

# Failure of Steam Generators at the San Onofre Nuclear Reactors

## SUMMARY Fairewinds Report

Friends of the Earth  
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- ⤴ The San Onofre reactors near San Diego and operated by Southern California Edison (SCE) have significant problems because its four new steam generators have extensive degradation and are unable to perform their design function of carrying radioactive water in the facility and powering the electrical generators.
- ⤴ **Fairewinds Associates recommends that both San Onofre Unit 2 and Unit 3 remain shut down until the “root cause” of each nuclear power plant’s rapid tube failures are understood and repaired, reliability is assured, and radioactive releases are prevented.**
- ⤴ On March 13, 2012, Chairman Jaczko stated, **“The root cause of the tube leak has not yet been determined. ...NRC approval is not required for the licensee [SCE] to restart Units 2 and 3.”**
- ⤴ Tube failures cause a significant nuclear safety issue by substantially increasing the risk of an accident that releases radioactivity into the environment.
- ⤴ Gross failure of one or more of the steam generator tubes could create a nuclear accident similar to that of a “small line break” accident. However, unlike the small line break, the radiation releases from a tube break are not trapped inside the containment building and instead leak into other buildings.
- ⤴ San Onofre design engineers believed that steam generator tubes installed when the reactors were built would last for the lifetime of the nuclear reactor without any appreciable leakage but there was degradation in the original steam generators. Due to this tube deterioration and degradation, Edison decided to replace its original steam generators by 2009/2010 with new steam generators manufactured in Japan by Mitsubishi.
- ⤴ These were installed in the San Onofre reactors in 2009 and 2010, with Unit 2 operating since May 2010, and Unit 3 operating since February 2011.
- ⤴ With their typical lack of transparency, Edison and the NRC, never told the public about the significant degradation in Unit 2’s steam generator tubes. While Unit 2 was shutdown for refuelling, Unit 3 was operating at full power when it experienced a complete perforation of one steam generator tube that allowed highly radioactive water from inside the reactor to mix with the non-radioactive water that turns the turbine in an unshielded building without a containment system. Thus Unit 3 was also forced to shutdown.

### The root cause of steam generator damage at San Onofre?

- ⤴ The four steam generators have been in operation for less than 2 years; less than one year in the case of the two steam generators in Unit 3.
- ⤴ Why did the original design of steam generators last for 25 years while the new design failed in two years?
- ⤴ What did San Onofre and Mitsubishi modify that was different than the original design?
- ⤴ Fairewinds review of the SCE/MHI report determined that the four most critical changes likely to be a cause of the current tube leaks at San Onofre Units 2 and 3 are:
  - ⤴ **the tube alloy was changed,**
  - ⤴ **reactor flow rate was changed,**
  - ⤴ **more steam generator tubes were added, and**
  - ⤴ **modifications were made to the “egg crate” that holds the tubes separate and apart.**

- ⤴ Years before the new steam generators were installed, Edison requested a 10CFR50.59 review of the steam generator replacement process so that NRC approval for the replacement steam generators would not be required. Due to Edison's application of the 10CFR50.59 review which portrayed the steam generator replacement project as a *like for like* replacement not necessitating NRC review, the NRC was never involved in any oversight of the steam generator replacement project.
- ⤴ As a result of design changes by Edison and MHI to the original steam generator tubes and related components, both San Onofre Units 2 and 3 have experienced extraordinarily rapid degradation of their steam generator tubes.
- ⤴ The extensive changes made by SCE to the new San Onofre steam generators are hardly a *like for like* change as the NRC was informed by Edison.
- ⤴ Simple inspections conducted by using Eddy Current tests indicate that more than 100 tubes show astronomical wear rates, need further evaluation, and must be plugged prior to resuming plant operation.
- ⤴ Additionally, of this small sample, SCE has pressure tested only the tubes in San Onofre Unit 3 and failed to perform similar tests on Unit 2
- ⤴ SCE and San Onofre engineers should have precise maps detailing the degraded and leaking tubes as well as the exact location of the leak(s) on each tube. Such data is critical to conducting a thorough root cause analysis of the problem and determining an accurate solution.
- ⤴ By failing to pressure test the tubes in San Onofre Unit 2, SCE will be unable to determine the full extent of this critical safety and expensive reliability issue.
- ⤴ Therefore, Fairewinds believes that in order to prevent radiation releases and assure ongoing long-term reliability, SCE must keep San Onofre Unit 2 shutdown until thorough and systematic tube pressure tests and a root cause analysis have been completed.
- ⤴ Furthermore, a complete analysis by SCE of the individual tubes in each San Onofre nuclear reactor is the only accurate engineering method available to ascertain if the tube failures are due to metallurgical problems or mechanical wear.
- ⤴ It appears that the mobilization of an NRC Augmented Inspection Team to only San Onofre Unit 3 is an effort by the NRC and SCE to obfuscate the issue and not conduct an orthodox, thorough, and requisite engineering root cause analysis. Without a thorough examination of the tubes in San Onofre Unit 2 the cause of the tube thinning will remain unresolved creating both a significant safety issue as well as compromising the reliability of the San Onofre reactors.
- ⤴ Fairewinds Associates recommends that both San Onofre Unit 2 and Unit 3 remain shut down until the "root cause" of each nuclear power plant's rapid tube failures are understood and repaired, reliability is assured, and radioactive releases are prevented.

**For further information**

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