
TIMELINE: Mitsubishi Fails to Repair or Replace Its Defective Steam Generators at San Onofre

Following is a timeline about the failures of Mitsubishi Heavy Industries (Mitsubishi) to repair or replace its defective steam generators (RSGs) installed at the San Onofre Nuclear Generating Station. Southern California Edison (SCE) met repeatedly with Mitsubishi regarding the need to repair or replace the RSGs. Despite these constant meetings and other communications, Mitsubishi failed to offer a repair plan that (1) solved the cause of the RSG failures, (2) was feasible and implementable, (3) was validated and (4) was licensable. Mitsubishi continues to claim that its source documents about its failures to repair or replace the RSGs are proprietary, preventing SCE from disclosing information from these documents. Subject to the limitations imposed by Mitsubishi, this timeline summarizes certain key events.

- February 2004** Mitsubishi submits a bid to replace the steam generators at San Onofre, promising it has the expertise and experience to design the steam generators to preclude all forms of detrimental vibration and wear.
- September 2004** SCE selects Mitsubishi to replace the San Onofre steam generators based on Mitsubishi's repeated assurances that it has the design and manufacturing expertise and operating experience to provide safe and reliable RSGs for the promised 40-year life. Mitsubishi promises it can and will preclude all modes of destructive vibration and wear without exception or limitation.
- 2004-2010** Mitsubishi designs the RSGs based on its proprietary design procedures and computer codes, including FIT-III. SCE repeatedly meets with Mitsubishi and challenges its design assumptions, and Mitsubishi repeatedly assures SCE that Mitsubishi's design will preclude all forms of detrimental vibration and wear. Given that SCE did not have the required expertise or capability to design and build the RSGs, it relies on Mitsubishi to provide safe and reliable RSGs.
- April 2010** Mitsubishi's RSGs for San Onofre Unit 2 are placed into service.
- February 2011** Mitsubishi's RSGs for San Onofre Unit 3 are placed into service.
- January 2012** One of Mitsubishi's RSGs in Unit 3 experiences a radioactive coolant leak after only 11 months of operation. SCE rapidly shuts down Unit 3 to prevent any threat to public health or safety and inspects all of the RSGs. Inspections reveal that both Unit 2 and Unit 3 suffered from excessive tube wear phenomena, including tube-to-tube wear.
- SCE requests that Mitsubishi honor its contractual obligation to repair or replace any defective aspect in the RSGs at Mitsubishi's sole expense with due diligence and dispatch. Over the course of the next 16 months, from

January 2012 until June 2013, SCE cooperates in good faith with Mitsubishi on the repair efforts but ultimately looks to Mitsubishi to repair the defective RSGs so that they can safely return to 100-percent power for their 40-year life.

- March 2012** SCE confirms to the Nuclear Regulatory Commission (NRC) that its “top priority is to protect the health and safety of the public by understanding the causes of these issues and taking corrective actions to address those causes.” In response, the NRC issues its Confirmatory Action Letter outlining requirements for restart of San Onofre, including “reasonable assurance . . . that the unit will operate safely.”
- May 7, 2012** Mitsubishi presents its progress on developing a repair plan and promises to provide SCE more detailed information in late May 2012.
- May 31, 2012** Mitsubishi provides several theoretical possibilities for inserting new anti-vibration bars (AVBs) into the U-bend area of the RSGs, which require additional testing. Mitsubishi does not propose a final recommendation, and its ideas are preliminary and require additional evaluation.
- July 2, 2012** Mitsubishi outlines potential repair plans, listing multiple, possible short-, intermediate- and long-term repair ideas. Mitsubishi’s repair ideas require additional testing and evaluation. SCE reminds Mitsubishi that any repair proposal must be validated and substantiated sufficient to show that it would return the RSGs to 100-percent power for their 40-year operation life, address the underlying thermal-hydraulic conditions that led to the tube wear, be capable of being implemented, be licensable and, most importantly, be safe.
- July 27, 2012** SCE launches the steam generator repair (SGR) team to further support Mitsubishi’s efforts to repair the RSGs.
- Aug. 3, 2012** Mitsubishi outlines several, possible short-, intermediate- and long-term repair options, none of which would meet the specified criteria for a viable repair. Mitsubishi continues to present preliminary repair concepts and fails to recommend a particular or preferred repair.
- Aug. 6, 2012** Mitsubishi assures SCE that it has the “project management and technical expertise necessary to complete this very important repair with the efficiency and quality that SCE expects.”
- September 2012** Mitsubishi informs SCE that it will not have a recommended repair option until the end of November and that it cannot reduce the number of possible repairs being considered until at least October. SCE reiterates that because it is not a steam generator designer, it is relying on Mitsubishi to provide a repair recommendation.
- November 2012** Mitsubishi informs SCE that insertion of 30-degree AVBs and comb-shaped AVBs are not feasible repair options. SCE expresses concern over

“[Mitsubishi]’s level of research conducted” related to its repair ideas but commits to “continue to work with MHI on the development of an acceptable interim and permanent remedy.”

- Nov. 30, 2012** Mitsubishi misses the Nov. 30, 2012 deadline to propose a final repair plan to the SGR team.
- Dec. 20, 2012** Mitsubishi recommends a replacement of the tube bundles of the RSGs. However, Mitsubishi’s plan is still a “conceptual design.” Mitsubishi’s replacement proposal would take 5½ years for the first unit — not including the time that had already elapsed since the outages, the time required for manufacturing tube bundles for the other unit or the time needed for installation and licensing.
- January 2013** In order to fully assess the RSG failures and Mitsubishi’s proposed repairs, SCE invokes its right under the contract to review Mitsubishi’s documents related to the design and manufacture of the RSGs. Mitsubishi refuses to allow SCE to examine Mitsubishi’s documents.
- February 2013** Mitsubishi again refuses to provide SCE access to design documents and materials necessary to fully analyze the work that led to the RSG failures.
- March 2013** The NRC posts Mitsubishi’s redacted Supplemental Technical Evaluation Report to its website. In the Technical Report, Mitsubishi admits that a combination of high thermal-hydraulic conditions and inadequate supports caused flow induced vibration, including fluid elastic instability and random vibration, which in turn led to four excessive tube wear phenomena.
- March 11, 2013** Mitsubishi provides SCE a draft report of its proposal for a tube bundle replacement. Mitsubishi’s plan does not show that it will address the thermal-hydraulic conditions that contributed to the failures in the RSGs or that the support structures are supported by sufficient operating experience.
- April 5, 2013** Mitsubishi delivers a proprietary proposal to insert thicker AVBs into the RSGs. SCE and its experts closely review Mitsubishi’s plan and determine that it is not supported by sufficient testing. Mitsubishi’s proposal risks introducing new and additional problems into the RSGs, including new modes of tube bundle damage, deformation of tubes, ballooning of tubes and increased tube-to-tube wear. Mitsubishi’s AVB proposal does not address the adverse thermal-hydraulic conditions within the RSGs. Mitsubishi’s plan also fails to show that it can be safely implemented and is licensable.
- May 2013** Mitsubishi denies SCE access to a narrow list of Mitsubishi materials that SCE requested in order to fully review and analyze Mitsubishi’s repair proposals.

- May 13, 2013** SCE reiterates “SCE cannot agree to implement a repair without evidence that the repair will solve the serious problems with the [RSGs] and ensure that severe wear conditions do not occur again. To date, Mitsubishi has not provided sufficient documentation to SCE to establish that any of its proposed repair options is safe, effective and would be approved by the [NRC] in a reasonable time.”
- May 16, 2013** Mitsubishi delivers another draft of its plan to replace the RSG tube bundles. Mitsubishi’s proposal continues to be conceptual in design and fails to show it is viable, implementable and will safely restore the RSGs to full power.
- June 4, 2013** Mitsubishi asserts that its plan to insert thicker AVBs “contains a comprehensive description of a repair that Mitsubishi recommends be implemented.” Mitsubishi also claims that its repair would solve all of the failures in the RSGs “without needing to modify the existing RSG thermal hydraulic conditions,” even though Mitsubishi had identified the thermal-hydraulic conditions in the RSGs as an underlying cause of the failures.
- June 2013** Given the uncertainty of whether or when San Onofre would ever operate again, SCE decides that its only prudent course of action is to retire the nuclear plant permanently. SCE informs Mitsubishi that Mitsubishi failed to meet its contractual obligation to repair or replace the defective RSGs with due diligence and dispatch. In particular, Mitsubishi failed to offer a repair plan that (1) solved the cause of the RSG failures, (2) was feasible and could be implemented, (3) was validated and (4) would meet NRC licensing requirements.