Risky Business: Westinghouse and the AP1000

Lessons Learned from the AP1000 Disasters in the U.S.

Workshop on the Westinghouse AP1000, 18 June 2024

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SRS WATCH

Savannah River Site Watch

Given AP1000 project failure in the US is trouble coming your way for new reactor projects?

Total Failure: VC Summer AP1000 units 2 & 3, South Carolina Electric & Gas (SCE&G); construction started in 2009, halted in 2017 after $9 billion wasted on construction. There is a cover-up about this project in the CEE.

Partial Failure: Vogtle AP1000, units 3 & 4, Georgia Power Company; construction started in 2009, were to be finished in 2016 and 2017 but started operation in 2023 and 2024. The cost went from estimated $14.5 billion to $36 billion, raising rates 24%. These could be the world's most expensive nuclear reactors.

Photos: VC Summer, November 2020 ©High Flyer & Vogtle, 18 February 2024 – 2 reactors for ~$48 billion

Anticipating success in the US, the plan appears to have been in 2009 for WEC to next push the AP1000 in Europe. With the AP1000 economic disasters in the US, what does that mean for efforts in Europe? WEC promotion is the same now as before the US failures but the target has shifted from the US to CEE.

In 2009, WEC was already looking at the European market, claiming then that the AP1000 "cost basis can compete with other energy sources" and that there was a "high degree of certainty for schedule and cost." The first point is questionable and the second point is correct as we are now certain about significant schedule delays and massive cost overruns, making the claim of "reduced construction time and cost" demonstrably false. Due to the US failure, WEC went bankrupt in 2017.

AP1000 Satisfies EUR

- AP1000 assessed against EUR, Rev. C, Volumes 1 & 2
- AP1000 Assessment detailed and through
  - Over 5000 requirements assessed
- Assessment demonstrates AP1000 is a mature design and the level of compliance is high
- AP1000 can be deployed in Europe

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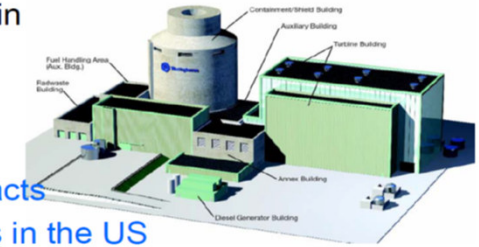
New Designs Have to Deliver

- Cost basis that can compete with other energy sources
  - High degree of certainty for schedule and cost
  - Reduced construction time and cost
- Increased levels of safety
- Easier to operate and maintain
- Standardized plants

AP1000 can deliver

- Currently delivering on contracts for 4 units in China and 6 units in the US



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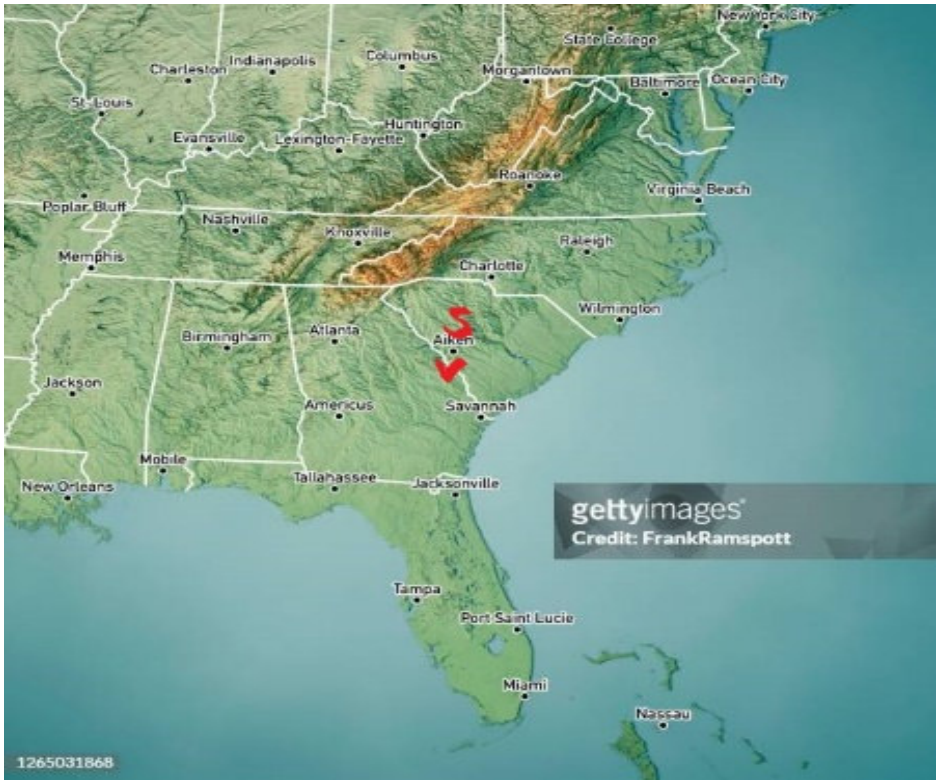
Identical twins: VC Summer, located in South Carolina, and Vogtle in Georgia.

The state regulators - the "Public Service Commissions" (PSCs) - separately approved the projects in 2009. Afterwards, the PSCs approved all requests by the private utility companies for ever increasing costs and continuous schedule delays for both projects. Both PSCs in those states failed in their job and to protect consumers and did exactly as asked by the utilities, even when it was clear there were problems. This resulted in rate payers bearing the burden of ever-increasing costs of the troubled projects.

Though supposedly serving the public, the PSCs in reality serve the electricity companies and protect their profits. The PScs are examples of "captured regulators" (controlled by those supposedly regulated).

S = VC Summer in South Carolina - 83,000 km², 5.4 million population, 7 nuclear reactors - project of South Carolina Electric & Gas (now Dominion Energy)

V = Vogtle in Georgia -154,000 km², 11 million population, now has 6 nuclear reactors - project of Georgia Power Company (& parent Southern Company)



V.C. Summer - units 2 &3 - after work was halted on 31 July 2017. Incomplete “shield buildings,” reactors and turbine buildings have been exposed to weather for 7 years.

Unit 1, by the lake - started operation 1984, Westinghouse 3-loop PWR. Like almost all US nuclear reactors, all highly radioactive spent fuel remains at the site as there is no high-level nuclear waste disposal facility.

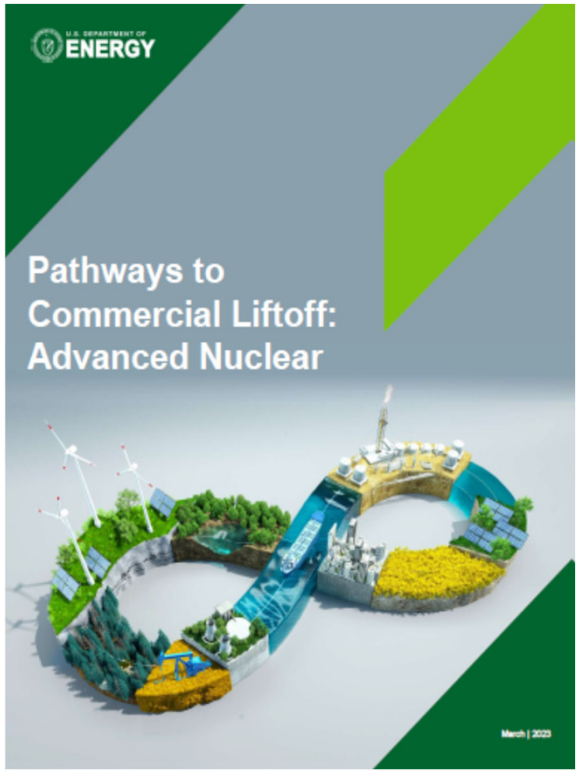
Vogtle units 3 & 4 under construction in 2020 (on the left);
“shield building” under construction (on the right).

Units 1 & 2 started in 1987 and 1989 - Westinghouse 4-loop PWRs. Now, the 4-unit Vogtle facility is the largest nuclear power station in the US. All spent fuel since 1980s remains at the site.

The Reasons for Failure are Many

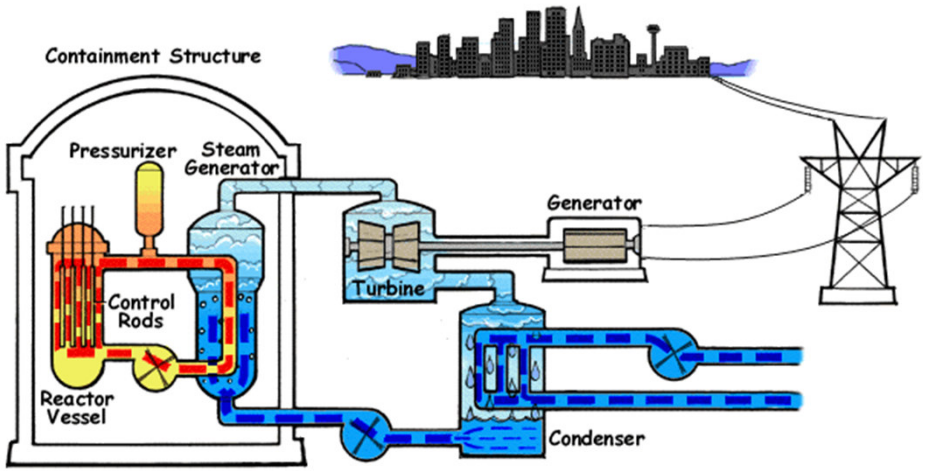
U.S. Department of Energy finally admitted in 2023 some of the debilitating problems in pursuit of the Westinghouse AP1000 reactors. Due to the AP1000 experience, DOE has turned away from the AP1000 and other large reactors in the US but is pushing the AP1000 in CEE. Why?

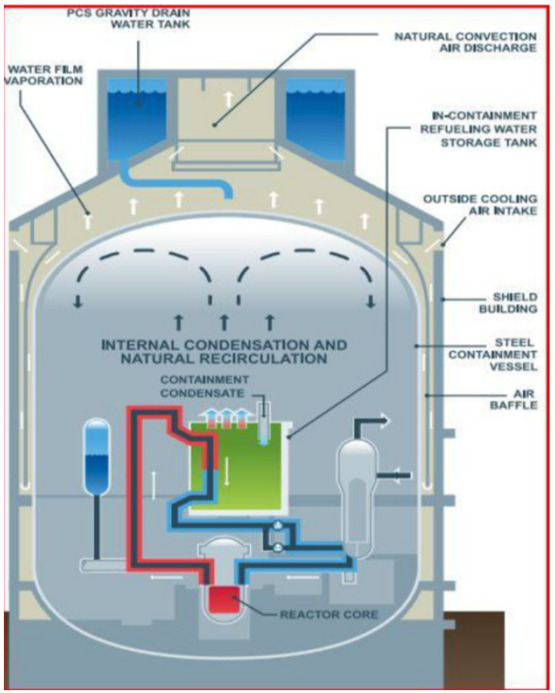
- Inadequate integrated project schedule,
- From the start, absence of valid project cost estimates,
- Lack of reliable, public rate impacts from the start & now,
- Shortage of experienced labor,
- Failure of supply chains,
- Lack of companies with nuclear certification,
- Incomplete design before start of construction,
- Ongoing design issues of safety concern,
- Lack of coordination between construction consortiums (Westinghouse & construction companies) and owners (electric utilities),
- Construction problems (like with concrete, welding),
- Endless deception and lies to regulators and the public about schedule delays, cost overruns & rate impacts - illegal,
- No solution to high-level radioactive waste disposal,
- Inadequate review of energy alternatives.



The “shield building” is open to the environment

Note “containment structure” in diagram on left of typical pressurized water reactor (PWR). In AP1000 diagram, the “shield building” (~90 cm thick) is open to the atmosphere at the top - see “outside cooling air intake.” But there is a steel “containment vessel” (~2.5 cm thick) in which the reactor is located. Water tank weighs 325,000 kg and holds ~3 million liters, for “passive” cooling.





The design was challenged during the NRC licensing process

These reports, for the "AP1000 Oversight Group" (NGO group) by Fairewinds Associates, raise concerns about the AP1000 design, are from 2010. They were part of a challenge to the operating licenses by NGOs before the NRC. The NRC rejected NGO interventions on both projects & issued the licenses in 2012.

Video: https://www.fairewinds.org/nuclear-energy-education/fukushima-and-its-impact-upon-the-westinghouse-toshiba-designed-ap1000-atomic-power-plant

The US Nuclear Regulatory Commission (NRC) approved the design of the AP1000 in 2004, but there were 19 formal design changes through 2011. (NRC webpage on the AP1000: https://www.nrc.gov/reactors/new-reactors/large-lwr/design-cert/ap1000.html)

Post Accident AP1000 Containment Leakage

An Unreviewed Safety Issue

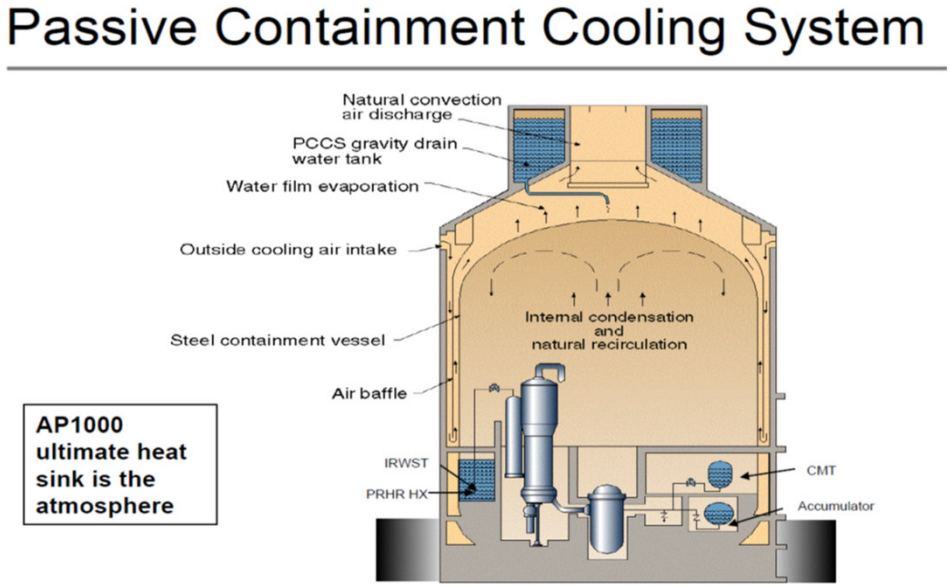
Fairewinds Associates, Inc, April 7, 2010

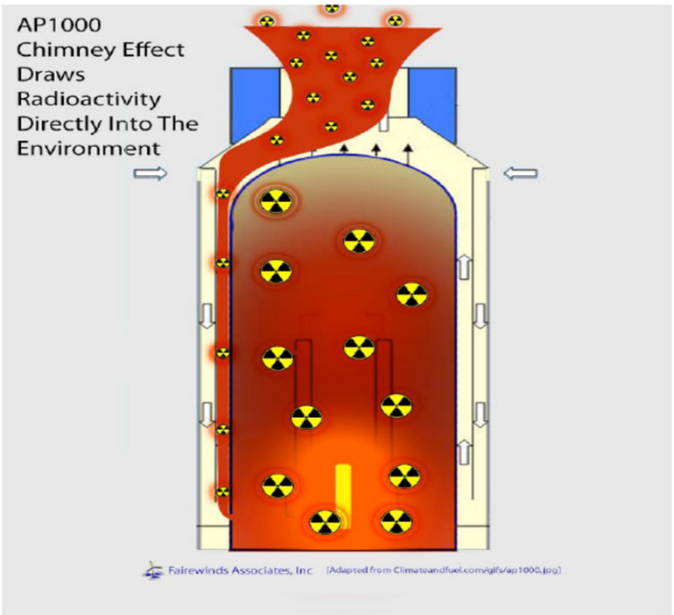
A Report by Arnold Gundersen, March 26, 2010
Chief Engineer, Fairewinds Associates, Inc

Design concerns remain

In diagram of the reactor building on the left, with 3-million liter water tank on the top, note arrows and "natural convection air discharge" and "AP1000 ultimate heat sink is the atmosphere."
Diagram from WEC's "The Westinghouse Advanced Passive Pressurized Water Reactor, AP1000" - https://inis.iaea.org/collection/NCLCollectionStore/_Public/42/026/42026956.pdf

The "shield building" is not the usual robust LWR containment building and is open to the atmosphere. In case of a serious reactor accident or attack, a breach in the reactor pressure vessel and the steel containment vessel could lead to the "chimney effect," whereby radiation escapes directly into the environment. If water in the tank is lost by seismic event or attack, the "passive" cooling system is at risk.

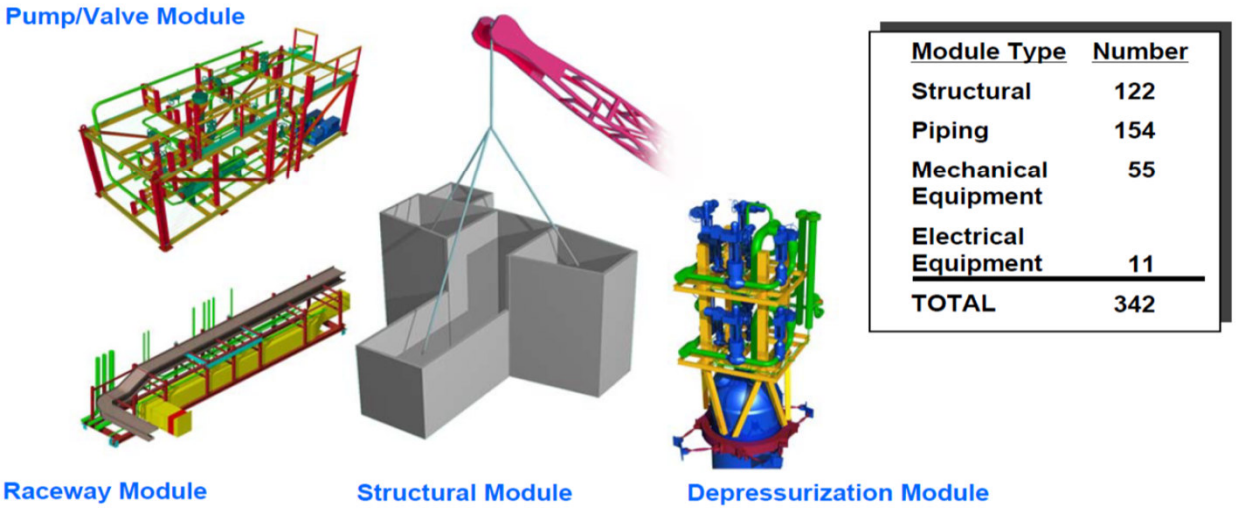




“Modular construction” of AP1000s at both VC Summer and Vogtle was falsely advertised by WEC from before construction that modular construction would result in more efficient, quicker construction.

Image from *The Westinghouse Advanced Passive Pressurized Water Reactor, AP1000*
https://inis.iaea.org/collection/NCLCollectionStore/_Public/42/026/42026956.pdf

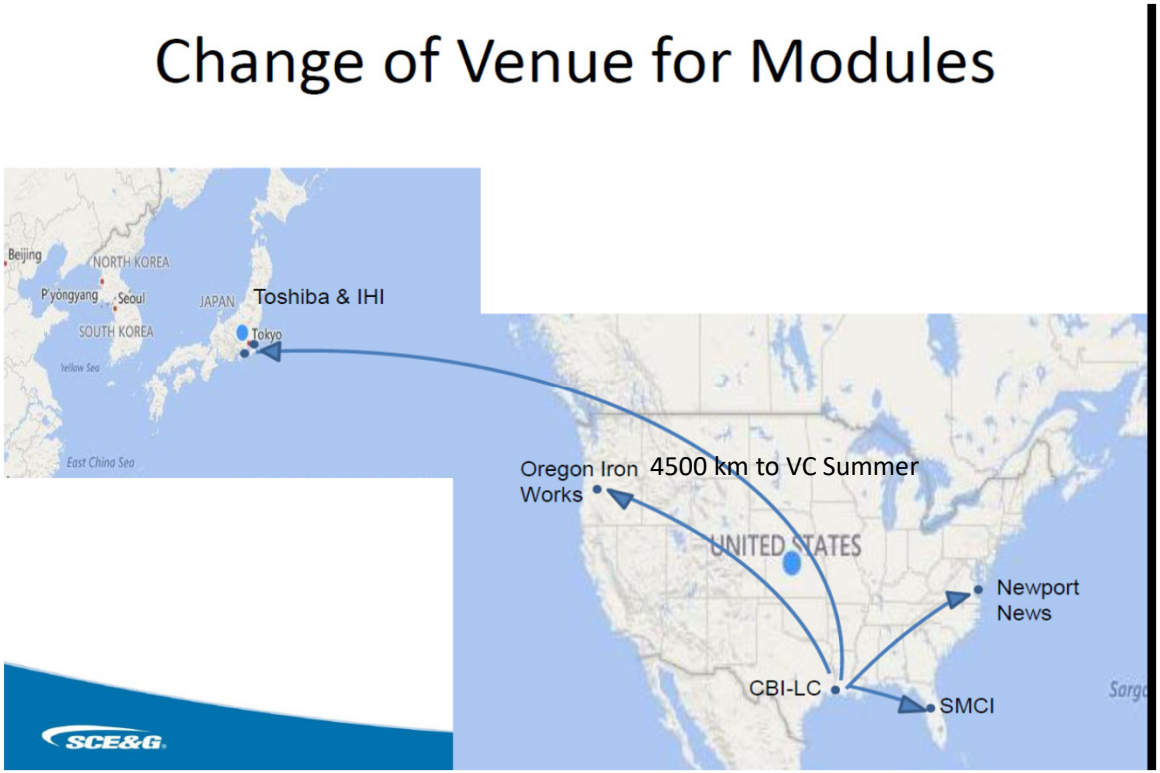
Modules Designed into AP1000 from the Beginning



Module Type	Number
Structural	122
Piping	154
Mechanical Equipment	55
Electrical Equipment	11
TOTAL	342

The Chicago Bridge & Iron (CB&I) modular construction facility in the state of Louisiana failed quality control inspections by the US NRC and was removed from the project.

Construction of the modules had to be shifted to other facilities and modular assembly had to be done at the AP1000 sites. The claim by WEC that modular construction would be more efficient and cheaper was shown to be incorrect and caused significant schedule delays and cost increases.



“Modular Assembly Building” (MAB) is the large, white building. Note the large crane, used to lift modules and such heavy things as the reactor pressure vessels, steam generators and “shield building” rings. Where will such cranes, the largest in the world, come from for numerous AP1000 projects at the same time?

Bechtel investigation failed to prevent project collapse.

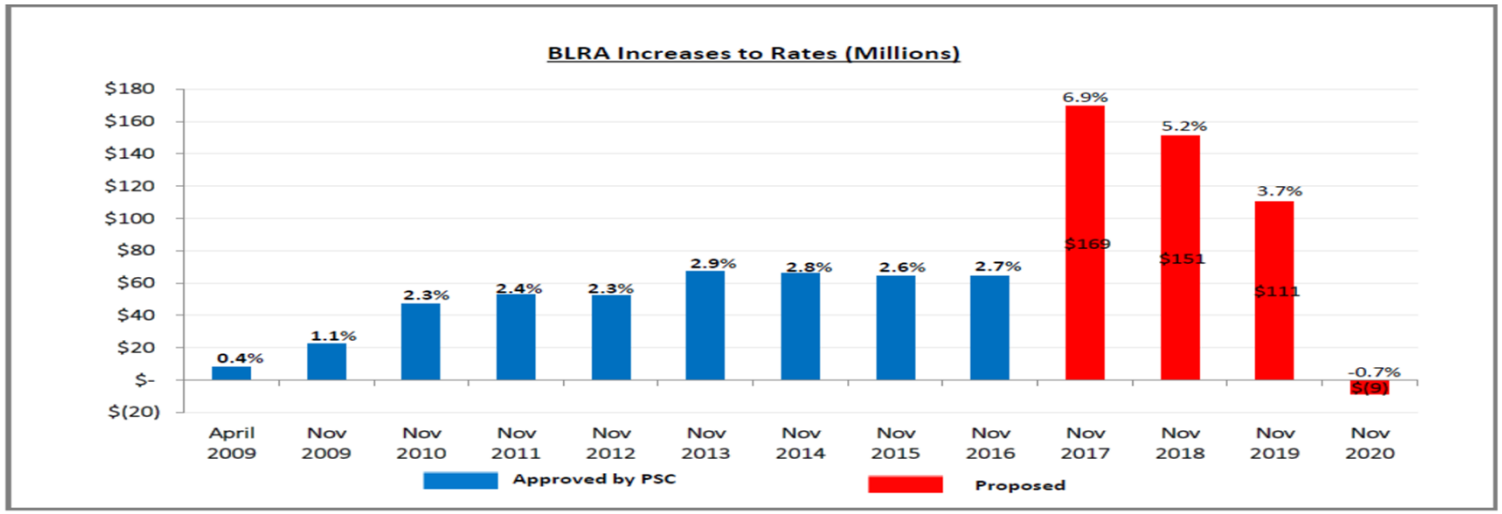
Given the growing problems, SCE&G and its partner contracted Bechtel in 2015 to analyze what was wrong with the VC Summer project and how to rectify things. Bechtel's *Project Assessment Report*, February 5, 2016, was kept secret for well over a year until after project termination in 2017. SCE&G did not want anyone to know how many problems had been identified and which were not correctable. The "strictly confidential" report avoided stating the obvious but it was clear the project could not be saved (and it collapsed 1 1/2 years later).

As a consolation with a positive side, Bechtel, if involved in the CEE projects, knows the huge challenges that will be faced. But Bechtel was not able to salvage the failing VC Summer project. Report posted here: https://srswatch.org/wp-content/uploads/2024/06/Bechtel-Report-on-VC-Summer-construction-2016.pdf

How much VC Summer customers have paid since 2009 is not publicly known

From 2009 to before the VC Summer project was halted on 17 August 2017, SCE&G customers were hit with 9 rate hikes for reactor construction, as allowed by our "Construction Work In Progress" (CWIP) law. Those were only for financing charges and not shown on the monthly bill. Further CWIP charges and much larger rate hikes to pay for capital costs (for construction) were thankfully avoided.

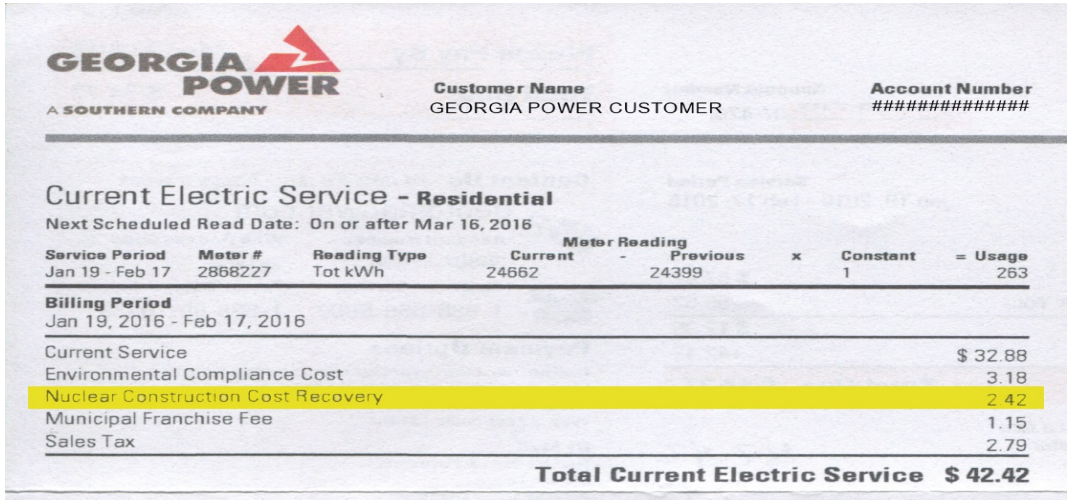
In part, the project collapsed because SCE&G and its partner (40% ownership) could not afford the rising costs and couldn't tolerate the political pressure caused by constant cost-increases, rate hikes, endless delays and project mismanagement. We are now paying 5.6% of the monthly electricity bill for the dead project and under an agreement with SCE&G intervening parties, we will pay until 2039. FOE did not agree to the "settlement." We do not know how much we have paid since 2009. The 40% state-owned partner has not started charging customers yet - they will soon see huge increases in their electric rates.



Vogtle customers have little idea how much the project has cost and don't how much they are paying

The interest charge on the debt for Vogtle was allowed to be collected from customers before the reactors were operational and appeared on the Georgia Power bill as "Nuclear Construction Cost Recovery." This was not the capitol cost of construction, which is now going into the bill but is not shown to the customer. The 24% rate increase so far for the company's controlling interest (45.7%) of the 2 new reactors is not on the bill. 54.3% ownership in Vogtle units 3 &4 is by 3 smaller public utility companies.

The company's "return on equity" in 2022 was a startling 11.9%. Under Georgia electricity regulation, electric utilities are guaranteed a profit on expenses, so the more they spend or waste the more they make, and were given a "blank check" for cost of the AP1000 reactors. Also, Vogtle got $12 billion in federal "loan guarantees," money loaned at a low interest rate to Georgia Power. They may never pay this back as there are tax advantages to just paying the interest on the debt every year.



GEORGIA POWER
A SOUTHERN COMPANY

Customer Name
GEORGIA POWER CUSTOMER

Account Number
###############

Current Electric Service - **Residential**

Next Scheduled Read Date: On or after Mar 16, 2016

Service Period	Meter #	Reading Type	Meter Reading Current	- Previous	x	Constant	= Usage
Jan 19 - Feb 17	2868227	Tot kWh	24662	24399		1	263

Billing Period
Jan 19, 2016 - Feb 17, 2016

Current Service	$ 32.88
Environmental Compliance Cost	3.18
Nuclear Construction Cost Recovery	2.42
Municipal Franchise Fee	1.15
Sales Tax	2.79
Total Current Electric Service	**$ 42.42**

“Qu’ils mangent de la brioche.”

Time for some to celebrate!? Well, Georgia Power is celebrating the $36 billion Vogtle debacle, on which they will profit for perhaps 60+ years. AP1000 cake at the dedication of Vogtle, unit 4.

The bags of money that the peasants are being forced to pay are not shown...but everyone knows the customers of Georgia Power and the 3 partners are the

US Government Attorneys: The Summer AP1000 project in South Carolina became a “criminal conspiracy”

The US Dept. of Justice brought federal felony charges - for fraud - against two top SCE&G officials and two Westinghouse officials, for lying in official, legal proceedings about the cost, schedule and insurmountable technical difficulties. They knew the project was failing but kept it going as it made money.

The SCE&G CEO (in photo on left, in 2021) and the vice president in charge of construction served time in federal prison; one Westinghouse construction official received home detention and one (on the right) is yet to be sentenced. There have been no criminal charges in the Vogtle project.

While the company and PSC hid in the shadows, activists in South Carolina made the “conspiracy” visible to the media and public

Outside the federal courthouse in Columbia, South Carolina, during a hearing for SCE&G CEO. We made two “WANTED” posters with 17 people on them - all guilty for their role in the VC Summer project. This got a lot of attention, especially as we had the public in agreement with us, which is one reason that the four charged pleaded guilty, avoiding a jury trial.

Citizens protested like this for 10 years – we saw the storm clouds of disaster right from the start

SCE&G CEO walks by citizens during a PSC hearing on a yet another rate increase and schedule change for the VC Summer project. Friends of the Earth-US was a key party before the South Carolina PSC in 2009 and onwards, especially in 2017 when we filed that the project must be terminated after WEC went bankrupt and it was clear the project could not continue and would never be completed due to skyrocketing costs, large schedule delays and mismanagement of the project.

"Recognition - "award certificate" - is to SCE&G
for "Worst Performance in 21st Century" for VC Summer debacle.

South Carolina legislature enabled the crimes by passing legislation written by a lawyer for the utility

At the South Carolina state capitol, with SCE&G (in tuxedo) and “state legislature” - which in 2007 passed the CWIP law that allowed the AP1000 disaster to happen - holding the “blank check” issued in 2009 by the Public Service Commission for the VC Summer project. The legislature-SCE&G-PSC action on adopting a CWIP law was a legal but unethical conspiracy. We have used this check many times in public events and news conferences.

Alert! Tim Echols, member of Georgia Public Service Commission was to be in Poland, 12-13 June for a “Nuclear Energy Regulatory Forum.” He allowed the Vogtle disaster to happen and is now informing others how to pull off similar fraud.

Possible action items

- Demand full story about VC Summer & Vogtle be told; halt the information cover-up.
- Before reactors pursued, demand full review of alternatives, including efficiency and conservation.
- Demand and/or create citizens' review panel.
- Demand full EIS, including seismic review & waste management and disposal plans, with public hearings.
- Before construction, demand solution for spent fuel disposal.
- Set up "hot line" to solicit information from officials and workers.
- Starting now, need review by economists & energy analysts.
- Meet with US Embassy, EXIM Bank, US DOE. Come to Washington.
- Demand right to formally "intervene" against the project licensing & financing.
- Demand explanation where huge work force will come from for AP1000s in 4 countries at the same time and how supply chains will function.
- Demand list of "nuclear qualified" (NQA-1) vendors and suppliers.
- Demand companies and electric utilities participating take the financial risk and not ratepayers or the taxpayers.
- Demand fixed schedule & fixed price, with penalties if they are not met, and no cost to customers until reactors operating ("used and useful").
- Demand that all construction, financing and planning costs be shown on the monthly electricity bill.
- Hold colorful demonstrations.

VC Summer, units 2 & 3

Site preparation: 2009 (tree clearing in 2008)

State of South Carolina permission: 2009

US NRC construction license: 2012

Forecast start dates in 2008: 2016, 2019

Cost estimate 2009: $9.8 billion; 2013: $11.5 billion

Project termination: 2017; $25 billion projected cost

Amount wasted: $9 billion + $2 billion financing; about 50% complete, but extent of construction problems unknown

Vogtle, units 3 & 4

Site preparation: 2009

State of Georgia permission: 2009

US NRC construction license: 2012

Forecast start dates in 2008: 2016, 2017

Cost estimate in 2009: $14 billion

Actual start dates: 2023, 2024

Current cost: $36 billion (with $12 billion US DOE loan guarantees); with interest & profit = ??? billions

While about $11 billion has been wasted so far on the VC Summer project, at least it was terminated well before the cost tripled and before the reactors operated. Concerning costs, things are far worse with Vogtle. The $36 billion cost will only increase as profits will be made forever on interest and construction costs.

<u>What do Westinghouse & their friends have planned for you?</u>

Thank you.

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