Given all the news swirling about the permanent shutdown of San Onofre Units 2 & 3 due to fatally flawed steam generators, Dr. Gordon Edwards, President of the Canadian Coalition for Nuclear Responsibility (CCNR) has prepared a backgrounder on the subject:

All Pressurized Water Reactors (PWRs) require the use of "steam generators". A steam generator is basically a boiler -- a vessel where the heat from the core of the reactor is used to boil a lot of water, to make a lot of steam. The steam exits from the steam generator and is used to spin the blades of massive steam turbines in order to generate electricity for the grid.

Every steam generator has two entirely different flows of water passing through it, called the "primary coolant" and the "secondary coolant". The primary coolant carries the heat from the core of the reactor to the steam generator, and the secondary coolant produces the steam that is needed for the turbines. The two coolants do not mix unless there are pipe failures inside the steam generator.

For this reason, the steam generators are in a very strategic location; they represent the boundary between the "nuclear side" of the plant, where most of the radioactivity is (represented by the primary coolant), and the "conventional side" of the plant, where there is usually little radioactivity (represented by the secondary coolant).

The primary coolant flows right through the core of the reactor. It becomes radioactively contaminated because it comes into direct contact with the nuclear fuel. It also becomes extremely hot (about 300 degrees C or 570 degrees F) but is kept under such high pressure that it cannot boil.

Inside the steam generator, this superheated water is fed through many thousands of very narrow pipes -- over 50 kilometers (30 miles) long if laid end to end. These narrow pipes become blistering hot and act as heater elements inside the steam generator vessel.

See [http://ccnr.org/Tubes_in_SG.pdf](http://ccnr.org/Tubes_in_SG.pdf)

The secondary coolant is not pressurized. It boils when it comes in contact with the outside surfaces of all these hot pipes inside the body of the steam generator. The resulting steam exiting from the vessel is what drives the turbines and produces electricity.
If pipes inside the steam generator leak, then a pathway exists for radioactivity from the core of the reactor to escape from the primary coolant to the secondary coolant, and therefore into the conventional side of the plant. That radioactivity will end up being released into the environment.

At San Onofre, the old steam generators were leaking and so they were replaced with new ones in 2009 and 2010. But more than 8% of the pipes in the new steam generators started leaking within 2 years of installation because of vibration and other damage mechanisms. This led to radioactivity being released off-site. The reason for the failure is apparently due to faulty design.