

The French nuclear industry in deadlock

The burden of France's nuclear gamble in the era of the energy transition

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Yves Marignac, Manon Besnard

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Executive Summary

The deep crisis which the French nuclear industry is experiencing is no real novelty, despite the fact that its suddenness and extent may surprise even the most critical observers. It actually represents the outcome of a strategy launched at the end of the 1990s, of which the fundamental principles have long been considered flawed. The project involved an aggressive export development policy to make up for the foreseeable difficulties on a national level. The errors of judgment with regard to the international dynamics of nuclear power, its advantages for the country and the technical solutions put forward by French industry have turned projected growth into massive losses. Facing declining markets and increasing expenditure on a domestic level, EDF and Areva cannot keep up for long. The French State, which is liable for this strategic failure, must now step up and play its full role. The industrial *restructuring* that it has just undertaken is necessary, but alone will not save the industry. The deep roots of the crisis mean that tomorrow the same priorities cannot be profitable, and only genuine *reorientation* can prevent further disaster for the French economy.

The French nuclear industry is indisputably undergoing a major crisis in 2015, marked by the Areva's announcement of catastrophic results. This champion of the integrated model (reactors, services, fuel, etc.) founded fifteen years ago was supposed to have succeeded on a global scale. With four years of losses, including a record figure of €4.8 billion in 2014 and debts of €5.8 billion against a turnover of €8.3 billion, the group is facing bankruptcy and cannot sidestep a far-reaching redistribution of its business operations.

Despite less worrying results, the EDF group, whose fifty-eight nuclear reactors operated in France provide more than 75% of the country's electricity, is also experiencing a difficult situation. Boosted by its turnover of €72.9 billion, the electricity company recorded net profits of €3.7 billion in 2014.

Yet its debt situation is increasingly a matter of concern, reaching €34.2 billion and its cash flow has been massively negative for several years, resulting in a recurrent inability to cover its increasing investment needs.

A far cry from being a symbol of French industrial success, the future of the national nuclear industry is called into question. In the era of the energy transition, in which France has set itself the objective of lowering the share of nuclear power in its electricity generation to 50% by 2025, this future will be unable to reproduce the past. Against this backdrop, it is all the more necessary to get to the deep-rooted causes of the industry's current difficulties in order to analyse its actual prospects more clearly.

In fact, the crisis is not only due to a problem of industrial organisation or of a cyclical decline following the Fukushima-Daiichi disaster. More structural explanations must be found in the basic principles of the strategy implemented for more than a decade. The solutions rolled out require an analysis of these principles.

● **The illusion of a nuclear “renaissance”**

Above all, this strategy is based on the idea that French nuclear power could access a dynamic and buoyant market in Europe and worldwide. The export dimension has long been a significant argument to justify a project traditionally associated with France's recovery of its international magnitude.

Since the end of the 1990s, the French nuclear industry has maintained the idea that nuclear power is the only source likely to meet the strong growth in global energy demand by producing massive amounts of non-carbon energy. It theorized the turnaround in reactor orders at the turn of the century as a magnificent nuclear “renaissance”, while claiming its leading position.

Buoyed by the massive, and therefore more visible, nature of nuclear projects in relation to the much more scattered development of renewable energy sources, it reinforced the idea that renewable energy could only take a subsidiary role. This vision is increasingly far from reality.

After peaking at 17.6% of global electricity generation in the mid-1990s, the share of nuclear power dropped to 10.8% in 2014. Between 2000 and 2014, in-service capacity of nuclear power only increased by 7.5%, i.e. almost seven times slower than the total global electricity generation capacity (if the sustained stoppage of forty-eight reactors in Japan is deducted, nuclear capacity has even declined by 6% over this period).

This decline in nuclear power is set to gain pace as the new constructions of reactors, between sixty-five and seventy depending on the source, are currently insufficient to offset the closures of an ageing global fleet (439 units operated for more than twenty-nine years on average). Since 2010, investments in nuclear generation have only represented an average of less than \$10 billion per year worldwide.

By means of comparison, renewable energy sources are enjoying strong growth. Over the same period (2000-2014), they represent investments of more than \$150 billion on average, and their share in global electricity generation, constantly rising, reached 22.8% in 2014.

● **The uniqueness of French nuclear power**

Up to now, France has maintained the uniqueness of its electricity mix despite these developments. Out of the thirty-one countries operating nuclear power plants, it is the only one in which this energy source significantly exceeds 50% of its electricity generation. In 2014, renewable energy sources only contributed to 17.7% of electricity consumption, and France is lagging behind with regard to its European commitment to reach 27% by 2020.

While France undertook the construction of a new nuclear reactor, the Flamanville-3 EPR, in 2005, the pace at which it has launched new renewable capacities seems very slow in view of the country's potential. With 8 GW of wind power and 5 GW of solar power installed between 2000 and 2013, France has developed these energy sources 2.5 times slower than the European average, and

respectively 3.3 and 7 times slower than Germany, which has less potential in terms of these two energy sources.

In terms of investments, France is currently making roughly the same effort for nuclear power as for renewable energy. While this may seem a major adjustment on the domestic front, it is, however, very far from the high priority given to renewable energy over nuclear power in European and global investments: energy policy hesitates between loyalty to its traditional model and a shift to future growth sectors.

● **The French nuclear industry's failure on an international level**

The underlying idea behind these decisions is still that France gives priority to its nuclear industry in terms of energy to support its export capacity, and that these exports are significantly advantageous for the French economy. France's performance in this field, however, has not been a success.

The positions occupied by France in the sector of mining, enrichment and conversion are ultimately relatively comparable to the approximate 20% stake occupied by French nuclear power plants in the global fleet. The same goes for the sectors of maintenance and reactor services, and for decommissioning and waste management activities. Out of these different business sectors, the market shares held by the various players change relatively little.

Two sectors stand out. The first and most important is the new reactor construction sector. French industry has clearly stated its great ambitions in this field, offering both turnkey reactor construction by Areva and the export of the constructor-operator model proposed by EDF. However, only three units of the EPR reactor proposed by France are under construction worldwide, in Finland and in China. No other order has been taken in eight years. In total, counting the eleven reactors previously exported, France has only provided 2% of reactors completed or under construction outside of the country.

The second sector is that of the reprocessing of spent fuel and the reuse of the resulting plutonium as MOX (mixed oxides) fuel. France, which has made this option own management solution, offers this service to foreign electricity companies. Yet out of the thirty-one countries operating nuclear power plants, twenty-five have never used or have ceased to use reprocessing. The La Hague plant has lost practically all of its foreign clients over the last decade, with the exception of the Dutch operator, which has only one reactor: it therefore only uses provides reprocessing service to 0.2% of installed nuclear capacity abroad. Areva holds almost around 90% of this global market, but currently the market consists almost solely of EDF.

● **A questionable outcome for French industry**

It is difficult to conduct a full comparative analysis of the advantages and disadvantages related to the industrial priority France has given to nuclear power. One can, nevertheless, question the real benefits provided by this choice for the country by highlighting a few key aspects.

The first point is that, as France is providing political support to domestic and exported nuclear power, it is also neglecting its renewable energy industry. As a result, it is lagging far behind in international competition in this field, particularly in the two sectors currently experiencing massive growth, namely wind and solar power.

France has thereby neglected an important potential. By means of example, the German renewable energy industry recorded more than €13 billion per year in export turnover in these two sectors in 2012-2013. In comparison, French industry recorded an export turnover of €5.8 billion in nuclear goods and services, to which can be added approximately €2 billion per year from EDF's net electricity exports from France to its European neighbours.

It is, however, important to consider that most of the approximate €1.5 billion in added value created by French nuclear business abroad is based on plants and services located in the countries in question,

where it therefore remains. These activities also often record significant liabilities: the acquisitions of Constellation Energy in the USA by EDF and of Uramin by Areva cost them losses of at least €2.7 billion and €1.5 billion respectively, while the additional costs and delays of the Finnish EPR account for at least €3 billion more in Areva's losses. Alone, these three items represent more than €0.5 billion in losses per year averaged out over the last ten years.

Conversely, the operation of French nuclear power gives rise to imports, ranging from uranium, which represents a cost of approximately €0.5 billion per year, to more than 20% of the facilities and services required for the construction of the Flamanville-3 EPR. Lastly, the analysis must also include the fact that the development of renewable energy sources in France now mainly relies on imports, due to the lack of a French industrial champion.

● **EDF's bleak future**

Failing the ability to provide the expected benefits to the domestic economy, the French nuclear industry's international strategy should at least serve the companies that support it. Faced with the prospect of a saturated market and increasing costs in France, they used their French base to roll out their international business so that it could in return finance the continuation of their domestic project.

This strategy did not work for EDF. Besides its participation in the two EPR under construction in China, affected by delays and additional costs, its export strategy as an operator-constructor of many EPRs failed in the USA, Italy and South Africa, and remains hindered by many obstacles in the United Kingdom, where the Hinkley Point project has so far cost the group around €1.5 billion.

Burdened by losses, EDF's foreign activities are currently unable to finance its increasing requirements in France, where the production costs of nuclear plants are rising by around 5% each year and investment needs are also increasing. The extension of operations at the nuclear plants, which exceed an average of thirty years, beyond forty years would cost at least €110 billion, or even more if the safety requirements come closer to the target level for the EPRs. Most of the reinforcement project must be completed over ten years. EDF does not seem to have the financial and industrial capacity today to successfully conduct such a project.

In addition to the crossover between historically low financing capacities and historically high investment requirements, EDF faces another scissor effect, as market prices seem to be on a long-lasting downward trend and are already lower than the nuclear plants' production costs (between €38 and €40/MWh as against €42/MWh), which are conversely on the rise. In view of the opening of an increasing proportion of the French market and the evolution of regulated tariffs, EDF is set to witness the erosion of its sales, and the growing risk of not being able to make the investments concerning the extension of its fleet profitable through sales.

The renewal of the fleet of power plants seems even more out of reach. The cost of the Flamanville-3 EPR project, launched in 2005 to anticipate this possible requirement, has been multiplied by 2.8 and its timeframe by 2.4, even before the announcement in April 2015 of a major manufacturing defect in the vessel that could compromise the entire project. With a production cost now expected to reach around €90/MWh, the EPR is no longer able to compete with the most attractive renewable energy sources.

● **The Areva disaster**

Areva, which has less solid foundations than EDF, pays a heavier and more immediate price for the failure of its international development. Areva's gamble, which granted a set price to win the first third-generation reactor order with Olkiluoto-3 to act as its international showcase, has backfired. The fiasco of this project, at a cost currently estimated at €8.5 billion as against the €3.3 billion initially projected and which records total delays of more than nine years, significantly reduces prospects for new exports. Today, Areva has no other potential direct orders than the two EPRs that have been the

subject of talks with India for almost five years. The reactor constructor has no other real alternative either: the design of the ATMEA reactor remains at this stage much too preliminary for a genuine sales proposal to be launched.

The situation is not much better for the group's second traditional business area: the plutonium industry. Areva suffered another great failure with the construction of a MOX plant at Savannah River in the USA, which has more than fifteen years of delays and soaring costs, to the extent that the project is all but shelved today. Above all, the continuation of its reprocessing business at La Hague is subject to the same increasing costs and investment requirements as for reactors, while EDF takes advantage of its position as sole client to cut prices, thereby endangering the plant's profitability.

Technically bankrupt, Areva cannot avoid drastic restructuring in the short term, including a total or partial take-over of its businesses and recapitalisation. Yet there is no sign that such actions will revive prospects in these two key sectors in which Areva's business seems to be in deadlock.

● **The imperative return of the State as a strategist**

EDF was a long-standing state-run company, and the French State still has an 84.5% share in the group. The State also chaired the creation of Areva of which it also has a current share, mostly directly or via the French Atomic Energy Commission (CEA) of 86.5%. It therefore has a large share of responsibility in the strategic directions taken by the French nuclear industry for many years, and in the deadlock they have led it to.

However, the State has acted in recent years as though no crisis was on the cards. The contradictory targets it imposes on EDF – to invest more while cutting costs and creating dividends, without any considerable increases to French regulated tariffs – seem to be guided by the increasingly unrealistic idea that the current nuclear plant fleet represents an income. At the same time, the State has never really reacted, prior to the situation it finds itself in today, to Areva's increasing difficulties.

The government must now resume its role as a strategic driver to accept its liability in the failure and to redefine realistic prospects for the French nuclear industry, in line with the nuclear reduction policy that it is defining as part of the energy transition. Clearly, it will not be sufficient to reorganize the industry by calling on EDF to absorb Areva's reactor business or any other of its activities, to inject more capital and cover losses. As regards reprocessing, the interests of EDF, for which it represents additional costs, and of Areva diverge, particularly as the continuation of this activity will give rise to significant reinvestment. For the new reactors, it is in EDF's interest to preserve the maintenance capacity, but the continuation of a reactor export capacity, with only lessening potential, does not make sense.

The situation calls for not simply restructuring but a totally new direction. If the fundamental principles that have precipitated the French nuclear industry into its current crisis are not acknowledged, much effort and public money will be invested in an approach which is doomed to fail. The international trend is not for a nuclear renaissance but for a boom in renewable energy, and France will not be able to export significantly more reactors, or to develop new reprocessing contracts abroad under profitable conditions. The future of the French nuclear industry must urgently shift its focus to the maintenance of current reactors and decommissioning and nuclear waste management services.