What kind of energy do we want for the future?

Bernard Laplonche

NUCLEAR PHYSICIST, a graduate of *École Polytechnique*, Bernard Laplonche is adamant: France is wrong. With the nuclear option, it persists in favoring a type of energy that is not only dangerous but also obsolete. Although there are other solutions, thanks to which the Germans have already started their energy transition.

He is one of them. Anyway, he was one of them. A graduate of *École Polytechnique,* a nuclear physicist, in the 1960s Bernard Laplonche participated, within the Atomic Energy Commission (AEC), in the gestation of the first French nuclear power plants. The discovery of the working conditions in la Hague[1] came as a shock to him: it made him aware of the danger of the atom, which he considers morally unacceptable. In the 1980s Bernard Laplonche, thereafter a militant within the French Democratic Labor Confederation (CFDT), began to advocate the control of energy consumption and the development of renewable energy. The following decades proved him right. But France, the only country in the world that has chosen to be fully nuclear, persists in error, regrets, and shut its eyes to reality: energy of the past, with no possibility of innovation, nuclear energy is more than just a terrifying threat to us as well as to future generations; it condemns our country to miss the opportunity of the indispensable energy revolution.

Vincent Remy – *Nuclear energy is always presented as a very sophisticated technology. You say that it is just the "most dangerous way to get hot water to boil".*[2] *It sounds provocative, no?*

Bernard Laplonche – Not exactly ... A nuclear reactor is only a boiler: it produces heat. But instead of the heat being generated from the combustion of coal or gas, like in thermal power plants, it results from the fission of uranium. This heat, in the form of water vapor, powers a turbine that produces electricity. Nuclear power, therefore, is not this miraculous thing that would make electricity "come out" of the reactor as if there was an almost spontaneous production.

VR – *Why has this idea settled in?*

BL – Advocates of nuclear energy are not keen to highlight the raw material, i.e., uranium. This is due to the fact that at the origin nuclear energy was developed in the military context, and therefore is strategic in nature. Further-

more, by suggesting that electricity is produced directly, they give it a magical aura and make it three times more powerful, as it is the heat produced that is assessed, not electricity. Well, two-thirds of the heat is lost in the process and heat the river or sea water used to cool the reactors.

VR – *Let us then talk about fuel...*

BL – They are uranium rods, in this case uranium slightly enriched in 235U, for French reactors. Fission is a recent discovery (1938): a neutron strikes a uranium nucleus that explodes producing fragments, therefore energy, and neutrons, which will strike other nuclei – it is the chain reaction. The multiplication of fission produces heat. Well, fission fragments are new radioactive products that emit Alpha, Beta, Gamma, etc. rays. Therefore, heat is produced inside the reactor - it is the positive side - but there are also radioactive products, especially plutonium, the most dangerous element one can imagine, which exists only in minute quantity in nature. We should have asked ourselves from the beginning: Is this means of producing hot water acceptable?

VR – *This chain reaction, after all, can be interrupted at any moment, right?*

BL – Under normal operating conditions, the control rods are lowered into the heart of the reactor: they are made of materials that absorb neutrons, and this interrupts the chain reaction. But you have to continue to cool the interrupted reactors because the radioactive products continue to produce heat. The very nature of the technique, therefore, is a source of multiple risks: if there is a malfunction in the control rods, there will be a progression of the chain reaction, which can cause a nuclear explosion; if there is a crack in the water circuit, cooling will be compromised, extreme heat will destroy the fuel cladding, some radioactive products will leak, hydrogen will be produced - this hydrogen carries radioactive materials and can explode.

VR – *But protection systems have been multiplied…*

BL – Even with this multiplication, there are always situations in which these protections do not hold. In Chernobyl the blame was laid on reactor malfunction and an error in experimentation; in Fukushima it was the flooding caused by the tsunami. In Blayais, in Gironde, where the plant was flooded and we came very close to a serious accident, the 1999 storm had not been foreseen. But we see accidents without tsunami or flooding, as in Three Mille Island in the United States in 1979. In many countries it could be an armed conflict, sabotage ... As the starting point is the creation of radioactive products in large quantities, the catastrophe is intrinsic to the technique. The reactor produces the means of its own destruction.

VR – *Have there been innovations in the nuclear field?*

BL – No great technological progress in nuclear energy has occurred since its emergence in the 1940s and 1950s. The current reactors in France are the engines of American nuclear submarines of the 1950s. Most of them are technologies inherited from the Second World War. All that's happened is an

increase in power and additional protections. But as the system is increasingly more complicated, we realize that these protections not always improve security.

VR – *It's hard to believe that there has been no major innovation ...*

BL – Of course there has been innovation - the fast reactor![3] With the Super-phoenix, the reactor model was changed. Fortunately, we were able to stop it in 1998, because it was based on the use of plutonium. Plutonium is a million times more radioactive than uranium. How could we think of turning such a hazardous material into fuel for a class of reactors exportable to the world?

VR – *Nicolas Sarkozy says that if we reject nuclear energy we should accept candle light. What do you think?*

BL – It is tiresome to hear leaders who understand nothing about the subject say just about anything. Nicolas Sarkozy has no idea how right he may be: one day, perhaps starting this summer, the French will need candles for lighting: as we are the only country in the world that has chosen to produce 80 percent of its electricity from a single source, i.e., nuclear, and a single technique, i.e., the pressurized water reactor, if we are forced to stop our reactors, then it is back to candles! No need for a disaster, just a big generic glitch or an exceptional drought and heat wave, for we cannot boil river water. Conversely, if we decide to phase out nuclear power in twenty years, we could leverage our energy inventiveness to avoid precisely the candle.

VR – *Advocates of nuclear energy say that in France, with this new reactor being built in Flamanville - the European Pressurized Water Reactor (EPR) - the risk is almost nil ...*

BL – Each country makes sure that its reactors are better than the others'. Before Fukushima, the Japanese discourse was the same as that of the French. Five reactors have already been destroyed (Three Mille Island, Chernobyl and three reactors in Fukushima), totaling 450 in the world, hundreds of square kilometers of uninhabitable land. The theoretical probability, according to experts in nuclear safety, should be one in a hundred thousand "reactor years" [one reactor-year means a reactor operating for one year], perhaps one million reactor-years for a more serious accident like Chernobyl! The reality of what has been found is three hundred times greater than these known calculations. There is therefore a high probability of a major nuclear accident in Europe.

VR – *An important innovation in this field could lead you to rethink your assessment?*

BL – I see no solution in the current state, not of engineering, but of scientific knowledge. I'm not saying that some day a scientist will not find a way to use the binding energy of the nuclei in a smart way, without creating these mountains of radioactive products. But for now, there is none!

VR – *Why are you against the International Thermonuclear Experimental Reactor (ITER), a fusion experiment conducted in Cadarache under the aegis of the International Atomic Energy Agency (IAEA)?*

BL – Fusion is the opposite of fission. Two small rings, two isotopes of hydrogen, deuterium (one proton and one neutron) and tritium (one proton and two neutrons) are welded together, and this weld releases energy. But you have to be able to weld them, these nuclei! In the Sun, they coalesce due to gravity. On Earth we can use an atomic bomb, it works very well. The explosion causes the fusion of the two nuclei, which in turn causes a much stronger second explosion: the hydrogen bomb, the H bomb. Fusion without bomb requires creating colossal magnetic fields in order to reach temperatures of one hundred million degrees. ITER, originally a Soviet project, is a laboratory experience at a colossal scale in which extremely powerful neutrons bomb the steel walls of the reactor, these materials become radioactive and must, by the way, be frequently replaced. I'm not an expert in fusion, but I remember our last two French Nobel Prizes in Physics Pierre-Gilles de Gennes and Georges Charpak, saying that ITER was not a good idea. They advocated basic research before building this huge mess. Nobody listened to them and our politicians rushed, based on arguments of pure communication - we recreate the energy of the sun - for ITER to have a chance in France.

VR – *Why?*

BL – Because the French want to be the world champions in nuclear power. The Japanese wanted ITER, but their Nobel Prize in Physics, Masatoshi Koshiba, said "no way" because of the seismic risk. I think that this project will be stopped because its price increases exponentially. And no one has asked the question: "What if this never worked? What would a fusion reactor be like?" As people in the Negawatt Association[4] say, "Why would anyone want to recreate the energy of the sun on the Earth if it comes to us in large quantities?"

VR – What do you say to those who think that the imperative of global warming, therefore the necessary reduction in Co_2 emissions, compels us to accept nuclear energy?

BL – First, we cannot allow CO_2 emissions to be the only criterion for choosing between electricity producing techniques. Should we have to accept, in the name of climate, an accident like Fukushima happening somewhere in the world every five or ten years? Besides, the International Energy Agency (IEA) has shown that if we want to meet our targets of reducing CO_2 emissions, half the effort should focus on energy savings. As for the other half, the use of renewable energy is essential as its nuclear share represents a mere 6 percent. It is therefore necessary to put the advantage of nuclear energy into perspective.

VR – *You began your career in the Atomic Energy Commission (AEC) and you were one of the craftsmen of that energy. What happened?*

BL – I even wrote a thesis on plutonium, and did not question myself. Everything is very compartmentalized at the AEC, I did my calculations on the EDF 3 plant of Chinon and had no idea of the risks of an accident, or of the waste problem. Then I became an activist at the French Democratic Labor

Confederation (CFDT), after 1968, and we developed an interest for the working conditions at la Hague. I realized that, as an engineer at my office, I knew nothing about their working conditions, and that people at la Hague did not know what a nuclear reactor was. As a result, in 1975 we wrote a collective book that became a best-seller - *Electronuclear Energy in France*. The director of AEC at the time recognized the quality of the book. To get to that, I worked for six months on American documents, because in France there was nothing on the subject. The CFDT then took a stand against the nuclear program. I started working on alternatives to nuclear energy, and in 1982 I joined the French Agency for Energy Management.

VR – *That was thirty years ago ... What did you advocate back then?*

BL – The same thing as today: energy savings and renewable energy! The principles of solar energy; solar panels, therefore, were already known. Today all people talk about is electricity, but what should be first installed everywhere, is the solar water heater! Nothing could be simpler: a heat transfer fluid flows through a tube in a glass panel, and provides water to 60 degrees. Germany, a country with less sunshine than France, has ten times more solar water heaters. In the south there is none... or very few.

VR – This does not require a lot of innovation ...

BL – Innovation, first of all, enables reducing costs. The competitiveness of wind power over nuclear energy has been achieved. As for photovoltaics, the Germans anticipate a 5 percent cost reduction each year. There is much research to be done on marine energies, currents, wave energy, the heat of the earth with geothermal energy. Renewable energies, under a collective name, are very different and can meet nearly all energy needs. The Germans estimate that they will meet 80 percent of their needs between now and 2050. This is more than credible, provided that we always seek energy savings.

VR – Has the fact that electricity has been produced from nuclear energy at a moderate cost, not taking into account the costs of decommissioning and long-term management of radioactive wastes, penalized renewable energies?

BL – Yes, and as we've built many nuclear plants, there has always been pressure for the consumption of electricity, especially for its most idiotic use, electric heating, for which France is a champion in Europe. We've built substandard housing, installing coils that cost nothing, and this creates a global electric power problem: in Europe, the difference between average consumption and the winter peak is owed 50 percent to France! As a result, in the winter we need to buy electricity from Germany, which produces this electricity from coal ... Besides heating, the French consume 25 percent more electricity per capita than Germans, who not only have better insulated homes but also more efficient home appliances and pay more attention to consumption, since electricity is a bit more expensive to them.

VR – *What will be the major future innovations in energy?*

BL – The "smart grids"! Thanks to computer technology we can optimize the production and distribution of electricity. The scale of a town, a city or a state, you manage consumption, you can ensure for example that all refrigerators do not start at the same time. Advocates nuclear energy always highlight the fact that renewable energies are fluctuating - the wind does not blow all the time, the sun doesn't always shine - to say that, if we eliminate nuclear energy we will need so many million wind turbines ... Everything changes, however, if we think in terms of combinations! The Germans are studying grids that combine biomass, hydro, wind and solar energy. And they work on demand: at night the demand is weaker; so with wind energy at night they pump the water that will replenish a dam that will work for the peak of the day ... This is the great innovation in energy transition and it is the complete opposite of a large centralized system such as that of nuclear energy. The system of the future? Territory with smart meters, which are the perfect connection between consumption and local production. Small is beautiful. The Germans are going through this energy transition right now. Because they decided to do so. The main thing is: you need to make the decision. This implies real awareness.

VR – *How do you explain the lack of awareness of the French?*

BL – The arrogance of the group of mining engineers, on the one hand, and the subservience of politicians, on the other. A small techno-bureaucratic caste has always ruled the energy issues, because they were the ones who controlled the exploration of coal, then oil and then nuclear energy. They have always pushed to the extreme and imposed the mono-energy obsession on politicians.

VR – Does t*his come from our centralized government?*

BL – Absolutely! In the 1970s a Swedish researcher produced a study on the fact that nuclear energy works in some countries and not in others. And he concluded that an authoritarian and centralized political-administrative structure had allowed it to develop in two countries: the Soviet Union and France. For false reasons - energy independence, the power of France – we maintain the link between civil and military nuclear energy – the AEC has a military application arm and Areva[5] provides plutonium to the Army. This military-state-industrial complex leads us to believe that Mrs. Angela Merkel is crazy. Instead of saying that if the Germans act differently we could at least watch ... But no, we've decided that the Germans are idiots. Our officials trumpet that we have the safest reactors; that nuclear energy is the future and we will sell it everywhere. It is the argument we have always used and we have barely sold nine reactors in fifty years, plus the two that are under construction in China. It is not what was expected ... In ten years the Germans created approximately 400,000 jobs in renewable energy.

VR – *Apart from environmentalists, nobody, including the left, is questioning nuclear energy …*

BL – Things are changing fast. Fukushima shook the honest pro-nuclear. I think the German decision will influence, not our current leaders, but our industry people and also our investors. They must tell themselves: Will I continue to bet my chips on a business like that? In the past we had the Areva-Siemens alliance to offer EPR reactors, but Siemens got out years ago. You can always reassure yourself by thinking that the Germans are wrong, but it is difficult to say that they have made bad choices in recent decades and that their industry is feeble ...

VR – *Can the environmentalists put pressure on the socialists?*

BL – Most certainly! Back in 2000 everything was ready for the EPR, but Dominique Voynet, the Environment Minister, told Lionel Jospin: "If you do the EPR, I quit." It was the only time she offered her resignation and the EPR was not done at the time. I worked for her as an advisor on these issues. I put out 350 notes on this subject. There was a daily battle between the Ministry of Environment and the Ministry of Industry, which did not give a damn about safety. Unfortunately, the EPR was resumed with Chirac in 2002. And it will cost us dearly. In half a century, we have wasted energy, done just about anything. We need urgently to choose an energy civilization that does not threaten life.

Notes

1 Location in France that houses a plant for the reprocessing of nuclear fuel (TN)

2 Title of a contribution on the pages of Rebonds de Libération (March 24, 2011).

3 Type of reactor that produces more fissile matter than it consumes (TN).

4 French organization dedicated to the implementation of energy policies characterized by sobriety, efficiency and the use of renewable energies (TN).

5 French multinational company in the field of nuclear energy (TN).

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