

DOCKETED

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See attached

Additional submitted attachment is included below.

7 May 2015

To: California Energy Commission
Attn: Chairman Dr. Robert Weisenmiller & Commission Members
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Written Comments for: 27 April workshop on nuclear-power matters.

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- a) **Initial workshop remarks** by CEC Commissioner Weisenmiller referenced a well-known statement by former ORNL Director Alvin Weinberg that nuclear power involved a “Faustian bargain”. Weinberg & Murray were co-inventors (in 1946) of the present type of commercial power reactors used around the world in past decades – the light-(or heavy)-water, solid-Uranium-fuel, fission reactor.

The reason for Weinberg’s remark was simple – solid fuel allows buildup of both fission products and transuranics (elements created via neutron capture that are heavier than Uranium). This pollutes the solid, originally-pure Uranium fuel and forces us to remove it from reactors after about 5 years, as its useful reactivity declines. We must then decide what to do with it.

The fission products are highly radioactive because they’ve been split from Uranium nuclei and are decaying quickly to stable, common elements, like Cerium, Zirconium, etc. Some are already stable when fuel is removed from a reactor, and almost all will lose their radioactivity within a few hundred years. The transuranics generally decay far more slowly, some lasting many thousands of years, but in consequence, they are far less radioactive.

Weinberg’s “Faustian bargain” remark applied to this type of reactor design and fuelling. The French have for decades dealt with this by simply taking used (spent) fuel (even from other countries) and chemically separating the fission products, transuranics and Uranium that’s useful for new, recycled fuel. The US planned to do the same, until President Carter closed our similar facility by Executive Order, as an international gesture for non-proliferation. That order had no worldwide effect and is the fundamental reason we’ve had buildup of “spent fuel” around the country – fuel that could have been recycled for decades.

Weinberg’s “Faustian bargain” remark did not apply to nuclear-power in general. Otherwise, his memoirs would not be titled: “*The First Nuclear Era*” and “*A Second Nuclear Era*”.* Nor would his subsequent work at ORNL, including the invention (with Nobel chemist Wigner) of the Molten-Salt Reactor, have occurred. His work demonstrates that he knew there was no need to run solid-fuel

cycles and no need to create solid-fuel ‘wastes’, such as what we now see as solid, “spent fuel”.

I’ve studied Weinberg’s work. I’ve spoken with his son, Richard. I’ve helped a bit with founding the Weinberg Foundation in London. Commissioner Weisenmiller oddly misrepresented Weinberg to the public, on 27 April. Why?

- b) Nuclear waste.** As with anything thrown out, “one man’s garbage is another’s treasure” -- nuclear-fuel waste (‘spent’ fuel or enrichment ‘waste’). France has for decades run a country on nuclear fuel, recycling it and storing fission products and transuranics, yielding a carbon footprint less than half that of the US or any industrialized country. Ontario Province is similarly ~60% nuclear powered, like Chicago (but Chicago still burns some coal, while Ontario burns none).

In the US, we have >500,000 tons of almost pure Uranium (^{238}U) left over from the Uranium-fuel-enrichment process that most countries use. We have about 72,000 tons of ‘spent’ fuel assemblies, sitting in cooling pools or dry casks around our power plants.

About 95% of ‘spent’ fuel is the same Uranium that was originally used to make it – about 1% is the valuable, enriched fission fuel ^{235}U . Fission products account for about 4% and transuranics the remaining 1% or so. One can see why France and others recycle their fuel – present reactors can use about 96% of what we call “spent fuel”. Our recycling of beverage containers doesn’t come close to that recycling benefit.

So, what we call “nuclear waste” from reactors mostly isn’t, and the volume of that material that actually can’t be reused in today’s reactors amounts to a short pile (<3200 tons) between the goal line and the 5-yard line on a football field. In contrast, just one US utility that uses coal has >100 million tons of coal ash piled in unsealed ponds, pits and mounds around our southeast. That true “waste” contains Arsenic, Lead, Thallium, Mercury, etc. that never decay away, just as the Mercury from our Gold Rush continues to settle in San Francisco Bay and remain with us forever. And, the burning of coal or gas for power is forgiven its radioactive emissions (NORM Exemption) – emissions no nuclear fuel processor or power plant could produce.

The actual waste from >57 years of nuclear-power operation is the US easily fits in existing facilities, like WIPP, or a few boreholes, as Sandia has researched. There’s no need for Yucca Mountain, and no need to waste the useful ~96% of ‘spent’ fuel. In addition, advanced reactors, such as DoE’s IFR, Weinberg’s (and Canada’s & China’s) MSR, or the Euro EVOL MSFR can consume that 96%, producing only short-lived fission products, medical/industrial isotopes and clean power. There’s no “Faustian bargain”. Combustion power certainly has revealed itself to be such. Nuclear power has not. The CEC should long have known this.

- c) **Commissioner's interjections** during public comments. It's well known that the shutdown of San Onofre's >2GWe of generation has caused California some international embarrassment for increasing its emissions, because of increased gas burning and even indirect increases in coal burning outside our state.**

One member of the public mentioned that closure of San Onofre and loss of its >2GWe of clean generation increased both coal & gas burning in powering our state. As he was speaking, Commissioner Weisenmiller interrupted and there was "no coal being burned". Perhaps the Commissioner was unaware of the facts in the references below?

Regardless, when a few other people voiced public comments containing clearly false statements, the Commissioner never interjected – not even when one poor woman said she believed that nuclear plants produce "Carbon 14".

The Commissioner gave appearances of bias against nuclear power, even in private discussion with him after the public workshop session. We citizens rightfully expect our CEC, and all state agencies, to be concerned with facts. Certain facts seem to be a challenge for the CEC.

- d) **Spent-fuel safety.** Long vs short half-life isotopes have exceedingly different attributes, when it comes to radiological exposures to life. Long half life means an isotope is, on average, low in emissions over its decay time, so, natural radioactive isotopes around and inside us, like Uranium and Potassium, have long been tolerated by nature's evolution of cellular processes. Far greater threats to health arise from breathing of Oxygen and metabolic production of corrosive chemicals, etc.

We each, for instance, live healthy lives despite internal decays of ⁴⁰Potassium that produce over 4000 beta & gamma emissions per second, throughout our bodies, for life. We survive metabolic production of aggressive oxidizers, like hydrogen peroxide, etc. We survive cosmic rays and breathing their byproducts, such as ¹⁴Carbon. And so on, because "half-life" means that radiation around us was always higher in our evolutionary past.

Thus, the >95% of 'spent' nuclear fuel that is long half-life material (U, Pu, etc.) is not a threat, if stored with simple care, or recycled into new nuclear fuel.

The dangerous isotopes are the fission products, which are generally short in half life and thus highly radioactive. They require careful storage after separation from used fuel, because some are biological analogs for essential elements like Calcium. Thus, the ~4% of used nuclear fuel that is fission products must be stored away from life forms. Fortunately, they decay to stability in seconds, decades or centuries, not millennia, as indicated in the references below.***

France and other nations have long been dealing with this, and have effective storage facilities in planning or operation: <http://tinyurl.com/kkmyhze> (p21 on).

Even if not separated into Uranium vs other components, used fuel can be safely stored, without active (fuel-pool) cooling within several months of removal from a reactor. This is true simply because decay heat, from fission products that disappear so quickly, also goes away quickly***. Having provided UCS with used-fuel-storage recommendations myself, I can say that “dry-cask” storage is safe and optimal storage for as long as desired. If the US restarts its fuel-recycling program, the casks will allow safe transport to such facilities – their content is extremely valuable for clean power generation.

As to handling of used fuel within a reactor facility, using fuel pools, the normal, 18-month fuelling cycle means that a pool holding 1/3 of a core’s just-removed used fuel will see its cooling demand fall as about 1/N, from <7% of rated reactor power at the moment of shutdown. In a few months, decay heating falls below 30kW/ton. By the next 18-month removal, the original, 1/3 core in the pool(s) has long been ready for air storage. This all means that a reactor’s ‘spent’-fuel pool(s) can usually be empty, if they’re viewed as a security weakness for attack. The security concerns raised by UCS’ David Lochbaum at the 27 April workshop are easily addressed.

- e) **San Onofre shutdown.** The current head of the CPUC stated that there will be a “huge hole in the grid” after the 1GWe Encina gas plant closes (2017), if the 2GWe San Onofre station remains closed.

The former CPUC head (Mike Peevey) is now being investigated for inappropriate relations with SCE, centering on shutting San Onofre. When head of the CPUC, he oversaw the poor regulation that led to the unconscionable 2010 San Bruno gas explosion and fire. The NTSB found both the CPUC and PG&E gas management negligent. Under Peevey, our CPUC had allowed poor gas-transmission maintenance to kill 8 fellow citizens and destroy >30 homes. This failure of CPUC trust even missed the utility’s inability to shut off a 30” gas main in less than 2 hours. It’s hard to find more disgraceful utility mis-regulation in our country.

We will not meet emissions and desalination targets without San Onofre. The CEC should recommend that Governor Brown use his executive authority to put San Onofre decommissioning on hold, at least until all facts are revealed about how Peevey and SCE management arranged San Onofre’s unnecessary closure.

- f) **San Onofre repair.** Ohio’s Davis-Besse plant, run by FirstEnergy, was repaired last year for \$600M, eliminating several coal plants’ emissions (<http://tinyurl.com/mem8lhq>). San Onofre needs the same repair – new steam generators. The investigation taking place for e) above should include determination of why our CPUC and SCE did not proceed with alternative

measures, after the new Mitsubishi steam generators were determined to be defective in design.

California citizens deserve to know why a clean-power plant in California, in need of the same repair that an Ohio plant recently obtained, must incur a now-estimated \$7B in decommissioning and power-replacement costs. We, whom our CEC & CPUC are charged to serve, rightfully expect an explanation of why there's even a suggestion to spend an additional \$2.5B to replace San Onofre with new gas generation.

In other words, we Californians, and our environment, deserve an answer to why unnecessarily spending about \$10 billion, while adding emissions from gas leakage & burning, indicate anything but gross regulatory failure. FirstEnergy will be happy to share their repair contractor's phone number with our CEC, CPUC, Governor and SCE. Ohio officials will even explain why they're working to include nuclear in their RPS, as are other states, and as we should be.

- g) Desalination power.** The new desalination plant at Carlsbad is scheduled to start operating in a year or so. It's estimated to demand several tens of MW to serve just 7% of San Diego County. Our present CPUC head rightly recognizes the problem this presents. In order to just provide potable water for the county's citizens, 14 such plants would be required. The 24/7 power to do so cannot be supplied by any clean source but nuclear – San Onofre, in particular.

Our Governor's stated emissions and water-conservation targets are impossible to meet without all the nuclear energy we can bring forth. This means restoration of San Onofre, protection of Diablo Canyon, and new nuclear construction to boot. Our CEC should discuss this reality with our Governor and CPUC so that our state recaptures the environmental leadership it displayed under Art Rosenfeld.

- h) Diablo Canyon – water issues.** The CWRCB is considering issuing a waiver to continue "once-through" seawater cooling. The concern for marine life centers on damage to them from passage through the plant or capture in the plant's filters.

Historical records from all once-through-cooling plants (gas or nuclear) were presented at the CEC workshop. Diablo Canyon accounted for 22% of all once-through water volume, but less than 3% of all physical damage to sea organisms entering its final cooling stage. A California Fish & Game representative stated, at a prior CWRCB hearing, that about "1.5 trillion fish larvae were" possibly damaged or killed each year. The plant gulps about 2 billion gallons of seawater per day. This means that 2-3 fish larvae per gallon may be damaged by the plant.

The density of fish larvae per gallon of seawater outside the plant's intake bay, in breeding areas, is obviously far greater than 2-3/gallon, which explains why local fishermen interviewed have seen no effect on catches attributable to larvae destruction at Diablo Canyon's low rate.

This is stated for reference only, since CWRCB has jurisdiction and may grant PG&E a waiver, or require some form of remediation, such as artificial-reef construction.

- i) **Diablo Canyon – earthquake issues.** The design of nuclear plants employs the strongest structural shapes available: cylinders, hemispheres and their combinations. This engineering reality extends from the reactor vessels and steam components out through the required containments.

It should be no surprise then, that the greatest ground shaking ever experienced by a nuclear plant (Onagawa, per IAEA, <http://tinyurl.com/o852xg5>) caused no dangerous reactor damage in 2011. It should also be no surprise that every operating reactor in Japan, on that day of the greatest recorded Japanese earthquake, shut down properly. Diablo Canyon is no different, except that it's nowhere near a tectonic-plate subduction zone, as most of Japan's reactors are.

Earthquakes on subduction interfaces, capable of raising/lowering seafloor or surface structures many meters, do not exist in California. What do exist here are hundreds of primarily-horizontal slip faults that have been variously active for millions of years, gradually bringing coastal California (west of the San Andreas Fault) northward from Mexico, at a rate near 2cm/year.

The geophysical reality of this is simple – California fault movements have been so frequent and dispersed in our coastal region that ground substructures are widely fragmented and poorly transmit earthquake energy over large distances. This is distinct from both Japan and the US East, where little-fractured granitic rock (the base of the Appalachians) transmits quake energy easily over long distances.

Thus, the New Madrid Illinois quake in the 19th century rang church bells in Boston. The more recent 5.8 quake in Virginia did similar -- the North Anna nuclear plant, being just 11 miles in direct line to that quake's epicenter, suffered no damage. Yet it received stronger shaking than faults in the fragmented substructures anywhere near Diablo Canyon have been tagged by USGS as capable of.

The reality is basic – walking/running on a beach near the surf line, where sand and water have formed a dense 'pavement' is easy. Running/walking in the dry sand farther up the beach from the water is very draining & tiring, because the loose, fragmented surface dissipates our steps' energy quickly and widely among many more sand grains.

Coastal California is thus a good place to site nuclear plants, because: a) they're away from subduction zones; b) their structures are strong; and c) geologic materials under them absorb earthquake energy quickly.

A submission to this Docket, by a lawyer for ANS makes a very odd, unscientific statement (attorney Geesman's his page 3): "Where is the deterministic analysis of a San-Simeon-type earthquake taking place directly beneath the Diablo Canyon Nuclear Power Plant?" Since USGS has said there are no significant faults beneath Diablo Canyon NPP, is this lawyer suggesting one be moved there?

This kind of submission (or public comment) illustrates the need for all to swear oaths, just as in a court of law. I happened to speak with an ANS lawyer at a CWRCB hearing a few months ago and, at a break, asked him why he made a clearly false statement in his public comment to the Board. He responded: "Well, there's no oath or judge so I can say what I want."

Call me naïve, but many Californians prefer that our state agencies make good decisions based on facts, as Sergeant Joe Friday used to request.

If the CEC & CPUC wish to make realistic assessments of Diablo Canyon's earthquake security, then please study North Anna, similar US & Japanese plants (especially Onagawa) and determine if there are any improvements needed for our NPP residing in a far milder earthquake-energy region. And, recognize that the Parkfield & San Simeon quakes have already provided useful, natural 'tests' and recorded data at Diablo Canyon.

- j) Fukushima and Chernobyl.** The failure of Fukushima Dai-Ichi was raised in the 27 April workshop, as if it were somehow relevant to either San Onofre or Diablo Canyon plants. Fukushima Dai-Ichi, Onagawa, and all the many other Japanese plants were not mentioned. Why?

The IAEA and Bulletin of Atomic Scientists referenced in i) above make clear that the root cause (what all engineers are obligated to seek) of Fukushima Dai-Ichi's failure was non-nuclear – the government and regulator (NISA) allowed TEPCO to remove 25 meters of natural elevation from the site in order to cheapen construction. The plant was thus near sea level and unprotected from known, large tsunami, even as ancestors had painstakingly warned against via carved stone warnings: "*Don't build from here to the sea.*"



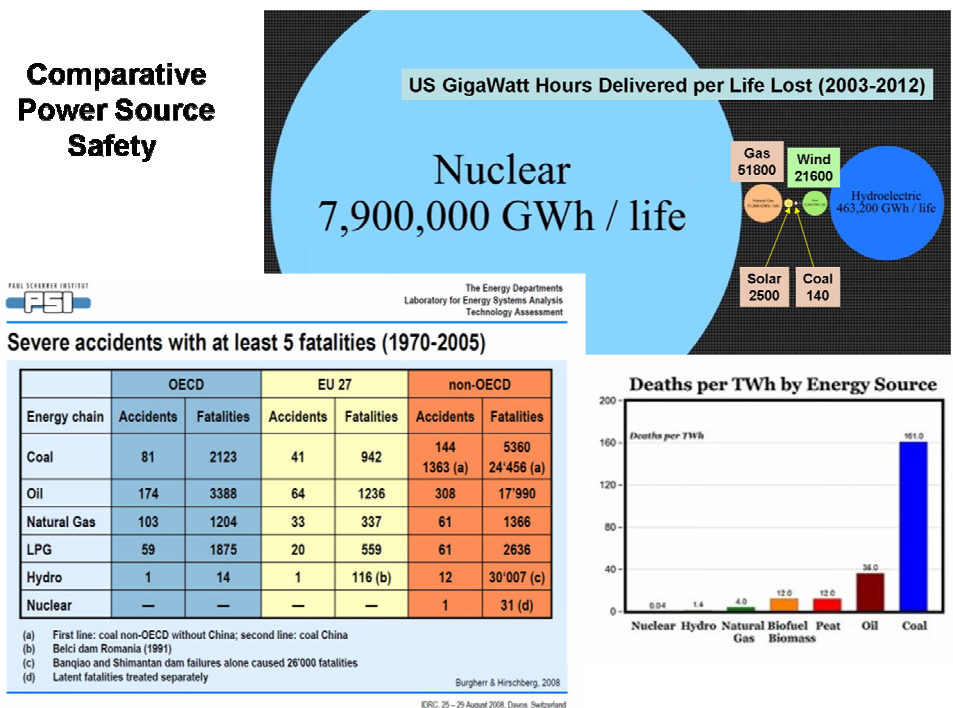
<http://web.stanford.edu/~plipsy/LipsyKushidaIncertiEST2013.pdf>
www.nirs.org/fukushima/naic_report.pdf

Chernobyl was not mentioned, but on the minds of some in post-workshop discussions. Why?

Chernobyl's RBMK reactors were illegal everywhere outside the former Soviet Union. They were inherently unstable, without containment and used to make Plutonium for weapons, not simply to generate steam for power.

Both Fukushima & Chernobyl demonstrate the safety of properly-regulated, civilian nuclear power. Our CEC should certainly know all this.

For example...



<http://tinyurl.com/42wvr9l> (PSI 1998)

<http://tinyurl.com/d7ocq5w>

<http://tinyurl.com/6m2o7c5>

www.wano.info//article.cfm?id=the-human-cost-of-energy

<http://tinyurl.com/oj6adbr>

<http://tinyurl.com/nzzegky> (2015)

<http://tinyurl.com/kn22qcn> (Hansen & others)

- k) **Citizen education.** Under former CEC Commissioner Art Rosenfeld, we Californians benefited from a concerted effort to educate us. AB32 was supported and later defended against repeal, because the CEC of Rosenfeld had earlier made good effort to explain to us why better home lighting, insulation, heating, roofing, etc. were important.

We became the state that maintained flat energy-per-capita consumption, while all others continued upward consumption rates. We even understood why roofs are painted white in hot climates and how many vehicles' emissions would be countered by doing so to our roofs.

We learned what The Heat Island Group, LBL and Caltech's Lewis Group had to say about wise environmental decisions. We even learned why nuclear power was clean & essential, as opposed to what gas & coal interests wished us to believe. We need our CEC to return to such broad, factual citizen education. That might prevent another misinformed woman from addressing the Board, saying she heard "nuclear plants emit ¹⁴Carbon", while Board members present remain silent. It might prevent a lawyer for a special-interest group from asserting need for non-existent earthquake faults.

There is no time left to serve political & business interests ahead of environmental realities, like extended drought, global warming, sea rise and ocean acidification. We'll all be pleased to see the California Energy Commissions redouble its efforts to educate our citizens.

I hereby certify that all my statements herein are true.

Sincerely,

Dr. Alexander Cannara
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650-400-3071

References...

* Alvin Weinberg's memoirs:

<http://tinyurl.com/lam24sn>

<http://tinyurl.com/msqw97z>

** "California, Germany, and Japan have one thing in common, increased carbon emissions for Earth Day [2014]. Within the past three years, each closed nuclear power plants and replaced the virtually emission free power source largely with coal and fossil fuels." <http://tinyurl.com/l17zalx> <http://tinyurl.com/oa676x7>

Coal use induced by San Onofre shutdown (column 6):

2013 Total System Power in Gigawatt Hours

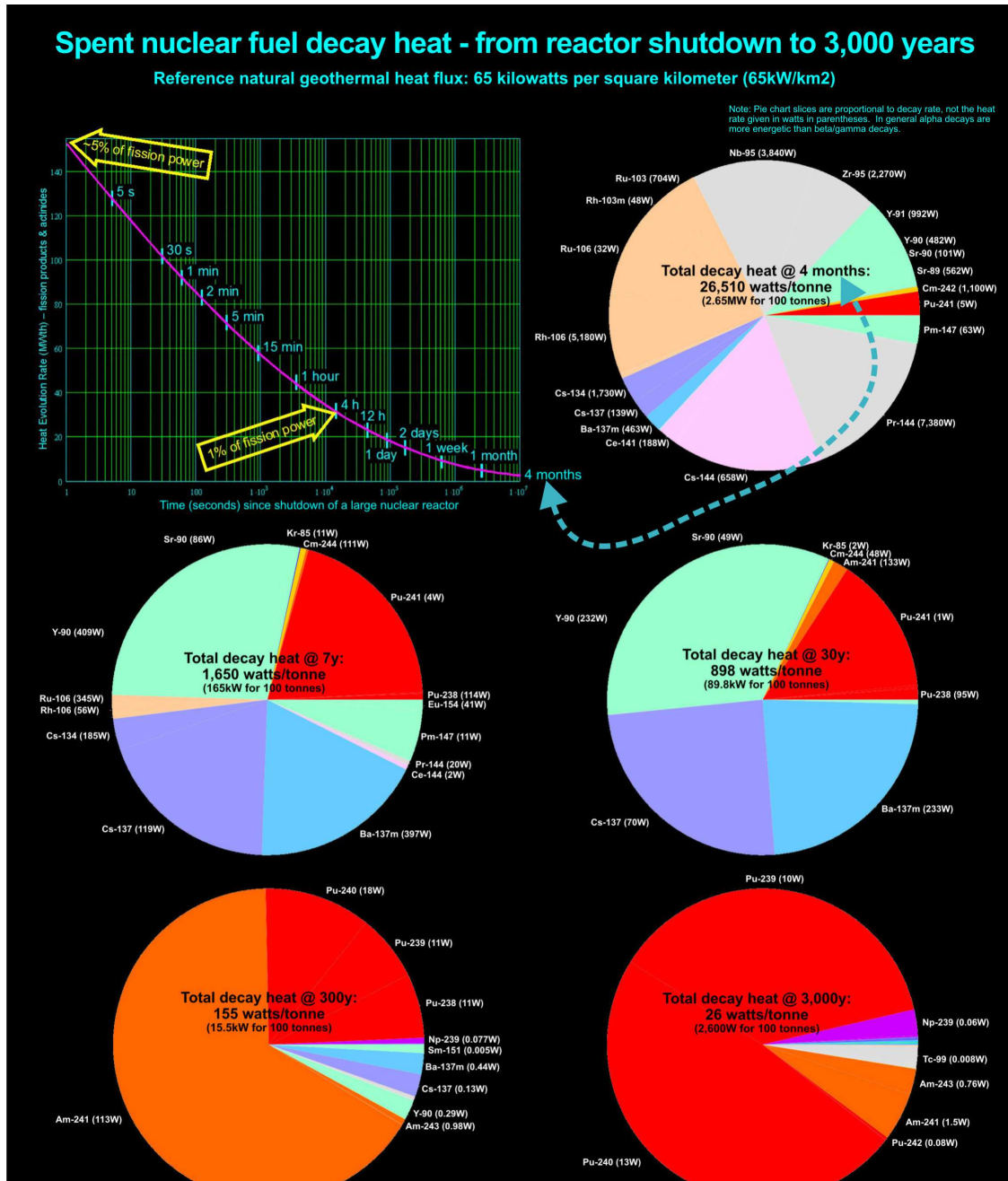
Fuel Type	California In-State Generation (GWh)	Percent of California In-State Generation	Northwest Imports (GWh)	Southwest Imports (GWh)	California Power Mix (GWh)	Percent California Power Mix
Carbon-Free Sources						
Nuclear	17,860	8.94%	0	8,357	26,217	8.84%
Large Hydro	20,754	10.39%	96	2,159	23,009	7.76%
Biomass	6,423	3.21%	1,485	21	7,929	2.67%
Geothermal	12,485	6.25%	212	495	13,192	4.45%
Small Hydro	3,343	1.67%	470	0	3813	1.29%
Solar	4,291	2.15%	58	1,040	5,389	1.82%
Wind	12,694	6.35%	10,962	1,700	25,356	8.55%
Totals	77,850	38.97%	13,283	13,772	104,905	35.37%
Non-Carbon-Free Sources						
Coal	1,018	0.51%	812	21,363	23,193	7.82%
Natural Gas	120,863	60.50%	1,241	9,319	131,423	44.31%
Oil	38	0.02%	0	0	38	0.01%
Unspecified Sources of Power	N/A	N/A	19,750	17,305	37,055	12.49%
Other	14	0.01%	0	0	14	0.00%
Totals	121,933	61.04%	21,803	47,987	191,723	64.63%
Grand Total	199,783	100.01%	35,086	61,759	296,628	100.00%

Source URL: http://energyalmanac.ca.gov/electricity/total_system_power.html Archived 05 04 15

Note: "biomass" burning isn't "carbon-neutral", due to tilling, harvesting, processing, transport and combustion emissions. It also threatens soil & nutrient losses and adds water consumption.

*** 'Spent fuel' heat & isotope lifetimes:

www.energyfromthorium.com/javaws/SpentFuelExplorer.jnlp



Spent nuclear fuel decay heat - from reactor shutdown to 30 years

Reference natural geothermal heat flux: 65 kilowatts per square kilometer (65kW/km²)

Note: Pie chart slices are proportional to decay rate, not the heat rate given in watts in parentheses. In general alpha decays are more energetic than beta/gamma decays.

