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Report on heat production during preliminary tests on the Rossi “Ni-H” reactor.

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In this first and preliminary document are reported the heat production measures done during two short tests done on December 16 2010 [Test 1] and January 14 2011 [Test 2].

On December, 16 2010 I had the opportunity to test, for the first time, a prototype of the Rossi “Ni-H” reactor. A photograph of the apparatus used in both tests is shown in fig.1 and a scheme is shown in fig. 2.



Fig.1

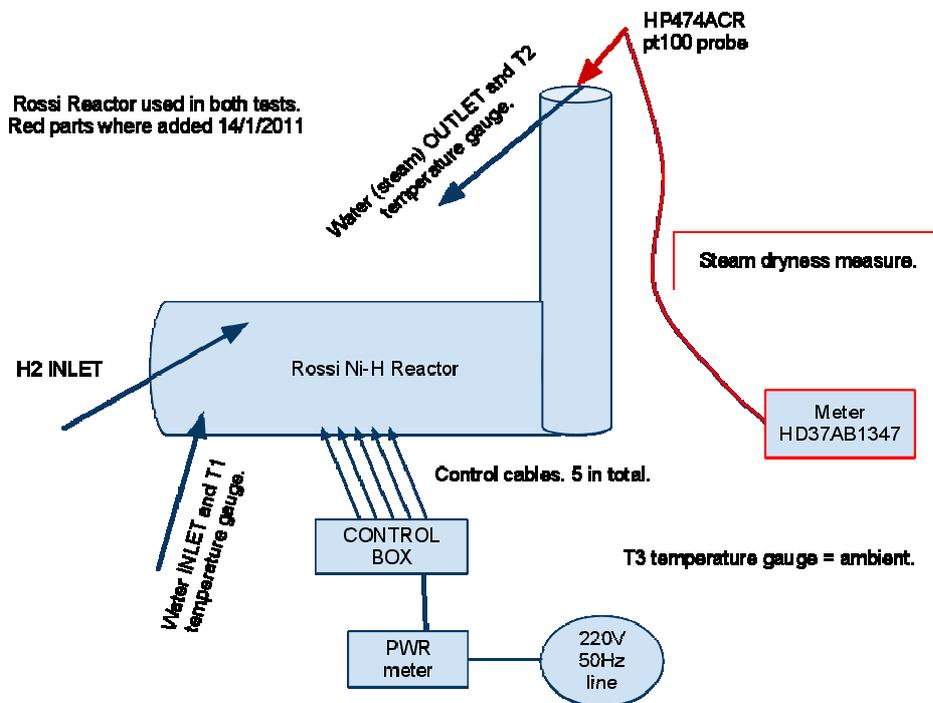


Fig.2

The Rossi Reactor prototype has a main horizontal cylindrical body ending with a vertical pipe. The H₂ inlet was connected to a Hydrogen bottle through no return valves. There was no H₂ outlet apart from a small purge valve that was closed. Cables were connected to a control box with 5 digital plc that were “controlling the power sent to the resistors inside the reactor”. Prudentially I have lifted the control box in search for any other eventually hidden cable and found none. The weight of the control box was of few Kg. Two water pipes were connected to the system. Temperature was measured and logged by two NTC sensors. Another sensor, in the logger, was measuring the ambient temperature. Power from the 220V line was monitor and logged by a “WATTUP?” Pro Es power meter.

Before igniting the reactor the water flux was set and measured by collecting, , and then weighting, an amount of water in a container in a given time.

The measured flux was of 168 +/- 2 g in 45 +/- 0.1 s.

Then the power was turned on an temperatures started to rise. In Fig 3 is show a plot of the temperatures as appeared on the monitor during the test taken from the start to just after the end of the test.



The three lines refers:

(B) blue line: T1 water input temperature

(Y) yellow line: T2 water (steam) output temperature

(R) red line : ambient temperature

As it can be seen the system was turned on just around 16.55. After approx 30 minutes a kink can be observed in the (Y). Because input power (1120W also checked via and clamp amperometer) was not modified (see fig.5 later) this change of slope testify that the reactor was ignited. After a startup period approx 20 minutes long a second where the reactor power was almost constant taking the water to ≈ 75 °C a second kink is found when the reactor fully ignites rising the measured temperature at 101.6 ± 0.1 °C and transforming the water in to steam.

At this point we can try a simple calculus in order to evaluate the power produced. In order to raise the temperature of 168 g of water by 1 °C , $\approx 168 * 4.185 = 703$ J are needed. The water inlet temperature was 15 °C so the ΔT was 85 °C. We have $703 * 85 = 59755$ J. At this energy one must add the evaporation heat ≈ 2272 J/g * 168 = 381696 J. Total energy in 45 sec is $59755 + 381696 = 441451$ J, and power is $441451 / 45 = 9810$ W.

Statistical experimental errors in power estimation, due mainly to flux measurements, can be conservatively estimated in about 1.5%. In this case we have ± 150 W.

This result is only a lower limit of the energy produced because the system was not completely isolated and we have not taken into account any heat loss. From the calculation of the “produced power” when the water was at 75 °C which give a result that is less than the electrical input power is easy to understand that this systematic under estimation surely exceeds the statistical errors .

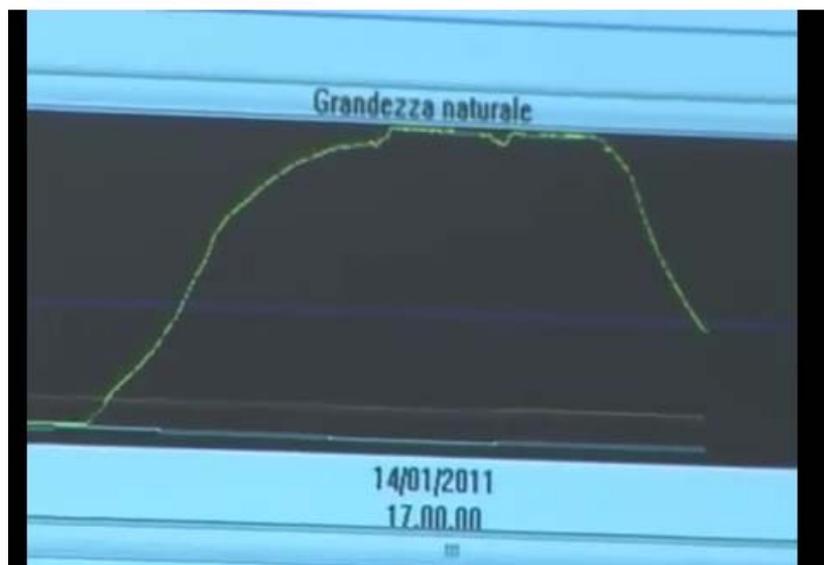
Before ending [Test1] all the power was reduced and then switched off from the resistors and also the hydrogen supply was closed. No pressure decrease was noted in the H2 bottle. Even in this conditions the system kept running self sustaining, for about 15 minutes until it was decided to manually stop the reaction by cooling the reactor using a large water flux (note the decrease of the water input temperature).

The main origin of possible errors in [Test1] measure was that the steam was not checked to be completely dry. During [Test2] this measure was done by Dr. Galantini a senior chemist who has used an “air quality monitor” instrument HD37AB1347 from Delta Ohm with a HP474AC probe . Also in [Test2] a high precision scale (0.1g) was used to weight the Hydrogen bottle (13 Kg) before 13666.7

+/- 0.1 g and after 13668.3 +/- 0.1 g the experiment. The cause of this unexpected rise was traced to be the remnant of piece of adhesive tape used to fix the bottle during the experiment. After careful examination of the tape the weight loss was evaluated to be <1g. This is far less the expected weight loss due to chemical burning. In fact 1g of H can produce (max) 285 Kj. In [Test2] the power measured was 12686 +/- 211 W for about 40 min with a water flux 146.4g +/- 0.1 per 30 +/- 0.5 s. This means that $12686 * 40 * 60 = 30446400$ J where produced. Dividing this number by 280KJ a weight of 107g is obtained two order of magnitude larger than the H consumption observed.

As a prudential check the reactor was lifted to seek any eventually hidden power cord. None was found.

During the test the main resistor, used to ignite the reaction, failed due to defective welding. Even in that condition the reactor successfully started operation using the other resistors but the duration of the experiment in full power (≈ 40 min) was “to short” to observe a self sustaining reaction.



The temperatures recorded in [Test 2] are shown in fig 4. Unfortunately the original data has been lost but the different evolution is evident.

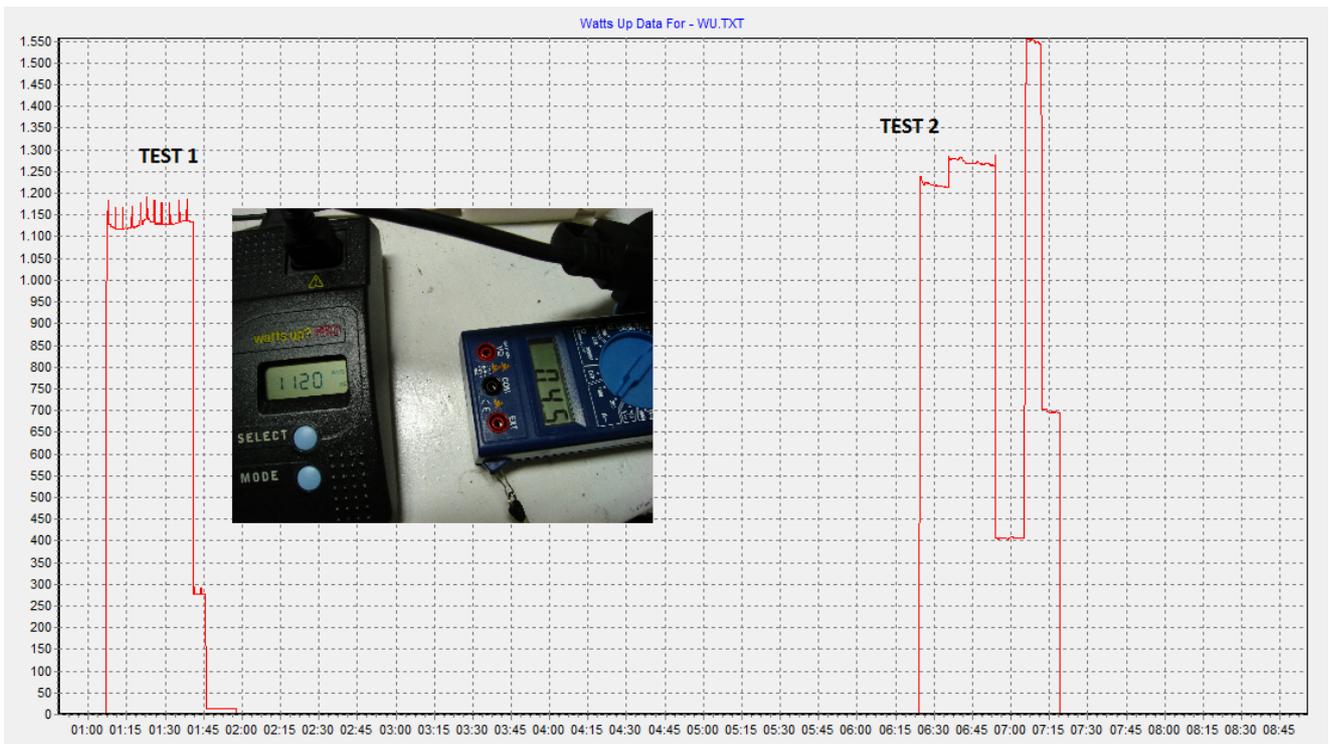


Fig. 5 - Power adsorbed during tests in W. The time abscissa has 15min tics from counted from the first record. Spikes in [Test 1] are due to line voltage spikes. The anomalous behavior in [Test 2] is clear.

The average power adsorbed during [Test 2] is $\approx 1022\text{W}$.

Conclusions

The amount of power and energy produced during both tests is indeed impressive and, together with the self sustaining state reached during [Test 1] could be an indication that the system is working as a new type of energy source. The short duration of the tests suggests that is important to make more long and complete experiments. An appropriate scientific program will be draw.

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Experimental evaluation, for radiation protection purpose, of photon and neutron radiation field during the public presentation of the prototype called "Energy Amplifier"

PREFACE

On 14/01/11 at the GM System plant of Via dell'Elettricista 16 in Bologna, I performed radiation field measurements for radiation protection purposes as per your request of 09/11/10.

This report is therefore about the evaluation of the photon and neutron radiation field near the prototype called "Energy Amplifier" during its public presentation.

The process, the geometry and the materials used for the production of energy inside the "Energy Amplifier" are unknowns that I'm not aware of. Environmental monitoring is defined temporally before, during and after the test in question

The field evaluation can not relate to criteria of functionality of the system and can not be used for comparison in systems different from this one, in the process, in the geometry or in the construction materials used.

TIME DESCRIPTION OF THE TEST

The test has been conducted without interruptions in the measures presented below, which therefore represent, to all intents and purposes, a continuous monitoring of the photon field and of the neutron field samples as summarized in table:

ID	Phase	Start time	End time
0	External environmental background	13:10	13:20
1	Before ignition	15:45	16:22
2	Ignition	16:22	16:45
3	Stability	16:45	17:25
4	Switching off	17:25	17:55
5	After switching off	17:55	19:00

Table 1: Time phases of the present measures during the presentation of the "Energy Amplifier".

REPRESENTATION OF THE MEASURE GEOMETRY

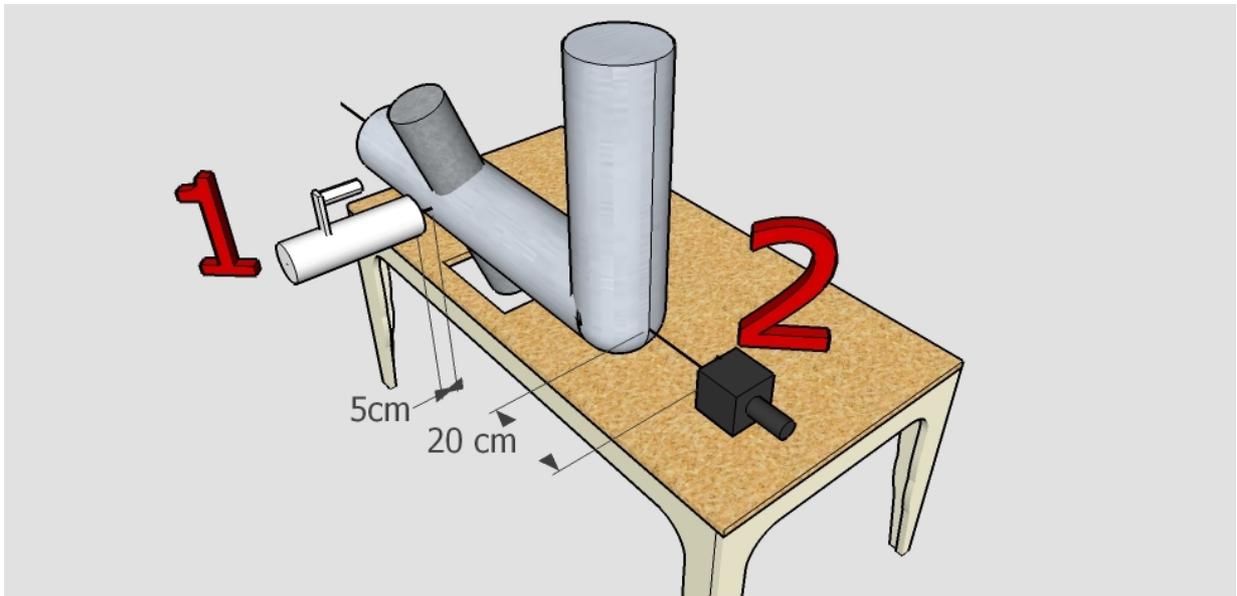


Figure1: This is the prospective representation of the relative position between probes and the “Energy Amplifier”. This figure can be used to represent the environment in which the instruments were used. Probe”1”: as describe in Table 2. Probe”2”: as describe in Table 4

EVALUATION OF THE X e γ FIELD

This measure has the purpose of detecting, only for radiation protection purposes, the X e γ radiation around the “Energy amplifier” during it's using.

This measure does not take into account in any way the internal attenuation of the photons produced by the apparatus and can not in any way be traced back to the production or otherwise of the photons due to the same apparatus.

METHOD

Has been defined a measurement protocol structured as follows:

- In agreement with the ICRU definitions (*International Commission on Radiation Units and Measurements; rif. Report 57-1998*), we have chosen to evaluate the ambient dose equivalent $H^*(10)$ as a dosimetric indicator of the X and γ field;
- The ambient dose equivalent measurements have been performed in dose rate mode;
- The measurement position is not fixed but is variable around the “Energy amplifier” at a minimum distance of measurement from the outer structure equal to $d=(5\pm 2)$ cm. This choice has the purpose of monitoring the possible anisotropic radiation through the mapping of the radiation solid angle around the system;
- The measurements have been repeated at a frequency such that the average of the values is magnitude representative of the dosimetric values distribution;
- The average values are both temporal (time phase) and spatial (different positions of measurement);
- The analysis of the data is based on the comparison with the environmental background measured in an independent temporal phase (phase 0) and in an environment reasonably far from the “Energy amplifier” ($d>50m$).

MATERIALS

The measurements were performed with the following instrumentation:

• AUTOMESS 6150 AD-b (s/n 93883);
• Last calibration certificate SIT 065/R n. 9521/S/12/10 del 20.12.2010);
• Probe: zinc sulfide (ZnS scintillator) size 3” \times 3”;
• Measuring range 23 keV – 7 MeV;
• Resolution declared of 1 nSv/h;
• Measuring range of 50 nSv/h – 99.99 μ Sv/h.

Table 2: Specification data of the used instrument for the present measure.

RESULTS

The measured values are shown in the following table:

Temporal Phase	H*(10) [nSv/h]
0	118 ± 10%
1	107 ± 10%
2	111 ± 10%
3	115 ± 10%
4	116 ± 10%
5	123 ± 10%

Table 3: Ambient dose equivalent for each test phase as described in Table 1 (Please note that Phase 0 correspond to the background value)

The uncertainty on the measure is estimated in accordance with the methods described in ICRU Report 76 *Measurement Quality Assurance for Ionizing Radiation Dosimetry (2006)*.

CONCLUSIONS

From the measures it is shown that there are no evidence of meaningful differences of H*(10) compared to the background environmental radiation.

Furthermore the dosimetric measures are not dissimilar from the environmental background measurement both as average and as maximum peak values.

EVALUATION OF THE NEUTRON FIELD

This measure has the purpose of detecting, only for radiation protection purposes, the neutron radiation around the “Energy amplifier” during its using.

The measure does not take into account in any way the attenuation and the thermalization of neutrons maybe produced or present inside the apparatus and can not be in any way be traced back to the production or otherwise of neutrons due to the same apparatus.

MATERIALS

For the measurement we used a direct reading electronic detector described by the following technical summary:

<i>Manufacturer:</i>	LUDLUM
<i>Electrometer:</i>	LUDLUM 2221 Scaler/Ratemeter SCA
<i>Probe:</i>	Prescila 42-41 Neutron Radiation Detector (neutron recoil scintillator)
<i>Sensitivity declared by the manufacturer:</i>	350 cpm per mrem/h;
<i>Angular dependance:</i>	15 % in all the measure range

Table 4: Specification data of the used instrument for the present measure.

The instrument has been periodically calibrated by an accredited ENEA center that has provided the following calibration factors:

- On 17/03/2010 (N°1N10) with AmBe source ($E_{\text{neutrons}} = 4.4 \text{ MeV}$) equal to 36CPM per $\mu\text{Sv/h}$
- On 28/01/08 with di Pu-Li source ($E_{\text{neutrons}} = 0.54 \text{ MeV}$) equal to 15 cpm per $\mu\text{Sv/h}$

METHOD

Has been defined a measurement protocol structured in the following way:

- The evaluation of the neutron field is based on the rate measurement of the counts per minutes (cpm) so as they are provided by the instrument, by integrating the registered counts in 60 seconds;
- The measurement position is fixed with respect to the “Energy amplifier” at measurement distance from the external structure equal to $d = (20 \pm 5) \text{ cm}$. This choice has the purpose to monitoring the neutron radiation in the room in the chosen angular direction. The choice of the position is due the instrument available space;
- The values provided are the average of the values collected in the temporal interval;
- The measurements have been repeated at a frequency such that the average of the values is representative of the distribution of dosimetric values;

- The analysis of the data is based on the comparison with the background measured in an independent temporal phase (phase 0) and in an environment reasonably far from the “Energy amplifier” (d>50m).

RESULTS

The results are presented in temporal rate of counts per minutes type (counts per minutes) in the same way as what is provided directly by the instrument (average values for each time interval in question):

PHASE	CPM (counts per minutes)
0	16 ± 2
1	15 ± 2
2	16 ± 2
3	15 ± 2
4	14 ± 2
5	16 ± 2

Table 5: Count per minute values for each test phase as described in Table 1 (Please note that Phase 0 correspond to the background value)

CONCLUSIONS

From the measures it is shown that there are no evidence, within the bounds of the instruments presented before, of meaningful differences in the measured values compared to the background environmental radiation.

Further:

- The absence of neutron field observable from the measured background does not allow the dosimetric analysis for a comparison with the calibration values associated with the instrument.
- The measure results are not dissimilar from the environmental background both as average and as maximum values.

In faith
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