Focus 17 From "too cheap to meter" to too expensive to tell?

The forecast of American nuclear proponents in the 1950s – that nuclear power would be "too cheap to meter", in other words that the cost of metering would exceed the cost of production and delivery to the customers – demonstrates how confidence in the technology produced a skewed vision of its economic performance.

From the very beginning, the nuclear industry has always promoted itself as being one of the cheapest options for electricity. In fact, the planned costs have most of the time been unrealistically low, due to a series of repeated biases in economic assessments, including forecasting mistakes, over-optimistic technical assumptions, systematic use of the best suited economic values, extensive use of accounting methods favouring nuclear power, etc.

The French Consultative Commission for the Production of Electricity of Nuclear Origin (PEON), gathering 31 high-level experts from the administration and the industry, advised the government from the end of the 1950s to the end of the 1970s on the projected costs of new nuclear projects. It produced 11 reports from 1964 to 1979. Then the Department of Gas, Electricity and Coal (DIGEC) in the Ministry of Industry took over with a series of studies prepared with a working group of administration and industry experts on the "reference costs" of electric power. It produced eight reports from 1981 to 2004.

These reports invariably advised in favour of the nuclear option, and backed continuous support from the government to new reactor projects, from the launch of the PWR fleet with the Messmer programme in 1973-4 to the decision to build a first EPR in Flamanville in 2005-6. A quick historical glance shows how much this process has been flawed all the way along, and decisions made on a succession of unrealistic assessments.

To start with, PEON reports, which based their economic analysis of the need for new power capacities on forecasting of electricity consumption, have systematically overestimated the growth in demand. The 1973 report, which was key to the launching of the French nuclear programme as it stands now, overestimated electricity demand as close as in 1975 by 7.7 percent (real consumption reached 181 TWh instead of the forecasted 195 TWh), in 1985 by 32 percent (303 TWh real against 400 TWh planned) and in 2000 by 75 percent (430 TWh real against 750 TWh planned).

The same 1973 report, fifth in the PEON series, included for the first time in the cost calculation of new nuclear reactors the cost of nuclear waste management, neglected before. Yet it included neither the decommissioning costs, which were not taken into account until in the 1977 report, nor the R&D costs, which were considered for the first time in the 1993 DIGEC report.

It is also noteworthy that the investment cost assumed for a new PWR in the 1973 report was the lowest ever in the PEON-DIGEC series. The report used, based on the return of experience of the first generation of French reactors (natural uranium, graphite and gas, UNGG), an investment cost of 4,000 FrF96. After the construction of the first reactor in Fessenheim, which took two more years than expected to complete, the assumption used in the 1977 report rose to 5,200 FrF96. The investment costs used in the next reports increased, each time, to catch up with real costs that were invariably higher than the projected ones.

As the reports included the fuel costs and compared new nuclear reactors with other options, their assumptions about the prices of oil, gas or uranium played an important role. The PEON and DIGEC reports, like many others, constantly got it wrong when predicting the prices of primary energy materials, with all reports before 1973 forecasting low price rises, then all reports before 1986 forecasting high ones. More recently, 1997 and 2003 DIGEC reports have assumed high oil prices that nevertheless remain far off the actual increases.

Similar mistakes in forecasting uranium prices provided a faulty basis for very important decisions in the period 1975-85. The peaking of uranium prices in 1975-9 (from 25 \$2007/lbU_3O_8 in 1973 to more than 110 \$2007/ lbU_3O_8 in 1977) resulted in a forecast of high prices for the next decades that proved wrong, as prices on the uranium market fell as soon as 1980 to 40 \$2007/ lbU_3O_8 and remained very low for the next 20 years (below 20 \$2007/ lbU_3O_8 between 1988 and 2003), only climbing again in recent years to reach a new peak at 120 \$2007/ lbU_3O_8 in 2006, from which they went down to below 60 \$/ lbU_3O_8 in mid-2008. Meanwhile, the French government decided, based on projected prices for uranium more than twice those later realised, to launch the fast breeder reactor Superphénix in 1977, and the large-scale policy of spent fuel reprocessing and plutonium re-use as MOX for PWRs in 1985. The two-fold mistake on uranium prices, though, was key to giving PEON's and then DIGEC's own calculations a positive economic result instead of a negative one.[96]

Another regular bias is the systematic use of the best range of technical and economical hypotheses regarding the performance of new reactors. In its 1997 report, DIGEC concluded that new nuclear reactors would reach a better performance, by a narrow margin, than modern thermal plants using gas. However, this was only the case when piling up a series of assumptions on the economic conditions of investment and operation of a new reactor, each of them unlikely to be met in real conditions. For instance, the investment cost had to be scaled down by ordering ten reactors instead of one, an unrealistic assumption in the context of overcapacity of the French electric system. Also, the new reactor needed to reach a load factor of 85 percent, an unrealistic assumption given the fact that the French PWRs never exceeded an overall performance higher than 80 percent of load factor. Applying the more realistic assumptions of 20 percent higher investment cost for a single order instead of a series, and of a 75 percent load factor for a new reactor would wipe out the supposed competitiveness of a new nuclear reactor. Yet this is only shown in a table in an annex of the report, while the conclusions for the decision-makers are based on the over-optimistic scenario.

The last report of the series, published by DIGEC in 2003, proved even more controversial than its predecessors, mostly due to a lack of transparency in its preparation. Its calculation of the projected cost for a first EPR benefited from the usual kind of assumptions: investment cost based on a ten-series order, higher load factor of 90 percent, and even a fuel performance of 70 GW.d/t, although reaching this level is highly unlikely.[97] But the report went even further, introducing highly controversial unit costs by using the cover of industrial and commercial secrecy.(It argued that new competitiveness between industrial players required protection of their sensitive data. Accordingly, DIGEC proposed that the unit cost for each energy be discussed between DIGEC and each operator rather than in a working group.) Discussions between DIGEC and Areva provided unit costs for EPR construction and reprocessing far below those provided, only a few years before, by the same operator to the authors of the Charpin-Dessus-Pellat report: 1,043 €/kWe instead of 1,320 €/kWe for the construction cost, and 450 €/kg for reprocessing instead of 870 to 1,500 €/kg. Such hypotheses were highly criticised in the working group and outside it for lacking credibility and appearing "tailor-made" to respond to the political will of a positive result for nuclear competitiveness.

[96] It can be added, regarding the decision to launch Superphénix, that the rationale for developing a plutonium-based industry was aimed at reducing the pressure on the natural resource of uranium, in the context of over-optimistic projected installed capacities. The 1974-6 PEON reports forecast 158 GWe of installed nuclear capacity in France by 2000, or more than two and a half times the actual capacity of 63 GWe.

[97] The performance of fuel, expressed in burn-up of "power days per tonne" (GW.d/t), refers to the quantity of nuclear fuel needed to produce a given energy in the reactor. Increased performance means a decrease in the outage time for reloading the reactor, and a decrease in the quantity of nuclear material to handle, both described as favourable in terms of economics. 70 GW.d/t is well above the current 55 GW.d/t reached in the current fleet, and a number of technical and safety issues would have to be resolved before such a burn-up could be authorised and reached in a French reactor.