

EDITORIAL

NUCLEAR ENERGY: FUTURE OPTION FOR CHILE?

On August 17th this year, at the Second Meeting of Electrical and Electronics Engineers from Universidad de Tarapacá, a forum titled “Feasibility of Electricity Generation through Nuclear Plants as part of the Energy Matrix of Chile” took place.

In this forum it was clear that of all the ways of generating energy, nuclear energy causes the most controversy and negative responses. In spite of its advantages, doubts arise mainly about safety and, above all, it is criticised for the problem of disposal and storage of radioactive residues.

Even though 21 years have elapsed, everybody remembers the Chernobyl accident. In this forum, as in previous ones on this theme, the participants –including the scientists– considered that the effects of Chernobyl to be an unavoidable topic with regard to the consideration of nuclear plants as a possible option for an energy matrix, and that Chile is not an exception to this. It is advisable at this point to analyse this matter.

In 1986, one of the four first generation reactors in Chernobyl, operating in an ordinary building without the protection of a steel and concrete chamber, exploded due to significant operating errors, with its nucleus at 1500°C. As a result, a radioactive cloud was emitted with devastating effects. This event is not representative of the safety found in present-day nuclear plants, which have three protective barriers, together with a series of safety devices and procedures that must be tightly followed. Nowadays it is unthinkable that a catastrophe such as Chernobyl could reoccur in any operational power plant.

During the nineties, the Chernobyl accident turned nuclear energy into a synonym for disaster and destruction. Environmental groups made it their most important enemy. Nuclear energy was so synonymous with evil that a few years after Chernobyl the creator of “The Simpsons” brought the character Mr. Burns to life. As the villain of the series, he was given the most hated job: head of the local nuclear power plant. The significance of this disaster has remained in the collective mind until now.

In connection with radiation damage on live tissue that can arise from nuclear waste, may I remind you that the unit of measurement for effects is the millisievert. In some countries such as England, an individual is exposed to about 2.5 millisievert per year due to the background radiation from natural sources. Workers in a modern nuclear power plant are exposed to approximately twice that amount.

Nevertheless, the psychological effect in public opinion is distorted. For example, with regard to commercial airlines, the crew at an altitude of 12.000 metres receives the same amount of radiation from cosmic rays as the workers in a nuclear plant, i.e. about 5 millisievert.

It is the responsibility of scientists, engineers and journalists to deflate these problems and portray them according to their true proportions.

At a global level within the nuclear energy technological sector, great efforts are being made to address, amongst others, the increase in efficiency, use of fuel, waste reduction and, above all, to improve the safety of these plants with advanced reactor design, basing their safety on smaller size, simplified design, and natural convection cooling so that their operation does not depend on mechanical systems.

The return to the nuclear option would meet the need for a new global energetic system, capable of giving a solution to urgent problems such as greenhouse gas reduction and the search of fossil fuel replacement, currently providing 70% of the energy consumed in the world. The greenhouse effect is connected to acid rain, toxic emissions, respiratory diseases, heavy metals pollution and CO₂ emissions, and so forth.

The atmospheric concentration of CO₂ has reached an historical record in the year 2007 (450 ppm), and hence the International Energy Agency (IEA), as well as an MIT study group, have classified the current globalised energetic system as dirty, expensive, insecure and vulnerable, and furthermore have recommended the construction of new nuclear plants and investment in renewable energy.

Regarding the latter, there seems to be consensus about the important role that renewable energies (both solar and wind, among others) ought to play. However, although the potential exists and the production capacity has been proven, there is a clear inconvenience in their large scale technological immaturity, their slow evolution with time and the variability of the natural resources (availability of water in dams, wind strength, amount of sunshine, etc.).

All this has opened a worldwide debate about nuclear energy. Should it play a role as a fundamental component of a new energy matrix in the near future, or not? Proof of how topical this debate is can be found in the fact that news regarding this theme is constantly appearing in all types of media.

It is important to add to this debate the opinions of those who have changed their minds, such as James E. Lovelock from Oxford University (author of the Gaia Hypothesis), who now thinks that nuclear energy might be the only option to save the world from disaster, and especially Patrick Moore (co-founder of Greenpeace), who after 30 years of thinking that “nuclear energy was a synonym of holocaust” now says that “nuclear energy is the only source not emitting greenhouse gases that may effectively replace fossil fuels and, at the same time, satisfy the growing demand of energy”.

With regard to Chile, other conditions also need to be considered in addition to those discussed above, such as the problems caused by the reduction in natural gas supplied by Argentina (70% of the country's consumption), which clearly highlighted a short term energy policy that could be corrected with the nuclear option. This political decision, backed by the people, would create a sustained increase in security, reliability and robust independence from volatile and costly international suppliers. In our country, the energetic system should be based on sustainability, energy saving, efficiency improvement and diversification of the energy matrix. For this purpose, the use of renewable energies, and nuclear energy in particular, are options that must be considered.

Uranium has the advantage of being a highly concentrated type of energy, transportable at low cost. One kilogram of natural uranium (equivalent to 25 grams of uranium 235) is equivalent to 50 tonnes of high quality coal. The contribution of fuel to the total cost of electrical energy is relatively low, thus an increase in the price of uranium would have a minor effect. For example, if the price of enriched uranium doubled, electricity costs would increase by 10%, whereas if the price of gas doubled, electricity costs would increase by 80%. The uranium reserves in our country would enable the option of a nuclear plant, and it should also be borne in mind that politically and economically stable countries, such as Canada, Australia and possibly Brazil, could supply enriched uranium.

Moreover, with an appropriate design of a nuclear plant (with radioactive material recycling capability), the increase in the lifespan of these plants would further reduce generation costs, since the plant would already be amortised. It may be said in favour of nuclear energy that nuclear reactions are a million times more energetic than combustion, thus the volume of residues is, proportionally speaking, comparatively smaller and found in the form of solids. In comparative terms, a 600 Megawatt coal plant produces one and a half tonnes of residues, whereas a nuclear plant of similar power capacity produces only 15 tonnes, which are reduced further if a recycling process is available. At the moment, barely 5% of the energetic power of uranium is used, so an improvement in the fuel reprocessing cycle and transmutation will enable a significant reduction, both in the volume of waste and its radioactive life.

In order to consider a nuclear option for our country, some essential prerequisites must be met:

- a) The country must have a long term nucleo-electric generation policy (20 to 30 years).
- b) A program of this nature must have support from both the government and the people.
- c) Adequate legislation in the field of radiation and nuclear safety must be implemented.
- d) An interconnected electrical network, adequate for this technology must be established.

It would also be necessary to establish firm international agreements concerning technology transfer and highly qualified personnel training in all of those areas that may guarantee the competitiveness of the system. The possible limitations due to the seismic nature of our country should not present an insurmountable obstacle, if serious studies are carried out in this area.

As far as applied research is concerned, this alternative would enable provision of non-polluting fuels like hydrogen. In this context, numerous studies are currently being carried out abroad, aimed at obtaining hydrogen through thermal decomposition of water, by thermochemical cycles (series of oxidation-reduction reactions that lower the required temperature from 3000°C to less than 800°C) that may be provided by the nuclear plants, producing electricity and hydrogen at the same time, increasing the overall efficiency of the plant.

Another reason for which this option should not be a priori excluded from the design of a new energy system for Chile is that the nuclear and solar energy sectors may, in the future, form a powerful partnership, working together to optimise the cycles and move on from laboratory scale work (at which other countries are currently working), to being capable of producing hydrogen at competitive prices compared with conventional hydrogen production systems, without greenhouse gas emissions.

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