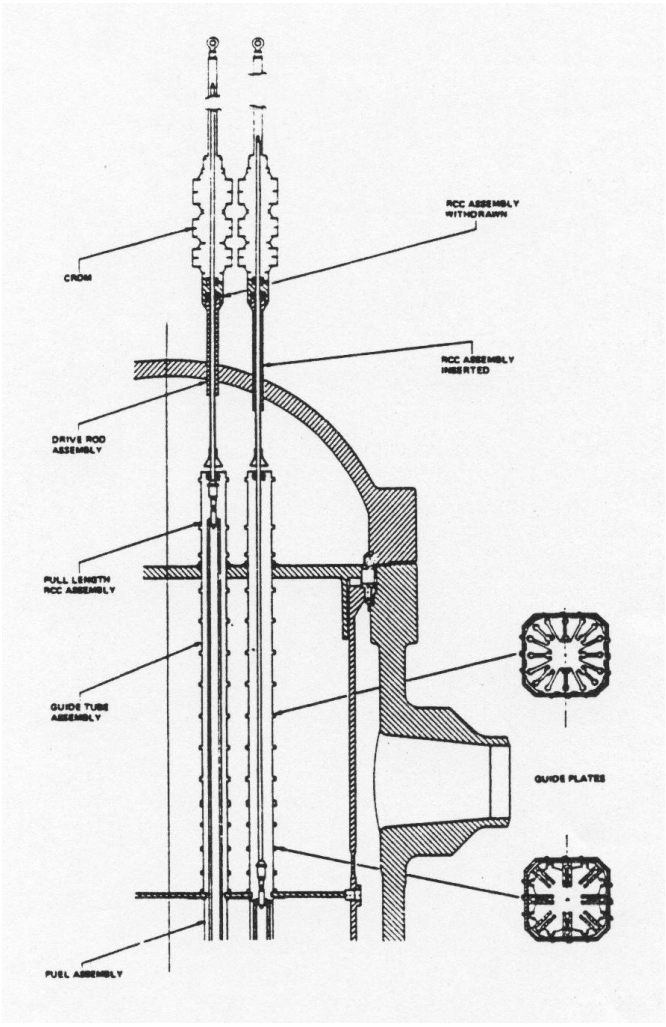
Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions
issue brief

"NO DETECTABLE DEFECT" AT SAN ONOFRE?

During three consecutive refueling outages spanning four years, Southern California Edison (SCE) detected a defect in one of the control element drive mechanism (CEDM) nozzles at their San Onofre Unit 3 reactor. The defect appeared to be a crack nearly two inches long extending more than halfway through the nozzle wall. When the crack appeared to grow larger, SCE repaired the problem using an NRC-approved weld overlay. But when the crack appeared to grow deeper than the NRC allowed this repair method to fix, SCE opted for a very imaginative, lower cost, unique remedy – they simply reclassified the defect they had detected in three straight refueling outages as being "no detectable defect." Thus, SCE now maintains the crack it repaired three years ago never existed. Only time will tell if SCE was right when they detected the crack or if they are right now when they make it magically disappear.

BACKGROUND

San Onofre Unit 3 is a pressurized water reactor (PWR). The control rods that govern the rate of the nuclear chain reaction within the reactor core are themselves regulated by control element drive mechanisms (CEDMs) mounted on top of the domed reactor vessel head. The CEDMs are essentially motors that permit the operators to insert and withdraw control rods to raise and lower the reactor core power level. Each CEDM is connected via a long metal shaft to its control rod. The shafts pass through the reactor vessel head inside nozzles that are approximately four inches in diameter with metal walls about 2/3-inch thick. Because the pressure inside the reactor vessel is very high during operation (over 2,000 pounds per square inch), the CEDM nozzles are welded to the reactor vessel head to provide leak-tight connections.



After workers at the Oconee nuclear plant in South Carolina identified that reactor cooling water had leaked through cracked nozzles, the NRC required SCE and other plant owners to inspect the CEDM nozzles. During a refueling outage in January 2003, workers detected what appeared to be a crack in CEDM 56 at San Onofre Unit 3. The cracks appeared to be about 1.7 inches long and to extend more than

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halfway through the 0.661-inch thick nozzle wall. Following that detection, workers used a more sensitive test method to check both the inside and outside surfaces of the nozzle wall over the entire length of the crack, but no openings were identified. The absence of surface cracks eliminated primary water stress corrosion cracking (PWSCC) as a factor. SCE restarted Unit 3.

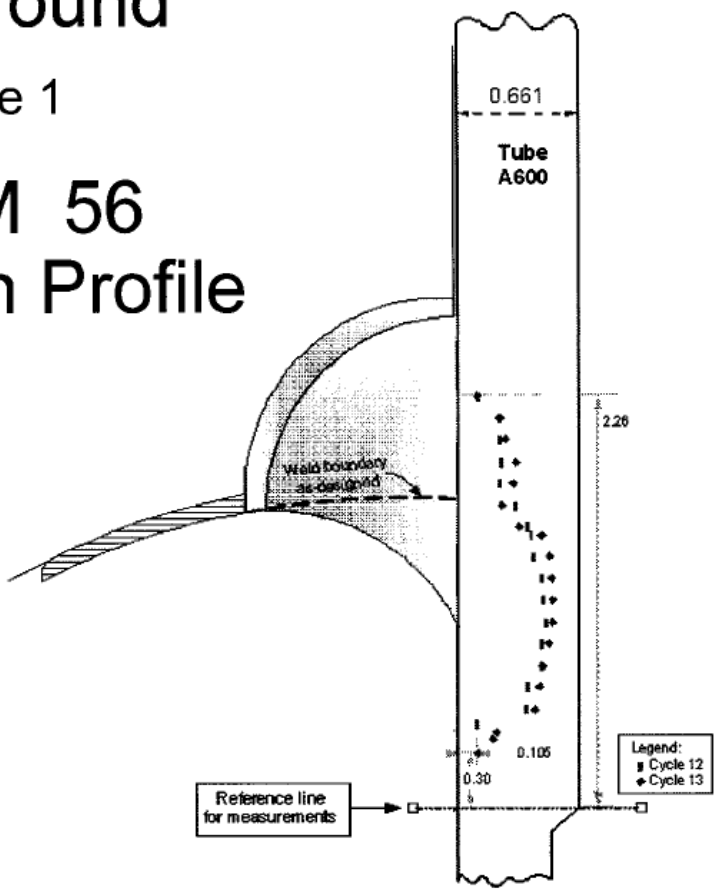
The type of metal used in PWRs is particularly vulnerable to PWSCC. PWSCC occurs when two degradation mechanisms – rust and stress – team up. When a tiny crack or pit appears in the surface of metal, it tends to concentrate the stress forces acting on that metal similar to how cutting a notch in a wooden rod makes it easier to break with your hands. Water corroding, or rusting, the creak area weakens the metal enabling the stress to enlarge the crack and expose more surface to corrosion. But PWSCC needs a surface blemish for stress and corrosion to then exploit.

During the next refueling outage in October 2004, workers once again detected what appeared to be a 1.7-inch long crack in CEDM 56. This time however, the crack appeared to have deepened from January 2003 (Cycle 12) to October 2004 (Cycle 13).

Background

Figure 1

CEDM 56 Indication Profile



SCE reacted to the signs of crack growth by implementing an NRC-approved repair to CEDM 56. They welded an overlay around CEDM 56 so that the nozzle would remain structurally intact.

During the next refueling outage in October 2006, workers once again detected what appeared to be a 1.7-inch long crack in CEDM 56. It showed little change from the 2004 inspection. Using a more precise inspection method, however, the depth of the crack was measured to be about 76 percent of the nozzle wall's thickness. This result had significant consequences – the weld overlay repair method applied during the October 2004 refueling outage can only be used for cracks up to 75 percent of wall thickness. SCE sought and obtained a relief request from the NRC allowing Unit 3 to be restarted with the CEDM 56 repair method even though the crack was slightly larger than the legal limit. SCE promised the NRC to pursue a permanent resolution to the CEDM 56 problem to be implemented during the next Unit 3 refueling outage.

On September 25, 2007, SCE met with NRC to unveil their permanent resolution. The meeting occurred in a small conference room in the NRC's headquarters in Rockville, Maryland, but it should have been conducted on a stage or venue more fitting the magic act that SCE performed.

> ***The crack that SCE plotted and charted and repaired is – PRESTO CHANGO! – gone. It never existed. There is not now nor never was a crack in CEDM 56.***

How fortunate for SCE that the crack that appeared to exist in January 2003, October 2004, and October 2006, unselfishly disappeared entirely after it was measured to be deeper than allowed by NRC's requirements.

SCE told the NRC that indications which so many people for so many years mistook for a 1.7-inch long crack were merely "grain noise." SCE claimed the very sophisticated ultrasonic testing method they employed sent such a sensitive acoustical pulse through the nozzle's metal wall that it refracted from the grain boundaries of the crystals forming the metal. An NRC staffer asked the room full of metallurgical experts – with collective experience of nearly 100 years – during the September 25th meeting if any had ever encountered or read or heard rumors about a time when "grain noise" had aligned so as to suggest a 1.7-inch long crack. None ever had, until now. SCE wants to reclassify the indications on CEDM 56 as "no detectable defect."

How did the NRC respond to the SCE magic show? The NRC was happy before when SCE said that CEDM 56 was cracked and the NRC appears equally happy now to have SCE recant and have the whole nasty business just go away. The NRC sure is a happy-go-lucky bunch.

As if by magic, SCE's crack problem is now gone. They no longer have to worry about a more elaborate, and costly, repair to a cracked nozzle on CEDM 56 because there is no crack. It's not a cracked nozzle (as it was in 2003, 2004, and 2006), it's now just a noisy nozzle. And if you are skeptical about this mystical transformation, you might want to keep those concerns to yourself. SCE might use any leftover magic to turn skeptics into toads or simply make them disappear.

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