Phénix

30 years of history: the heart of a reactor

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To all who work in fast breeder reactors

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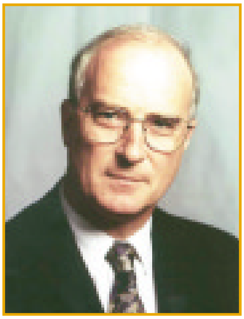

Thirty years already ! When Phénix started up in 1973, no one doubted the need to develop, and rapidly, the breeder reactor type. Our oil-based civilisation was facing the first economic shocks and the resulting early geopolitical warnings. In full growth, the western world feared the threat, clearly none too far in the distance, of a shortage of the oil which was so indispensable to continued progress. All the calculations showed that thermal neutron reactor development potential would remain too limited to provide for future needs. And though at the time the concept of sustainable development had not yet influenced thinking, mid and long-term forecasts were indeed the foundations for the choices to be made. In a climate of fierce industrial and international competition, there was no time to be wasted. Less than eight years passed between the first design project specifications and reactor criticality. The teams from the CEA, EDF and the industrial community moved fast, efficiently and dynamically. This enthusiasm for an ambitious objective would later be found in the early studies for a 1000-MWe power plant and in the Superphénix pre-project.

For fifteen long years, Phénix met every expectation. The plant started up flawlessly and was connected to the grid in record time. The reactor worked beautifully, despite a few incidents which did not challenge the basic design choices. The first demonstration was the viability of using sodium as the coolant for a 300 MWe-type reactor. At that time, the only water reactor producing electricity in France in the same power category was the reactor at the Ardennes power plant. A second major result of the early years of Phénix operation was the effective demonstration of breeding. The reactor produced approximately twelve percent more fissile matter than it consumed. The validity of the estimated calculations was first proved by the experiments in the reactor core, then confirmed by the recycling of the plutonium produced. The core was actually completely recycled three times, and this experience remains today the only industrial demonstration worldwide of the possibility of using all the uranium through breeding.

Among the other achievements attained by Phénix, stand the flexibility of reactor use and the excellent radioprotection results, two undeniable advantages of the pool type reactor concept, and of course the impressive amount of experimental results obtained from the many in-core irradiation devices. The main incidents which occurred during the first fifteen years involved the heat exchangers (intermediate heat exchangers and steam generators). They confirmed the conclusion reached on all the other reactor systems for the same power range – that the choice of materials and the design detail are delicate and rarely succeed the first time around. Fortunately, the modularity and the overall design allowed for rapid solutions to the first failures. Other incidents, this time characteristic of the choice of coolant, were the sodium leaks. These only affected the secondary circuit, and thus did not involve radioactivity, but did each time cause localised, rapidly controlled fires. There were over twenty throughout the reactor life, which confirmed the need for a powerful detection system and the ability to intervene rapidly to control the incident.

The late 1980's saw storm clouds gather over Phénix. Worldwide, protests against fast breeder reactors had reached a peak. Superphénix, the focal point of these protests, was facing technical problems which, once again, occurred at the worst possible time, though they did not question the overall concept. And Phénix, which had operated smoothly up until then, was suddenly shaken by the well-known negative reactivity trips, whose origins would be searched for, in vain, for months to come. The final conclusion deemed that the phenomenon was harmless and could have had at least two plausible causes, signal interference or mechanical movement by the sub-assemblies in the core. The reactor was loaded with additional instrumentation to record an event … which never occurred again.

The decade which followed was marked by two major orientations – the research program on very high activity waste which implied experimentation for transmutation of the waste and created a new objective for the reactor – and the need to upgrade the reactor safety level. This safety upgrade, which quickly proved itself more challenging than originally thought, was a unique experience which provided in-depth knowledge for future projects. After thirty years, the reactor is once again operating, and there is no doubt that it will continue to provide major results for the future of fast neutron reactors.

Because there is a future for fast neutron reactors, and more aptly than ever before, the symbol of the phoenix comes to the fore. After all the western countries had more or less obstinately stopped all form of development of fast neutron reactors – first the Americans, then the Germans, the British and finally the French with the shutdown of Superphénix – the concept is now returning in force, in the fourth generation studies, on the grounds of sustainable development and the need to burn the actinides rather than placing them in waste. Phénix is once again on centre stage, part of the international scene where it has always had its place, having continuously been courted by many foreign collaborators and visitors whose presence and interest were always warmly welcome.

In the upcoming years, this international cooperation should focus on other tools, such as Monju, a great hope, BN 600, if its lifetime allows for continued work, and other prototypes, in India, China ….

In retracing the life of this reactor, author Jean-François Sauvage has written important history, emphasising the significance of the context and of the people involved in every step of the way. I would like to join him in paying homage both to the teams, from the visionaries at the outset to the artisans behind the renovation work, whose human qualities made such a success possible, and to the local populations and their elected leaders who always kept an open mind, and whose reception shall remain unforgettable for the many French and foreign colleagues who had the pleasure of working with Phénix.

It is not because things are difficult that we do not dare,
it is because we do not dare that they are difficult.

Seneca

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