CHAIRMAN Resource

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Cc: Werner, Greg; Kulesa, Gloria; R4ALLEGATION Resource; melanie.darling@cpuc.ca.gov; Lantz, Ryan
Subject: [External_Sender] San Onofre Continued Sad Saga - US Number 1 Nuclear Safety and Financial Watergate created by SCE, MHI, CPUC & NRC - This horrible situation needs to be fixed not for money but also for nuclear safety of Americans and credibility of S...

SCE Defective & Highly Speculative Unit 3 Root Cause Evaluation, words of Independent Root Cause Guru, MHI Unlicensed repair plan with thicker AVBs and contact forces > 30 Newtons to prevent in-plane FEI, design of NRC Licensed Palo Verde RSGs, SCE/MHI AVB Meeting Notes and SCE's refusal to release Units 2 & 3 operational data completely exposes the naked lies of SCE, MHI and NRC AIT Team regarding the difference in damages between out-of-plane San Onofre Unit 2 & 3 RSGs (with thinner AVBs and less than 3 Newtons contact forces).

SCE reversed engineer the design of OSGs and designed/specified only out-of-plane RSGs to produce the maximum thermal power without a NRC License without any meaningful research and benchmarking. With MHI intentionally not invited, SCE made a conscious decision not to inform NRC in June 2006 NRC Meeting of the most important issue of the high void fractions and low circulation ratios, but bragged about other unverified improvements of AVB Design and SCE's excellent design teams/oversight procedures and meeting.

SCE/MHI Technical Meeting, September 14-16, 2005: "( ) summarized - tubes that pass through a zone where the void fraction is very high are the ones that are most prone to wear, even though the

wear sites may be at support locations outside the high void zone. ( ) warned that tubes with preload in the high void region should be avoided (because they have less mechanical damping). The AVB Team concluded that the design basis is the most uniform gaps achievable and as near zero without excessive preload." MHI Root Cause states, "The AVB Design Team decided on an AVB gap design basis with the most uniform gaps achievable and as near zero without excessive preload. So the variation of tube-to-AVB gap sizes was minimized to avoid an increase of contact force (preload) by increasing the nominal AVB thickness, reducing the AVB thickness tolerance, reducing the allowable value for twist, and decreasing the tolerance for the tube G-value (diameter)." SCE's Unit 3 Tube Leak Root Cause Analysis states, "The facts identified in this analysis indicate that even though the Unit 3 tube bundle components (tubes and [Anti-Vibration Bars (AVBs)]) might have been fabricated and assembled better, the tube-to-AVB as-built gaps might have been in fact larger in the Unit 3 RSGs as suggested by the ECT results. Based on this, it cannot be ruled out that the tube-to-AVB gaps are larger and more uniform in the Unit 3 RSGs than the Unit 2 RSGs. This might have resulted in reduction of the tube-to-AVB contact force and consequently in multiple consecutive AVB supports being inactive. Inactive tube supports might have resulted in tube-to-tube wear."

NRC Independent Consultants blast the SCE Unit 3 Tube Leak Root Cause Analysis and state, "The average of the gaps between the outermost tubes and the central columns was found to be essentially the same between the Unit 2 and Unit 3 steam generators, which does not support a premise that more uniform manufacturing practices for Unit 3 steam generator tube bundles resulted in less contact force between anti-vibration bars and tubes. Eddy current testing inspection measurements of tube-to-anti-vibration bar gap were determined to be of questionable value in an assessment of likely tube wear

behavior. Review of Figure 4.1.2-1 in Mitsubishi Document L5-04 GA564, Revision 2, indicated the potential fallacy in projecting differences in average contact forces (at tube-to-anti-vibration bar intersections) between Units 2 and 3." (Ref. Ref. SONGS NRC Confirmatory Letter Response Action Report dated September 20, 2013, Pages A2-3 & A2-6). NRC Inspectors agree with NRC Independent Consultants and state, "The inspectors concur that the measured gaps between the outermost tubes and the anti-vibration bars in the central columns do not in-and-of-themselves support a premise that more uniform manufacturing practices for the Unit 3 tube bundles resulted in less contact force between the tubes and anti-vibration bars." (Ref. SONGS NRC Confirmatory Letter Response Action Report dated September 20, 2013, Page 34).

SCE's Unit 3 RSG Tube Leak conclusions are not only highly speculative but they are only based upon a rough approximate analysis of the behavior of the entire RSG U-tube bundle instead of accurately determining the tube-to-tube behavior in the most affected area (4 percent region) of the Unit 3 RSG tube bundle. The reason for tube-to-tube wear in in the most affected area (4 percent region) for some of the tubes was the production of dry steam due to zero tube-to-AVB gaps, reduced tube-to-tube clearances and more energy transfer due to high primary flows in the Unit 3 RSGs regions of highest heat flux. The adjacent tubes in the same region, which did not experience tube-to-tube wear was due to the production of wet steam due to larger tube-to-AVB gaps and increased tube-to-tube clearances. SCE failed to provide any specifics regarding thermal-hydraulic analysis, tube wear data or vibration analysis, which is why SCE's analyses conflicts with mine, NRC Independent Consultants, NRC's Inspection Team and MHI analyses.

Based on review of SCE/MHI Meeting Notes and MHI Root Cause Evaluation, I conclude that Unit 3 RSGs had smaller delta G-values (variance in the outer diameter of the tubes), more uniform AVBs (than Unit 2 RSGs) and more "zero gaps" (gaps with negligible contact forces) compared with Unit 2 RSGs. The tubes moved in the middle of the U-bends in the in-plane direction with large amplitudes (due to dry steam) without being significantly restrained (in the in-plane direction) by the anti-vibration bars (Consistent with MHI Root Cause Analysis). SCE approved the AVB's design with zero or negligible contact forces. So how is it possible to reduce zero or negligible contact forces or make the zero gaps larger in Unit 3 RSGs from the hot to the cold conditions? If conditions in Unit 2 were the same as Unit 3, why did it not occur in Unit 2.

NRC, SCE, MHI and NRC ASLB never listed the impact of differences (weaknesses) between RSGs and OSGs. Rather, NRC, SCE and MHI described at great length the advantages of RSGs over OSGs to justify SCE's bogus and false position on 10 CFR 50.59 Screening and Evaluation to avoid a NRC 50.90 License Amendment. Based on a review of several SCE/MHI Meeting Notes, it is concluded that SCE was more interested in checking Mitsubishi's cost and schedule for maximizing the profits from new RSGs rather than checking Mitsubishi's velocity calculations. The small difference in the steam quality between Unit 3 and Unit 2 RSGs due to operational differences between the units explains the difference in significant tube-to-tube wear in Unit 3 RSGs and Zero tube-to-tube wear Unit 2 RSGs due to elevated steam velocities and zero damping consistent with the new industry study and analysis of DAB Experts.

AREVA has provided a report (which shows the observed tube-to-tube wear is highly localized. Other tubes in the same row, with very similar dimensions and secondary flow conditions did not exhibit any tube-to-tube wear. The eddy current testing (ECT) results show that these same tubes did have tube-to-support wear (e.g. 3E088 Row 108, Column 86). MHI analysis indicates that high tube-to-AVB wear occurs when there is low friction between the AVB, allowing in-plane vibration to occur (this fact has not been confirmed by SONGS). Since all tubes are equally subject to the 100 Hz primary side flow excitation, these adjacent tubes would also show tube-to-tube wear if this mechanism were by itself capable of creating that type of wear." The reason for tube-to-tube wear in in the most affected area (4 percent region) for some of the tubes was the production of dry steam due to zero tube-to-AVB gaps, reduced tube-to-tube clearances and more energy transfer due to high primary flows in the Unit 3 RSGs regions of highest heat flux. The adjacent tubes in the same region, which did not experience tube-to-tube wear was due to the production of wet steam due to larger tube-to-AVB gaps and increased tube-to-tube clearances.

Let us review another series of statements made by Dr. Dhir hidden in the NRC Report. He states, "With support damping of 1%, the two phase mixture velocity can exceed the critical velocity for onset of FEI when the void fraction approaches unity (DAB Note: dry steam). It should also be noted that lack of contact forces and damping due to anti-vibration bars may be the dominant reason for existence of FEI and severe tube damage in Unit 3 RSGs. As a result of FEI, initially out-of-plane vibrations are expected to occur in the lift direction normal to plane of the tubes. However, this instability in the absence of restraining force from anti-vibration bars can excite in-plane vibration that can be the cause of tube to tube damage." So now Dr. Dhir arrived at essentially the same conclusions

as I did, which are described in several papers, I have published. My conclusions were also reconfirmed on December 18, 2015 in discussions with a former College Professor, Reactor Engineering and Nuclear Safety Systems Expert and in November 2015 by another Nuclear Safety Systems Expert.

SCE's Unit 3 Tube Leak Root Cause Analysis states, "ECT indicates wear has been occurring since initial operation of the U3 Replacement SGs (Feb 2011). No wear observed during preoperational ECT." This SCE disclosure confirms that SCE changed the Unit 3 RSGs operational conditions leading to more primary flow than Unit 2 RSGs after acceptance of the RSGs functional testing. This time period is the same as the start of the occurrence of extra alarms in Unit 3 RSGs. That confirms that extra alarms were an indicator of tube-to-tube wear.

SCE's Unit 3 Tube Leak Root Cause Analysis confirms DAB Experts and Dr. Pettigrew's (NRC Commissioner San Onofre 2013 Presentation by Dr. Pettigrew) conclusions by stating, "The SONGS SGs are designed with the AVBs that prevent out-of-plane tube vibration, but do not have provisions to prevent in-plane tube vibration." RSGs SCE lead design and a California Professional Engineer, David Calhoun reconfirms DAB Experts and Dr. Pettigrew's position in an Obscure Industry Paper published in 2013 (A4NR-SCE-002 Supplemental Q.10 Attachment 2 of 2 found in CPUC Archives), "The standard industry methods (state-of-practice) for flow induced vibration analysis assume that anti-vibration bars provide effective support for restraining "in-plane" motion with the result that "in-plane" motion is not likely to occur because of the higher frequency of "in-plane" motion than for "out-of-plane" motion. This assumption might be incorrect for large steam generators with local regions of high steam velocity and/or high void fraction."