SCE Violated NRC 10CFR 50.59 by making unsafe changes, then doing unauthorized tests and experiments.

In 2001, SCE applied to the NRC for a license to increase the power of San Onofre's (SanO's) original steam generators (OSGs) completely ignoring the potential of increasing the amount of tube wear and plugging that would be caused due to the use of the newly approved high burnup fuel rods. The NRC is not concerned with increased OSG wear until it reaches a predetermined number of plugged tubes (It was about 20% of the total number of tubes for San Onofre; it varies for each reactor design) since they consider that a "maintenance issue." In California, per the CPUC, ratepayers are liable for all maintenance costs, not the Utility/Operator, even if it cost ratepayers a billion dollars or more and was the utility/operator's fault.

In 2004, SCE told the CPUC it wanted to increase the amount of power they were producing (and money they would be making) at SanO. To do this they needed to minimize their continuing losses by replacing the degraded original steam generators (OSGs) ASAP. For this to be done quickly, they also needed to avoid a lengthy license amendment process called NRC 10CFR 50.90 which includes a public review process. SCE's solution was to design the RSGs themselves, have them manufactured quickly by Mitsubishi Heavy Industry (MHI), and claim they were simply like-for-like replacement parts that did not require a NRC 10CFR 50.90 review.

June 2006, SCE notified NRC of its intent and timeline to replace Units 2 and 3 OSGs under NRC guidelines called 10 CFR 50.59, which is appropriate for like-for-like exchanges that will have no net effect on nuclear safety. In their presentations, ***SCE never told the NRC of all the design changes that they made which had never been verified as safe***.

In 2009, both Unit 2 RSGs were installed, tested, officially accepted and brought online. SCE was so pleased with how well their new RSG design performed that they immediately started talking about extending their lifespan to 60 years or more. Slight manufacturing changes were made when both of Unit 3 RSGs were manufactured. SCE believed these changes made them "better" (than Unit 2's RSG's) at converting reactor heat into the steam that drives the turbines connected to the generators that produce electricity. SCE also installed new turbines, with newly designed higher efficiency TURBINE blades, to take advantage of the expected higher steam output of the new "like for like" RSGs.

In 2010, Unit 3 RSG's were installed, tested, officially accepted and brought online. SCE issued a press release on October 8, 2010, which stated, "We decided to replace the San Onofre plant's steam generators when a cost-benefit assessment revealed the plan could save customers approximately $1 billion during the plant's current license period, which runs through 2022, when power generated by the plant was compared to the likely cost of replacement power," said SCE Chairman and Chief Executive Officer Alan Fohrer.

In 2011, SCE and MHI engineers presented a steam generator paper at ICAPP 2011, in France which a later Nuclear Engineering International (an industry trade journal) article was based

upon which was published in January 2012 called, *Improving like-for-like RSGs*. "Even though all design and fabrication challenges were addressed during manufacturing, it was not known if the as designed and fabricated RSGs would eventually perform as specified. To verify this, the RSGs were functionally tested after installation in the plant, after unit re-start from the replacement outage. The RSG post-installation test results met or exceeded the test acceptance criteria for all specified test parameters, thus properly rewarding the effort put into their fabrication." Said another way, there is no doubt that SCE accepted that MHI met all of SCE's required Design, Fabrication & Operational specifications per SCE's contract.

January 31, 2012 – Up to this point, SCE thought the RSG's were working perfectly. Unit 2 was off line and shut down for scheduled refueling and Unit 3 was the generating the only power coming from SanO. For whatever reason (perhaps because SCE thought that Unit 3 RSGs were "built better") SCE had been exceeding the functional testing/design & 10 C.F.R. 50.59 screen (*red line*) limitations of the new Unit 3 RSGs in order to generate more power (and profits) but it was being done without NRC approval. Suddenly without notice, inside a Unit 3 RSG, a single tube (out of 9,737 in each RSG) started leaking radioactive core coolant, which caused SanO's operators to shut down Unit 3. [AREVA & International safe time estimate based on actual tube rupture events to terminate the tube leak to prevent tube rupture is 50 minutes, SanO's actual time to terminate the tube leak was 65 minutes.] In addition to the leak, 5 more tubes failed during later in-situ testing. Additionally, over four hundred other tubes were damaged, which exceeded Unit 3's NRC approved technical specification plugging limitations, which meant that Unit 3 RSGs were no longer usable! Now with both Unit 2 and Unit 3 shut down, SanO was no longer providing *any* power to southern California. Since SCE had always maintained that SanO was necessary to prevent energy shortages, everybody started asking SCE, the CPUC and the NRC questions about what caused the almost new Unit 3 RSG's to leak radiation and how long SanO would be shut down. Ratepayers were now paying $64 million per month while SanO was shut down even though they were not receiving any energy. *A year and a half later, they would finally be told that San Onofre would never produce electricity again*, yet the CPUC ruled that ratepayers should keep paying $64 million per month and will continue to do so for the next ten years.

March 16, 2012 – NRC Region IV (responsible for overseeing SCE's operation of SanO) formed an Augmented Inspection Team (AIT) to find the "root cause" of Unit 3 RSG's leak. After the formation of the NRC AIT, the new NRC Chairman appointed another group of Independent Consultants (SG experts not affiliated with the NRC), who were chartered with performing an independent evaluation of San Onofre in order to find any perceived gaps in the response actions taken by the NRC Region IV AIT Team or SCE due to the Unit 3 RSG tube leak. The primary focus of the Independent Consultants was to assess the differences in damage between Units 2 & 3 due to tube-to-Anti-Vibration-Bar (AVB) gaps, contact forces and thermal/hydraulic related aspects of operation.

July 13, 2012 – After an intense & in-depth review, the Independent Consultants identified significant, conflicting and adverse "gaps" in the NRC AIT Team and SCE's Unit 3 Tube Leak

Root Cause Evaluation Reports. The Independent Consultant's report was submitted to the **NRC (but not shared with the public) prior to issuance of NRC AIT Report on July 18, 2012.** *This critical report by the Independent Consultants was withheld from the public for over a year until it was finally published as an Appendix on* ***September 20, 2013***.

After the radioactive leak occurred in Unit 3, during the inspection and comparison of the damage in Unit 3 RSG's to each other and to both of the "undamaged" Unit 2 RSG's, it became clear that *SCE's design was causing "unprecedented" internal tube damage to occur in all four RSGs*. Additionally, in Unit 2, one RSG tube was discovered with 90% through wall wear far exceeding its 30% wear limitation. **The structural integrity of thousands of damaged tubes in both SanO Units 3 and Unit 2 RSG's was termed by NRC as a "very serious" safety issue. The almost-new SanO RSG's had more damaged and/or plugged tubes than the rest of the US power plants combined, which is unprecedented in the history of the U.S. Operating Nuclear Fleet.** Credit: *SanOnofreSafety.org*

Animation of what could happen when one or more tubes fail inside a Steam Generator
http://tinyurl.com/ocgct3s

DAB — Steam Generator Basics: The steam flowing around the U-tube bundle inside a nuclear steam generator (SG) increases as a function of the reactor's power level (the hot reactor coolant flowing inside the tubes), its circulation ratio and the height, thickness, heat transfer coefficient, and number of tubes in the tube bundle. If not designed and/or operated properly, a phenomenon known as **In-Plane Fluid Elastic Instability (IPFEI)** can occur. IPFEI results when areas of "dry" steam form around the outside of some of the tubes. IPFEI causes high secondary fluid velocities; excessive hydro-dynamic pressures, and reduces tube damping. Some of the U-tubes inside San Onofre's Replacement Steam Generators (RSGs) bundle of 9,727 U-bends, because of their shape, have less rigidity and/or less in-plane dampening strength and were thus affected by these factors. These tubes move with large amplitudes in the in-plane direction unless the U-tube bundle is designed with tube supports that have sufficiently large contact forces (>30 Newtons) to restrain them. Otherwise the U-tubes can repeatedly strike against other adjacent U-tubes and cause tube-to-tube wear. If the wear becomes excessive, the tube walls can leak or crack -- or even fail, causing a break-away/rupture in one or more of the tubes that are tightly packed inside the RSGs. Any leakage would allow the high temperature, radioactive reactor core primary coolant circulating inside the tubes (which is under high pressure – about 2250 psi) to flash into steam and mix with the secondary coolant loop water/steam mixture, which is at a much lower pressure (about 833-942 psi). If radioactive core coolant leaks from the primary loop to the secondary loop, some of it then escapes into the environment when the steam is condensed back to water (this is how the January 31, 2012 tube leak at San Onofre was discovered). Since the tubes in the SGs are packed so close together, one tube failure could damage adjacent tubes, leading to a possible cascade of tube failures. Additionally, if enough primary coolant is lost (one broken-away tube might be enough, and definitely two or three), the reactor core could become uncovered in less than 15 minutes,

resulting in a catastrophic nuclear meltdown, which if it had occurred at San Onofre, would have affected all southern California.

Note: This analysis was performed during a 3½-year period by DAB Safety Team using "critical questioning and an investigative attitude" with the help of Global Experts based in USA/India pertaining to the Root Cause of in-plane fluid elastic instability (IPFEI) in San Onofre Unit 3 RSGs. Parts of these analyses have been shared with the NRC Commission, SCE, MHI and ALJ Melanie Darling's appointed CPUC Safety Engineer. The NRC Commission, SCE, MHI and the CPUC have been unable to refute the findings of the DAB Safety Team.

The DAB Safety Team: Don, Ace and a BATTERY of safety conscious San Onofre insiders plus industry experts from around the world who wish to remain anonymous. These volunteers assist the DAB Safety Team by sharing knowledge, opinions and insight but are not responsible for the contents of the DAB Safety Team's documents.

Our Mission: To prevent a Trillion Dollar Eco-Disaster like Fukushima, happening in the USA.

Written by Don Leichtling and Ace Hoffman

#SanOnofreGate — *Hashtag summary of the investigation into the multi-billion $ SCE-CPUC ripoff.*