# On the way out

*In sharp contrast to multiple reporting of a potential 'nuclear revival', the atomic age is in the dusk rather than in the dawn.* ***By Mycle Schneider and Antony Froggatt***

In order to keep the number of operating nuclear plants constant, roughly 80 reactors would have to be planned, built and started up over the next ten years – one every month and a half – and an additional 200 units over the following 10-year period – one every 18 days. With extremely long lead times of 10 years and more, it is practically impossible to maintain, let alone increase, the number of operating nuclear power plants over the next 20 years, unless operating lifetimes would be substantially increased beyond an average of 40 years.

Twelve years ago, the Worldwatch Institute in Washington, WISE-Paris and Greenpeace International published the *World Nuclear Industry Status Report 1992*. This report concluded: "The nuclear power industry is being squeezed out of the global energy marketplace. Many of the remaining plants under construction are nearing completion so that in the next few years worldwide nuclear expansion will slow to a trickle. It now appears that in the year 2000 the world will have at most 360GWe of nuclear capacity, only 10% above the current figure. This contrasts with the 4450GWe forecast for the year 2000 by the International Atomic Energy Agency (IAEA) in 1974."

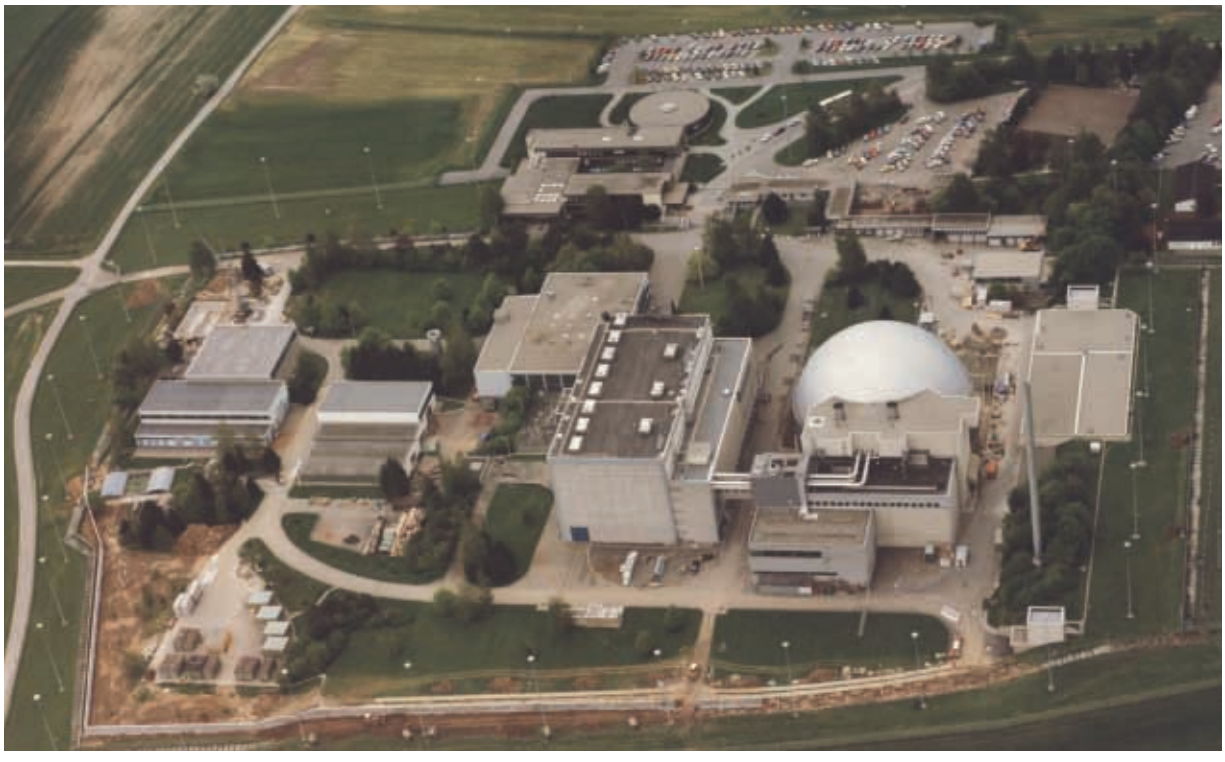
In reality, the combined installed nuclear capacity of the 436 units operating in the world in the year 2000 was less than 352GWe, or 7% above the 1992 figure. The analysis in the 1992 report proved correct. At the end of March 2005 the 441 worldwide operating reactors – just five more than in 2000, but three less than at the historical peak in 2002 – cumulated 367GWe of installed capacity (see Figure 1).

The total installed capacity has increased faster than the number of operating reactors because units that are being shut down are usually smaller than the new ones coming online and because of uprating of capacity in existing plants. However, in the absence of significant new build, the average age of operating nuclear power plants in the world has been increasing steadily and stands now at close to 22 years.

In total 108 reactors have been permanently shut down with an average age of about 21 years – the figure is up four years from the situation in 1992. Over the last 12 years, 33 reactors have been shut down and 54 have been connected to the grid, which corresponds to a net addition of less than two reactors per year.

The annual nuclear capacity increase since year 2000 corresponds to about 3GWe, including uprating. This figure should be compared to the global increase in all electricity generating capacity of about 130GWe to 180GWe per year. This leaves nuclear power with a market share of roughly 1.5-2.5% of the annual increase. Therefore the increased output from nuclear power will not allow nuclear power to even maintain the current 16% share in the world power production and the 6% in the commercial primary energy or about 2-3% final energy. All these parameters are already on the decline.

Nuclear energy remains limited to a restricted number of countries in the



Phased out: under current German legislation, nuclear plants will close after an average of 32 years. Pictured is Obrigheim, which shut down on 11 May 2005 after 36 years of operation

world. Only 31 countries, or 16% of the 191 UN member states, operate nuclear power plants. The big six – USA, France, Japan, Germany, Russia, South Korea – produce about three quarters of the nuclear electricity in the world. Half of the world's nuclear countries are located in Western and Central Europe and count for over one third of the world's nuclear production. The historical peak of 294 operating reactors in Western Europe and North America had been reached as early as 1989. In fact, the decline of the nuclear industry, unnoticed by the public, has started many years ago.

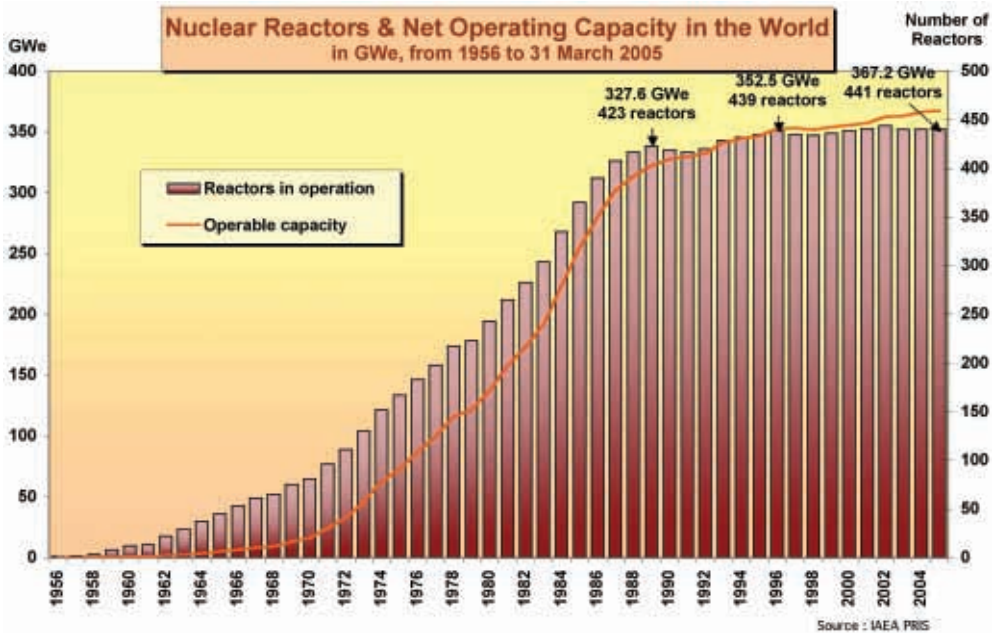



Figure 1: Development of world nuclear industry

## A ROSY FUTURE?

The international nuclear industry proclaims a rosy future. "Rising gas prices and greenhouse constraints on coal have combined to put nuclear power back on the agenda for projected new capacity in both Europe and North America," according to the World Nuclear Association. The IAEA, however, sees the future mainly restricted to Asia: "Twenty-two of the last 31 nuclear power plants connected to the world's energy grid have been built in Asia, driven by the pressures of economic growth, natural resource scarcity and increasing populations. Of the new plants presently under construction, 18 of the 27 are located in Asia, while construction has virtually halted in Western European and North American countries with long-standing nuclear power programmes." But as Figure 2 shows, current numbers of reactors under construction fall far short of the number necessary to even replace existing units.

In order to evaluate the status of the world nuclear industry, it is helpful to estimate the number of units that would have to be replaced over the coming decades in order to maintain the current number of operating plants. We have considered an average lifetime of 40 years per reactor – with the exception of the remaining 17 German nuclear plants that, according to German legislation, will be shut down at an average age of about 32 years – which is optimistic as the average age of reactors closed to date is 21 years, but which seems possible given the progress that has been achieved on the current generation of plants compared to the previous one.

Over the next 10 years, 80 new reactors would have to start up operation. The calculation takes into account 18 reactors with a firm start-up date of the 27 units listed as under construction by the IAEA as of June 2004. In other words, another 71 reactors would have to be planned, built and started up until 2015. This is virtually impossible given the long lead times for nuclear power projects. One EPR in Finland and one more in France won't change that picture. Furthermore, over the next 15 years 167, and over the next 20 years a total of 277 units (or 171GWe), would have to be replaced in order to maintain the same number of plants operating than today. China is said to have plans for up to 32 new nuclear plants until 2020. A prospect that seems highly unlikely but not impossible. But even such an extraordinary undertaking in terms of capital investment, technical and organisational challenge would cover hardly more than 10% of the number of units that reach age 40.

The number of nuclear power plants operating in the world will most likely decline over the next two decades with a rather sharper decline to be expected after 2020.

## THE ANALYSTS' VIEW

Many analysts consider that the key problems with nuclear power have not been overcome and will continue to constitute a severe disadvantage in global market competition. Ken Silverstein, director of the US based consultancy Energy Industry Analysis said: "As a result of deregulation of power and other market- and policy-based uncertainties, no nuclear power company can afford to take the financial risk of building new nuclear plants. A report published by Standard & Poor's identifies the barriers. The financial costs for construction delays, for example, could add untold sums to any future project. That, it says, would also increase the threats to any lender. To attract new capital, future developers will have to demonstrate that the perils no longer exist or that energy legislation could successfully mitigate them." Peter Rigby, a Standard & Poor's analyst and author of the report said: "The industry's legacy of cost growth, technological problems, cumbersome political and regulatory oversight, and the newer risks brought about by competition and terrorism concerns may keep credit risk too high for even (federal legislation that provides loan guarantees) to overcome."

In particular, in the USA the nuclear industry has put up a smoke screen in front of its own difficulties to survive, but it does not seem to work. "The political reality in the USA today would lead to the conclusion that there will not be any more nuclear power plants built in this country for a long time," said James Baker, the former secretary of state to president George H W Bush.

French establishment analyst Jean-Marie Chevalier, director of the Geopolitical Center for Energy and Primary Materials (CGEMP) corroborated Baker's point of view: "[President George W] Bush can always say that nuclear power should be re-launched. Investors are not queuing up, because nuclear power has as the enormous disadvantage today to require a very capitalistic investment and it is very long to build. Nobody knows what the electricity markets will be in seven or eight years when the plant will be built. And therefore, the financing bodies, the bankers are currently very, very

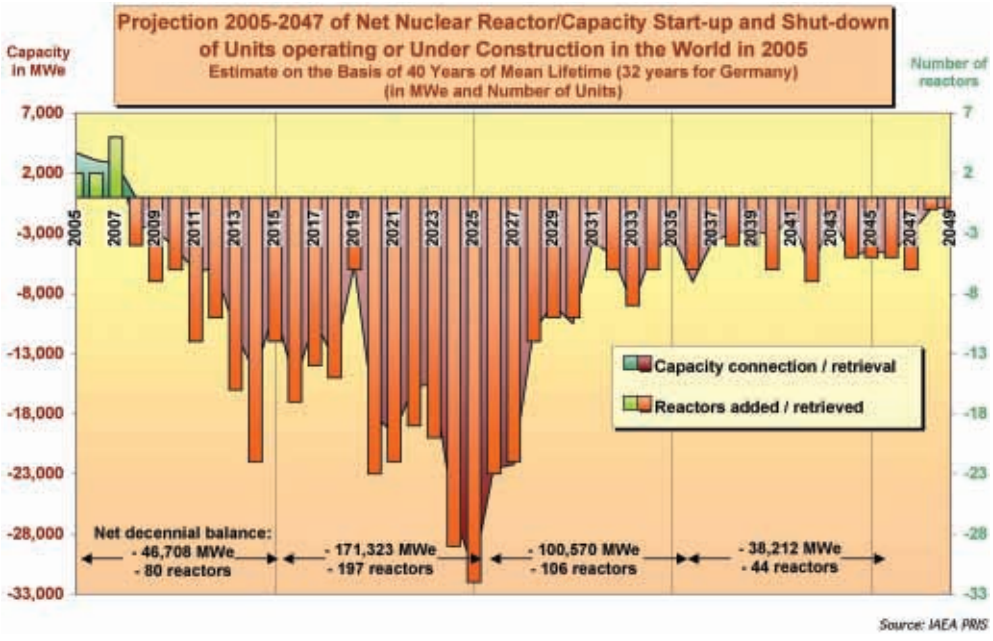



Figure 2: Projection of world nuclear reactors/capacity

hesitant about nuclear power." Actually, the bankers' reluctance towards nuclear energy is not new. The World Bank, for example, has never financed a nuclear power plant and there are no signs that it would have changed its financial risk analysis. But even in Asia, where many nuclear optimists see the hope for a nuclear revival, the Asian Development Bank does not finance nuclear projects.

Much of the optimism displayed by the nuclear lobby is limited to rhetoric. The *New York Times* ironically summed up the issue under the headline "Hopes of Building Nation's First New Nuclear Plant in Decades" in the following way: "The companies, including the two largest nuclear plant owners in the United States and two reactor manufacturers, have not specified what they would build or where. In fact, they have not made a commitment to build at all. But they have agreed to spend tens of millions of dollars to get permission to build, and they anticipate tens of millions from the federal government, which requested such proposals in November. The money would go to finish design work useful for a new generation of reactors and to develop a firm estimate of what such plants would cost."

But not even the ultra-pro-nuclear Bush administration seems willing to spend the money. The US Department of Energy (DoE) cut the 2005 budget request for the *Nuclear Power 2010* programme by 47% to modest $10 million while the nuclear industry is asking for $60 million to $80 million. At a 10 February 2004 congressional hearing, a DoE representative has suggested that the cut came because DoE did not have sufficient support from industry about new plant construction to pursue the programme "in a more aggressive way." The *New York Times* seems right.

The international energy industry as a whole remains extremely sceptical about nuclear power. Leonardo Maugeri, senior vice president for corporate strategies at ENI, the Italian oil and gas giant, wrote in *Newsweek*: "Many energy industrialists think nuclear is the answer, but they rely on a misleading analysis of its cost competitiveness. Even if you ignore the political concerns surrounding nuclear waste, producers often fail to correctly calculate the real price of electricity produced from nuclear energy. It costs about as much to close a nuclear plant as it does to build a new one, which is why nuclear power companies are now lobbying worldwide to delay planned plant closings."

The overall nuclear industry strategy is quite clear. In the absence of a short or medium term revival of the nuclear industry, hopes remain with an entirely new generation of nuclear power plants, so-called Generation IV reactors. They would be much smaller in size (100-200MWe) and capital investment, represent a more flexible solution due to much shorter building times and a lower potential risk due to smaller radioactive inventories and passive safety features. In the meantime, nuclear utilities try to extend plant lifetime as much as possible and do their best to keep up the myth of a nuclear future.

The 2004 Energy Policy Review by the OECD's International Energy Agency (IEA) analyses governmental energy research and development (R&D) budgets: "Support for renewable energy technologies and energy efficiency has formed the bulk of measures taken or planned over the past few years. Conversely, there continues to be relatively limited support for nuclear energy, although it remains attractive from a climate change point of view. The government R&D budget for fossil fuels and nuclear fission has seen a significant drop since the early 1980s while nuclear fission still has the largest share." Indeed, considering its limited significance in the world's energy supply, nuclear energy – fission and fusion – still absorb vast amounts of R&D money: half of the energy R&D budget of $87.6 billion spent by 26 OECD member states between 1991 and 2001 went to nuclear research.

Already in its *World Energy Outlook 2003*, the IEA stated: "The nuclear share of energy use for electricity production is expected to decline in most regions of the world as a result of public opposition, waste disposal issues, concerns about nuclear arms proliferation, and the economics of nuclear power. The nuclear share of electricity generation worldwide is projected to drop to 12% in 2025 from 19% in 2001." The 2004 edition of the *World Energy Outlook* still assumes that nuclear power "will decline progressively," because it will have "trouble competing with other technologies." Even under a new 'alternative' scenario that assumes a 13% increase of nuclear energy generation between 2002 and 2030 – considering that no new country would go nuclear – the nuclear share in world commercial primary energy in 2030 would only represent 5%. Furthermore, only 10% of the $CO_2$ emission savings in the 'alternative' scenario would stem from increased nuclear. The lion's share of greenhouse gas emission reductions comes from energy efficiency measures. Still no sign of a 'nuclear revival'.

*Based on "The World Nuclear Status Report", commissioned by the Greens-EFA Group in the European Parliament. Mycle Schneider is an international consultant on energy and nuclear policy and has worked for a broad range of clients, from the International Atomic Energy Agency to Greenpeace International, including three governments, numerous MPs, and the European Commission. Antony Froggatt is an independent energy consultant specialising in European issues. He works for a variety of clients including NGOs, industry and governments. Mycle Schneider Consulting, 45, Allée des deux cèdres, 91210 Draveil (Paris), France; Antony Froggatt, 53a Nevill Road, London N16 8SW, United Kingdom*