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AUTHOR: Ace Hoffman

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From: Ace Hoffman [rhoffman@animatedsoftware.com]
Sent: Sunday, March 10, 2013 3:46 PM
Subject: The flawed logic behind restarting San Onofre in light of Fukushima...

3/10/2013

Dear Readers,

As we approach the two-year anniversary of the Fukushima nuclear disaster (tomorrow, March 11, 2013), dozens of other nuclear commemorations now fill the year: Three Mile Island later this month, Chernobyl next month, Hiroshima/Nagasaki in August, and then there's Bikini, the highly polluted Nevada Test Site, Sellafield, Mayak, Hanford... and North Korea again earlier this month (they've set off their 3rd nuclear device).

The list of incidents involving massive releases of nuclear materials from industrial and military sources grows longer every year.

After so many nuclear disasters, why is there STILL no public monitored radiation system in place, nor any public health surveys being done regularly, instead of "just" forecasted for the future? There's an unofficial history of misery, starting with the uranium miners, the bomb victims, the bomb test "downwinders," "Chernobyl heart" and "thyroid necklace" children, and now Fukushima thyroid cases abound... yet nobody counts.

So far, San Onofre doesn't belong on any list of major nuclear accidents. Let's keep it that way. However, they carted away more than 50 truckloads of tritium-laced beach soil after pulling apart the old Unit 1 reactor and finding it had been leaking who-knows-how-much for who-knows-how-long. Big surprise? Not really: Nuclear power plants leak like sieves. Tritium (a radioactive form of hydrogen) leaks have been reported at most nuclear power plants in the country (and probably went unreported at the rest, just as San Onofre's leaks had gone unreported (and supposedly undiscovered) for many years). The regulatory authorities rely on the utilities to provide the information -- there is no independent monitoring.

In fact, small daily releases and occasional larger "accidental" releases are normal operating procedure for all nuclear power plants. Permissible amounts are "As Low As Reasonably Achievable" ("ALARA") which is defined as what they can achieve and still operate, which is to say: still make a profit. It is not what is actually safe, since no amount is safe. The entire nuclear industry still calculates the hazards from any release based on a "reference man," a mythical being who is 100 or 1000 times less susceptible to radiation damage than a "reference fetus" would be, and somewhere in-between for a "reference child." A adult "reference woman" is also more susceptible to radiation's damaging effects, and not to mention, if she's pregnant, damage to her fetus and even her fetus's eggs! Instead of worrying about any of that, the nuclear industry uses the "lowest common denominator" to minimize their liability, in addition to minimizing it with the Price-Anderson Limited Liability Act, which has been copied all over the world, and which practically lets nuclear utilities get away scott-free after any accident. They might destroy their entire state, and leave hundreds of thousands of people homeless, and cause thousands of cancers over the coming years, and yet stay happily in business (and not go to jail)!

Southern California Edison and the rest of the nuclear industry refuse to face the reality of the situation they are creating (and then walking away from with their pockets full of their ratepayer's money). Radioactive waste is so hazardous, that it must remain isolated from human beings and all other living things for thousands of generations. How can this be done? No one knows how to do it or where to store it.

So, it just sits there on our coast. Ceramic pellets of fuel which have had a small fraction of their uranium atoms split. Those split atoms now comprise two (usually two) unstable fragments of the original atom's nucleus, each about half the size of the original atom's nucleus, and each with too many neutrons in its core. The two new elements are also destined to decay, usually again and again, perhaps a dozen times or more, changing what element they are and their chemical properties each time, and releasing an elementary particle or beam, such as an alpha or beta particle traveling near the speed of light, and/or a gamma ray or xray traveling AT the speed of light.

At San Onofre, approximately four million pounds of spent nuclear fuel sits on our coastline, waiting to be released in the event of an airplane accident, or even an asteroid. The asteroid which struck Russia recently could have breached these casks. It actually landed in one of Russia's most highly secretive nuclear sites.

We don't want a nuclear catastrophe in Southern California. California is the salad bowl, fruit bowl, nut bowl, and cheese plate to not only much of the United States, but even around the world. Our agriculture would be even bigger if there were more water available -- something nuclear power cannot help with. Nor can nuclear power help with global warming, because it uses vast amounts of fossil fuels to mine the uranium, process it, refine it, mill it, etc., and then more fossil fuel energy to actually build and run the plant, to build replacement parts for it and so forth. (And replacement parts for failed replacement parts, for that matter.)

And then, afterwards, that endless storage problem... does not happen for free. Even if we just consider the necessary security guards (and ignore the scientists working on better solutions, the steel and cement fabricators, etc.), the guards alone will need housing, transportation, weapons, instruction videos, training exercises... for, oh, 100,000 years! This will cost a considerable amount money, and burn a considerable amount of fossil fuel. (A closed nuclear power facility on the east coast estimated their costs for maintaining their spent fuel "farm" at about \$10 million per year, ad nauseam.)

So nuclear power cannot possibly help solve the global warming problem in any way, and the smaller the pile of nuclear waste we leave our progeny, the better. It was true 30 to 40 years ago when most of today's obsolete and aging nuclear power plants were commissioned, and it's more true now.

And if all those reasons for not restarting San Onofre were not good enough -- which they most definitely are -- then its own problems, problems unique to San Onofre, should be good enough. San Onofre is not a good investment for society (or for SCE's stockholders).

Look at the facts: In 2004 the old steam generators (two per reactor) were showing significant wear and it was clear they were not going to last until the end of their current 20-year license periods, around 2022/2023. An ever-increasing number of tubes in the original steam generators would have to be plugged each time the reactors were shut down for refueling/maintenance. It was costing a fortune and the plant was delivering less and less steam-generated electricity. Tube wear was apparently accelerated after a 2001 power uprate. The additional energy in the system (increased flow rates, increased heat, etc.) increased the vibration and increased the rate of damage. Sort of like driving a rented car harder than you would your own.

Southern California Edison didn't need to worry about cost of replacing the steam generators earlier because of the increased wear rates because -- perhaps you've guessed it -- the ratepayers, and not SCE, would pay for the new steam generators. This was justified to the California Public Utilities Commission by claiming that, over the next 20 years, the steam generator replacement project would SAVE ratepayers a billion dollars over estimated costs of replacing San Onofre with fossil-fuel power plants. Cheap gas-fired modern turbines were never even considered - a properly operating San Onofre (i.e., not melted down, and not

impaired by long-term shutdowns such as what has actually happened) was compared to old-style clunkers such as coal plants! Getting rid of San Onofre wasn't compared to wind power alternatives, or solar rooftops, or even plain-old conservation, which STILL offers the potential to completely "replace" San Onofre if properly undertaken. And it would be cheaper. And can't melt down.

The cost of the replacement steam generator project was projected by SCE at about 700 million dollars -- obviously, less than the amount that would supposedly be saved, making it a "cost-effective" replacement project for the ratepayers -- they said.

The CPUC bought the bait -- hook, line, and sinker: Why not? The head of the CPUC was the former head of SCE, and never met a nuclear power plant he didn't like. (He still heads the CPUC and still supports San Onofre in every way possible.)

Then, on January 31, 2012, a hole developed in one area of one of the 9,727 u-tubes in each of the two new replacement steam generators in each of the two operating reactors at San Onofre. Radiation leaked from the primary coolant loop to the secondary coolant loop, and was detected in the turbine building, from where it was vented to the public airspace. Small quantities of highly radioactive Nitrogen-14 and other "hot" elements were released and the reactor -- Unit 3 -- was shut down. The other functional reactor at the time, Unit 2, was already shut down for scheduled maintenance and a reactor pressure vessel head replacement.

(The new RPVH was one of the many smaller jobs which Edison originally had planned to ask for ratepayer funding for along with the steam generator replacement project. However, when the price climbed to around a billion dollars and opposition grew, they dropped the rate hike request by several hundred million dollars and delayed everything except the steam generator replacement, which answered the most vocal activists' claims, who had tried to get the project stopped or delayed based solely on the actual cost of the replacement project alone, instead of looking at the big picture (the spent fuel problem, potential for accidents, etc.). SCE was allowed to charge the ratepayers the reduced total, and move forward with the project.)

Now what? SoCal Edison has effectively given up on Unit 3 due to excessive damage that has already occurred. It can probably be assumed Unit 3 won't reopen unless they replace the steam generators, which they probably don't have the money for -- unless it can be billed to ratepayers, who are complaining vociferously against any mention of it right now. That's good, but as before: Is it enough?

Unit 2 on the other hand, might be different. Edison believes Unit 2 can be restarted safely at reduced power output and efficiency. Such thinking is faulty, but nevertheless, Edison applied to the Nuclear Regulatory Commission in October of last year for permission to restart Unit 2 at 70% power output, to see if their theory of what caused the two different types of vibrations in Unit 3 are correct. Everyone admits the shortened time period is an experiment: They'll shut the reactor down afterwards and see how much wear actually occurred. The media refer to it as a test, SCE union workers refer to it as a test, everyone refers to it as a test.

But if you say to the NRC, "DON'T EXPERIMENT WITH THE SAFETY OF 8.7 MILLION PEOPLE!" they get all huffy and offended, and say they WON'T experiment with the safety of 8.7 million people, even though that's exactly what they'll be doing if they allow the restart of that faulty reactor.

San Onofre's Unit 2 steam generators are faulty because they were designed without proper engineering review. Without "critical thinking" or "independent analysis."

In other words, shoddy workmanship and deficient management.

Now, SCE is trying desperately to put all the blame for the failure on Mitsubishi Heavy Industries (the manufacturers of the replacement steam generators), and it's true: MHI made a lot of mistakes. But SCE was responsible for MHI's actions at every stage, according to NRC regulations!

San Onofre is filled with subcontractors and sub-sub-contractors. A few years ago SCE released Bechtel as the main subcontractor and brought in The Shaw Group instead (known to be the smoothest talkers with the best lawyers in the industry. Perhaps SCE had an inkling of the problems they would be facing?). About 40% of the onsite employees at San Onofre are SCE workers, the rest are sub-contractors of some sort or other. Even SCE is, effectively, a subcontractor of Southern California Gas & Electric, which does nothing at the plant, yet owns 20% of it, and the city of Riverside, which owns less than 2% and also is not involved in operating the plant.

So who's responsible?

Federal regulations state, NRC commissioners state, and even Southern California Edison itself from time to time states that SCE is responsible for the actions of their contractors, including fabricators of parts, security forces (always subcontracted at every nuclear power facility), soda deliverers, etc.. Everyone.

MHI failed to calculate adequate clearances between tubes in the u-bend region -- some are only a 20th of an inch apart (industry standard is nearly half an inch apart).

MHI failed to calculate the flow rates of the mixture of steam and water as it rises up through the u-tubes: It was too fast, averaging around 28 or 29 feet per second in Unit 3, somewhat slower in Unit 2. (And traveling at double that speed around some of the inner u-tubes.)

MHI failed to properly calculate the circulation ratio of water that falls down from the top of the steam generator where they "dry" the steam and returns for a second (or third...) loop. The circulation ratio should have been well above 3, but it wasn't.

MHI failed to properly calculate the fraction of water-to-steam in the upper portion of the u-tube bundles. They expected the tops of the u-tubes to still have significant amounts of water surrounding them, which provides damping against vibration. Steam is 30 times less dense than water, and so, less able to dampen vibration.

MHI failed to account for the extreme dry-out conditions of the steam, which caused the outer surfaces of the u-tubes to lose the thin layer of water that normally coats them. This thin water layer aids in efficiently transferring heat from the inside of the tubes to the outside, to be carried away from the reactor. Thus, the heat stayed in the tubes longer, and was released later, on the downward, "cold" leg of the steam generator's u-tubes. This created unexpected additional flow in the cold side, additional u-bend flow effect, additional turbulence in the upper areas of the u-tubes, and additional wear and tear.

MHI failed to perform proper cross-checks of their mathematical models for the above behaviors of the steam generators.

MHI repeatedly reassured SCE that the steam generators were being well-designed and well-manufactured.

MHI warranted their work for the cost of manufacture only, NOT for the cost of replacement power during an outage, NOT for the cost of a meltdown from a catastrophic cascade of tube failures, NOT for the loss of the entire reactor due to faulty steam generator design. JUST for part of the replacement costs of the four steam generators themselves (about \$138 million

dollars appears to be the maximum recoverable, with about \$50 million of that already paid by MHI to SCE).

So is MHI the only entity at fault?

Not by a long shot! SCE was supposedly overseeing the whole operation, and made repeated visits to the Kobe and other MHI factories (and their subcontractors) in Japan, and approved all of MHI's work. In the NRC's own Augmented Inspection Team report (summer, 2012), it states that the possibility of manufacturing defects (which are blamed (or perhaps I should say "credited") for some of the differences in behavior between Units 2 and 3) are not considered in the NRC's assumptions -- that is, the NRC assumes that parts supplied to nuclear reactor operators have been built to design specifications. Now, small differences in manufacturing methods are being blamed for differences in wear between Unit 2 and Unit 3: Namely, the "3 mil gap" between the u-tubes and the tube support plates is more round and tighter-fitting in Unit 3, which led to less water getting through and more wear in Unit 3, they think (but nobody really knows).

The NRC has stated time and again that nuclear power plant operators are responsible for the quality of work of their subcontractors, and MHI was a subcontractor of SCE.

SCE is irresponsible to be saying they were "reassured repeatedly" that MHI's designs were adequate. So what if they were reassured a thousand times? One might also ask why repeated reassurances were needed! SCE should have done their OWN calculations to determine the adequacy of the new design. They should have opened up those new designs to NRC and public scrutiny so other experts could have reviewed them. SCE's steam generator engineers signed off on the design before construction -- they "put their 'chop' on it," which makes it "legal" in California!

Of course, the NRC is hardly blameless. It is their responsibility to ENSURE that public safety is maintained at nuclear power plants regardless of the cause. To merely mention "safety" at a public hearing other than the NRC is to risk being reminded that "safety" is the authority of the NRC. (Just as, to mention "cost" at an NRC hearing will get you told they don't regulate based on cost, which is utterly untrue.)

The MHI document released by the NRC last Friday makes it clear that avoiding a thorough review of the design changes was one of the requirements SCE gave to MHI for the steam generators. SCE is actually proud of this attempt (successful, so far) at avoidance: Their spokesperson said Friday after the MHI report came out that "triggering" the NRC review process is something nuclear power plant operators are SUPPOSED to try to avoid, because it adds to the expense of making changes safely! Of all the double-talk I've ever heard, that's Orwellian for sure!

SCE and MHI also wrote serious articles in nuclear trade journals "bragging" about how wonderful "their" replacement steam generators were, which were published just about the time the generators failed. And MHI planned to substantially increase their nuclear parts supply business, and is still hoping to do so, somehow. They might even get SCE's business for a third set of steam generators!

Go figure.

Now, SCE wants very badly to restart Unit 2. It took them the better part of a year before they even felt confident enough to go to the NRC to ask for permission to restart at a lowered output level for a five-month period -- the "experiment" that's not an "experiment." It may take the NRC the better part of a year to respond back to SCE, and they've asked some tough additional questions, such as in a December 26, 2012 letter to the Chief Nuclear Officer of SCE, Pete Dietrich, stating that SCE needs to show that the Unit 2 reactor can be

safely run at 100% power, not just at 70%. But then again, the NRC might give SCE restart approval next month (April, 2013).

SCE dug into their deep supply of lawyers to respond to the December 26 letter, and told the NRC that the NRC doesn't know how to read their own regulations, and "70% power" is the new "100% power," and so the regulations should allow them to restart, without having to prove they could do so safely at the previous "normal" power output level!

And of course, SCE promises not to turn up the dial past 70%. Swears they won't. But they also squeezed in a comment, in responding to the NRC's letter, that not raising the power level above 70% becomes their choice, not the NRC's, after the five months is up!

And SCE doesn't even promise to do 170,000 inspections like they say they did last time, they only promised to "take a look and see what we find." 170,000 inspections on nearly 40,000 tubes isn't as many per tube as all that: Just over 4 per tube. This is a crucial point: All the original inspections were inadequate: It was only after Unit 3 sprung a leak that Unit 2 was determined to also have very significant wear that prevents it from operating too. Even the post-shutdown tube inspections continue to be inadequate: SCE is NOT using the latest available inspection equipment, they are using cheaper alternatives that return less accurate data.

And on top of all that, the data they are collecting -- the inaccurate data from the cheaper inspection equipment -- is being used to estimate that NOT ONE TUBE will go out of compliance with NRC regulations (35% wear rate) during the five-month test-that's-not-a-test. Some of the tubes that have not been plugged are worn more than 20% already, so it's not even a game of inches -- it's a game -- a gamble -- of small fractions of a millimeter. One tube in Unit 2 was 90% worn -- and this was only found after the other reactor failed and a "closer" (more thorough) inspection was done! There was less than 1/200th of an inch protecting us from a tube rupture in Unit 2 -- the Unit they want to restart -- and they didn't even know it. An additional worry: The inspection system they are using does not examine the insides of the tubing for fatigue cracks (as apposed to "fretting" and other wear on the outside of the tubes that thins the walls substantially) like the state-of-the-art inspection equipment does.

Why isn't Edison using the state-of-the-art inspection equipment? Perhaps because if they "find" too much damage then the steam generator will be unusable since its plugging limitation will be exceeded. You can't see what you don't look for.

Southern California Edison expects the NRC to give it permission to restart San Onofre some time in late April, for operating at 70% power output for five months. During that five months there will be no way to know ahead of time if a rupture is eminent. If the reactor tubes survive the test, and if upon inspection after shutdown, the wear rates are significantly reduced, they will try to operate for longer, at higher heat flows to the turbines, and then inspect, and plug, and inspect, and plug, until the NRC's plugging limit for one of the steam generators is reached. When this happens SCE will try to smooth-talk the CPUC that all this is just part of doing business and the ratepayers need to pay for all-new steam generators a third time, at an additional cost of probably well over a billion dollars.

Meanwhile, alternatives such as wind, wave, solar, etc. have already made the whole idea of nuclear power obsolete. But SCE won't endorse change if it would mean they are not the ones "generating" the electricity, since they want to keep their energy monopoly. As it is now, SCE pays themselves far more for the solar energy they generate than they do for the solar energy "we" generate and put into the grid, which is great for their shareholders, but a rip-off for ratepayers who should get safe energy for the lowest possible price.

We need to decommission San Onofre NOW. We must not allow restart "TESTING" of San Onofre's faulty steam generators at the risk of the health and safety of the 8.7 million people living

within 50 miles of the plant, and the tens of millions more who live just a few minutes further away as the wind blows.

Ace Hoffman
Carlsbad, CA

The author has been studying the failures of nuclear power for more than 40 years. It's not getting any better. www.acehoffman.org .

** Ace Hoffman, Owner & Chief Programmer, The Animated Software Co.
** POB 1936, Carlsbad CA 92018
** U.S. & Canada (800) 551-2726; elsewhere: (760) 720-7261
** home page: www.animatedsoftware.com
** email: rhoffman@animatedsoftware.com
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