

The Rossi 10 kW Reactor

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Andrea Rossi and Sergio Focardi held a public demonstration on January 14, 2011 of Rossi's ECat (energy catalyzer) boiler, a nickel-hydrogen fusion reactor, at the University of Bologna (Italy). A group of about 50 scientists from the university and the Istituto Nazionale di Fisica Nucleare (INFN, the Italian Institute of Nuclear Physics) were on hand to examine the device. The experiment was organized by Dr. Giuseppe Levi and other faculty at the University of Bologna/INFN.

A video of part of the demonstration, the abstract of International Patent WO/2009/125444, other related material and news items are available on the website for *The Journal of Nuclear Physics* (<http://www.journal-of-nuclear-physics.com>). The site, created by Rossi and his colleagues, has published a handful of papers over the past year, but is at this time primarily a news source for the Rossi reactor. Focardi and Rossi's paper, "A New Energy Source from Nuclear Fusion," is also available there.

After the January 14 demonstration, Levi prepared a "Report on Heat Production During Preliminary Tests on the Rossi 'Ni-H' Reactor" (<http://www.lenr-canr.org/acrobat/LeviGreportonhe.pdf>) based on short tests he conducted on both December 16, 2010 and at the demonstration on January 14. Levi's report includes a section by Dr. David Bianchini, "Experimental Evaluation, for Radiation Protection Purpose, of Photon and Neutron Radiation Field During the Public Presentation of the Prototype Called 'Energy Amplifier.'" Additionally, an important report by Prof. Mauro Villa, "On the γ Radiation Measurements on the Rossi System," is also available (<http://www.lenr-canr.org/acrobat/VillaMonthegamma.pdf>).

At the demonstration on January 14, no measurable nuclear radiation was detected. Villa wrote, "The energy

power input and output and gamma radiations were measured before, during and after the active phase of the system, as well as the hydrogen consumption. While a net energy output was observed, no γ excess (with energy above 200 keV has been measured above the natural background level (<180 Hz rate in single mode, compared to an expected rate largely in excess of 1 MHz)."

The magnitude of the effect suggests that the ECat is a viable energy technology that may use commonly available materials. Rossi claims that the device will not produce carbon dioxide, or radioactive waste, and will be economical to build. The device generated more than 10 kW of excess power. The ratio of input power to output power was over 10.

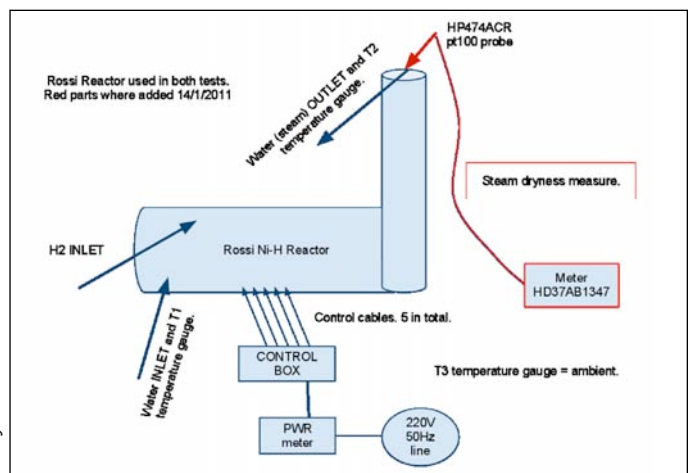
The demonstration was intended to establish the ECat's performance as a "black box." Levi's instruments measured the electrical power and hydrogen supplied to and consumed by the ECat and measured the amount and temperature of the water to be heated to steam by the ECat. Rossi operated the ECat while Levi took those measurements.

Villa reported, "Even if the measurements were severely limited by the non-disclosure of the reaction chamber and of the associated electronics, nevertheless some important aspects have been tested." Villa noted that the following parameters were controlled during the test: input electrical power was measured on a power meter and recorded every eight seconds; the environment temperature and input water and output steam temperatures were logged every two seconds; the vapor quality was measured online; the water flux was measured at the beginning and assumed constant; gamma production from the system was monitored with NaI counters. Villa reported, "No flux measurement has been done on the output steam flow."

Figure 1 shows the experimental set-up for the January 14



Figure 1. January 14 demonstration of the Rossi reactor.



(Photo by Daniele Passerini.)

Figure 2. Schematic of the Rossi reactor. (Courtesy of Dr. Levi.)

demonstration. A plastic reservoir (left side of photo) delivers water, via a plastic tube and through a displacement pump, into the ECat's insulation. Hydrogen was supplied from a pressure vessel on the floor through a line to the ECat. A controller (which sat behind the ECat) regulated the supply of hydrogen and electrical power to the ECat. Three thermocouples measured: T1, temperature of the room; T2, temperature of the water pumped into the reactor by a positive displacement pump; T3, temperature of the output of the ECat. Another probe measured the dryness of the steam that exited the ECat system. An input power meter was also used. Also seen in Figure 1 are other measurements that took place, including nuclear radiation detection. Figure 2 shows a schematic of the Rossi device.

After Rossi turned on the ECat, the temperature of the output rose during a transient phase of operation. After about an hour, the ECat produced steam with a temperature of ~101°C. The steam is "dry"—liquid water was all converted to steam. This is the steady-state operation that describes the performance of the ECat.

During the demonstration, T2 = 13.3°C and T3 = 101.2°C. Using the values of the specific heat (cal/degree-gram) for water, and the heat of vaporization (540 cal/gram), and the rate of flow of water into the apparatus (4.9 g/s), a value exceeding 12,900 W for the excess power was inferred, when the input power was less than 370 W.

Much debate and discussion has ensued since the January 14 demonstration, particularly in the LENR field. Much of the discussion has centered around issues related to safety, the need for further testing and the particulars of the nickel involved in the process. Rossi has made himself widely available to colleagues, answering any questions that are not proprietary in nature. Many were surprised that Rossi announced on January 14 that his Leonardo Corporation (which holds the rights to the technology, and is partnered with Defkalion Green Technologies) might start shipping commercial devices within the next few months and start mass production thereafter. Mention of a 1 MW reactor also drew criticism, as such a large reactor would bring with it many safety concerns. Rossi has since indicated that the 1 MW reactor would consist of numerous smaller reactors working together. He noted, "I will start up the 1 MW plant that I will install

in Athens in October 2011." He indicated that industrial production, with a product geared toward consumers, will take place by the end of the year as well.

Rossi and Levi have since conducted a longer test of the ECat, at the University of Bologna on February 10. The ECat was run for 18 hours this time. Also, a much higher flow rate was used, to keep the cooling water from vaporizing. This choice was made in response to some of the critiques of colleagues; it makes moot concerns about dry steam.

Mats Lewan, of NyTeknik (www.nyteknik.se), interviewed Levi about the test run. Levi indicated that the test was instrumental in determining what parameters must be controlled and whether the device could run for longer periods of time. Levi told Lewan: "This is the third time I've seen the device and again it produces energy. . . [W]e loaded the unit with hydrogen at the beginning, and then the bottle was closed. It then worked for 18 hours with the bottle closed. . . I weighed container before and after charging, and including the gas we let out to empty the tube of air, the consumption of hydrogen was 0.4 grams. . . Minimum power was 15 kW, and that's a conservative value. I calculated it several times. At night we did a measurement and the device then worked very stable and produced 20 kW. Now that I have seen the device work for so many hours, in my view all chemical energy sources are excluded."

Levi reports that power briefly peaked at 130 kW, with an average of 15 to 20 kW; since all parameters and measurements have not been fully reported yet, the 130 kW is an estimate and the peak period is unknown. Answering skeptic's concerns about hidden batteries, Levi told Lewan: "This time I opened the control unit. . . [T]he box was empty except for the control electronics. . . I have also seen inside the unit itself—most of the volume is insulation and most of the weight of about 30 kg is due to lead." Rossi will have Levi do analysis, before and after operation, of the nickel powder involved in the process as a catalyst.

Rossi tells *IE*, "We are making a thorough series of tests with the University of Bologna, which will be 12 months long with a reactor in operation 24 hours per day. During this year we will make a long theory of measurements and tests, also in collaboration with CERN researchers. A report will be made at the end of the 12 months of measurements."