

WORLDWIDE OVERVIEW OF NUCLEAR POWER

It is very likely that 1996 has been the year with the largest production of electricity generated by nuclear fission. This year, 1998, will be the first year in history with an decrease of installed nuclear capacity. Next year, 1999, will turn out to be the last year in history with a nominal growth in installed nuclear capacity. If nothing unforeseen happens. Something 'unforeseen' would for example be a revival of nuclear power. That such a revival is not very likely to happen will be shown in the following world-wide overview.¹ The overview focuses on nuclear reactors, not on other nuclear issues such as uranium-mining, waste storage or MOX programs.

In 1974 the International Atomic Energy Agency predicted a nuclear capacity of 4,450,000 MW by the year 2000. It will be something like 345,000 to 350,000 MW, more than 12 times less. Increasing costs, intractable waste disposal issues, and safer, more economical energy alternatives have resulted in a stagnation of new nuclear plant orders and a gradual global marketplace rejection of the technology.

Ever since the partial meltdown at Three Mile Island (US) startled the world in 1979, the nuclear industry has insisted that its image would rebound, and that construction programs would accelerate again. But in the past two decades, nuclear power has gone from a near-term, conventional energy option to one beset with seemingly incessant problems and decreasing in importance in nearly all countries. Rejection of nuclear power spread from the United States and Western Europe to Latin America in the 1980s. The wave of democracy that swept Central and Eastern Europe and the former Soviet Union in the late 1980s and early 1990s led to the postponement and cancellation of dozens of plants in the region. Nuclear programs have also faced setbacks and growing public criticism in Asia. As a result, worldwide plans for expansion of nuclear power have consistently fallen short, even in those countries considered to be its leading proponents.

Worldwide, as of January 1, 1998:

- * Only 28 nuclear plants with a combined capacity of 24,329 MW remained under active construction. Only four countries in the world - France, China, India, and South Korea - were each actively constructing more than two nuclear reactors;

- * 440 commercial nuclear plants were in operation (including the 7 Canadian reactors, temporarily(?) closed till the next century), only one more than there were in January 1996;

- * Total installed nuclear generating capacity was at 351,795 MW, only about nine percent higher than the January 1990 level of 318,271 MW. In 1974, the United Nations' International Atomic Energy Agency (IAEA) forecast that nuclear capacity would be 4,450,000 MW by the year 2000; and

- * Nuclear power's share of electricity is currently likely at its peak at around 17 percent. The IAEA now forecasts that it will produce only 13 percent of the world's electricity by 2015.

The international trend away from nuclear power was fuelled by serious accidents at Three Mile Island (1979) and Chernobyl (1986). Mounting chronic problems include: high construction and operating costs, technical and safety difficulties, broad public opposition, confounding waste storage issues, and skyrocketing decommissioning costs. Its most serious obstacle now may be its inability to compete in an increasingly deregulated marketplace. Even the much mentioned (but nevertheless

1- The structure of this overview is based on *Mythbusters #10*, published in April 1996 by the US-based Safe Energy Communication Council (SECC). The update is made possible thanks to numerous sources at the extensive Laka archive on nuclear energy in Amsterdam

untrue) claim "nuclear energy is the solution for the Greenhouse problem" cannot bring about a renaissance of nuclear power.

Indicative of the industry's present condition is the story of Ivan Selin, former chairman of the US Nuclear Regulatory Commission. In 1995, Selin announced his decision to rejoin the private sector. Choosing not to enter the nuclear business, he planned to build gas turbine power plants in Asia. Why? "I'm not predicting that the nuclear industry will pick up," Selin responded.

THE AMERICAS

Nuclear power's era of expansion in the **United States**, the major and original proponent of the technology, is over. Total nuclear capacity of the 110 US reactors has peaked at 100,000 MW, accounting for less than 20 percent of the country's electricity supply. In 1997 seven percent less nuclear electricity was produced as in the year before. The last reactor under construction was grid-connected in early 1996. Every US reactor ordered since October 1973 has been subsequently cancelled; no reactor orders have been placed since 1978. In fact, over the past 30 years, utilities cancelled some 120 reactors, totalling 132,000 MW. With competition emerging in the electric power industry, the US can expect a gradual but steady phase-out of existing reactors. The New York investment house of Shearson Lehman Brothers predicted in 1993 that economic reasons (including accelerated ageing) could cause 25 US reactors to close prematurely by the year 2003. An 1998 report by the Public Citizen's Critical Mass Energy Project concluded that 42 nuclear reactors are not competitive: they cannot compete with price of replacement power. According to the Washington International Energy Group's *The 1996 Electric Industry Outlook*, an annual survey of US utility executives, 89 percent of the respondents said they would not consider ordering a new nuclear reactor while only 8 percent said they expect a resurgence of the US nuclear power industry.

In **Canada**, a three-decade-long push for nuclear power by provincially-owned Ontario Hydro and the federally-owned nuclear industry, Atomic Energy of Canada, Ltd., has ended. The result: 21 reactors with no more being built or planned. Meanwhile, over the last two years Ontario Hydro has shut down seven of its reactors (in total 4,367 MW). It is not likely that all these reactor will operate again. Even nuclear proponents claim the reactors will not be restarted. AECL remains very active at the foreign market, but without much success lately; deals with Turkey, South Korea, Romania and China are very uncertain.

Only five nuclear reactors now operate in all of Latin America: two each in both **Argentina** and **Mexico**, and one in **Brazil**. All have been accident prone, and are often shut down for repairs. Argentina and Brazil each have one reactor under active construction, while a second project in Brazil was cancelled in May 1993 due to a shortage of funds. Both reactors will most likely be finished in 1999. However it remains unclear if Argentina's third reactor (Atucha-2) will be completed, as costs have soared to US\$5,014 per installed kilowatt, among the world's most expensive. Argentina is in the process of privatisation of its nuclear power plants and it is unclear what this means for Atucha-2. Every Saturday morning, for more than ten years already, a group of women, called the 'Mothers of Veracruz', demonstrate against the Mexican reactors at Laguna Verde.

Cuba announced late September 1998 it will not continue construction of Cenfuegos reactors. In August 1992, it already halted construction of two planned Soviet-designed reactors due to a shortage of funds. In the spring of 1995, however, Russia's Ministry of Atomic Energy created a controversy (particularly in Florida) when it announced the restart of work on Cuba's plants in a joint venture with Western companies. The companies, though, denied participating, and even Cuba's deputy minister for energy said the announcement was "not true."

WESTERN EUROPE

In Western Europe, the construction of new nuclear reactors has stopped everywhere, and the debate is shifting to when, not whether, to close existing reactors.

Finland was expected to lead a nuclear renaissance in Europe - but in September 1993, the Finnish parliament rejected government plans to allow construction of a fifth plant. However it is one of the European countries with the strongest nuclear lobby and the fifth reactor is again proposed. The utilities are in the process of increasing capacity of the existing reactors by some 400 MW.

Sweden's new government, elected in September 1998, again stressed it would phase out nuclear energy by 2010. This phase-out is a result of the 1980 parliamentary decision. However, the first reactor had to be closed on July 1, but a Swedish court prevented this by deciding in favour of the utility. However, it is still possible the reactor, Barsebaeck-1, will be closed during 1998.

In November 1994, the **Dutch** parliament voted to reject industry requests to extend to 2007 the operating license of The Netherlands' only large nuclear plant. The 449 MW Borselle reactor is now expected to close by the end of 2003 at the latest. In November 1996 the operating utility decided to close the 52 MW reactor at Dodewaard, due to 'a lack of perspective for nuclear energy in the Netherlands'. The reactor, in operation since 1968, was closed in March 1997.

Austria completed its only nuclear plant, at Zwentendorf, in 1978 and abandoned it eight years later without it ever operating. Austria is very concerned with the nuclear safety in Eastern Europe and has a active anti-nuclear policy. It is active in trying to prevent further completion of nuclear reactors in surrounding countries.

Switzerland, which has not completed a nuclear plant since 1980, cancelled 22-year old plans in 1988 to build the country's sixth reactor at Kaiseraugst. In September 1990, voters approved a moratorium on future nuclear construction until after the turn of the century. In the 1995 national parliamentary elections, the anti-nuclear Socialist Party emerged as the largest vote-getter, with one of its members, Moritz Leuenberger, once the lawyer for the Swiss Society for Solar Energy, appointed as the country's new energy minister.

In November 1987, **Italy's** voters blocked the expansion of the country's nuclear program, and in June 1990, the Italian parliament approved dismantling the nation's three units that had been closed since the 1986 Chernobyl accident.

Turkey is still waiting for the decision which consortium will get the order to construct the countries first nuclear reactor. It is, however, very likely that an actual construction will never take place. The country first decided in the late sixties to built a reactor, but it never materialized.

In **Germany**, with 19 operating reactors, no new nuclear plants have been ordered in the former West Germany since the mid-seventies, and currently no additional plants are under construction in the now unified nation. After the general elections in September 1998 won by the Social Democrats and the Greens, anti-nuclear forces in government increased. In the agreement to form the new federal government the two parties concluded that nuclear energy has to be phased-out. However there is no time-frame for closure of the reactors and there is some cynicism: the Greens say the phase-out should take place within five years; the SPD says within 20 to 30 years. Most likely a few obsolete reactors will be closed during the next two years (Stade, Obrigheim, Biblis A). However, dreams from the German nuclear industry to build new reactors (the European Pressurized Reactor) have now definitely gone up in smoke.

After the re-unification, all six operating reactors in the former East Germany were closed and five nuclear power construction projects abandoned within a year after the two Germany's were unified. German nuclear regulators declared the East German reactors unsafe for continued operation without massive and expensive upgrades.

The **United Kingdom's** nuclear program, limping for most of the last two decades, suffered a near fatal blow in 1989 when the government was forced to pull nuclear power from its plan to privatize the nation's electric power industry. Ironically, just one day prior to the announcement, then-Prime Minister Margaret Thatcher had delivered a United Nations speech lauding the critical importance of nuclear power. As the books were opened on the UK nuclear industry, it became clear that the government had lied to itself as well as the British public about the nuclear industry's real costs. Generation costs turned out to be about double what the government had claimed, with decommissioning costs roughly four times greater (BP15 billion (US\$23.8 billion)). The nuclear sector

remained in government hands after investors purchased the other portions, with consumers paying an 11 percent electricity tax (a "non-fossil fuel levy") to cover the excess cost of nuclear power. The last project under construction, the 1,188 MW Sizewell B Unit, was connected to the grid in 1995, and was partially paid for with money diverted from the consumer-funded subsidy. This occurred despite government promises that the tax was to be used to pay for decommissioning liabilities instead of new construction.

The British nuclear industry had hoped that if it were privatized, additional reactors could be built. However, British Energy, plc, the soon-to-be privatized company, announced in December 1995 that it was dropping all plans to build additional reactors a move designed to gain investors' confidence and capital. According to the Financial Times, "No new nuclear power stations are likely to be built in the U.K. for a couple of decades, if ever."

Spain has a 10 year moratorium on the construction of new reactors. It has no intention to restart a nuclear program. Plants to construct reactors together with **Portugal** were cancelled. Spain has nine reactors, the last one was taken in operation in 1988.

In **Belgium** the government decided in 1995 not to build an eight reactor. Since 1975 no reactor is ordered.

France is seen as the capital of nuclear power. And indeed, even in the late eighties it planned to start the construction of at least two nuclear reactors each year. How things have changed! Currently there are four reactors which have not been taken into commercial operation. But this is due to technical and safety problems. Three of those four, all of the new developed N-4 1500 MW-series, are already finished and have been in operation. The two Chooz B reactors and Civeaux-1 are plagued by incidents and accidents and are shut down for partial reconstruction after a serious accident at Civeaux-1 in May 1998. Civeaux-2 has not been in operation yet but has to be adapted too. That unit, which was planned to be in commercial operation in July 1998 is the countries last nuclear unit under construction! It could well be the countries last nuclear reactor ever constructed. In October 1998 Dominique Voynet, the Green minister for the Environment called for a phase-out of nuclear energy in France. The superphenix fast breeder reactor (once the pride of the nuclear industry) was permanently shut down in January this year. The development of the European Pressurised reactor (a joint production of KWU Siemens and Framatome) is doomed to fail by lack of a domestic market. Currently France has 59 reactors, producing some 78% of all electricity. No reactor has been ordered since 1991.

EASTERN EUROPE AND THE FORMER SOVIET UNION

Nuclear programs in Eastern Europe and the former Soviet Union have experienced serious setbacks since the 1986 Chernobyl accident. Political upheaval unleashed a torrent of domestic public criticism, while financial and safety problems have re-focused Western concern. In 1992, then-Swedish Prime Minister Carl Bildt observed that 40 of the 58 Soviet-designed civilian nuclear reactors then operating would be "closed down by yesterday" if they were located in the United States or Sweden.

Concerns over the safety of the operating plants remain high, partly due to the series of accidents that have bedevilled Soviet-designed reactors since the fall of the Iron Curtain. In 1995, a fire occurred at **Bulgaria's** Kozloduy nuclear plant, a facility deemed among the world's most dangerous by the U.S. Department of Energy (DOE). Particularly in the former Soviet Union, worker morale has suffered as employees have gone unpaid for months at a time, leading to worker slow-downs and sit-ins at several plants, including Smolensk, Kola, Kalinin, and Bilibino. In **Russia**, shortages of spare parts have caused safety conditions at nuclear plants to deteriorate in recent years. Lack of money is a serious threat: in 1995 the supply of electricity to Murmansk naval base was stopped because of unpaid bills. Result: the cooling of reactor fuel stopped and a meltdown could only be prevented because the military forced the utility at gunpoint to restart electricity supply. Conditions will not improve due to the 1998 economic crisis. Although there are officially still four reactors under

construction in Russia, work at all the sites has stopped. Work at the last reactor under active construction Rostov-1, was abandoned.

Initial post-Chernobyl Western calls for the outright closure of some two dozen older, unsafe reactors in the former Eastern bloc were pursued only in Germany. International pressure was constrained by the attempts of Western suppliers to secure contracts for repair work on some of the Eastern reactors. In one remarkable case, funds earmarked for the US Agency for International Development's regional energy efficiency project were used to train **Czech** nuclear regulators as part of the successful effort by Westinghouse to win a contract (and US government loan guarantees) to finish two Soviet-designed reactors in the Czech Republic. Completion of both Temelin reactors is under constant threat of increasing costs, further delays and growing both domestic and foreign opposition. Meanwhile, in **Armenia**, Russian engineers completed "rehabilitation" work and reopened one reactor at the Metzamor nuclear facility in 1995. The plant had been closed by Soviet authorities as a precautionary safety measure following a powerful earthquake in 1988, and it remains on the U.S. DOE's list of most dangerous Soviet-era reactors. It is very unlikely Metzamor 2 will be restarted despite continuing reports upgrading work continues.

Lithuania is the country with the highest share of electricity produced by nuclear fission: 81 percent. Only two large RMBK (Chernobyl type) reactors are in operation. According to many experts the Ignalina reactors are among the most dangerous reactors in the world. The European Union adopted the policy that the reactors have to be closed before Lithuania can join the EU. However, this policy is not joined by very clear measures. The government is claiming that since the reactors have been upgraded (with EU) money, they are safe and can operate till their expected life time. It has to be seen if the EU has the power and the political will to close the reactors (which export a large share of the electricity to Finland and Sweden). Work at two other RBMKs has been stopped.

Cernavoda-1 in **Romania** was taken online in 1997. Financing the construction of the second unit is problematic. In May 1998 a Canadian/Italian consortium signed an interim agreement to continue work, but work has not been restarted. Completion is expected not before 2002, if ever.

The push by Western vendors for reconditioning has continued despite a 1993 confidential report by the World Bank and the OECD's IEA that stated it would be less expensive to close the most dangerous former Eastern bloc plants than attempt to improve their safety. Still, scores of nuclear projects have been cancelled or mothballed in Bulgaria, Russia, the Czech Republic, Slovakia, **Hungary, Poland** and **Ukraine** since the collapse of the Soviet empire. Some 50 reactors planned or under construction in the former Soviet Union alone were aborted in the five years following Chernobyl. But western pressure for the closure of the remaining Chernobyl reactors in the Ukraine and replacement power produced by new nuclear reactors (Khmelnitsky 2 and Rovno 4) is still continuing. Especially KWU Siemens, Framatome and the EBRD (European Bank for Reconstruction and Development) are pushing to pay for the construction of K2/R4, in spite of completion not being the least-cost option, an EBRD condition for payment. Euratom, the nuclear energy community of the European Union, is also willing to pay for new nuclear capacity in Eastern Europe. But international opposition is mounting.

In **Slovakia** the first unit of Mochovce was finally taken in operation during 1998 and the second unit is expected to go online in 1999.

By September 1998, just five reactors remained under active construction in the former East bloc: Mochovce-2, Temelin-1 and -2 and K2/R4 (although it is not sure if there is currently construction work at the site). This figure is dramatically lower than the 65 reactors under construction in the region at the time of the 1986 Chernobyl accident.

AUSTRALIA, MIDDLE EAST & AFRICA

Australia has not been seen as a nuclear market after the 1970s. Although the country is planning to construct a research reactor, there is no and there will be no program for the construction of electricity producing nuclear power reactors.

The Middle East was feared to be the next playground for the nuclear industry. Still in December 1996, on a conference held in the Syrian capital of Damascus, the Arab world (except Algeria) called for "adopting steps to establish nuclear plants to generate electricity and desalinate sea waters".

Syria is saying to negotiate an agreement with Argentina for the supply of a nuclear reactor. But nothing will materializes.

Israel, Egypt, Libya and other northern African states all abandoned their plans to produce electricity by nuclear fission.

Currently, only **Iran** has a nuclear energy program. It claims that the Busher-reactors, which constructed started 1975 by German company Siemens, are still under active construction. Iran signed an agreement with Russia for completion, but worked seem to be halted because Russian companies are not paid yet.

In the continent of Africa only **South Africa** has nuclear reactors. The two Koeberg units were damaged by ANC bomb attacks but finished in the mid eighties. There is no program for the expansion of the current 6% nuclear electricity share, although the utility Eskom is claiming to start construction of a prototype High-Temperature Reactor (100 MW) in the second half of 1999.

ASIA

The East Asian countries of Japan, South Korea, China, and Taiwan account for nearly one-third of the plants still being built worldwide. But here too, public opposition continues to rise, and utilities and governments are considering alternatives. In all these countries, current expansion plans are far more modest than those of 15 years earlier.

In the late 1970s and early 1980s, Taiwan planned to increase its inventory to 20 reactors by the turn of the century, China to 10 reactors, and South Korea to 47 reactors. However, the high cost of nuclear power and public opposition catalyzed by the Chernobyl catastrophe has knocked back those projections.

South Korea has the most active nuclear construction program in the world, with four reactors actively under construction: Wolsung-4, Ulchin-4 and Yongwang-5 and -6. Work at two other units (Ulchin-5 and -6) was put off due to cash problems as a result of the current economical crisis. In a country characterized by years of fast economic growth, rapidly rising electricity demand, minimal fossil-fuel resources, and authoritarian governments, the development of nuclear power has been a top state priority. Twelve nuclear plants supplied 35 percent of the electricity in South Korea in 1997.

Economic hurdles are not South Korea's only obstacle to meeting its goals. Since Chernobyl, South Korea has faced growing domestic opposition to its nuclear power program. In December 1988, South Korea experienced its first demonstration against nuclear power when residents near the Kori facility marched against radioactive wastes illegally buried outside the plant's fence. The movement is having an effect. In January 1996, local government officials revoked permission to build two additional reactors at the Yonggwang station. Also, a plan announced in December 1994 to store wastes on a small island off the west coast was cancelled in November 1995 due to unstable geological conditions and public opposition. Even the vice president of the state-owned utility, KEPCO, admits that the utility is having difficulty finding sites for additional reactors and for storing nuclear waste.

South Korea's nuclear establishment has been tainted in the bribery scandals that have rocked the country. In one case, KEPCO's Chair Ahn Byong-wha was jailed in 1994 for receiving bribes from a South Korean representative of the Canadian nuclear vendor, Atomic Energy of Canada, Ltd. (AECL). Despite the arrest, the bribe apparently had its intended effect. In 1992, AECL won a bid to build two additional reactors in the country. However, after an evaluation of the future direction of the Korean nuclear power program in January 1998 there were signs that AECL would not get any further orders.

In **Taiwan**, six nuclear reactors provided 30 percent of the country's electricity as of 1998. Plans to build two new reactors at Yenliao were unveiled in 1982, but the government has repeatedly

delayed construction because of a decrease in electricity demand, the nuclear waste storage dilemma, public outcry over the Chernobyl accident, and excessive costs. Residents of the selected site overwhelmingly rejected (96.2 percent of the voters) the nuclear plant in a 1994 non-binding referendum. Construction started late 1996 with hopes of beginning commercial operation on the Lungmen units in 2004 and 2005. In May 1998 the government announced that there would be no reactors built until 2020, but oppositional groups claim this is just "playing with words" and the government still has a covert agenda of building more nuclear units at the already existing sites. International protest was heard when Taiwan announced the storage of nuclear waste in North Korea. But the deal is virtually scrapped.

By signing the radwaste deal with Taiwan, **North Korea** hoped to get some cash. The isolated country signed an agreement with KEDO, the Korea Peninsula Energy Development Organisation, for the construction of two light water reactors (and 500,000 metric tons of heavy fuel oil annually) in turn of the ending of its plutonium program. This agreement is under great pressure because of the economical crisis in KEDO partners Japan and South Korea. In August 1998 US intelligence services claim to have detected a huge secret underground nuclear complex 40 km north of the Yongbyon nuclear site. Fears that the country restarted its nuclear weapons program were further raised by the launching of a long-range missile.

Besides France **Japan** is generally seen as a stronghold for nuclear power. That is changing too. Locations for new reactors are very hard to find. Currently 35% of the electricity is produced by 54 nuclear units. In 1997 two reactors started commercial operation and only one is under construction: Onagawa-3, planned to start operation in 2002. More reactors are planned but, even according to the IAEA construction has not been started. A ministerial "Outlook for Long-Term Energy Supply and Demand" (June 1998) states the country will construct 21 reactors until 2010. Severe accidents in the last years and the attempts by the nuclear industry to keep them secret or mislead the public on the dangers and consequences, was a blow to public acceptance of nuclear energy. The Monju breeder reactor is still shut down due to the December 1995 accident, and is endangering the whole Japanese breeder program.

China has one domestically engineered nuclear reactor operating at Qinshan and two French-designed reactors at Daya Bay near Hong Kong. The Daya Bay plants have already had a rocky history. By August 1986, before construction had even started, more than 1 million of the 5.5 million Hong Kong residents (now part of China) had signed a petition calling for the cancellation of the project. Fears were heightened when, five weeks into construction, engineers noticed that more than half of the vertical reinforcing steel in the foundation had been left out. Adjustments were made, but confidence in Daya Bay was not to recover. The reactors finally came on-line in 1993 and 1994 (three and four years later than originally planned), and they have since suffered numerous operating problems. Despite high costs and technical problems, China has again outlined ambitious new goals, forecasting eight new reactors by 2005, and a total nuclear capacity of 20,000 MW by 2010. In 1994, China began work on two domestic reactors and signed a memorandum of understanding with Canada's AECL to begin negotiations on a sale of two reactors. China placed orders for four additional reactors with French and Russian vendors in 1995. Under pressure of the (nuclear) industry US president Clinton lifted the ban on economical activities in China for US companies in 1997. US companies are claiming there is a possible US\$50 billion nuclear market in China. Although much reports are published on possible orders, signed agreements are still scarce.

Elsewhere in Asia, **Thailand** retreated in 1994 on its plan to order as many as six reactors. The OAEF (Office for Atomic Energy for Peace) signed a contract with General Atomics for the construction of a 10MW research reactor, but opposition is vehement.

For a long time **Indonesia** continued to move slowly on a long anticipated reactor order to be located near the dormant volcano of Mount Merapi on Java. However, in August 1997 the government announced an indefinite deferral. In June 1997, Habibie, long-time advocate of nuclear energy and now the successor of president Suharto (but at that time minister of Research and Technology) had to accept a World Bank report claiming the country did not need nuclear power.

The **Philippines**, meanwhile, spent US\$2.2 billion on the Bataan plant between the late 1970s and the mid-1980s. The plant never opened, due to technical problems and bribery that took place during its construction under the dictatorship of Ferdinand Marcos. The plant's builder, Westinghouse Electric, was banned from doing business in the Philippines until December 1995 because of the bribery. Over the last years, the government, supported by the IAEA, launched public acceptance programs promoting nuclear energy. In December 1996, the Department of Energy revealed ten sites for the construction of nuclear plants.

Despite its strong scientific infra-structure, technical delays and cost overruns have stalled **India's** nuclear program. By the early 1990s, the government cut its goal of 10,000 MW of nuclear power by the year 2000 to 6,050 MW. Yet by the end of 1997, the rated capacity of the country's 10 reactors totalled only 1,695 MW, contributing less than 1 percent of India's commercial energy. The domestically-designed reactors' performance averaged only 28 percent of rated capacity in 1994, the lowest level of any country in the world. In 1997 the overall capacity factor had increased to 41 %, still one of the lowest in the world. Even if completed, the four additional units under construction would yield only 808 MW of new power, for a total of 2,503 MW, far below the government's projection. In 1998 construction on Kaiga 1 & 2 and Raps 3 & 4 seems to be frozen due to financial problems. In 1994 a 130-ton slab of the containment dome collapsed at a reactor under construction at Kaiga, increasing doubts about the safety of India's ten operating reactors.

After the 1974 nuclear test, India again conducted several nuclear test in 1998, triggering a reaction by neighbouring **Pakistan**. With help from China, Pakistan's Chessnupp-1 reactor is still under construction and is planned to start operation in 1999.

Although Asia remains the last bastion of nuclear growth in the world, the reality differs much from the expectations.

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