About ITER project

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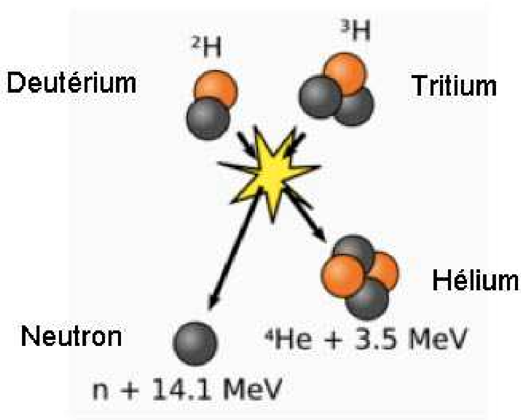
The scientists working on ITER underline the great importance of the project:

- *Putting the sun in a test tube*
- *Getting unlimited energy.*
-

The aim is to resolve the energy needs of all humanity hence the participation of 34 countries in this enterprise, including 7 European countries, as the article reminds us.

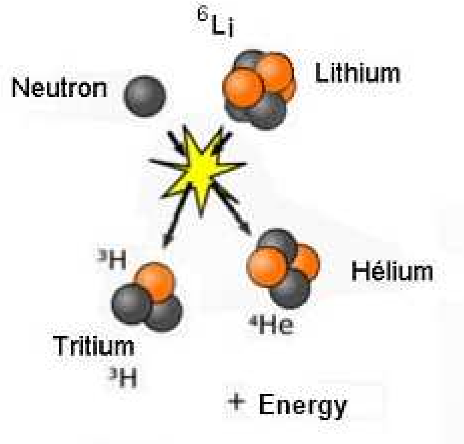
The basic operating principle of a fusion generator (which, a priori, is not alone, an aspect that will be treated at the end of this letter) and for which ITER only represents the first stage, is based on two nuclear reactions.

A neutronigenic fusion reaction



This concerns two hydrogen isotopes, deuterium and tritium. If the first, non-radioactive, is extremely abundant in nature, the second, with a 12.3 year half-life, is not. In the first stages the ITER machine would operate with tritium synthesised in the Canadian CANDU reactors.

It is out of the question to feed an operational fusion generator with factory made tritium. This must be synthesised in situ in the reactor itself through a tritigenic reaction. This is based on a second nuclear reaction, tritigenic, inseparable from the first[1]:



Which means that, globally, the exo-energetic reaction is written as:

Deuterium + **Lithium** gives 2 **Helium** + **energy**

There are 35 grams of deuterium and 0.17 grams of lithium in each cubic metre of sea water. In relation to the expected energy production, production costs of these two "combustibles" is negligible.

It is correct therefore to speak of "unlimited energy".

The temperature at the sun's centre, which gets it energy from fusion, is 20 million degrees. As this fusion was achieved (for one second) by the British tokomak JET, it is not incorrect to use the expression:

The image of a "sun in a test tube" is not false.

Fission reactors supply plutonium at a more or less greater rhythm. This plutonium is the basis of fissile nuclear weapon construction (A bombs) which in their turn are used to set off fusion weapons (thermonuclear "hydrogen" bombs).

The project for the creation of energy generators using fusion was born during a meeting between Reagan and Gorbatchev in Geneva in 1985. The idea was to create a nuclear industry that was not directly aimed at armaments (which is only partly true as tritium can be used to dope certain nuclear weapons). A year later the accident at Chernobyl underlined the danger of fission reactors, which are also synonymous with the dissemination of nuclear weapons in the world.

Straight away nuclear fission was adorned with all the virtues. From the security aspect it was argued that accidents such as those of Chernobyl or Fukushima couldn't happen because, in the event of a breach in the reactor's envelope, as the pressure and temperature dropped,

[1] The reaction is based on the istope of lithium ^{6}Li which forms only 7,5 % of the natural lithium, the second isotope being ^{7}Li (92,5 %)

fusion would immediately cease. Studies and work on the possible future development of a fusion reactor also continued because of several other pressures:

- *The fear of running out of hydrocarbon reserves*
- *The desire of many countries for energy autonomy*
- *The idea that greenhouse gas, a result of hydrocarbon combustion, could lead to climate warming.*

In 1991, scientists working on their JET (Joint European Torus) machine obtained the first (notable) fusion reactions, first with a deuterium-deuterium mix heated to 150 million degrees, then by effecting probative experiments with a deuterium-tritium mix heated to 100 million degrees.This European machine, a tokomak conceptually similar to the ITER machine, by fusion reactions, produced the equivalent of 70% of the energy injected.

In the French machine Tore-Supra, installed at Cadarache, it was possible to create a magnetic field of 4 teslas in a toroidal chamber, delivered by a superconducting magnet, for a record duration of 6 minutes in a 25 cubic metre chamber, against 840 cubic metres for ITER). But despite the positive announcements that accompanied the project launch in 1982 ("the sun in a test tube" etc.), the temperature obtained in this second tokamak did not allow fusion reactions to be obtained. Maintaining plasma at a high temperature allowed data to be obtained concerning the behaviour of a carbon wall and the capture of energy through this wall.

In this type of fusion generator , schematically, the quantity of energy produced increases with the volume of the machine, that is to say as the cube of the characteristic dimension. The losses are effected at the wall and therefore increase as the surface of the toroidal chamber, which increases as the square of the dimension of the machine.

In passing from the JET to the ITER machine, twice as large, we can hope to obtain at least a factor of two for the ratio Q=energy produced/energy injected, and obtain a ratio Q=1.4; superior to the unit.

This constitutes the main objective of the ITER experiment: show that a fusion reactor can produce *more energy than it consumes*. There is no reason why this objective cannot be attained. The project's designers hope to obtain a Q superior to 5.

The fact of using a superconducting magnet also allows the field of operation to be extended over several hundred seconds. It is perfectly possible that this second objective be attained also. The ITER calendar anticipates that the first trials with energy production should be (at least and if there are no problems) in 2030, *that is to say in 18 years.*

Does that mean that the two results will be sufficient to move on to the next step: the construction of DEMO, a complete machine, demonstrator of the viability of a generator using fusion energy?

Nothing is less certain.

This letter is not composed of a series of questions that I would like to ask the designers of ITER who, generally, formulate their replies through their "communication service".

ITER is not “a project”, to use the expression used in the Marseille article but

A 15 billion Euro experiment.

Which includes several problematic points open to criticism. We could begin by saying that this enterprise *has never been the object of a debate among the international scientific community.* The decisions were taken on a political level and many of these decision makers, in all the countries concerned, would have difficulty producing a discourse which goes beyond the intense propaganda put out for years by the promoters of ITER and anything more than a schematic description of the industry.

Today the ITER ORGANIZATION presents a dossier which formulates a request for an authorisation for the creation of “the basic nuclear installation ITER”.

It is astonishing that the large dossier submitted to the commission is so sparing in technical data concerning the installation itself, most of this thick volume concentrates on data relative to the site, the environment and security.

As some elected representatives have noted, it is a fact without known precedent that such an important enterprise be submitted during the summer period (5^{th} June – 5^{th} August 2011), as if it was just a question of the installation of a bridge, a roundabout or a municipal dump, by putting the dossier only in the town halls of the localities at a distance of less than 15 kilometres around the site (simple villages). For example, no dossier has been proposed for consultation in Aix-en-Provence. We will show that this “ITER experience” contains several doubtful points, several random aspects.

For each of these the invariable (unofficial) reply is:

Only experience will give the answer.

If just one of these answers is negative, the entire enterprise will be compromised and its chances of success seriously brought into question.

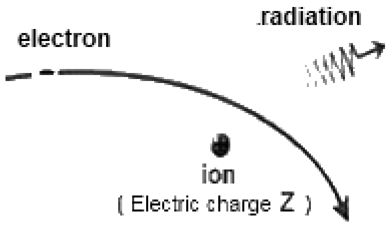
1) The problem of resistance of the material making up the primary wall

If the construction of ITER is undertaken it will be without having reliable data on the behaviour of the “primary wall”. This must be capable of resisting an eventual disruption of the plasma (instability) which could bring about very important thermal flux excursions. ITER will be twice as big as the British JET reactor. On every level all engineers and researchers confirm that, on this question, the change of scale could have unforeseen consequences, difficult to manage, in particular in the area of plasma instabilities, which provoke “disruptions” capable of seriously damaging the “primary wall” of the reactor.
If the neutrons produced by the fission reactions carry an energy of 2 MeV (two mega electron volts), the fusion neutrons have an energy seven times as great (14 MeV). The behaviour of the material, vis-à-vis an intense neutron flow possessing this energy, as the Japanese Nobel Prize winner Masatoshi Koshiba points out, *constitutes a <u>totally</u> unexplored area.*

Only experience will bring an answer to this question.

When Tore Supra was built it was believed that a covering of carbon tiles (of CFC, very similar to those used on the space shuttle) would be sufficient. Carbon sublimates at 2500°C and when atoms detached from the wall ionise, they carry six electric charges.

This fact is important, we will see why later. These “heavy ions” induce a radiative loss by “braking radiation” or “bremmstrahulung” which increases as the square of the electric charge.



Braking radiation

The modesty of the carbon charge (each carbon ion brings about a radiative loss equal to 36 times that due to the encounters between hydrogen electrons and ions) makes it a good candidate. Unfortunately this type of covering had to be abandoned for several reasons.

- The bombardment by hydrogen ions is accompanied by uncontrollable hydrocarbon creation (radioactive if formed from tritium).
- High temperature, this carbon behaves like a sponge, absorbing hydrogen, and so tritium, which renders the entire covering radioactive.
- Its ability to resist abrasion is insufficient and could lead to an explosion of the mass of radioactive waste linked to the machine’s operation, even before the machine produces energy.

There is also another problem. The reactor’s chamber cannot be closed. An orifice is required, running along a circular slit, to allow the absorption of the gas and the elimination of the fusion “ash”, that is to say, helium. The fresh, or purified mixture, is then injected through a second, circular orifice. Specialists consider that a proper operation requires the maintenance of a percentage of less than 10% helium ions. The trials using Tore Supra were based on a system of entry-exit affecting the shape of a “mat” called “limiter”.

The chamber of Tore Supra. At the bottom, its “limiter”.

- During the 25 years of trials, and despite the numerous and laborious modifications, it was seen that carbon could not resist the high temperatures occurring near the entry-exit system.

So the ITER project is not based on encouraging results, on which we can count, concerning this primary wall which, on this machine, covers one thousand square metres. The choice then turned to two other materials.

- Beryllium, the lightest metal, whose fusion temperature is 1280°C and which, when ionising, acquires 4 electric charges, meaning that the radiative losses by braking radiation are 16 times greater than those due to hydrogen electron-ion encounters. This would cover 700 square metres of the internal surface.

The problem of material behaviour in reactors using thermonuclear fusion has been the subject of an international research programme called IFMIF (International Fusion Material Irradiation Facility[1])

The IFMIF is a research project managed by Japan, the European Union, the United States of America and Russia under the control of the IEA (International Energy Agency). This programme, which only exists on paper, is based on the setting up of an intense source of neutrons, obtained from a particle accelerator, in sufficient quantity and for a sufficiently long period to be able to test the behaviour of materials liable to constitute the primary wall of a fusion reactor.

It would have been logical to wait before beginning the “ITER experiment” that this installation existed and gave reliable information concerning the material to use. Let us remember that a fusion reactor is not a machine destined for an impulsional operation but must ensure energy production *at a permanent regime.*

Despite the absence of this information of the greatest importance, the green light was nevertheless given. So, for the one thousand square metres of the ITER’s primary wall, 700 will be made of beryllium, the lightest metal, (highly toxic and carcinogen) whose fusion temperature is 1280°C.

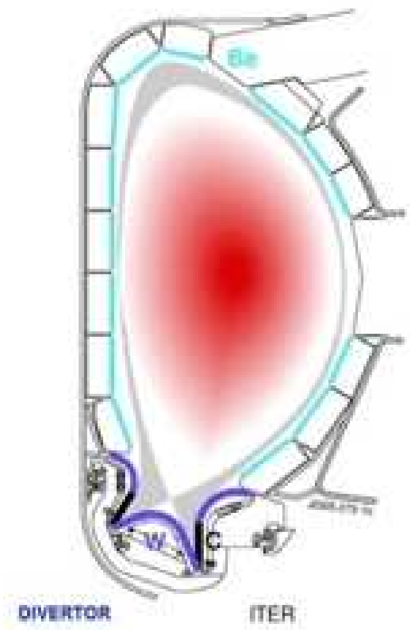
If we pose (unofficially) the question to specialists:

- **Can you assure us that this wall, with a fusion temperature of only 1280°C, will resist.**

They reply:

- **Only experience will bring the answer**

Tungsten, whose fusion temperature is 3000°C but which carries 74 electrons, covers the remaining 300 square metres, making up a new entry-exit system called *divertor.*



The ITER Divertor (at the bottom)

The specialists consider that the tungsten ions will carry 50 to 60 electric charges. That is to say that in relation to losses by braking radiation, each tungsten ion will have a radiative loss equivalent to 2500 to 3600 hydrogen ions.

To this braking radiation loss must be added the important loss through "free-linked" radiation, where electrons that have remained captive around the tungsten ions will be subject to transition, because of collisions with free electrons, followed by a radiative desexcitation.

A machine like DEMO will not be designed for a limited operation of a few hundred seconds but for *continual operation.* This will also include a divertor, an "entry-exit" system, whose role is not only to eliminate the helium produced and the re-injection of a fresh mix, but to continuously *depollute* the plasma of the heavy ions torn from the wall. If a sufficient rhythm for the extraction of these heavy ions cannot be ensured, then the radiative loss will be so great that it will hinder all long term operation of the generator and will bring about a lowering of the temperature and the disappearance of fusion reactions. The divertor question is currently being studied on the German ASDEX (Axially Symmetric Divertor Experiment) machine which has a tungsten covering[2]. But the discharge time of this machine is less than 10 seconds.

> *If the question of continuous depollution of a fusion generator is not treated, this will irremediably condemn the formula.*

If we pose (unofficially) the question to specialists:

- **Can you assure us that the depollution system, of heavy ion extraction, will show itself to be sufficiently efficient to allow the maintenance of a permanent regime in a fusion reactor.**

Again they reply:

- **Only experience will bring the answer.**

2) The superconductor magnet problem.

As mentioned above, we have available the experience obtained from the Tore-Supra machine installed at Cadarache, France, which was able to create a field of 4 teslas in a volume of 25 cubic metres for 6 minutes (against 840 cubic metres for ITER).

Let us quote the opinion expressed by the late French Nobel prize winner Pierre-Gilles Degennes:

- *As I understand fairly well superconducting metals, I know that they are extraordinarily fragile. So to think that the superconductor windings used to confine the plasma and subjected to the neutron flow comparable to an H bomb will be able to resist throughout the lifetime of such a reactor (ten to twenty years) seems completely mad to me*[3].

End quote.

To the question:

- **Do you think that the superconductor magnet will be able to resist this neutron bombardment?**

Again the reply is:

- **Only experience will bring the answer.**

Another Japanese Nobel prize winner, Professor Masatoshi Koshiba, has declared himself totally hostile to the ITER project and has said that materials have never been tested that are subjected to a neutron flow of 14 MeV, an energy level seven times higher than that of the neutrons produced by fusion, which we know degrades the walls and produces the activation of the walls by creating radioactive elements through transmutation.

For the time being, while waiting for the IFMIF installation, there are only two places where experiments can be carried out to test material subjected to a neutron flow of 14 MeV.

- In the JET machine
- In the fireball of a hydrogen bomb.

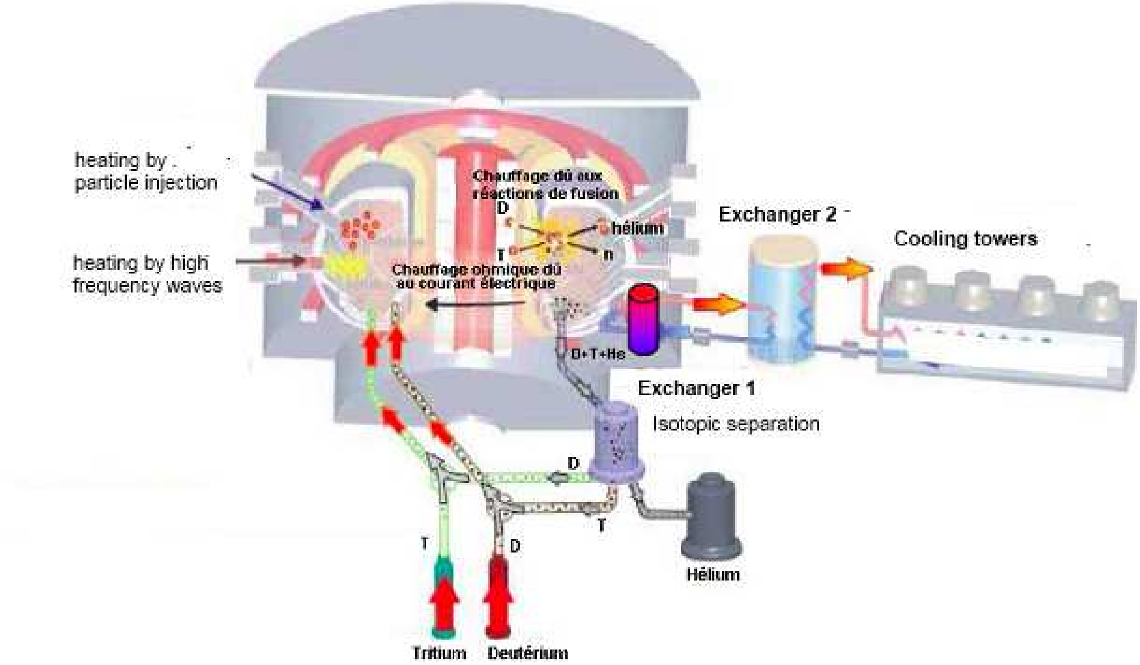
To the question:

- **Do you think that the walls of fusion generator structures, the end-result of the ITER-DEMO projects, inseparable, could properly resist a neutron fusion flow carrying 14 MeV?**

The unofficial reply is:

- **Only experience will bring the answer.**

When a visitor consults the several thousand page dossier made available in various town halls near the future ITER site as part of the public enquiry, opened on the 15th June 2011 and to be closed on the 5th August 2011, he will only find three pages on the technical description and whose content does not differ from the propaganda served up to a wider public for years now. That is also the case for the documents submitted for examination to the environmental authority for example – see its report of the 23rd March 2011- which includes the reproduction of the schematic description that was supplied to this authority.



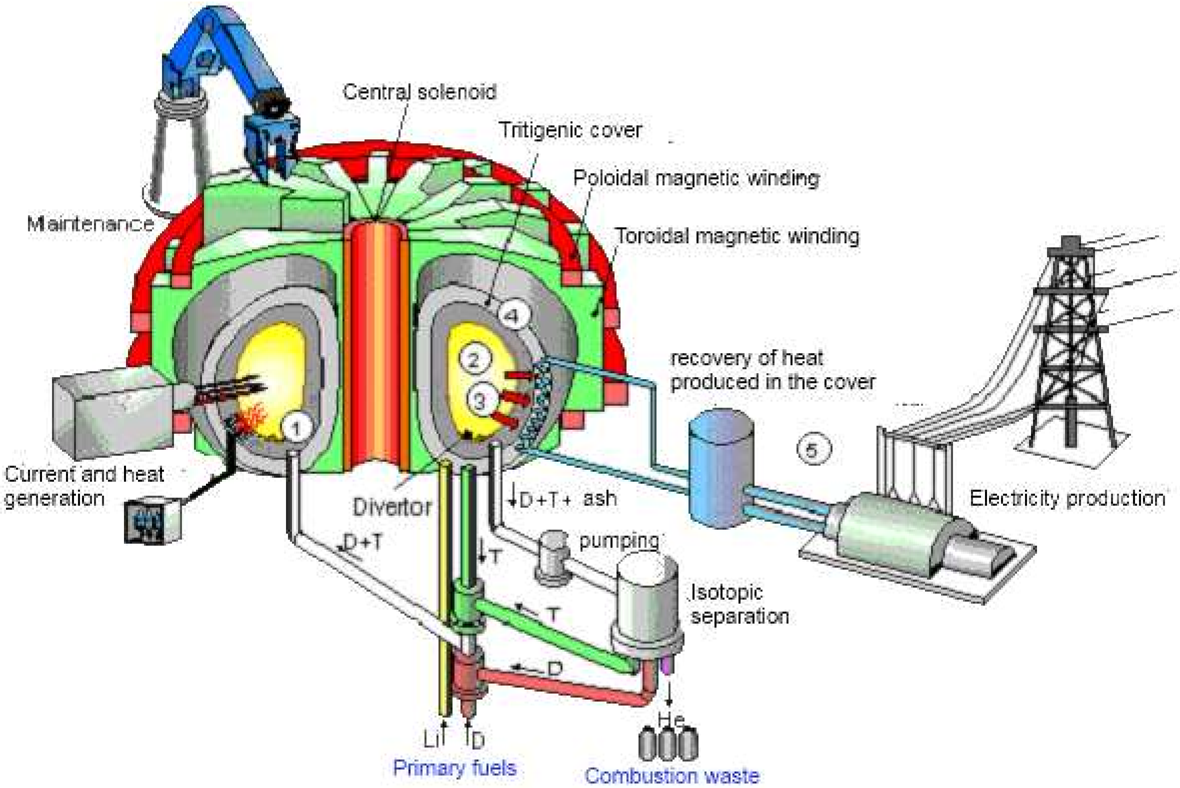
Official ITER schema (extract from the environmental dossier)[4]

3) Problems linked to the tritigenic blanket

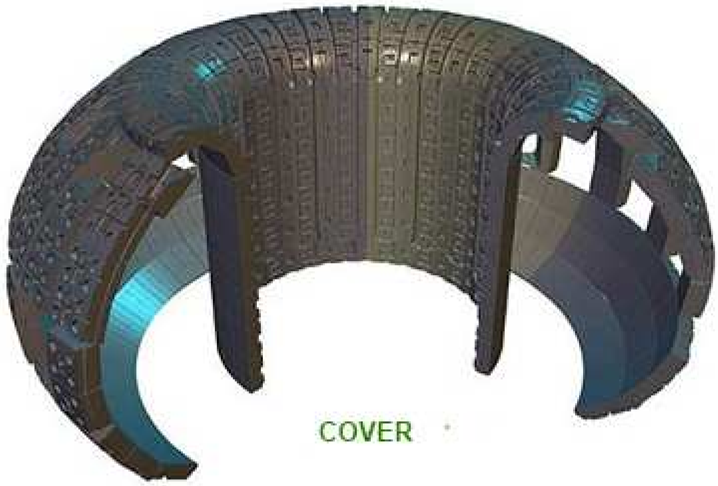
While there are many texts of this type covering the environmental aspects, including in the documents linked to the public enquiry, they remain opaque concerning essential elements such as the tritigenic blaket, without which a fusion reactor cannot function. What is it exactly?[5]

A fusion reactor is not based on one nuclear reaction but two, *absolutely inseparable,* as mentioned above.

While the experiments to be made with ITER will use Canadian tritium, that cannot be the case for its successor DEMO, which will have to be equipped with a complete tritigenic blanket. This will be placed between the primary wall, in beryllium, and the superconductor magnet. Below is the schema taken from the CEA web site.



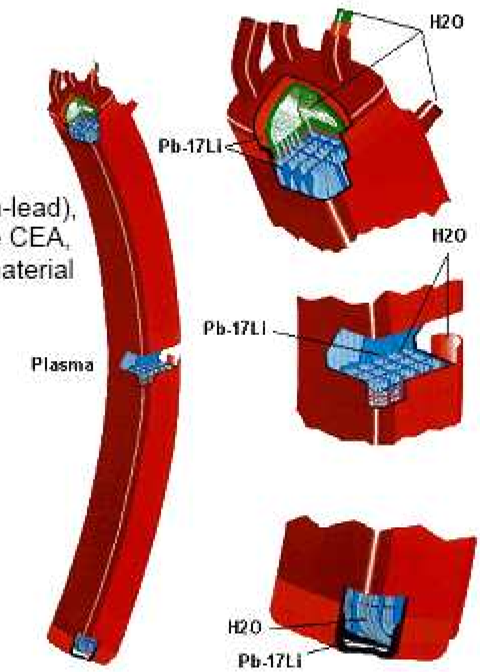
Schema ITER (source: CEA site)



Tritigenic blanket geometry (ITER website)

Tritium must be continually reconstituted in the reactor. However the deuterium-tritium fusion reaction only produces one neutron which, being unaffected by the magnetic field, is emitted in an isotropic manner. Not all the interior parts of the plasma chamber will be adjacent to the tritigenic blanket. On the ITER website at the address indicated in the note[6], a description can be found of the cover being submitted to both heat flow and neutron bombardment. If one uses as a base the tritigenic lithium plus neutron reaction, as this blanketdoes not extend over the entire chamber, regeneration is not then conceivable at 100%. Therefore a *neutron multiplier* is required. Lead could ensure this function. Descriptions of tritigenic modules, WCLL developed under the responsibility of the CEA, can be found on its site, where *pressurised water circulation* removes the calories given off in an eutetic mix lithium-lead in liquid state (17% lithium, 83% lead).

The WCLL concept (water cooled lithium-lead), developed under the responsibility of the CEA, uses a liquid metal, (LiPb) as tritigenic material and water as a refrigerant



A formula which, if the DEMO project managers choose it, will be *fundamentally dangerous*. Lithium, highly reactive, burns in air and explodes in contact with water.

Nearby there will be a chamber containing thermonuclear plasma, whose temperature will reach 100 million degrees, outside of this a magnet bathing in liquid helium at 3°K and between the two, tritigenic cells where a lithium-lead mix at 500°C will be threaded with tubes ensuring pressurised water circulation in order to evacuate calories.

The danger of a reactor thus equipped, carefully hidden from the public eye, becomes evident.

Lithium, a close relation of magnesium, combines with air, water and even nitrogen to give off nitrures. All these components are toxic. Lead causes saturnism. Tritium is radiotoxic. Beryllium causes an incurable illness, berylliosis, and is notoriously carcinogenic. At the least incident an uncontrollable fire could start which would immediately affect the helium bath cooling the superconductor magnet. A superconductor magnet developing 5 teslas and containing a phenomenal quantity of energy. In 2003 a local superconduction rupture at CERN moved a superconductor element of 4 tonnes over a distance of several metres. The setting off of what cold become an environmental catastrophe could begin with a failure of the magnet affected by the 14 MeV neutron flow.

A less dangerous solution exists, also mentioned in this “palette of possible formulae” where the lithium is present in a ceramic cooled by a helium flow. In such a case a neutron multiplying material must also be included, and it is precisely beryllium that would fulfil this function.

To the question

- **Do you think that the ensemble "primary wall of beryllium as a neutron multiplier plus tritigenic elements in the form of helium cooled ceramic" could ensure tritium regeneration ("tritigenic" function)?**

The reply is:

- **Only experience will bring the answer**

In the files made available to the public in the town hall of Saint Paul lez Durance, close to Cadarache, we find, in volume 2 ("Preliminary demonstration of safety") of the RPsR dossier, paragraph 68, the following passage:

The spectrum of dust present on table 2.3.19 of the annex was established from the activation of the tungsten (radiotoxicity superior by more than one order of magnitude in relation to that observed in the case of activation of the beryllium) and evaluating the contribution of each nucleid at dosage quantities or by inhalation/ingestion and in maintaining the values which contribute more than 0.1% over a duration varying from 0 to 6 months after the stopping of the tokomak. A different spectrum has been established for the characterisation of waste.
The spectrum of radionucleids in ***the cooling water,*** *presented in the table 2.3.20 of the annex, is based on the activation of corrosion of the loops of the primary wall from the PactITER code.*
The 6 modules of the Experimental Cover (TBM) can also generate certain nucleids by activation *of lead-lithium, lithium ceramic beds, beryllium beds,* **cooling water** *and other operational materials (electric insulators for example). The main nucleids produced in the TBM come from the reduced activation martensitic/ferric steel or RAFM (Reduced Activation Martensitic/Ferric such as Fe55, Mn54 or Cr51), from water (C14, N16), from a ceramic supergenerator and beryllium multiplier (tritium, Ar37, Fe55, Co60), from the lithium-lead (tritium, Pb203, Hg203, Ar37, Po210) and the electric insulators SiC/SiC (C14, A126). Because of the small masses of the activation products contained* ***in the TBM, the nucleid activation inventory*** *of these TBM is inferior by several orders of magnitude to the inventories contained in the covers, the cooling loops or the dust. Even if certain activities can bring about a dispersion of radioactive matter from the TBM (for example, the shaping of certain components in the TBM's Port Cells and in the Hot Cell Ensemble), the inventories would not be detectable at the chimney level because of the confinement systems used. For the* ***cooling water****, a rejection of this inventory could be envisaged but only in the form of liquid waste and not in gaseous form (see section 4.1.4.4).*

On reading these lines, *where mention is made of the activation of* ***the TBM's cooling water*** *(tritium regenerating modules)* it seems that this schema of tritigenic elements, with liquid lithium cooled by water, has not been ruled out and could be inscribed, *with the considerable risk linked to this formula*, in the future development plan of the thermonuclear fusion generator (DEMO). Does this mention, added to the fact that the schema still appears as the formula developed by the CEA on its site[7], correspond to an oversight?

The general impression of this "ITER experiment" is that its designers tell us:

- *Give us 15 billion Euros and free rein for a problematic and random project which, at best, might come to fruition at the end of the century, and let ITER ORGANIZATION* *manage the project on its own without allowing the international scientific community to look at it.*

To the question asked unofficially of the scientist involved in the project:

- **Do you think that this industry will allow the production of electricity to supply the needs of the planet?**

The reply is:

Yes, give or take a few decades and several billion Euros (or more).

The rapid neutron supergenerator Superphenix, at Creys-Malville in the Isère department, France, required the introduction into its reactor tank of 5000 tonnes of melted sodium to act as a primary calocarrying fluid, of weak moderating power. Thus rapid neutrons can continually transform uranium 238 into plutonium 239, a radiotoxic and carcinogenic body, highly dangerous because of its capacity to fix itself in the human body (50 years). Sodium bursts into flame spontaneously in air and explodes in contact with water (we do not know how to extinguish sodium fires of more than 500 kilos). *This fundamental dangerousness brought about the suspension of the operations of Superphenix, which we don't know decommission.* The same thing for its Japanese equivalent, installed at Monju, whose manipulation arm, situated in the reactor tank, detached itself recently, rendering any intervention impossible (…)

These projects have been developed *without the least consultation with the international scientific community (and even less normal citizens).* It is the same for MOX (Mixed Oxydes) fuel production, made up of 7% plutonium extracted from the refining of used fuels brought to the retreatment centre of La Hague. 29% of French reactors use it, as do the number 3 reactors of Fukushima.

This policy is a case of scientific and technical adventurism with no control from above.

The ITER enterprise is part of this same policy and should be the object of:

- **A moratorium**
- **An audit by the international scientific community before its launch**
- **Vital preliminary experiments in an IFMIF installation (which currently exists at the project stage) to test the capacity of resistance and the behaviour of the materials used in the walls, the structure and in elements of the superconductor magnet in relation to a neutron flow of 14 MeV.**

In this *formidably and incredibly complex* assembly that is ITER there is an impressive number of unknowns of all sorts. We believe that the experimental elements are largely insufficient for immediately engaging 15 billion Euros in a research project that might never succeed.

4) **“Nuclear or candlelight”: a lie.**

The production of energy by fusion, after brainwashing without precedent, is presented as the *only* chance for humanity to satisfy its needs in energy.

That is totally false. Other numerous and varied solutions exist on condition that certain countries abandon their obsession with energy autarchy. This policy should be managed *at an international level* and implies *Great Works,* generator of directly productive employment and able to attract massive capital investment.

Better management of the energy available could, of course, have a certain effect on the problem, including on local production levels. But the public, politicians and even scientists are ignorant the fact that *large scale solutions adapted to the needs of the planet* exist. It would be churlish of me to stigmatise this ignorance as before studying the question, I was unaware of them myself.

A first element concerns the possibility of transporting energy over distances of thousands of kilometres. This energy is produced classically in the form of alternating current using alternators. Then the current is raised to 400,000 volts (for the French standard) by transformers to be carried by high voltage lines over maximum distances of 200 kilometres.

Beyond 500-1000 kilometres the losses on line makes the process prohibitive.

Paradoxically, over distances above one thousand kilometres, direct high voltage current brings the solution.

Losses are then 3% per thousand kilometres!

It was the Canadians who developed this technique (know for many years) on a *large scale,* carrying the enormous electric power available, that they obtained from waterfalls of low height (10 metres) but with high flow rates, towards the centres of consumption situated at 1400 kilometres to the south, which required crossing the Saint Laurent river. The solution: produce high voltage alternating current then convert it into *high voltage direct current* of 450,000 volts using high power rectifiers. On arrival, the direct current is converted back to alternating current using powerful *inverters* then to low voltage alternating current by means of transformers. A system called HDVC (High Voltage Direct Current[8]).

This project is run by the Hydro Quebec company, a company founded in 1944 which, with its 60 hydroelectric power stations (against one nuclear power station), is the world’s biggest electricity producer (36,000 Megawatts, 4 million clients). 92% of Quebec’s electricity production is hydroelectric.

HT current rectifier installation at Hydro Quebec

This system is in no way unique, France uses it for instance to carry current from the Gravelines power station in the Pas de Calais across the Channel on a 73 kilometre line, of which 43 kilometres is below the sea. The 2000 megawatts of power carried under 275,000 volts direct current covers the consumption of 2 million British homes.

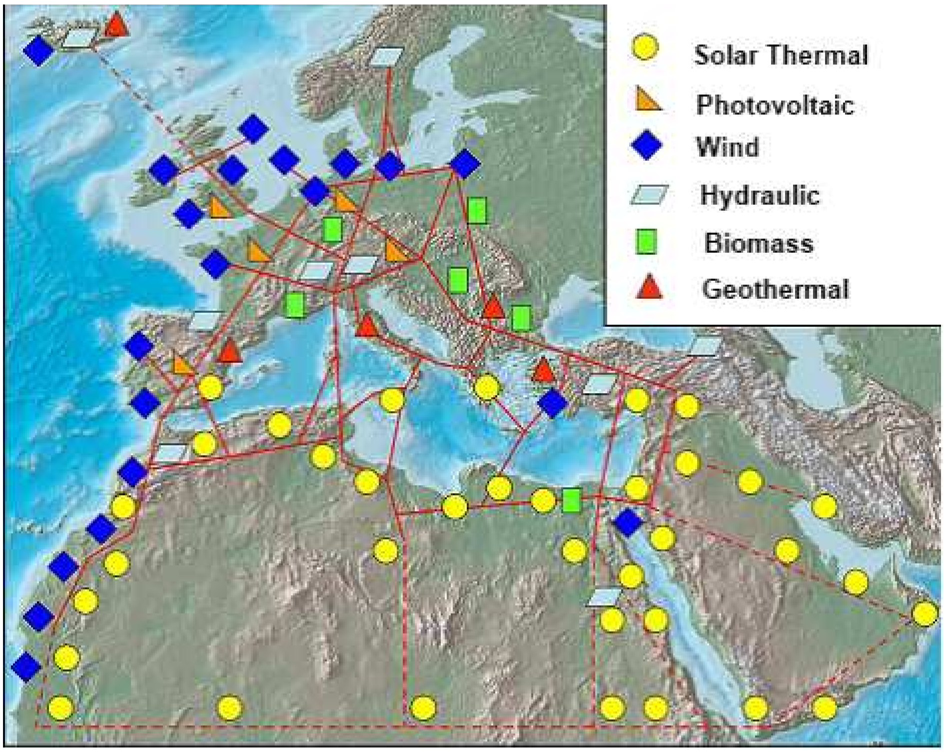
The actual record of distance on a submarine power line corresponds to the distance Denmark-Norway, 450 kilometres. Transmission over 3000 kilometres is perfectly possible.

Power currently carried as high voltage direct current, counting existing installations and those almost built, in all countries[9], is 105,000 megawatts, in 18 countries

The formula was born in 1885 with mercury vapour rectifiers. The first power transmission, several hundred megawatts, took place in 1965 using thyristor rectifiers. This development continues to accelerate simply because the distance between the centres of electricity production in many countries and the centres of consumption is more than 100 kilometres, which rules out transport by alternating current. The record for direct current transmission is held by the Xianjiaba-Shangai line in China: 6400 MW, opened in 2010. This technology is either unknown to electronuclear engineers or hidden by their lobby, given the negative implications for the "total nuclear" supporters.

For, effectively, this technique allows a complete decentralisation of production centres. The map below, on a European scale, is striking in this respect. Countries such as the United States have no need to import their electricity as they have an immense potential in their desert regions.

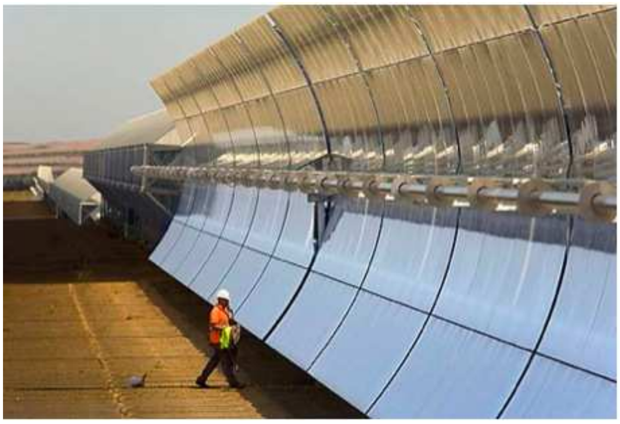
The exhaustion of energy resources is therefore a carefully sustained myth. On its own a sub-marine link Iceland-Europe (distance Iceland-United Kingdom: 1200 km) would allow a real manna of wind, hydraulic and, especially, geothermic energy to be poured into Europe. A fact which seems (or pretends to seem) unknown to British parliamentarians who chose recently to ignore the lessons of Fukushima by reconducting their electronuclear development programme.



A simple glance at the west coast of Africa shows that there are thousands of kilometres of quasi-desert, apt for the installation of thermal solar or wind turbine equipment (the alizée winds in this region blow for 4500 hours per year, an average of 12 hours a day).
The above map shows, with the required investment, a complete geopolitical upheaval, poor countries would become rich countries. For effectively, part of their production could contribute to their own development, something probably not desired by the "nucleocrats" and "petrocrats".

90% of the world's countries are within 3000 kilometres of a desert, the loss on-line over such a distance is 15%.

On the question of solar energy, the discourse of politicians and so-called directors and specialists shows that as photovoltaic solar energy production is diminishing they do not see (or do not want to) "thermal solar energy" where the energy is captured using parabolic mirrors of simple sheet metal, focussed on tubes placed at the point of focus and containing a calocarrying fluid at 500°C.



One of the solar mirrors of the Spanish Andasol installation.

Another formula, actively developed in the USA, is based on Fresnel mirrors laid on the ground, and also adjustable. Here is a pilot installation of the Areva company

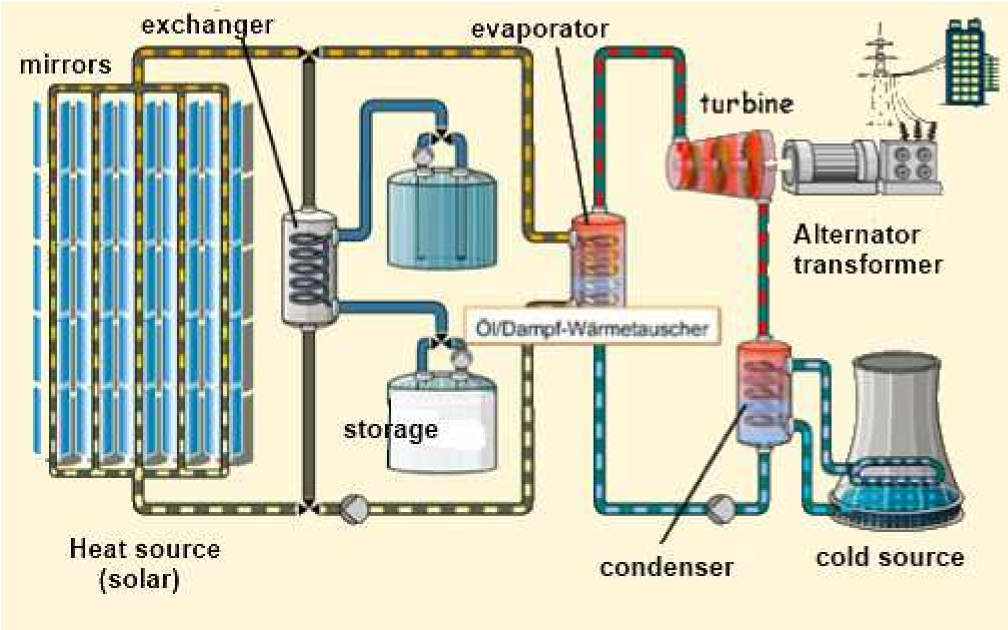
Linear Fresnel mirrors direct the rays towards the focal point, top right.

Using flat mirrors, this solar energy can also be sent towards a “solar tower”, this time the temperature at the focal point reaches 1000°C (a simple detail: the higher the temperature of the “heat source”, the better the Carnot yield).

Gemasolar solar tower near Sevilla, Spain. 20 MW plant

High power solar thermal installations have already been built in Spain (Andasol), the United States and the United Arab Emirates with power levels of between 100 and 1000 MW. The Total and Areva companies, careful to avoid putting all their eggs in one basket, run the projects in the United Arab Emirates and Australia.

The storage of energy in thermal form is not problematic (in the Andasol installation in Spain this is stored in tubs containing potassium and sodium nitrates at 500°C). These molten salts, not dangerous, bring together a high calorific capacity and good thermal conduction. The substances allowing such storage are numerous and it has been shown recently that even asbestos removed from industrial installations could be used for this purpose.



Schema of a thermal installation

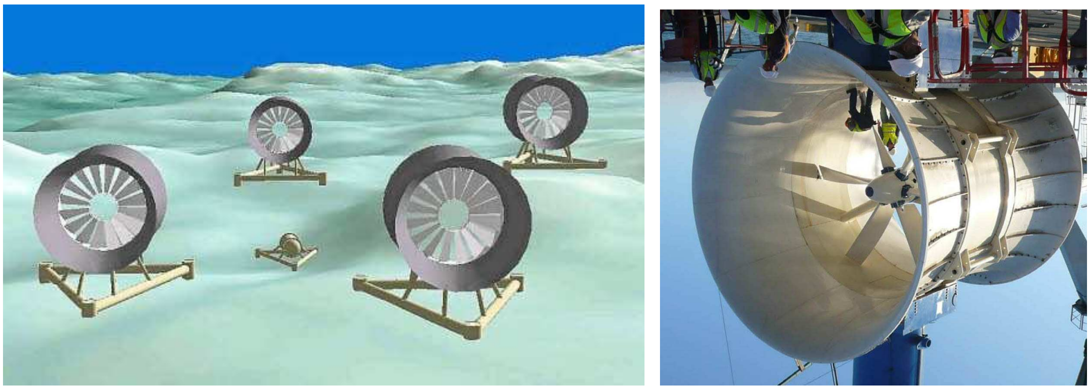
It should be noted in passing that everything found downstream from the heat source is no different from that that is found in a nuclear power station. Only the energy source changes, free of the flaws inherent in nuclear energy (dangerousness and unmanageable accumulation of waste).

Energy storage can be effected in many ways, at the production site or at a great distance, in a gravitational way if there are hills and mountains (70% of Japan is mountainous), by producing hydrogen via electrolysis of water, or in the form of compressed in deep water in offshore installations.
Elsewhere, such as in the United States, solar energy is concentrated by parabolic mirrors on a solar panel which activates a Stirling motor and an alternator.

Range of Stirling solar generators.

We can add to the table above the exploitation of temperature differences between surface and deep water in lakes or near coasts, power being supplied by Stirling motors.

We can also include hydrolians, for instance the exploitation of currents in offshore trials in the USA using hydrolians immersed in the Gulf Stream. This type of energy production cannot be under stressed, with a fluid circulating at a moderate speed, compared to aeolians, remembering that *water is 800 times more dense than air*. Nor are hydrolians subject to important seasonal or daily variations.



Venturi Hydrolian

The phrase “nuclear or candlelight” is a total lie therefore.

Even on French territory possibilities exist to equip vast surfaces for exploiting solar energy, and not only in semi-desert, abandoned or mountainous regions without any tourism interest. Let us add a respectable number of square metres that no one has thought of such as the (total) surfaces occupied by railways and motorways.

When we think of machines that move by electricity, such as the TGV, we are tempted to say that such engines could never move using solar cells on their roofs. However, recently, the Belgians equipped a forty kilometre long experimental section of railway line between Antwerp and the Netherlands. There an electric train is fed by 16,000 solar panels placed on a roof above the track. These are photovoltaic, which causes certain problems because of the cost of raw materials. This installation could easily use thermal solar energy, with relay installations, so not only ensure the movement of high tonnage trains but also feed the neighbourhoods around through energy stored in molten salts thus ensuring a general regulation of the network.

Ministers and pro-nuclear personalities invoke the aesthetic nuisance of the installation of numerous solar panels. But who would protest if the catenaries that populate an entirely electric network were replaced with inclined roofs similar to those on factories?

The same goes for motorways. We see engineers doing all they can to design electric or hybrid motors. There again we can imagine a cover generalised over the entire motorway network with toll booths in consequence. Motorists would then have two choices. Either they do no have vehicles equipped for electricity and could continue to use the network by burning hydrocarbons. A detail in passing: driving below covers which evoke the “saw tooth” roofs of factories and shaded from the sun, they would not have to use their on-board air-conditioning.

Or their vehicle would have electric motors, set in the wheels (in this way it would be simple to modify existing vehicles). After entering the motorway, either using conventional motors or using a reserve from an on-board battery, they could deploy a telescopic perch similar to those found on fairground bumper cars to take energy by connecting to a grating above and an earth running along the road (following the “road markings”). The driver could then “drive electric” even leaving the system to control the driving where the vehicle would move at a constant speed and follow the “earths” on the ground, thus making road accidents disappear.

On arrival at their destination, leaving the equipped roads, the perch would be retracted, the combustion motor restarted and the driver retaking control. Unless they decide to use the energy stored in an on-board battery, charged from a solar source.

These ideas might seem futurist, unrealistic, but no more than those of the 19th century to cover earth roads with tarmac or build “iron roads” to replace stagecoaches with locomotives which caused the rapid disappearance of animal traction. Concerning the covering of motorways and, eventually, all roads, this development could take place *progressively*, the new network allowing all vehicles to circulate whether they are adapted or not. In the end the automobile industry should turn towards vehicles with a low aerodynamic resistance, of limited power and capable of “all electric” operation on the network. While waiting for this vehicle conversion, the adapting of existing vehicles could combine electric propulsion using motors set in the wheels with the assistance of their combustion engines if necessary. The flexibility of the formula would ensure that the network was not closed to non-equipped foreign vehicles.

Concerning energy and transport, by trying to avoid including the energy reserve in the vehicle itself, designers are showing a lack of imagination.

It would require a whole book to list all the possibilities adapted to the geography and climate of each region.

The opposition to the wide scale development of renewable energy *is exclusively of a political nature and not technico-scientific*. Paradoxically, the majority of technologies required date from the 19th century (the gas turbine, the alternator, the rectifier, the inverter).

So technologies dating from a century ago, that need no sophisticated research but just political will and sufficient investment, are available to resolve the problems of humanity’s energy needs, energy sources being both enormous and unlimited. As an example, solar equipment on a 300 by 300 km square in the Sahara would suffice to cover the energy needs of the entire planet.

Projects such as ITER represent a relentlessness to hang on to primitive nuclear technologies; waste creators which damage the environment and people’s health. If we wish to make a comparison let us refer to the first experiments with heavier than air machines using a propulsion system. The first image that comes to mind is that of Clement Ader who, at the end of the 19th century, was supposed to have achieved the flight of a human being using a simple steam motor.

On this basis, let us imagine that at the time, after having seen the Ader plane rise a few metres above the ground, seven European countries decided to undertake an enormous project whose result would be an apparatus using steam engines capable of carrying passengers across oceans.

It is an image that makes us smile. Aviation didn't start to develop seriously until the first internal combustion engines appeared wherin fluids that move the pistons and those used for combustion are the same. In a steam engine the energy supplied by wood, coal or hydrocarbon combustion, the motive action was ensured by steam, which implied an energy transport through an exchanger (which represented the greater part of the locomotive's volume).

To turn to 19th century techniques to resolve *urgent* problem of humanity's energy needs does not mean that we should automatically turn our backs on important scientific breakthroughs. But fission and deuterium-hydrogen fusion, with their enormous trail of radioactive waste and their dangerousness, do not constitute a major advance in the matter of electric energy production. They are nothing other than 2nd and 3rd millennium steam engines. These two industries are neutronigenic. Their reactions emit neutrons which, by transmutation, render the entire environment radioactive. As for fission, it generates long life (100,000 years), unmanageable radiotoxic waste.

The Earth's crust is constantly agitated by terrestrial tides linked to the passage of the Moon[10]. At the equator the amplitude of this vertical movement reaches 1.5 metres. This terrestrial tide effect is far from being insignificant at higher latitudes. Thus the idea that a rock substrate can be inert over long periods of time and allow a subterranean storage is illusory. The Germans have had the cruel experience with the 30,000 drums stored in the Asse salt mine and the Americans are beginning to have the same problems.

That which we call "nuclear physics" was born in the hands of chemists and it would be more precise to speak of "nuclear chemistry". Fission is an autocatalysed spontaneous dissociation mechanism that we also find in mineral chemistry. Fusion is just a reaction linking two exo-energetic components.

We could reasonably expect that this nuclear chemistry conceals the same phenomena as those that so puzzled chemists in the past. Let us take as an example catalytic combustion of a hydrocarbon in a catalytic stove. When combustion is complete, the heating system emits only CO2 and water vapour, non-toxic and breathable, and does not require an evacuation system for the combustion products via a chimney. Who could have imagined that until the 19th century it would one day be possible to have a fire in a closed room without a chimney and without immediately suffocating?

Some chemical reactions produce electricity directly with only a tiny emission of heat.

These are the batteries invented by the Italian Volta.

Atomic physicists are already aware of "catalysed fusion by muons" (sorts of super-heavy electrons made at great cost by a particle accelerator). Unfortunately a process that is not cost effective but completely different to the D-T fusion envisaged.

No one can say that someone will not one day find a catalytic mechanism, cold, exoenergetic and non neutrogenic. Nor can anyone can say that there will not appear a system wherein this type of reaction will produce electricity without giving off heat. When? In a year's time, ten years, a century. No-one can say.

5) The new universe of hyper-dense and hyper-hot plasmas.

In 2004, unforeseen, an MHD compressor, the Z-Machine, allowed the creation of a temperature of more than two billion degrees for a brief instant by compressing an assembly made of 240 thin iron wires. See the article published in the prestigious review Physical review letters, signed by the English plasma physicist Malcolm Haines, who is a reference on the question. The title and references of the article are:

Ion Viscous Heating in a Magnetohydrodynamically Unstable Ion Pinch Over 2 x 10^9 Kelvin

M.G.Haines, P.D.LePell, S.A.Coverdale, B.Jones, C. Deeney, J.P.Apruzese

Physical Review Letters 96, 24 February 2006

It can be downloaded at:

http://www.jp-petit.org/science/Z-machine/article_Haines.pdf

This confirms his analysis of the data given at an international conference consecrated to Z-machines held in Biarritz from the 6th to the 9th June 2011, which brought together the most eminent specialists on the question. Haines completed this communication in a 168 page article published a few days earlier in a high quality review on plasma physics (Plasma Phys. Control. Fusion 53 093001, 2011), which is a reference on the question:

A review of the dense *Z*-pinch

M G Haines

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Plasma Phys. Control. Fusion **53** (2011) 093001 (168pp)

It can be downloaded at:

http://www.jp-petit.org/science/Z-machine/HAINES_juin_2011.pdf

We are no longer in the realm of speculation. Such temperatures require the use of very high currents (18 million amperes in the United States in 2004, 26 million in 2007, 50 million in a machine currently being built in Russia under the direction of Valentin Smirnov, director of the fusion department at the Kurtchatov High Temperature Institute in Moscow).

Such a growth of electric intensity, associated with an imperatively short discharge time (75 to 150 nanoseconds) allows, in theory, 7 to 20 billion degrees to be reached. An essential qualitative jump was thus made in the direction of *impulsional fusion*, which is already a reality (obtention of neutrons of 14 MeV with targets containing a mix of hydrogen isotopes according to several papers presented at the Biarritz conference).

At the centre of the sun: 20 million degrees. In a tokomak: 100 to 150 million degrees. In the fireball of a hydrogen bomb: 500 million degrees. Seven times greater than the American experiments. How many currently? No-one can say, the cloak of defence secrecy, as well as very active disinformation, has fallen on all this research both in the west and east.

Why is it so important to have obtained such a rise in temperature?

Nuclear fusion reactions only start from a temperature of 100 million degrees onwards for the lowest value, which corresponds to the deuterium-hydrogen mix. 150 million degrees for deuterium-deuterium fusion (start of fusion reactions on the British JET at the beginning of the 90s).

From a billion degrees upwards (largely surpassed by the United States in 2004) exo-energetic and non neutrogenic (or very weakly neutrogenic because of secondary reactions) become possible as in the reaction:

^{11}Boron + ^{1}Hydrogen giving four ^{4}Helium and no neutrons.

Then energy appears in the form of a small plasma mass made up of helium nuclei brought to a very high temperature and carrying two electric charges. By allowing this plasma to extend in a magnetic field, an induction current is created and a direct conversion of heat energy into electricity is obtained, with a yield of 70%. This method is known and successful experiments were carried out from the end of the 50s onwards using conventional explosives doped with caesium (the most easily ionisable substance in the Mendeleiev table). Here we see appear the concept of a “fusion two-stroke” to which an “inertia flywheel” must be added, that is to say a partial electric energy storage system allowing the following compression, a device that has nothing to do with science fiction. All that at an eventual rhythm of 50 times a second so that the new style generator produces 50 cycles.

This fusion two-stroke bothers the nucleocrats who deny all possibility of seeing this formula emerge and, since 2006, have actively impeded all efforts to develop such research in France. This is similar to the supporters of the steam engine who considered the idea of an internal combustion engine to be unrealistic and dangerous. Most of the time such people are not even aware of this outsider approach, founded on *impulsional fusion.*

Nuclear physics, this nuclear chemistry, is only at its beginnings therefore. Should we then hope for aneutronic fusion to appear, sending to the rubbish heap fission or D-T fusion power stations? Alas reality is not as rosy. In the fields of fission and fusion, humans began by creating bombs in both cases. There we have been confronted with the emergence, ineluctable and rapid (less than ten years), of “pure fusion bombs”, thermonuclear objects requiring no fission detonator as is currently the case, this imperative blocking the “critical mass” of the power of bombs from dropping below the equivalent of 300 tonnes of TNT.

In these pure fusion bombs, the very powerful electric discharge, feeding an MHD mini-compressor, will be delivered by an explosive (already in 1954 this technique, developed by Andrei Sakharov, allowed him to produce 100 million amperes). These bombs will be miniaturisables and, if they operate on the basis of a non-neutrogenic reaction, will also be “green bombs” which don’t damage to the environment. As this technology does not require the detention of fissile matter, such as uranium 235, extracted laboriously from the natural mineral (which contains only 0.7% of 235) by centrifugal processing, it will cause *proliferation*.

If we survive this new “progress” then maybe we will turn to civil applications, as was the case for fission and, today, fusion.

We have finished this article with a brief evocation, hardly encouraging, of a “progress” in gestation which is just the reflection of the stupidity of human beings and let us say that taking everything into account, it would be wiser to invest in solar, wind, hydrolian and geothermal energies that do not have immediate warlike uses other than being able to burn at distance, as Archimedes did at the siege of Syracusa according to the legend, burning sails by concentrating the rays of them sun on them with the aid of mirrors.

We desire, in the framework of the Public Enquiry and in presence of its members, to be able to present these arguments to the *scientific* directors of the ITER ORGANIZATION (and not in front of seconds-in-command responsible for “communication”), in particular, asking the questions evoked in this document and filming on video the questions and replies, the videos being made available on the net in the framework of this *public enquiry*, the only way of avoiding the classic “obfuscating” replies.

The use of an “independent expert” likely to give support to the enquiry commission’s conclusions in the time allowed is not a serious solution as a conclusion to this enquiry because such an expert simply does not exist given the extent of the problems linked to research, whose aim in essence is not to “show the feasibility of the extraction of power emitted by fusion avec Q>I and over a period counted in seconds”, but engaging France on a route leading to the conception of a machine giving a massive production of electricity to satisfy the needs of humanity.

Unless, that is, the commission considers the three pages inserted into the voluminous dossier that has been submitted to it to be sufficient, pages which present in a caricatural way the technical and scientific aspects of this pharaonic project.

Unless the commission, or an expert enrolled for the circumstances, considers that this aspect has already been the subject of a debate on a scientific level and that this aspect of the problem can be considered as covered, which is not the case.

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