE has created a Transportation Emergency Preparedness Program so that state, tribal, and local responders have access to the training and technical assistance needed to handle a transportation incident involving DOE-owned radioactive materials. The agency also provides

funds to states and tribes to support continued training for emergency officials along active DOE shipping routes. In addition, communication is required throughout the entire shipment process - coordinated with the U.S. Department of Transportation, NRC, U.S. Coast Guard, U.S. Department of Homeland Security, along with applicable state, tribal, and local agencies. The SNF transportation containers are thoroughly inspected prior to departure and strictly monitored along the route using communications centers and telemetric monitoring technology for tracking.

Myth: Transporting SNF exposes the public to high levels of radiation

While it's impossible to block all radiation, the amount of radiation emitted from a SNF transportation cask is very low and is actually lower than the background radiation that occurs naturally in the environment. These containers are designed to significantly limit radiation at the surface of the structure to low levels that meet regulatory requirements for safety. Even then, it is unlikely that an individual not associated with the transport of the SNF shipment, would ever be close to the package for a long period of time.

California Gets Serious About Keeping Diablo Canyon Operating



37 scientists, entrepreneurs and academics sent a letter to Energy Secretary Granholm expressing support for the Department of Energy's proposal. "Considering our climate crisis, failing to pass this amendment could lead to the plant's closure. That would not only be irresponsible, the consequences could be catastrophic. We categorically believe that shutting down Diablo Canyon in 2025 is at odds with this goal."

Looks like California is getting serious about keeping Diablo Canyon operating.

Parallel actions have recently occurred – one by the state's lawmakers, another by the governor, and another by PG&E.

California's legislature has a bill under consideration that would pave the way to extend the life of Diablo Canyon. This bill would allocate a reserve fund of up to \$75 million to the state Department of Water Resources to prolong the operation of aging power plants scheduled to close. If enacted, the bill addresses a couple of Governor Newsom's most pressing concerns - maintaining the reliability of the state's increasingly strained power grid and avoiding the politically damaging prospect of brownouts or blackouts.

While this energy bill does not authorize the extension of the plant's life, it does provide funding that would allow continued operation

should the state leaders decide to do so. However, such a move would require "subsequent legislation and review and approval by state, local and federal regulatory entities," said Lindsay Buckley, a spokesperson for the California Energy Commission. This bill seeks to help the state bridge the transition from fossil fuels to carbon neutrality by 2045 - because state lawmakers don't believe renewable energy alone, can meet the state's rising power demands.

In parallel, Governor Newsom said he would consider applying for federal funding to keep Diablo Canyon open past its scheduled 2025 closure. As you may know, the Biden Administration created a \$6 billion Civil Nuclear Credit Program to rescue financially struggling nuclear power plants, but in order to access the federal funding, PG&E is facing a July 5th deadline.

So, on June 28th, PG&E asked the federal government to grant a 75-day extension "to provide PG&E the time to collect and analyze the information and prepare an application." However, some federal requirements could prevent Diablo Canyon from qualifying for the federal funding, so the Newsome administration sent a letter to Energy Secretary, Jennifer Granholm, requesting some changes that would ensure Diablo Canyon's

eligibility.

The current energy policy of the state is to decommission the plant when the licenses expire in 2024 and 2025, but should an extension be granted to file for federal funding and that funding is approved, the funding will reduce costs to customers if the state decides to keep the plant open to help with grid reliability. The actual cost to keep the 37-year-old facility owned by Pacific Gas and Electric operating is not known, as its planned shutdown has been five years in the making. When PG&E spokesperson, Lynsey Paulo was asked for an estimate, she could not provide one.

Supporters insist the funds are necessary to keep the plant open and advance the state's goals of getting to a carbon-neutral economy while battling climate change. A coalition of 37 scientists, entrepreneurs and academics sent a letter to Energy Secretary Granholm expressing support for the Department of Energy's proposal. "Considering our climate crisis, failing to pass this amendment could lead to the plant's closure. "That would not only be irresponsible, but the consequences could be catastrophic. We categorically believe that shutting down Diablo Canyon in 2025 is at odds with this goal."

Can our Energy Policy Include Renewables, Coal, Oil, LNG, & Nuclear?



“If the EPA places the Permian Basin in a “non-attainment” status, it will force a significant reduction in the region’s rig count, severely limiting the domestic industry’s efforts to increase U.S. oil production at a time when the global oil market is already severely under-supplied. While our President claims to “work like the devil” to lower gasoline prices and Energy Secretary Jennifer Granholm says the President is “using every tool” at his disposal to do so, the EPA seems to be positioning itself to create the exact opposite impact.”

We often see our President say one thing in public while his appointees within the federal bureaucracy do the opposite. This phenomenon has taken place repeatedly. For example, the President has called for the domestic industry to produce more oil and gas, refine more gasoline, and ramp up exports of liquefied natural gas to Europe. But his agencies hold up permitting, issue restrictive new regulations, along with new rulings that directly inhibit the energy companies’ abilities to provide what the President has demanded.

And now, it has happened again, the Environmental Protection Agency (EPA) announced it may soon issue a ruling declaring that vast parts of the Permian Basin are in a “non-attainment” status under the agency’s ozone regulations. Should such a declaration be made, it will constitute a direct governmental assault on what is by far America’s most active and productive oil-producing region and its second most-productive natural gas area. The Permian Basin accounts for 43% of our daily oil

production and contains ~40% of the nation’s active drilling rigs.

The Supreme Court’s recent decision in the *West Virginia v EPA* case is not expected to impact the EPA’s ability to set and enforce standards on ozone levels. However, it seems likely that the agency will seek to become more aggressive in continuing to force coal-fired power plants out of business and hamper production by the domestic oil and gas industry.

Placing the Permian Basin in a “non-attainment” status will force a significant reduction in the region’s rig count, severely limiting the domestic industry’s efforts to increase U.S. oil production at a time when the global oil market is already severely under-supplied. Thus, while our President claims to “work like the devil” to lower gasoline prices and Energy Secretary Jennifer Granholm says the President is “using every tool” at his disposal to do so, the EPA seems to be positioning itself to create the exact opposite impact.

The EPA’s announcement comes just several days after Secretary Granholm summoned a group of refining company CEOs to Washington, D.C. where she urged them to increase their refining efforts, despite the fact that her own Energy Information Agency (EIA) reports that the industry is

already running at a historically high - 95% capacity. It also comes after both Granholm and the President, himself, have repeatedly called for the domestic industry to increase production levels of oil and gas to try to mitigate the nation’s high prices for gasoline and diesel.

Therefore, it’s only natural to ask, what is our official energy policy?

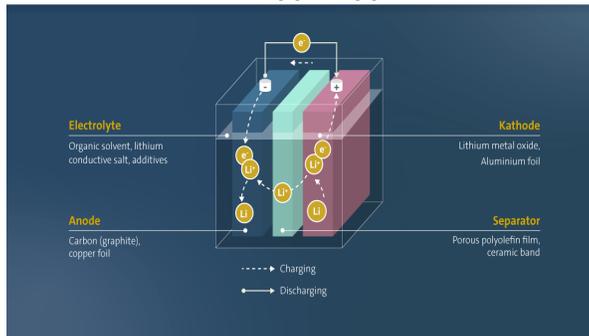
Do we want more oil production and more gasoline refined, or not?

It seems that recent government actions are directly targeting the nation’s most prolific oil-producing region, which would logically seem to interfere with the production of oil and probably lead to skyrocketing prices at the pump.

One way the President could help reduce costs, would be to follow the recent ruling by the Supreme Court - that any time an agency does something big and new – in this case addressing climate change – the regulation is presumptively invalid, unless Congress has specifically authorized regulating in this sphere - and instruct the EPA to stand down, as this is a job for Congress not for a government agency. But it appears the “Green New Deal” is the plan, and high prices at the pump are a fundamental piece of it.

Engineers Develop Li-ion Battery - Works in Extreme Cold & Heat

HOW A LI-ION BATTERY WORKS
From charging to discharging



“Latest battery technology has produced an energy-packed lithium-ion battery that performs optimally, at extreme hot and cold temperatures. “If you want a battery with high energy density, you typically need to use very harsh, complicated chemistry. High energy means more reactions are happening, which means less stability, more degradation. Making a high-energy battery that is stable is a difficult task itself—trying to do this through a wide temperature range is even more challenging”, explained Zheng Chen.”

If you have been following developments in battery technology, you know there has been no shortage of news – from a battery that could last 100 years to a water-based battery that can be produced at half the cost of the lithium-ion ones.

Well, the latest is that an engineering team at the University of California, San Diego, have developed an energy-packed lithium-ion battery that performs optimally at extreme hot and cold temperatures.

High-temperature operation is important for areas where the ambient temperature can reach triple digits and also for electric vehicles, where the battery packs are typically under the floor, close to the road where it can get even hotter. In addition, batteries heat up during their operation as current runs through them, and if they can’t tolerate this, their performance will drop-off dramatically.

The engineering team at UC – San Diego ran tests with their prototype batteries, and they retained 87.5% and

115.9% of their energy capacity at -40°C and 122°F , respectively. Better yet, the prototypes had high Coulombic efficiencies of 98.2% and 98.7% at these temperatures, which means the batteries can undergo more charge and discharge cycles before they cease to function.

However, developing the new batteries was no easy task.

“If you want a battery with high energy density, you typically need to use very harsh, complicated chemistry. High energy means more reactions are happening, which means less stability, more degradation. Making a high-energy battery that is stable is a difficult task itself—trying to do this through a wide temperature range is even more challenging”, explained Zheng Chen, a professor of nanoengineering at UC-San Diego.

In order to bypass these hurdles, the team invented a dibutyl ether electrolyte and engineered the sulfur cathode to be more stable by grafting it to a polymer preventing more sulfur from dissolving into the electrolyte.

The end result was batteries with much longer cycling lives than a typical lithium-sulfur battery. “Our electrolyte helps improve both the cathode side and anode side while providing high conductivity and interfacial stability,” said

Chen.

In the future, perhaps this battery design could enable electric vehicles to travel further on a single charge in cold climates while also alleviating the need for cooling systems to keep the vehicles’ battery packs from overheating in hot climates. However, more work is needed, they will need to scale up the battery chemistry, optimize it to work at even higher temperatures, and extend its cycle life.

All-climate temperature operation capability and increased energy density is recognized as the two crucial targets needed for battery operation, but they are rarely achieved together in rechargeable lithium (*Li*) batteries.

However, this design was able to accomplish this with monodentate dibutyl ether (*has both low melting and high boiling point*), as their sole electrolyte solvent. In addition, it avoided dendrite growth and enabled Coulombic efficiencies of 99.0%, 98.2%, and 98.7% at 23°C , -40°C , and 50°C , respectively. Employing tLi metal ($50\ \mu\text{m}$) anodes, and high-loading sulfurized polyacrylonitrile ($3.3\ \text{mAh cm}^{-2}$) cathodes (*negative-to-positive capacity ratio = 2*) they achieved an output of 87.5% and 115.9% at -40°C and 122°F , respectively.

Did You Know?



“That companies with women in leadership positions perform better? About 17% of the electrical industry have women operating in senior roles, while the energy industry is less, at around 14%. The electrical utilities have even a better percentage - 25% of their senior managers are women, and GTTSi is even greater at greater than 50%. Four of our seven senior management positions are filled by women. If you would like to learn more, please visit our website at www.gttsi.com to see their profiles.”



NRC License Operator Exam will cost \$232K

That the Nuclear Regulatory Commission is increasing their fees or rates? Each operating reactor will now pay a fee of \$5,165,000 (an increase of ~500K). Should the NRC develop a License Operator Exam for your plant, it will cost at least \$232,000 (\$290/hr). GTTSi can develop a License Operator Exam for your plant (**written, operating, JPM's, for both the Audit and the NRC Exam**) at a much lower cost – we have an ex-NRC Region II Exam Writer on staff.



Energy sector employs 7.8 million people in the United States, and about 41% of those jobs (3.1 million people), are dedicated to net-zero technologies

That the energy sector employs 7.8 million people in the United States? Approximately 41% of those jobs (3.1 million people), are dedicated to net-zero technologies. In 2021, energy jobs grew at a faster rate than the overall job market, increasing 4% versus the 2.8% increase experienced nationwide. Solar jobs led the way for generation technologies, adding 17,212 jobs. Solar was followed by wind, which added 3,347 jobs. Hydropower added 1,383 jobs. The transmission, distribution, and storage sectors employed 1.3 million people in 2021 with traditional transmission and distribution jobs increasing by 13,008. Battery jobs - grid storage and the electric vehicle sector added 2,949 jobs. Smart grid jobs increased by 1,136 jobs. The fossil fuel and **nuclear industry** were the only energy sector jobs that decreased – petroleum jobs decreased by 31,593 jobs, coal fuel job decreased by 7,125 jobs and nuclear **lost 2,440 jobs.**



Germany forced to use natural gas emergency reserves after Russia's Gazprom shutoff deliveries – reserves down to 64%.

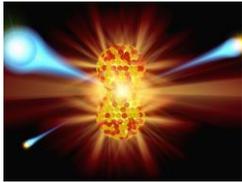
That German's energy giant, Uniper, has been forced to tap into its emergency supplies before the winter season after Russia's Gazprom shut off natural gas deliveries to the country? Uniper has had to lean on its emergency winter supplies to meet contractual obligations to its customers because it hasn't received any supplies via the Nord Stream 1 pipeline which is undergoing maintenance through July 21. Germany has already been forced to accept only ~40% of the expected gas deliveries from Russia, which has worsened the country's energy crunch. **Germany is facing a natural gas deficit but hope to refill their gas reserves to 90% by November, although it is now at ~64%.** These shortages could spill over and hurt other European nations including France, Austria, Denmark, Switzerland, and the Czech Republic.



Equinor acquires East Point Energy – battery energy storage company

That the Norwegian company, Equinor, has acquired another battery energy storage developer? This time in the U.S. – East Point Energy, headquartered in Charlottesville, VA. This acquisition provides Equinor's entry into the U.S. market and a **4.1 GW current pipeline of early to mid-stage battery storage projects focused on the US East Coast.** East Point will become a subsidiary of Equinor with its team continuing to develop the business, as well as adding capabilities to own and operate energy storage projects in the near future.

Can Nuclear be a Solution – Today and for the Future?



“A power shortage is the last thing consumers and businesses need, but with the forecast for rolling blackouts and brownouts this summer, it looks imminent. Our nation is looking for answers, and nuclear can provide us with reliable, dependable, resilient energy as we navigate through the ongoing energy crisis. Both governments and companies are turning to nuclear power. The Biden administration issued a notice of intent for the implementation of a \$6 billion nuclear credit program that supports the operation of reactors - “the nation’s largest source of clean power”. The U.S. Department of Energy just awarded over \$60 million for 74 nuclear projects.”

Although renewable advocates tell us they can supply our electrical needs in just a few more years, the nation needs a reliable source of energy now. A power shortage is the last thing consumers and businesses need, but with the forecast for rolling blackouts and brownouts this summer (***for half the nation***), it looks like this is where we are headed.

The development of, and investment in, nuclear energy sources and storage methods could be a solution. Our nation is looking for answers, and nuclear can provide us with reliable, dependable, resilient energy as we navigate our way through the ongoing energy crisis.

But with costs rising and few solutions at hand, both governments and companies are turning to nuclear power as a cleaner and cheaper source of energy to help them reach their ambitious climate goals.

Earlier this year, the Biden administration issued a notice of intent for the implementation of a \$6 billion nuclear credit program that supports the operation of reactors - “the nation’s largest source of clean power” - across the country. Last week, the U.S. Department of Energy awarded over \$60 million for 74 nuclear projects.

In the UK, British jet engine maker Rolls-Royce Motor Cars Ltd., backed by the UK government and other

investors, said late last year it was going to begin building smaller and cheaper reactors. Some of its compact modular reactors are expected to come online by 2029 and the regulatory processes are already underway.

The return to nuclear makes sense, as those areas where nuclear plants are operating have a reliable source of energy that is cheaper and competitive, especially with the rising cost of natural gas.

Many of the nation’s coal plants were retired over the past few years and their generation was replaced by renewables and natural gas plants. Although natural gas is much more reliable than renewables, the cost has escalated with the cost of natural gas. Renewables, for now, are cheaper but that won’t last much longer, as government subsidies will be terminated at the end of this year, and with their removal the cost will be greater than natural gas. Once energy storage is added to back-up the renewables, cost will escalate even further.

In Europe, where government subsidies are gone and nuclear is no longer available, the cost of electricity is double and triple U.S. rates – some of these countries have restarted abandoned coal plants to provide the power needed and reduce costs.

The biggest stumbling

block, for nuclear, is the deep-seated anxieties around safety and waste disposal.

Memories of nuclear accidents like Three Mile Island in 1979, Chernobyl in 1986, and Fukushima Daiichi in 2011 continue to loom large in both public and corporate memory. Yet, the U.S. safety record for nuclear is unrivaled by any other industry. The progress that’s been made on alleviating issues around nuclear power is underappreciated.

A host of startups are working on making nuclear power even more acceptable with SMR (***small modular reactor***) technology. NuScale Power LLC, Seaborg Technologies, Oklo, and TerraPower, to name a few.

Nuclear power stands to be a solution for today and for the future with SMR, Generation IV, and the recent developments with nuclear fusion (Tiger Global LP and Bill Gates).

Rejecting nuclear as a dependable, reliable, resilient power source will be a big mistake. We need to be discussing nuclear energy and raise public awareness, but this requires the public to listen with an open mind and with a willingness to understand. Can this be achieved? Only time will tell!



GTTSi Job Board Update

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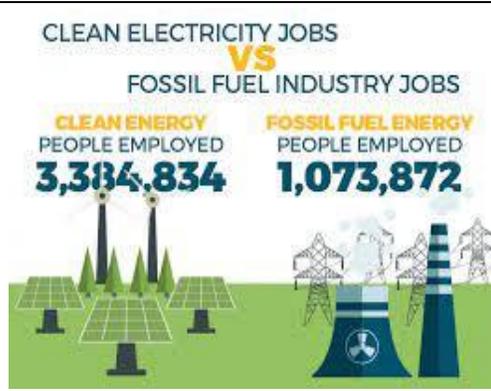
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GTTSi provides professional services to the energy and nuclear industry since 1980. We are a MWOBE (*minority woman owned business enterprise*) and have served over 80% of the US commercial nuclear facilities, 8 Federal agencies and prime contractors, 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 our Home Office at **864.882.3111**.

- **Engineer – Solar Farm Design & Construction**
- **Engineer – Wind Farm Design**
- **Shift Technical Advisor Instructors**
- **SRO Instructors (Classroom & Simulator experience)**
- **Maintenance Instructors (Mechanical, Electrical, I&C)**
- **Project Manager – E&C**
- **FIN (Fix-It-Now) Engineer**
- **Project Consultant**
- **Scheduler - RO or SRO (experience)**
- **Online & Outage Project Scheduler**
- **Scheduler / Cost Analyst**

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