Nuclear Threat
in the
Eastern Mediterranean

The Case Against Turkey's Akkuyu Nuclear Plant

by
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Executive Summary

In December 1996, the Turkish state electrical utility TEAS invited bids from foreign reactor vendors for the construction of a 100% financed nuclear power station to be built at Akkuyu Bay on Turkey's Mediterranean coast. Three nuclear vendors are bidding to build the plant: Atomic Energy of Canada Limited (AECL); Nuclear Power International (NPI, a partnership between Siemens of Germany and Framatome of France); and Westinghouse/Mitsubishi (UK/USA/Japan).

Ironically, Turkey's latest attempt to start a nuclear program comes just as most of the developed world has stopped building new nuclear plants and has opted for cheaper, cleaner, and safer generating options such as renewable energy and high efficiency natural gas. Nuclear power is plagued by high cost, erratic performance, endemic technical problems, the risk of catastrophic accidents, and environmental problems such as routine radiation releases and radioactive waste management. World nuclear power use is expected to peak in 2002, and then begin a period of sustained and permanent decline. Reliable independent cost studies show that nuclear power plants are about twice as expensive to build and operate as high-efficiency natural gas generating plants. Canada has been forced to temporarily shut down one-third of its own nuclear power reactors because of poor performance, bad management and safety problems. CANDU reactors have the worst performance among competitive reactor designs, yet AECL is trying to sell this flawed technology to countries in the developing world.

Turkey's state utility TEAS vastly overestimates electricity demand over the next twenty years, and does not take into account the effects of electricity sector restructuring. As electricity prices rise to reflect the phase-out of historic subsidies, demand will be moderated. Private sector projects will easily meet new demand without requiring an expensive and risky nuclear power plant. An Integrated Resource Plan can determine the right balance of energy efficiency and renewable energy technologies, which are cheaper, cleaner and safer than nuclear power. Turkey has the historic opportunity to 'leapfrog' ahead of other countries with efficiency programs and renewable energy development, and by avoiding the disastrous mistake of building nuclear power plants in the first place.

Turkey has made five attempts to start a nuclear power program, beginning in the 1960s. The selection of the winning nuclear vendor to build the Akkuyu plant was first supposed to have been made in June 1998. Between then and April 2000, the selection announcement was delayed at least 8 times. There has been increasing opposition in Turkey to the proposed nuclear plant at Akkuyu Bay. That opposition includes local citizens who depend on the land and the sea for their livelihoods, as well as members of the intelligentsia and nuclear establishment itself.

Some of Turkey's most prominent earthquake experts are demanding a halt to the nuclear plant until further research is conducted on the Akkuyu area. The death of over 18,000 people in the Izmit earthquake is a tragic testimony to the human cost of poor planning and inadequate regulation. The Turkish government and the nuclear vendors are conspiring to cover up the real earthquake risk at the Akkuyu site. An earthquake is the most likely cause of a catastrophic nuclear accident at Akkuyu. Such an accident could have devastating consequences for the 165 million people in the eastern Mediterranean region. The Akkuyu nuclear plant, if built, will also aid in the extinction of one of the world's most critically endangered species, the Mediterranean Monk Seal, of which there are only 50 to 100 individuals left in Turkey.

The dark underside of nuclear power has always been its potential for nuclear weapons proliferation, either through the production of plutoniu -- an inevitable byproduct of reactor operation -- or through the transfer of sensitive nuclear information, technology and materials. Turkey's nuclear program will fan the flames of the nuclear arms race in the Middle East. Turkey has also been implicated in nuclear arms aid to Pakistan. An earlier attempt to build an Argentinean-designed reactor was likely aimed at plutonium production for nuclear weapons. Evidence of nuclear smuggling based in Turkey, and Turkey's push for its own nuclear fuel capability and indigenous reactor design, all point to possible nuclear weapons

development. The support of prominent Turkish citizens for nuclear weapons development lends credence to this evidence.

Turkey has a long history of gross human rights abuses, which include systematic widespread torture and murder of prisoners in custody; death squad murders; disappearances; restrictions on freedom of speech; and incommunicado detention without legal representation. Despite the capture of PKK leader Abdullah Ocalan, and his ceasefire call, human rights improvements have been minimal. Incidence of torture actually worsened in 1999 as compared to the previous two years. Restrictions on free speech and overt political repression have continued despite pressure on Turkey to meet western standards in order to join the European Union.

Turkish political history over the last 40 years has been characterized by a series of unstable governments, interrupted at intervals by four military *coups d'état* in 1960, 1971, 1980, and most recently in June 1997, when the government of Prime Minister Necmettin Erbakan, was forced out of office. Allegations of corruption at the highest levels have added to this political instability, which has been accompanied by economic instability. Inflation has averaged more than 80% per year over the last ten years, and the national debt is over $100 billion (US). It remains to be seen if the current $4 billion (US), three-year anti-inflation program sponsored by the International Monetary Fund will succeed. Five similar programs in the 1990s failed, and many Turks believe that the cure may be worse than the disease.

Financially, the Akkuyu deal carries risks for both the vending countries and Turkey. In Canada, the government is prepared to provide $1.5 billion (CDN) in government funds to finance the Canadian component (35%) of AECL's bid. The governments of AECL's other partners will be providing funds through their respective state export/import banks. Similar arrangements will take place in other vendor countries. The $3 billion (US) deal is too big and too risky for commercial banks to even consider making the loans. This deal is also a problem for Turkey, where the treasury department has recently stalled the deal because it does not want to provide a sovereign (state) guarantee for the loans. Westinghouse has said that it is willing to proceed without a Turkish guarantee (at least initially). It is not clear if the other vendors are willing to do likewise.

There are many good reasons why the nuclear vendors and their governments should withdraw their bids to build the Akkuyu nuclear plant. Similarly there are many good reasons why the government of Turkey itself should stop the Akkuyu project. Simply put, nuclear power is an outdated technology that is very expensive, and carries real safety, environmental, and security risks. Renewable energy, conservation programs, and high efficiency natural gas plants are cheaper, cleaner and safer. A nuclear power program will only interfere with the hard road ahead for Turkey in building a sustainable energy future, healing its economy, democratizing its political system, and improving its human rights record.

1. Introduction

This study surveys a range of issues relating to Turkey's proposal to build a nuclear power plant at Akkuyu Bay on the Mediterranean coast north of Cyprus. It is ironic that as Turkey considers purchasing nuclear power reactors from Canadian, European or US vendors, these countries have put their own nuclear power programs on hold.

The arguments being made by the Turkish state utility TEAS and its supporters in the nuclear lobby are simplistic at best. Without conducting a proper comparison of demand management and supply alternatives, they are asserting that a nuclear power plant at Akkuyu will be needed, and will be cost effective. There is evidence that it will not be needed, and there is proof positive that it would not be cost effective (see: "The Turkish Electricity Sector" and "The Economics of Nuclear Power").

Then there are the safety and environmental concerns about nuclear power. In the post-Chernobyl world, it is shocking that the Turkish government pretends there is a "guarantee" against a catastrophic accident (see: "Nuclear Reactor Hazards"). A review of the hazards associated with the CANDU reactor illustrates some of the risks of nuclear power. That is not to suggest that other reactor designs are safer. The level of risk associated with the Pressurized Water Reactor (PWR) designs offered by NPI and Westinghouse is roughly similar to that of the CANDU reactor. It is simply that the author is better acquainted with Canadian nuclear technology. Information is presented about the environmental impacts of CANDU reactors in the same spirit (see: "CANDU Reactors: Environmental Impacts"). Similar studies of environmental impacts for Westinghouse and NPI PWRs could have been conducted.

CANDU performance is another matter. There is no doubt that CANDU performance has been consistently worse than both Pressurized Water Reactors (PWRs) and Boiling Water Reactors (BWRs), which are the world dominant reactors. (See: "CANDU: The Worst Competitive Reactor Design"). However, it is *not* intended to suggest that therefore Turkey should opt for the Westinghouse or NPI bids. While PWR performance is significantly better on average than CANDU reactors, similar safety, environmental, economic and proliferation concerns apply to PWRs.

Turkey has had a long-standing on-again, off-again love affair with nuclear power that began in the 1960s (see: "The Turkish Nuclear Program"). It has been Turkey's good fortune that it was unable to proceed with the proposals spearheaded by a small but influential band of nuclear technocrats. Many of the countries that opted earliest for nuclear power, such as the United States, Canada, and Germany, are now extricating themselves from their nuclear commitment at great cost. Historically, nuclear power needed massive state support to get started, and it has never delivered on the promise that it would be 'too cheap to metre'. In fact, nuclear power has been the single most expensive form of electricity generation that the world has known. In the new international era of de-monopolized electricity generation, the market has passed judgement on nuclear power, and found it wanting.

The issue of earthquake risk at the Akkuyu site has been controversial from the start, but the colossal disaster of the Izmit earthquake on August 17, 1999 understandably focussed public concern on this issue. Eminent earthquake experts pleaded with the government to halt development of the nuclear plant pending further geological research, but these pleas have been ignored. There is little doubt that the earthquake qualification set by TEAS for Akkuyu is grossly inadequate. (See: "Earthquake Risk at Akkuyu") The nuclear vendors are complicit with the Turkish government in concealing the real earthquake risk at Akkuyu.

The risk of proliferation is a difficult issue because it strikes at the myth of the peaceful atom -- a founding principle of the nuclear power industry. It is not hard to see that the United States does not entirely trust the safeguards against nuclear weapons proliferation administered by the International Atomic Energy Agency (IAEA). The evidence is in US opposition to the sale of nuclear power reactors to Iran. Just a few years ago, the United States also moved to prevent the sale of reactor technology from Argentina to Turkey,

and reportedly instituted a secret embargo on the sale of enriched uranium fuel to Turkey (see: "Nuclear Weapons Proliferation"). At the time, Turkey was a signatory of the Non-Proliferation Treaty, just as it is today. However, while political motivations change, the proliferation risk remains. Turkey is clearly headed towards nuclear fuel cycle independence that will make even those dubious safeguards irrelevant. The CANDU nuclear reactor is particularly amenable to nuclear weapons production (see: "The CANDU: A Proliferation-Prone Reactor").

The threat to the Mediterranean Monk Seal by the Akkuyu nuclear plant is a particularly poignant and tragic aspect of the proposal (see: "The Monk Seal"). The Monk Seal is one of the most critically endangered species in the world, with an estimated population of only 50 to 100 seals on the entire Turkish coastline, including the Black Sea, Aegean, and Mediterranean. There is a small colony in the Akkuyu area, which uses Beshparmak Island in the mouth of Akkuyu Bay (which is a relatively small bay). The government has protected the island, but not surprisingly, has failed to include the shoreline in the protected area. There is little doubt that between the increased ship traffic and entrapment in the plant's cooling water intakes, the Akkuyu nuclear plant will kill off this small but invaluable remnant seal colony.

There are also a variety of financial risks associated with the $3 billion (US) Akkuyu nuclear deal. Because of the size of the loans and the risks of nuclear power, private sector financial institutions are unwilling provide financing. Thus nuclear project financing has been left up to governments and their state export/import banks, in the respective nuclear vendor countries (see: "Economic Instability" and "Financing the Akkuyu Deal"). The announcement in spring 2000 by the Turkish treasury department that it could not supply a guarantee for Akkuyu loans has created a new crisis for the deal.

Turkey is infamous for its human rights violations. Human rights problems have largely originated with the civil struggle over the Kurdish fight for cultural and political independence, and have been aggravated by a weak democracy and military domination. Despite the capture of Ocalan and his unilateral ceasefire declaration on behalf of the PKK, human rights improvements have been slow in coming. The government has certainly made no diplomatic move to allow official use of the Kurdish language or to grant regional autonomy for the Kurds in their homeland in south-eastern Turkey. Instead the Kurdish political party has been harassed as has the Islamic party. Torture apparently continues unabated (see: "Human Rights in Turkey"). The question is whether other nations should be engaging in nuclear trade with Turkey while gross human rights violations continue.

Finally, it is helpful to review some recent Turkish political history to understand the international and national intrigue that invariably surrounds the sale of nuclear power plants (see: "The Current Political Situation in Turkey"). In many ways, Turkey has a vibrant democracy, and lively media. But the military loom very large in the background. The media may be active, but the boundaries of permissible debate are very clear, and self-censorship is very common. If the boundaries are transcended, then newspapers or TV stations are shut down. Elections may be hard-fought, and there are many political parties, but no party can run without the consent of the military. So in June 1997, the government was forced to resign, the Prime Minister was banned from politics, and his party was made illegal. All without tanks in the streets. Such is democracy in Turkey.

Corruption at the highest levels has been a national scandal. The implication of former Prime Minister Mesut Yilmaz in a scandal connected to organized crime resulted in Bulent Ecevit taking over as Prime Minister in January 1999. But then Yilmaz had only been appointed in charge of a 'caretaker government' after the duly elected government had been forced out by the military. Political instability and economic instability have been linked, as foreign debt has mounted to over $100 billion, and inflation has raged at an average 80% per year over the last decade (see: "Economic Instability"). This is the background to Turkey's tortuous 40 year history of trying to initiate a nuclear power program.

2. The Demise of Nuclear Power

Long touted as the energy source of the future, nuclear power can now be confirmed as a technology in decline. Around the world, nuclear power grew by more than 700% in the 1970s, and 140% in the 1980s, but only about 5% in the 1990s[1] , when it went from being the world's fastest growing form of energy to the slowest. The Worldwatch Institute has suggested that the world's nuclear generating capacity will reach a peak by 2002 at the latest, and will then begin a period of sustained decline.[2] The United States Department of Energy, in its long-term forecast for nuclear power world-wide has suggested that under its low growth scenario, nuclear power capacity will decline 49% between 1997 and 2020.[3]

The market for nuclear power plants has evaporated in most of the developed world. In Canada, there have been no new reactor orders since 1974.[4] The former Ontario Hydro[5] proposed a massive nuclear expansion in 1989, for up to fifteen 881 MW reactors at four stations, but after more than three years of public hearings, this ill-considered scheme completely collapsed in 1992-93. The introduction of competition to electricity generation in Ontario in 2000 means that there is almost no chance of any new nuclear power plants ever being built again, mainly because of their high cost. The debate in Canada is no longer about building new nuclear plants, but rather about when to shut down the old ones.

Ontario Hydro (the generating wing of which is now Ontario Power Generation) announced on August 13, 1997 that it would temporarily shut down its oldest seven reactors for reasons of poor performance and safety concerns.[6] This includes four 515 MW reactors at the Pickering "A" nuclear station, just east of Toronto, and three 848 MW reactors at the Bruce "A" nuclear station on the shore of Lake Huron near the town of Kincardine. Ontario Hydro had already shut down one reactor at the Bruce "A" station in 1995. Ontario Hydro also shut down Canada's last operating heavy water plant located at the Bruce site. CANDU reactors need large amounts of heavy water for both coolant and moderator, and permanent shutdown of Canada's only remaining heavy water plant may have serious implications for future CANDU sales.

The four Bruce "A" reactors lasted less than half of their expected 40-year lifetimes, before being shut down for long-term repair work. The Pickering "A" reactors lasted only 25 years, despite having been re-tubed at a cost of $1 billion (Cdn) following a disastrous pressure tube break at Pickering reactor #2 in 1983.[7] The shutdowns left Ontario Power Generation with 12 reactors in operation -- four at the Pickering "B" station; four at the Bruce "B" station; and four at the Darlington station. The closure of eight reactors is the largest single nuclear long-term shutdown by any nuclear utility in the world.

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1. Worldwatch Institute, "Nuclear power nears peak", *News Alert*, March 5, 1999.
2. Christopher Flavin & Nicholas Lenssen, "Nuclear Power Nears Its Peak", *World Watch*, July/August 1999, p. 36.
3. US Department of Energy, *International Energy Outlook 1999*, p. 77.
4. New Brunswick Power's Point Lepreau station (one 635 MW (net) reactor) was ordered in 1974, and began commercial operation in 1983. Ontario Power Generation's Darlington Nuclear Station (consisting of four 881 MW (net) reactors) was ordered in 1973, although the first reactor (Unit 2) did not begin commercial operation until 1990.
5. In 1998, the Ontario government passed legislation which divided Ontario Hydro into several entities, the two main ones being Ontario Power Generation (including all of the generating facilities) and Ontario Hydro Services Company, (including all of the transmission network as well as the rural retail system). These two utilities remain owned by the provincial government, although electricity generation is being opened to competition in 2001.
6. Ontario Hydro News Release, *Ontario Hydro moving ahead on major overhaul of its production facilities*, August 13, 1997. The four Pickering reactors were shut down December 31, 1997. The three Bruce A reactors were shut down March 31, 1998. The eight shut down reactors began commercial operation on the following dates: Bruce 1, September 1977; Bruce 2, September 1977; Bruce 3, February 1978; Bruce 4, January 1979; Pickering 1, July 1971; Pickering 2, December 1971; Pickering 3, June 1972; Pickering 4, June 1973.
7. CANDU reactors, unlike Light Water Reactors, have their fuel contained in hundreds of pressure tubes that run horizontally through the reactor vessel. These tubes are subject to high levels of stress, and may require replacement after twenty years. The replacement of the tubes in the four Pickering A reactors cost more than the original capital cost of the plant.

Outside of Ontario, there are only two nuclear power reactors in Canada -- one operated by Hydro Québec (Gentilly-2) and one operated by New Brunswick Power (Point Lepreau). The Québec government declared a moratorium on nuclear reactors in the province in 1978. Hydro Québec has no plans to build more reactors, and is considering the early retirement of the one it has. Although there was discussion of building a second reactor at Point Lepreau, that possibility has quietly died, since the federal government is apparently not prepared to provide 100% financing.[8]

A *de facto* nuclear moratorium exists in the United States of America, where no new nuclear plants have been ordered since the 1979 Three Mile Island accident in Pennsylvania. Since 1996, there have been five reactors permanently closed.[9]

In the United Kingdom, the privatized utility, British Energy, announced in December 1995 that it was dropping all plans for nuclear expansion. The last nuclear power plant opened in Britain, Sizewell "B", went into service in 1995, at a cost of about $3,000 (US) per kilowatt of capacity -- about ten times the cost of a gas-fired plant.[10]

In Western Europe, nuclear expansion halted in the second half of the 1990s. Green parties with anti-nuclear policies have parliamentary representation in Austria, Finland, France, Germany, Italy, and Sweden. Italian voters adopted an anti-nuclear policy in 1987, shutting down three operating plants and stopping construction of a fourth. Austria banned nuclear power in 1978, leaving a plant completed but never used. Sweden has 12 reactors, but decided in 1997 to phase them out. The first shutdown took place on November 30, 1999, after the Swedish Supreme Court dismissed a final law suit by Sydkraft to keep the Barseback-1 reactor open. The second reactor at Barseback is slated to close by June 30, 2001.[11]

In France, there has been aggressive state support for the nuclear industry, and 78% of electricity is generated with nuclear power. However, even there, the love affair with nuclear power is fading, as shown by the French government's decision in June 1997 to abandon the Superphénix breeder reactor.[12] In 1998, France put a moratorium on new reactor construction, and Green Environment Minister Dominique Voynet has called for the ban to be made permanent.[13] The Organization for Economic Cooperation and Development (OECD) has called on France to reduce subsidies to its nuclear industry and raise rates accordingly. The state electricity utility, Electricité de France (EdF) has a debt of about $30 billion (US).[14]

Nuclear plants in eastern Germany have been shut down, and the Social Democrat/Green coalition government elected in October 1998 has announced plans for the phase-out of the 19 reactors in the western states that currently produce about one third of the country's electricity. Negotiations for the terms of the nuclear phase out are continuing.

In eastern European countries, safety and closure of first generation Soviet-design reactors (VVER 440-230 and RBMKs) has been a key factor for accession to the European Union. Agreements have been reached under which eight reactors classified as dangerous and "un-upgradeable" will be decommissioned within a

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8. The Liberal New Brunswick government of Premier Frank McKenna, originally elected in 1987, was on record as saying that it wanted AECL to finance the entire cost of a second reactor: CP, "New Brunswick ponders second reactor", *Globe & Mail*, October 15, 1990, p. B6.
9. N. Lenssen & C. Flavin, 1999, *ibid.*, p. 36.
10. N. Lenssen & C. Flavin, "Meltdown", *World Watch*, May/June 1996, p. 25.
11. George Boehmer, "Across Europe, nuclear power on the way out", *AP (Fox News)*, January 2, 1999.
12. "Timing, manner of Superphénix death are not at all certain", *Nucleonics Week*, June 26, 1997, pp. 13-15.
13. N. Lenssen & C. Flavin, 1999, *ibid.*, p. 37.
14. N. Lenssen & C. Flavin, *ibid.*, p. 26.

decade. In November 1999, the Bulgarian government agreed to close the older Kozloduy-1 and -2 VVER 440-230 reactors before 2003, and the shutdown dates for the other two VVER 440-230s will be decided in 2002[15] (there are a total of six reactors at the Kozloduy plant). In addition, Slovakia will close two VVER-230 reactors (out of a total of four reactors) at its Bohunice plant by 2008.[16] Lithuania will close the Ignalina-1 RBMK reactor by 2005, but has said that it will not make a decision on the second Ignalina reactor until 2004. The European Commission has already said that it expects Ignalina-2 to be shut down in 2009.[17] The two 1500 MW reactors at Ignalina are similar in design to the Chernobyl reactors.

A long anticipated announcement was made in June 2000 that the Chernobyl nuclear station in Ukraine will be permanently closed on December 15, 2000, when the remaining Chernobyl-3 reactor will stop operating.[18] There were four 1000 MW RBMK reactors at Chernobyl. Unit 4 was destroyed in a catastrophic accident in 1986, Unit 2 was shut down in 1991, and Unit 1 was shut down in 1996. It is unclear if financing for completion of the unfinished Khmelnitsy-2 and Rovno-4 (K2/R4) reactors was part of the final agreement. Elsewhere in central and eastern Europe and the former Soviet Union or Commonwealth of Independent States (CIS), no new nuclear construction has started since economic reforms began.

It is mainly in Asia that some support for nuclear power remains. China and South Korea have had the most aggressive nuclear construction programs, however both have been affected by the long-lasting Asian financial crisis that hit in 1997. Up until 1999, China was planning a massive expansion of nuclear power to 20,000 MW by 2010. However, in 1998, Premier Li Peng, a strong supporter of nuclear power, was replaced by Zhu Rongji, a nuclear skeptic who has slowed down the nuclear expansion plans.[19] AECL sold two CANDUs to China in 1996 which are currently under construction at Qinshan, however, further CANDU sales now seem unlikely. China seems to be moving towards production of a standardized PWR, probably in a partnership arrangement with Framatome, Mitsubishi Heavy Industries (MHI) or Westinghouse.[20] Currently, in addition to the two CANDUs being built by AECL at Qinshan, Framatome is building two PWRs at Ling Ao, and Russia is building two VVER-1000 reactors at Lianyungang.

The Korea Electric Power Corporation (Kepco -- the state electrical utility) has been delaying a decision since 1996 to build up to four new reactors. At issue is a plan to add 12,600 MW of nuclear capacity between 2000 and 2010.[21] The Korean policy of subsidizing electricity prices is forcing up Kepco's debt level, and is making a proposed partial privatization more difficult. In turn, privatization at Kepco, and its subsidiary Korea Heavy Industries & Construction Company Ltd. (KHIC or Hanjung) may make a high-cost nuclear expansion less likely.

AECL is in competition with ABB-Combustion Engineering to supply additional reactors to South Korea. At issue is whether South Korea will continue to build both American-style Pressurized Water Reactors (PWRs) as well Canadian CANDU heavy water reactors. It now appears unlikely that AECL will be able to win this race (if indeed *any* reactors are built). ABB-CE has already transferred technology for the

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15. Ariane Sains, "Early nukes shutdowns pay off as eastern nations get EU entree", *Nucleonics Week*, December 16, 2000, pp. 8 & 9.
16. "European nuclear reactor phase out begins", *Environment News Service*, December 1, 1999.
17. Ariane Sains, *ibid.*.
18. World Information Service on Energy, "Chernobyl will finally be closed permanently", *News Communique 531*, June 9, 2000.
19. Mark Hibbs, "China confirms Zhu will slow nuclear buildup in Tenth Plan", *Nucleonics Week*, May 13, 2000, pp. 1,10, & 11.
20. Mark Hibbs, "Beijing orders nuclear sector to revamp PWR development plan", Nucleonics Week, January 6, 2000, pp. 4 & 5.
21. Mark Hibbs, "Kepco's debt position threatened by power subsidies, experts warn", *Nucleonics Week*, March 9, 2000, pp. 1 & 12.

CE System 80 1,300 MW PWR design. AECL and the Canadian government are apparently playing hardball on the deal, however... American sources have said the Canadian government has threatened to cut back on Korean imports, if Kepco doesn't order CANDU reactors.[22]

22. Mark Hibbs, "Chang ouster may delay award of reactor contracts by KEPCO", Nucleonics Week, May 6, 1999, p. 9.

3. Nuclear Reactor Hazards

There are several reasons for the demise of nuclear power. Safety issues have been prominent in the public mind since the accident at Three Mile Island in the United States in 1979, and the Chernobyl nuclear catastrophe in Ukraine in 1986. There is always a chance of severe accidents occurring when reactor systems fail to operate as designed and when operators make mistakes. There is also the possibility of externally caused accidents, for example, by earthquakes that nuclear plants were not designed to withstand.

A severe accident at a nuclear station located at Akkuyu Bay could cause widespread radioactive fallout affecting many countries. A study by the Centre for Resource and Environmental Studies (Australian National University), commissioned by Greenpeace, used meteorological data for 1993, which is in general agreement with long-term average wind patterns in the region, to model the movement of radioactive contaminants from the Akkuyu area. The report does not make assumptions about the probability or magnitude of a radiation release, but rather focuses on the expected patterns of long distance transport of contaminants.

The study concludes that Turkey itself and the eastern Mediterranean region would receive fallout, and that the more distant countries most likely affected will vary from summer to winter. In summer, the north east trade winds would tend to carry contamination over the Middle East and into North Africa. In winter the prevailing Westerlies would carry fallout over the Middle East, including Iraq and Iran, as well as countries in the western part of the former Soviet Union. Central European countries to the west have a substantially lower risk of receiving fallout, according to the report.[23]

A report entitled *Radiological Impact Assessment in the South-Eastern Mediterranean Area*, undertook to estimate the public health and environmental consequences of a catastrophic nuclear accident at Akkuyu, assuming that a CANDU 6 reactor were constructed at that location. The authors rely partly on the results of a probabilistic risk assessment conducted by Ontario Hydro for the Pickering "A" nuclear station in Canada, called *Pickering "A" Risk Assessment (PARA).* The report analyzes the collective dose to human populations over 70 years for a large area in the eastern Mediterranean, focusing on long-term health impacts including cancer incidence and cancer mortality. The study area for the analysis included populations from 50 to 1,250 kilometres away. Various established weather patterns were used to project the dispersion of contaminants for three CANDU accident scenarios. The results indicate that total cancer cases caused by a severe accident would be over 3,500 and total cancer deaths over 2,200, when results are averaged over all directions and weather patterns.[24]

Several questionable assumptions were made by the authors, including that there would be no public exposure to radioactivity from the consumption of contaminated food, and that no credit would be taken for evacuation or sheltering following an accident, nor for the use of stable iodine to counteract the effects of exposure to radio-iodine.[25] Exposure was assumed to occur from fallout from radioactive clouds, deposition of radioactivity on the ground, on skin and on clothing, from inhalation and also from resuspension of contamination over time.[26]

The report almost certainly underestimates the human health impacts of a CANDU reactor accident at

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23. John Taylor, Stuart Ramsden, *An Analysis and Visualization of the Risk Associated with Potential Failure of Nuclear Reactors in Turkey*, Centre for Resource and Environmental Studies, Australian National University, 1998 http://anusf.anu.edu.au/anusf_visualization/viz_showcase/John_Taylor/Turkey

24. F.K. Vosniakos *et al.*, *Radiological Impact Assessment in the South-Eastern Mediterranean Area*, Technological Educational Institution of Thessaloniki, 1999, p. 171.

25. F.K. Vosniakos *et al.*, *ibid.*, pp. 156-158.

26. F.K. Vosniakos *et al.*, *ibid.*, p. 171.

Akkuyu Bay location by a considerable margin. The *Pickering "A" Risk Assessment* was reviewed by Canada's nuclear regulatory agency, the Atomic Energy Control Board (AECB), which determined that PARA had serious flaws. The AECB stated, "PARA suffers from a mix of very conservative and some optimistic assumptions which introduces uncertainty on the numerical results and on the ranking of contributors to severe [reactor] core damage and fission products release".[27]

A very significant problem with PARA in relation to its applicability to the Akkuyu Bay study is that PARA does not model so-called "common-cause events" such as earthquakes. The AECB did not accept Ontario Hydro's reasons for ignoring this class of accidents[28], which have the potential to simultaneously damage multiple process and safety systems. Furthermore, the AECB did not even review the public risk analysis section of PARA, due to lack of confidence in the validity of the so-called external plant release categories (EPRC) results.[29] These are the assumptions about the amount of radiation released under different accident categories in the risk assessment. Another serious problem with probabilistic risk assessments is that the models are not able to accurately define the impact of complex human errors, sabotage, or war.[30]

Another reason that the report likely underestimates human health impacts of a CANDU reactor accident at Akkuyu Bay is that the PARA assumes only 15% of the inventory of iodines and cesiums, and 4% of telluriums will be released from the reactor core during an accident.[31] Optimistic assumptions about the effectiveness of CANDU safety features are unwarranted given the operating experience at CANDU stations in Ontario, and specific deficiencies in the assumptions about the effectiveness of the CANDU 'defence-in-depth' design philosophy.[32] The study team modified the assumptions about the releases from a CANDU accident, due to doubts about how realistic the PARA estimates are. They chose to peg the amount of fission product releases at the same percentage as would be released from a pressurized water reactor.[33]

Radiological Impact Assessment in the South-Eastern Mediterranean concludes that ocean ecosystems will be at risk from damage due to the potential for large spills of radiation into the ocean from the proposed nuclear plant at Akkuyu Bay. The report notes that the sediment becomes a long term source of exposure, which is relevant for species which live in or near the sediment layer. The Mediterranean Monk Seal, *Monachus monachus*, is noted as being the most vulnerable aquatic species, due to the fact that it is mammalian and therefore more sensitive to radiation damage. [34]

By way of comparison, a report by the proponent of the Akkuyu nuclear plant, the Turkish state utility TEAS, also draws unsubstantiated conclusions concerning severe nuclear accident risks at Akkuyu:

> "Nuclear technology imposes standards on the design of nuclear power plants such that, in the event that an improbable and hypothetical catastrophic accident happens, many safety systems come into operation to protect the public from harmful radiation. With the help of these systems it is guaranteed that the amount of radioactivity that would be released from the disabled reactor does not exceed

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27. Atomic Energy Control Board, *AECB Review of Pickering A Risk Assessment (PARA)*, AECB file #680556, December 1998, p. 1.
28. Atomic Energy Control Board, *ibid.*, December 1998, p. 5.
29. Atomic Energy Control Board, *ibid.*, December 1998, p. 7.
30. Hirsch, Einfalt, Schumacher & Thompson, *IAEA Safety Targets and Probabilistic Risk Assessment - State of the art, Merits and shortcomings of PRA*, Greenpeace, August 1989, pp.8-9.
31. F.K. Vosniakos *et al.*, *ibid.*, p. 73.
32. Irene Kock, *Comments to the Canadian Nuclear Safety Commission on the Draft Screening Report on the Pickering "A" Nuclear Station Restart Proposal*, Nuclear Awareness Project, June 2000.
33. F.K. Vosniakos *et al.*, *ibid.*, p. 73.
34. F.K. Vosniakos *et al.*,*ibid.*, 1999, p. 244.

permissible limits."[35]

In fact, there is no possible "guarantee" for any fission reactor design against a catastrophic accident. While the probability of a catastrophic accident is small, it is certainly a real possibility, as the Chernobyl accident has demonstrated beyond any doubt. As has been noted above, the CANDU safety record in Ontario illustrates that severe accident consequences have likely been significantly underestimated in the study by Vosniakos *et al.*.

The type of accident considered by TEAS as the most severe hypothetical scenario at a CANDU reactor is known as a *small* loss of coolant accident (LOCA) with reliable operation of the containment system. This is definitely not a conservative approach to risk assessment, as other more severe accident scenarios cannot be ruled out, including accidents involving loss of containment and the subsequent uncontrolled release of radiation from the reactor core. The TEAS report calculates the short term dose to populations in close proximity to the Akkuyu site for the purpose of establishing an appropriate size for an 'exclusion zone' where no residency would be allowed, and a 'low population zone', with the objective of protecting near-by residents from immediate effects of radiation exposure. The report concludes that an exclusion zone of 1.5 kilometre radius and a low population zone of 10 kilometres would be sufficient to reduce short term doses to near-by populations to within accepted standards for nuclear accident situations. The TEAS report does not consider long-term health impacts or the consequences to populations beyond the immediate 10 kilometre radius area of Akkuyu Bay.

In Canada, there have been a number of serious nuclear accidents which have exposed the myth of superior CANDU safety. CANDU reactors and their prototypes have experienced hundreds of serious accidents, including some of the world's worst accidents:

- In 1952, the NRX (a 40 MW reactor that was used to supply plutonium to the US military) at AECL's Chalk River site in Ontario, had the world's first major nuclear accident. Fuel melting, followed by a series of explosions destroyed the reactor core, and there was a substantial release of radioactive materials, including a million gallons of contaminated water.

- In 1958, an irradiated metallic fuel element at the NRU (another reactor at Chalk River which also supplied plutonium to the US military) broke off and caught fire after being removed from the reactor. 600 men (mostly Canadian soldiers) were involved in the clean-up of the radioactive contamination.

- On August 1, 1983, a pressure tube in Pickering Reactor #2 had a one metre rupture due to embrittlement, dumping primary coolant into the reactor building. Ontario Hydro had previously claimed that such as accident could not happen -- that pressure tubes would `leak before they broke'. This accident resulted in the retubing of all four reactors at the Pickering "A" Nuclear Station, at a cost of about $1 billion (Cdn, dollars of the year) -- more than the original capital cost of the station.

- Pickering reactor #1 had a "power surge" in November 1988 caused by operator error that resulted in damage to 36 fuel bundles. Ontario Hydro had not predicted that this type of accident would cause fuel damage.

- In January 1990, a computer problem caused a Loss of Coolant Accident resulting in a 12 tonne leak of heavy water from a fuelling machine on Bruce reactor #4.

35. Turkish Ministry of Foreign Affairs, *Basic Facts Concerning The Proposed Nuclear Power Plant at Akkuyu in Turkey*, undated, http://www.mfa.gov.tr/grupa/an/akkuyu.htm

- On September 25, 1990, Pickering reactor 2 had a "severe flux tilt", with large power shifts in the reactor core, caused in part by the CANDU design. Staff spent two days trying to stabilize the reactor core before shutting it down.

- On August 2, 1992, a tube-break in the moderator heat exchanger on Pickering Reactor #1 dumped 2,000 litres of heavy water contaminated with 2,300 trillion becquerels of radioactive tritium into Lake Ontario. It was the largest tritium release in CANDU history, forcing the shutdown of a nearby drinking water supply plant, and resulting in elevated tritium levels in drinking water along the north shore of Lake Ontario, including Toronto.

- On December 10, 1994, Pickering reactor 2 had a major Loss of Coolant Accident (LOCA). A pipe break resulted in a spill of 185 tonnes of heavy water. For the first time ever, at a CANDU, the Emergency Core Cooling System (ECCS) was used to prevent a meltdown, and 200 workers were involved in the clean-up. The reactor was not restarted until February 1996.

- In May 1995, a valve failure caused a 25 tonne leak of radioactive heavy water at Bruce Reactor #5. This accident involved the same equipment which caused the December 1994 LOCA at Pickering reactor #2.

- On February 19, 1996, about 500 tonnes of water spilled into the #6 reactor building when employees working on an Emergency Water Supply valve failed to isolate it from the system. An investigation revealed that safety equipment could have failed due to water damage, and both the primary and backup heat sinks were actually lost for a section of the reactor core. The accident blew a 30 kg. valve component 6 feet into the air, almost hitting a worker and water shot up to the reactor building dome.

- On April 15, 1996, Pickering reactor 4 had a heavy water leak from a heat exchanger that resulted in the release of 50 trillion becquerels of tritium into Lake Ontario. The level of tritium in local drinking water peaked at about 100 times the usual level.

There are also a number of 'generic' concerns about safety at CANDU reactors, which have been defined by the Atomic Energy Control Board as unresolved design problems or safety issues which apply to most or all CANDU reactors[36] ...

Hydrogen behaviour in the containment -- Following a Large Loss of Coolant Accident (LLOCA), there may be a risk of hydrogen combustion in the containment. The unresolved issue is whether hydrogen ignition systems can work effectively to burn off hydrogen and prevent an explosion.

Core cooling in the absence of forced flow -- Failure of the primary heat transport pumps to provide heat transport water for fuel cooling is a possibility in some accident sequences. There is an outstanding issue of whether passive circulation of coolant will be sufficient to prevent fuel from melting.

Assurance of continued nuclear power station safety -- Safety-related functions in nuclear power stations may not remain effective throughout the life of the stations. The Canadian utilities have yet to develop programs which effectively address the risks from nuclear station aging.

Post-accident filter effectiveness -- Filters may not be as effective as claimed by the industry during containment system venting following an accident. This could potentially result in unacceptable radiation exposure to downwind populations.

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36. Atomic Energy Control Board, "Canadian National Report for the Convention on Nuclear Safety", April 1999, AECB Catalogue # INFO-0690(E)

Reactor operation with a flux tilt -- The flow of neutrons can vary beyond the specified limits in various regions of the reactor core. This is known as a flux tilt, and it can lead to a loss of control and fuel melting. There have been numerous flux tilts at CANDU reactors. The regional overpower protection system may not be effective over the whole range of permissible operating conditions.

Best effort analysis of emergency core cooling system (ECCS) effectiveness -- The effectiveness of the ECCS has not been demonstrated for any CANDU nuclear power station to the satisfaction of the AECB. The ECCS is designed to add water to the core to prevent fuel from melting during an accident.

Impact of fuel bundle condition on reactor safety -- Fuel and pressure tube inspections at Ontario Hydro reactors in the late 1980s and early 1990s indicate that fuel bundle degradation may be beyond design assumptions, and that degraded fuel bundles may cause unanticipated accidents.

Molten fuel-moderator interaction -- Containment system failure caused by steam explosions can be expected if molten fuel contacts the moderator heavy water. The AECB claims that validation of computer models is still needed regarding the estimated damage that could be caused by the interaction of molten fuel with heavy water moderator in a meltdown situation.

Pressure tube failure with consequential loss of moderator inventory -- A spontaneous pressure tube rupture could result in the end-fitting being ejected or displaced. If the Emergency Core Cooling System was unavailable, then the moderator would be needed as a heat sink. However, the moderator liquid would have partially drained through the damaged end fitting, leading to a more severe accident.

Compliance with bundle and channel power limits -- There may be problems with compliance analysis and procedures for maximum channel and bundle power limits as set in the station operating licences.

Void reactivity uncertainty allowance in LOCA analyses -- Drastic increases in the rate of the nuclear chain reaction can occur if coolant does not circulate properly in the core, leaving a `void' (a steam bubble or air space). This inherent problem with all CANDU reactors is known as the Positive Void Reactivity Effect. It is a serious design flaw, shared by the Russian-designed RBMK reactor, which played an important role in precipitating the 1986 Chernobyl accident. Validation is still needed for assumptions about the power increase in the reactor core that will be caused by a Large Loss of Coolant Accident (LLOCA).

Moderator temperature predictions -- Validation is needed on assumptions about moderator temperature during LOCAs, since the moderator is assumed to provide a heat sink to prevent calandria tube failure.

Fire protection for CANDU nuclear power stations -- The AECB has required that all nuclear utilities undertake a fire safety assessment and upgrade fire protection measures in nuclear stations.

Feeder pipe fitness-for-service -- An unexpected reduction in the wall thickness of some outlet feeder pipes may be an issue with the potential to cause a loss of coolant accident if one or more pipes ruptures without warning. Feeder pipes bring high pressure heavy water coolant into and out of the reactor core, with one pipe attached to each end of each fuel channel assembly.

4. CANDU Reactors: Environmental Impacts

Even if a severe accident is avoided, routine radioactive pollution from CANDU reactors can lead to environmental degradation and an increased risk of public health problems. Radioactive contamination is impossible to see, smell or taste. The health effects of exposure may take years to show up, but can have deadly consequences, including increased rates of cancer and birth defects in down-wind and down-stream populations of animals and humans.

There are many radioactive pollutants from CANDU nuclear reactors. *Table 1* lists 29 radionuclides created in CANDU nuclear stations that are of environmental concern. These various radioisotopes emit different types of radiation at different energy levels, and cause varying degrees of biological harm.

Table 1. Radionuclides of Concern at CANDU Nuclear Stations

Activation Products*	Fission Products	
Tritium (H-3)	Strontium-89 (Sr-89)	Cesium-134 (Cs-134)
Carbon -14 (C-14)	Strontium-90 (Sr-90)	Cesium-137 (Cs-137)
Chromium-51 (Cr-51)	Yttrium-91 (Y-91)	Lanthenum-140 (La-140)
Manganese-54 (Mn-54)	Niobium-95 (Nb-95)	Barium-140 (Ba-140)
Iron-59 (Fe-59)	Ruthenium-103 (Ru-103)	Cerium-141 (Ce-141)
Cobalt-58 (Co-58)	Ruthenium-106 (Ru-106)	Cerium-144 (Ce-144)
Cobalt-60 (Co-60)	Iodine-129 (I-29)	Praseodymium-143 (Pr-143)
Zinc-65 (Zn-65)	Iodine-131 (I-131)	Neodymium-147 (Nd-147)
Zirconium-95 (Zr-95)	Xenon-133 (Xe-133)	Promethium-149 (Pm-149)
Silver-110m (Ag-110m)		
Antimony-124 (Sb-124)		

* Carbon-14 may also be produced from a number of nuclear reactions starting with oxygen-17 or nitrogen-14.

Source: Environment Canada, *Environmental Codes of Practice for Steam Electric Power Generation, Design Phase*, Report EPS 1/PG/1, March 1985, p. 23.

Tritium (^{3}H or T) is produced by the activation (irradiation) of deuterium (^{2}H) in heavy water. Because of the use of heavy water for both moderator and coolant in the CANDU reactor, tritium is one of the main radioactive pollutants emitted by the CANDU system. Other activation products are produced from metals in reactor material (for example Cobalt-60) and from corrosion products (for example iron-59). Most of the fission products noted in Table 1 are retained in the fuel bundles in the reactors, or subsequently in spent fuel storage.

The International Joint Commission for Great Lakes Water Quality[37] has noted that "The two main anthropogenic [human origin] sources [of radiation in the Great Lakes] are the fallout of military weapons

37. A bilateral Canada/United States Commission aimed at improving water quality in the Great Lakes.

testing and the generation of electrical power at nuclear power plants."[38] The Limited Test Ban Treaty in 1963 reduced the impact of atmospheric nuclear weapons testing significantly, and in the following thirty-five years the radioactive deposition from nuclear weapons has decayed significantly. Thus the impact of nuclear fuel cycle facilities in the Great Lakes Basin, as elsewhere, has increased proportionally as a source of radioactive pollution, resulting collectively in "...a significant contribution to the burden of radioactive materials in the environment."[39]

All of the radionuclides in *Table 1* may contaminate the heavy water that is used in CANDU nuclear plants for moderating and cooling. Because it is expensive, efforts are made to minimize the loss of heavy water, and to segregate and collect it when leaks and spills occur. However, despite these efforts, a significant amount of heavy water escapes. Thus, tritium, as well as other activation and fission products are routinely released into the air and wastewater from reactor buildings, decontamination centres, laundries, laboratories, etc.. There is a threat to clean air and clean water from normally operating nuclear plants, as well as fossil-fired plants. Loss of coolant accidents (LOCAs) produce large quantities of wastewater and air emissions. In the event of fuel bundle failure (melting, breakage or leakage) fission products escape to the primary heat transport circuit and can subsequently reach the environmental in even larger quantities.

Ontario Power Generation publishes radiological emissions data annually from nuclear plants at three sites: Pickering, Bruce and Darlington, reporting on fives categories of emissions to air: tritium oxide, elemental tritium, Noble Gases, Iodine-131, and Particulates. For water emissions, Ontario Power Generation reports on tritium oxide and Gross Beta/Gamma.[40]

Nuclear Awareness Project has documented uranium mining and refining emissions; thermal effluent (cooling water outflow); airborne radioactive emissions; waterborne radioactive emissions; low and intermediate level radioactive waste; and high level radioactive waste.[41] To examine life-cycle environmental impacts, 'front-end' emissions of the nuclear fuel chain, from the mining and refining of uranium would have to be considered, along with the back-end impacts of long-term radioactive waste management and reactor decommissioning.

4.1. Tritium

Since the release of large quantities of tritium is unique to the Canadian CANDU reactor among commercial power reactor systems, it is worth taking a special look at this pollutant. Tritium is a radioactive, cancer-causing form of hydrogen which forms as an unwanted by-product during CANDU reactor operation. It is a major pollutant released to the air and water in large enough quantities to build up in all parts of the local environment including surface water, vegetation, soil and groundwater. Tritium has a 12.3 year halflife, meaning that in 12.3 years, any given amount of tritium 'decays' into stable (non-radioactive) inert helium (a rare isotopic form, ^{3}He). Tritium emits beta radiation, and is relatively low energy (~5.7keV average). The beta radiation is not powerful enough to penetrate the keratin layer of the skin, but once it is absorbed, ingested or inhaled, it can cause harm to cells and genetic material. Tritium oxide, in the form of tritiated water (HTO) is about 1,000 times more dangerous (biologically effective) than elemental tritium, which is a

38. Nuclear Task Force, *Inventory of Radionuclides for the Great Lakes*, International Joint Commission, December 1997, p. 17.

39. Nuclear Task Force, International Joint Commission, *ibid.*, p. 17.

40. Ontario Hydro, *Annual Summary and Assessment of Environmental Radiological Data for 1997*, Technical Support Division Environment Department, April 29, 1998.

41. Irene Kock, *Nuclear Hazard Report 1991-1992: Waste Contamination and Safety at Ontario's Nuclear Facilities*, Nuclear Awareness Project, 1994, pp. 33-34.

gas (^{3}H or T).[42]

The Tritium Removal Facility (TRF) at the Darlington site in Ontario emits large quantities of elemental tritium, as opposed to the tritium oxide emitted from the nuclear power reactors. The TRF processes tritium-contaminated heavy water from all of Ontario Power Generation's nuclear reactors, using a cryogenic distillation process known as Vapour Phase Catalytic Extraction (VPCE). The pure elemental tritium is stored at the Darlington site and some is sold for commercial and pharmaceutical uses. The processed, de-tritiated heavy water is then returned to the nuclear reactor systems. While tritium oxide is about 1,000 times more dangerous, elemental tritium does carry its own risks and does convert to tritium oxide at a calculable rate after being released to the atmosphere.

Tritium oxide that is inhaled in air or ingested in liquid or food is virtually certain to be absorbed into the body. Tritium oxide can also be absorbed into the body through the skin. Ontario Hydro now assumes that the uptake of tritium oxide through skin absorption is equal to that through inhalation.[43] After absorption, tritium is distributed almost uniformly throughout the body, mixing with body water, resulting in a "whole body" radiation dose. The LD-50 (a dose acutely lethal to half of those exposed) for tritium oxide absorbed into the body is thought to be a 4 sievert dose. This dose is caused by about 200 gigabecquerels (i.e. 200 X 10^9 becquerels , or about 5.4 curies) of tritium oxide. Lesser doses, however, may increase the risk of cancer or birth defects.

Although tritium occurs naturally in small quantities through the effect of cosmic rays in the atmosphere, the operation of Ontario Hydro's reactors have raised the level of tritium in the Lake Huron and Lake Ontario significantly above the natural background level. Tritium travels everywhere that water does, since it is chemically similar to hydrogen and becomes part of water molecules.

Tritium pollution from nuclear plants is regulated directly by the Atomic Energy Control Board (AECB), which sets upper limits of allowable pollution for the specific radionuclides released to air and water. These levels are called Derived Emission Limits (DELs). DELs represent the amount of radioactive emissions the polluter estimates would result in a member of the public receiving a radiation dose of 1 milli-Sievert (mSv) per year, the current annual limit for public exposure to radiation from a nuclear facility.

The DELs set by the AECB for tritium (see *Table 2*) are extremely lax, and should be more strict. Despite very large emissions of tritium, Ontario Power Generation typically has no problem keeping its emissions within these huge limits.

Ontario Power Generation's approach to managing radioactive pollution (endorsed by the AECB) involves the ALARA principle (As Low As Reasonably Achievable - social and economic factors being taken into account). By contrast, the International Joint Commission on Great Lakes Water Quality (IJC) has championed the virtual elimination of hazardous substances at their source. This approach advocates "zero discharge" for persistent toxic substances, and can protect the broader ecosystem as well as public health by preventing avoidable exposures. The IJC has added radionuclides with a halflife greater than six months (which includes tritium) to its list of persistent toxic substances. The IJC has recommended that state and provincial governments "...incorporate those radionuclides which meet the definition of persistent toxic substances in their strategy for virtual elimination.".[44]

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42. Amory Lovins, Robert Sardinsky et al., *The State of the Art: Lighting*, Competitek Service of Rocky Mountain Institute, March 1988, p. 239.

43. Ontario Hydro, *Annual Summary and Assessment of Environmental Radiological Data for 1997*, p. 84.

44. Seventh Biennial Report on Great Lakes Water Quality, International Joint Commission on Great Lakes Water Quality, February 1994, Recommendation 12, p. 47.

Table 2. Annual Derived Emission Limits for Tritium at Ontario Hydro Nuclear Facilities

	Tritium to Air (TBq x 10^4)*	**Tritium to Water** (TBq x 10^4)
Bruce A	38.0	1.7
Bruce B	47.0	3.0
Darlington	21.0	5.3
Tritium Removal Facility **	730.0	
Pickering A	34.0	0.83
Pickering B	34.0	0.83

* Tbq = Terabecquerels. The prefix tera- indicates 10^{12} or trillion, so for example, the DEL for tritium to air for the Bruce B nuclear station is 47 trillion becquerels x 10^4 (10,000), or 470,000,000,000,000,000 becquerels.

** Ontario Hydro reports only on elemental tritium emissions from the TRF.

Source: AECB, *Info-210, Revision 8*, pp. 2 & 3

Table 3. Tritium Emissions from Ontario Power Generation Nuclear Facilities 1997-1999*

(Becquerels)

		1997	**1998**	**1999**
Bruce	Air	6.4 X 10^{14}	5.0 X 10^{14}	6.3 X10^{14}
	Water	9.8 X 10^{14}	4.6 X 10^{14}	2.4 X10^{14}
Darlington	Air	1.9 X 10^{14}	2.0 X 10^{14}	2.2 X 10^{14}
	Water	1.1 X 10^{14}	7.5 X 10^{13}	8.9 X 10^{13}
Pickering	Air	6.0 X 10^{14}	4.7 X 10^{14}	4.7 X10^{14}
	Water	4.0 X 10^{14}	1.6 X 10^{14}	1.7 X10^{14}
TRF	Air	5.3 X 10^{13}	7.2 X 10^{13}	2.4 X 10^{13}

* Emissions from Bruce, Darlington and Pickering are in the form of tritium oxide. Emissions from the Tritium Removal Facility (TRF) on the Darlington site are in the form of elemental tritium.

Source: Ontario Hydro, *Annual Summary and Assessment of Environmental Radiological Data [1994-1999]*

There has been strong pressure to make standards for tritium exposure more strict. The former Ontario government Advisory Committee on Environmental Standards (ACES)[45] recommended in 1994 that the standard for tritium in drinking water be lowered from 40,000 becquerels[46] per litre of water (Bq/L) to 20 Bq/L, in order to protect public health to the same degree that the public is protected from non-radioactive hazardous materials.[47] In 1994 the Ontario government decided to set an interim standard of 7,000 Bq/L,[48] after Ontario Hydro argued that about $500 million in capital costs would have to be spent to build detritiation facilities to remove tritium from the Active Liquid Waste streams of nuclear plants in Ontario.[49]

The large amounts of tritium released by CANDU reactors are estimated on an annual basis by Ontario Power Generation at each nuclear site. Thus, it is a simple calculation to express Ontario Hydro's emissions of tritium in becquerels per kilowatt hour of electricity production. The information in *Table 4* is based on annual total site emissions of tritium oxide to water and air, and annual gross electrical output at the Pickering, Bruce and Darlington Nuclear Stations. These figures do not include emissions of elemental tritium from the Tritium Removal Facility (TRF) at the Darlington Nuclear Generating Station site.

There have been many accidental releases of large amounts of tritium at Ontario's CANDU reactors. On August 2, 1992, Pickering reactor #1 had a heavy water leak from a moderator heat exchanger, which provides an interface between lake water and heavy water moderator. Debris from a broken strainer damaged the heat exchanger. A single broken pipe resulted in the release of over 2,000 litres of heavy water containing 2,300 trillion becquerels (Terabecquerels) of tritium oxide into Lake Ontario. The spill lasted for about six hours, and was the worst-ever tritium release from a CANDU reactor in Ontario. Sampling of local drinking water revealed significant increases in tritium levels. Despite dilution over four days, and a distance of five kilometers between the Pickering reactors and the Ajax water supply plant, by August 6th, water from the Ajax water plant exceeded 450 Bq per litre.

Tritium levels from the accidental release peaked on August 7th at 1,300 Bq/L and did not drop off to normal levels until August 14th.[50] Tritium levels in drinking water were elevated in the entire Greater Toronto Area, and in communities along the north shore of Lake Ontario. In July 1997, Ontario Hydro revealed that it had failed to report tritium contamination of ground water on the Pickering station property for the last twenty years. In 1979 it found 2,150,000 becquerels per litre (Bq/L) of tritium in ground water, and in 1994 found 700,000 Bq/L.

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45. ACES was disbanded by the Harris government shortly after it took power in June 1995.

46. The becquerel (bq) is a unit that describes the rate of radioactive disintegration of an element – one becquerel is one disintegration (by radioactive decay) per second. Tritium has a half-life of 12.3 years, so half a given quantity of tritium decays by release of beta radiation each 12.3 years.

47. Advisory Committee on Environmental Standards, *A Standard for Tritium: A recommendation to the Minister of Environment and Energy*, May 1994.

48. Ministry of Environment & Energy, "Ontario Sets lower interim drinking water objective for tritium", *News Release*, December 22, 1994.

49. Ontario Hydro, *A Submission to the Ministry of Environment & Energy on the Potential Impact of Reducing the Ontario Drinking Water Objective for Tritium*, August 26, 1994, p. 8.

50. Irene Kock, *Nuclear Hazard Report 1991-1992: Waste, Contamination and Safety at Ontario's Nuclear Facilities*, Nuclear Awareness Project, 1994, p. 24.

Table 4. Tritium Oxide Emissions from Ontario Hydro Nuclear Stations (becquerels per kilowatt hour)

Year	Bq/kWh
1995	52,500
1996	44,000
1997	38,000
1998	28,850
1999	27,600

Source: *Annual Summary and Assessment of Environmental Radiological Data [1995; 1996; 1997; 1998; 1999]*, Ontario Hydro, Environment Department.

4.2. Radioactive waste

At the front end of the nuclear fuel chain, uranium mines in the Canadian provinces of Ontario and Saskatchewan have left a deadly legacy of over 200 million tonnes of radioactive and acidic tailings. The tailings release many hazardous radioactive elements such as radium, polonium and radon (a gas). So-called low level radioactive wastes are also created by the uranium refining and conversion processes, during fuel fabrication, and during operation of the nuclear stations. There is no acceptable method for permanently disposing of these wastes, which remain dangerous for hundreds of thousands of years.

By the end of 1996, Canadian reactors had produced about 29,400 metric tonnes of high level radioactive waste -- about 1.2 million spent CANDU fuel bundles.[51] If all of the existing 22 reactors in Canada were to operate for their projected forty year lifespans, about 3.6 million spent fuel bundles would be produced by the end of 2033.[52] Most of the used fuel bundles are currently being temporarily stored in water-filled pools at each nuclear facility where they are being produced. In addition to the water-filled storage pools, dry storage canisters were developed by Ontario Hydro and Atomic Energy of Canada Limited, and are now being used at several Canadian nuclear facilities.

These highly toxic radioactive wastes are extremely long-lived...

> In total, spent fuel contains roughly 350 nuclides, about 200 of which are radioactive. Its level of activity per unit mass declines to that of natural uranium and its associated radioactive decay products after about one million years.[53]

It is generally accepted that high level radioactive waste must be kept isolated from the environment for a very long periods of time... in the order of hundreds of thousands of years. However, current storage methods require strict institutional controls, which cannot be assumed to be reliable beyond several hundred years. For

51. Canadian Environmental Assessment Agency, *Nuclear Fuel Waste Management and Disposal Concept: Report of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel*, February 1998, p. 12.
52. Canadian Environmental Assessment Agency, *ibid.*.
53. Canadian Environmental Assessment Agency, *ibid.*.

that reason, the Canadian nuclear industry (and other national nuclear programs) have proposed so-called "permanent disposal" options which theoretically would protect the natural environment even in the absence of institutional controls. The Canadian and Ontario governments, led by Atomic Energy of Canada Limited (AECL) initiated the Canadian Nuclear Fuel Waste Management Program in 1978, which led to the proposal by AECL and Ontario Hydro for deep geological disposal in granite landforms of northern Canadian. About $700 million was spent on research activities on nuclear fuel waste disposal, notably the Underground Research Laboratory that was established in Pinawa, Manitoba for test purposes.

In Canada, an environmental assessment panel was appointed in October 1989 to consider the question of safety and acceptability of nuclear fuel waste burial in a generic context (i.e. without a specific site proposal). After eight years of deliberation, the panel released a report in March 1998 (known as the Seaborn Panel Report after the Chairperson, Blair Seaborn), which was at best ambivalent about the nuclear industry's generic concept proposal. The final report stated,

> From a technical perspective, safety of the AECL concept has been on balance adequately demonstrated *for a conceptual stage of development*, but from a social perspective, it has not. As it stands, the AECL concept for deep geological disposal has not been demonstrated to have broad public support. The concept in its current form does not have the required level of acceptance to be adopted as Canada's approach for managing nuclear fuel wastes.[54]

Foremost among the 15 recommendations of Seaborn Panel Report was that the government create an independent nuclear fuel waste management agency (NFWMA) at "arm's length" from the nuclear utilities and from AECL, with a board of directors appointed from among "key stakeholders". The panel also recommended that the agency and its activities should be entirely funded by from "a segregated fund to which only the producers and owners of nuclear fuel wastes would contribute".

In its December 1998 response to the Seaborn Panel Report, the Canadian government supported creation of a NFWMA, but decided to place the nuclear industry[55] in sole charge of the agency, rather than placing "key stakeholders" on the agency's board of directors as recommended by the panel.[56] The government's decision was broadly condemned by environmental and community groups across the country.[57]

A leaked secret Cabinet document that was made public in March 1999[58] revealed that the government was manipulated by its own federal department dealing with nuclear issues (Natural Resources Canada -- NRCan). The cabinet was apparently panic-stricken by vague warnings from NRCan that the government could be liable for the expenses of radioactive waste disposal if it took broader responsibility in the nuclear waste agency. This became the rationale for granting the nuclear utilities sole control over the agency. This virtually guarantees that the thoughtful public consultation program recommended by the panel will not be carried out, and lays the groundwork for ramming through a program for site selection and burial of radioactive waste in northern Canada.

At the same time NRCan was also motivated by the desire to keep funding for radioactive waste management activities flowing to AECL, a federal crown corporation that depends in large part on

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54. Canadian Environmental Assessment Agency, *ibid.*, p. 2.

55. The three Canadian nuclear utilities: Ontario Power Generation, Hydro Quebec, and New Brunswick Power.

56. Natural Resources Canada, *Government of Canada Response to Recommendations of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel*, December 1998, p. 8.

57. See for example: Submission from Irene Kock on behalf of Nuclear Awareness Project to the Uranium and Radioactive Waste Division, Natural Resources Canada, Re: Federal Oversight on Nuclear Fuel Waste Management, February 28, 1999.

58. Natural Resources Canada, *Memorandum to Cabinet: Response to the Federal Environmental Assessment Panel on the Nuclear Fuel Waste Management and Disposal Concept*, October 1998.

government subsidies for its operating expenses. This is also inherently connected to the government's desire to enhance the image of AECL's main product, the CANDU reactor. The continued funding of AECL by the nuclear utilities (mainly Ontario Power Generation) for radioactive waste management activities is presumably the government's reward for giving the nuclear utilities carte blanche to proceed expeditiously with their burial proposal despite the findings of the Seaborn panel, and in opposition to Canadian public opinion.

No country in the world has yet devised an acceptable solution to the problem of long-term management of high level radioactive waste. While the nuclear industry would like to pretend that this is only a "social" problem, it is also a complex, intractable technical problem, given the incredibly long hazardous life-times of radioactive wastes. In Canada, the government's decision to ignore its own environmental assessment panel has set the stage for an enormously divisive social confrontation over the management of high level radioactive waste. This decision is an indication of the Canadian government's seemingly mindless commitment to nuclear power, no matter what the cost to its political integrity or the well-being of the country.

5. CANDU: The Worst Competitive Reactor Design

In 1999, the 20 operable reactors of Ontario Power Generation (OPG)[59] ran at an average capacity factor (the same as load factor) of 49.25% (see Table 5). Ontario Hydro's target capacity factor in 1999 was about 75% (capacity factor is the actual electricity production expressed as a percentage of its potential perfect output). The extremely poor performance record was due mainly to the fact that 8 reactors at the Pickering "A" and Bruce "A" Nuclear stations have been "laid up" (shut down temporarily) for repairs, and produced no electricity in 1999. OPG has tried to unfairly improve its performance statistics by not including Bruce reactor #2 in the accounting. However OPG does not consider Bruce reactor #2 to be permanently shut down, so it should properly be considered "operable" and should be included in performance statistics.

Table 5. Canadian CANDU Reactor Performance -- 1999
(Capacity Factor -- CpF)

Station	Unit	CpF	Station	Unit	CpF
Bruce "A"	1	0	Pickering "A"	1	0
	2	0		2	0
	3	0		3	0
	4	0		4	0
Bruce "B"	5	69.74	Pickering "B"	5	56.26
	6	91.15		6	74.97
	7	84.18		7	98.77
	8	54.86		8	78.19
Darlington	1	93.8	**Canadian CANDU 1999 average CpF = 49.25%**		
	2	84.53			
	3	73.74			
	4	81.13	**Ontario Power Generation 1999 average CpF = 47.07%**		
Gentilly-2		68.49			
Point Lepreau		73.58			

Source: "Nuclear Electricity Generation for December 1999", *Nucleonics Week*, February 10, 2000.

59. On April 1, 1999, Ontario Hydro ceased to exist. Its generating facilities were turned over to Ontario Power Generation, which is still a publicly owned entity.

CANDU performance world-wide compares poorly to other main reactor types. For example, according to *Nuclear Engineering International*, a nuclear industry trade journal, 1999 average capacity (load) factors for the major competitive reactor types were as follows: Pressurized Water Reactors (PWRs) = 79.8%; Boiling Water Reactors (BWRs) = 81.4%; Advanced Gas Cooled Reactors (AGRs) = 76.9%; and Pressurized Heavy Water Reactors (PHWRs, or CANDUs) = 59.2%.[60]

Table 6. International CANDU Reactor Performance -- 1999*
(Capacity Factor -- CpF)

Country	Station	Unit	CpF
Argentina	Embalse		98.93
India	Rajasthan (RAPP)	1	50
		2	70.64
Pakistan	KANUPP		6.49
Romania	Cernavoda		99.46
South Korea **	Wolsong	1	82.84
		2	89.21
		3	80.33
Average (Excludes Canadian reactors) 72.24%			
Average all CANDUs (Includes Canadian reactors) 55.38%			

* This table includes only CANDU reactors sold by Canada. It does not include the so-called 'CANDU clones' built by India using technology transfer.

** Wolsong-4 has not been included in this table since it only began commercial operation in October 1999.

Source: "Nuclear Electricity Generation for December 1999", *Nucleonics Week*, February 10, 2000.

Aging coupled with inadequate maintenance programs have clearly been large factors in worsening CANDU reactor performance. However, there are a few specific technical problems that have contributed to the decline of CANDU performance. The single greatest problem has to do with fuel channels – the calandria tubes and pressure tubes that are a unique feature of the CANDU reactor. After only 12 years of operation, Pickering reactor #2 was forced to shut down in 1983 following a major tube rupture that resulted in a loss of coolant accident. The rupture was due to embrittlement caused by hydrogen ingress in the tube alloy. This occurred at the points where pressure tubes had come into contact with calandria tubes due to faulty, out-of-position spacers. The problem forced the early retubing of all four Pickering "A" reactors. Other reactors suffer from the same 'hydriding' problem, although it is less serious because of the use of an improved tube

60. "Load factors to end December 1999", *Nuclear Engineering International*, June 2000, p. 36.

alloy. Pressure tube degradation and the necessity for replacement remain as the greatest known risk and liability of the CANDU reactor design.

Steam generator problems are the second most serious contributor to performance problems, although these problems are not unique to CANDU reactors. Fouling, corrosion, and fretting due to vibration are the major causes of tube failure in steam generators. These problems necessitate various expensive and technically difficult remedial programs, and will likely require eventual replacement of some steam generators. Remedial programs include: improved chemistry control of feedwater; high pressure water jet cleaning; chemical cleaning; increased monitoring of tubes; and computer prediction and modeling of problems.

Good CANDU performance is not guaranteed even during the early years of operation. Ontario Power Generation's newest reactors at the Darlington Nuclear Generating Station experienced severe performance problems during the first several years of operation. Reactors #2 (which was started first) had a three-year average capacity (load) factor of 11%, while the first year capacity factor of reactor #1 was 33%. Initial problems included cracking of generator rotors -- all original rotors were replaced by a new design.[61] These first two reactors at the four unit station were also kept closed for extended periods because of unexplained fuel bundle damage in the reactor core.[62] The fuel damage problem, known as "shake and break" was eventually traced to the design of the primary heat transport pumps in relation to the size and shape of the fuel channels at Darlington. The particular equipment chosen resulted in vibrations inside the fuel channels which caused rapid breakdown of the fuel bundles and damage to the pressure tubes. The design of the heat transport pumps had to be changed to stop the resonance of the fuel channels.[63]

The severity of performance problems at CANDU reactors was emphasized by the long-term shutdown of eight of Ontario Hydro's 20 reactors. Ontario Hydro announced on August 13, 1997 that it would temporarily shut down its oldest seven reactors (Bruce A reactor #2 had previously been shut down in October 1995). The *Independent Integrated Performance Assessment* (IIPA) and the *Nuclear Asset Optimization Plan* (NAOP) had previously been presented to Ontario Hydro's Board of Directors. Ontario Hydro characterized the IIPA as an identification of problems with the nuclear power program and the NAOP as the solution to those problems. The Board approved the IIPA and allowed the NAOP to proceed. The NAOP, later called the Integrated Improvement Plan, was designed to return the newer 12 reactors in Ontario to higher levels of performance through programs to improve all aspects of management and operations. Certain reactor safety upgrades were also included in the program. The main features of the NAOP were the temporary "lay up" of the four Pickering A reactors at the end of 1997, and the three remaining Bruce A reactors on March 31st 1998. Ontario Hydro began repairs on Pickering A in 1998 and originally intended to return the reactors to service between 2000 and 2002. The restart schedule for Pickering "A" has since been delayed until at least the end of 2001, pending the outcome of an environmental assessment process. Ontario Hydro originally planned to restart all four Bruce A reactors between 2003 and 2009, however, these plans may be changed by a decision to privatize all eight reactors at the Bruce A and Bruce B stations.

61. Atomic Energy Control Board, *AECB Annual Staff Report for 1992*, AECB BMD 93-138, July 27, 1993.

62. Atomic Energy Control Board, *AECB Annual Staff Report for 1991*, AECB BMD 92-145, July 28, 1992.

63. Irene Kock, *Nuclear Hazard Report 1991-1992*, Nuclear Awareness Project, 1994, p. 9.

6. The Economics of Nuclear Power

In addition to safety and performance problems, high cost has been a feature of all major reactor designs. It has long been argued by the nuclear industry that while nuclear power plants may have very high capital (construction) costs, the operating costs (primarily fuels costs) are very low, leading to a overall low lifetime unit energy cost. In fact, despite lower fuel costs, lifetime unit energy costs for nuclear power plants are relatively high. A study by the Institute for Energy and Environmental Research (IEER) found that nuclear costs are typically about twice the cost of combined cycle natural gas-fired generation. Under several scenario's nuclear total lifetime cost ranged from 4.58 cents/kWh to 8.79 cents /kWh, while combined cycle gas plants ranged from 2.26 cents/kWh to 3.897 cents/kWh.[64]

Another cost accounting of Canadian generating alternatives corroborated the IEER findings. A study conducted for the Independent Power Producers' Society of Ontario found that CANDU nuclear stations were roughly about twice the cost of gas-fired industrial cogeneration plants, both before and after environmental externalities were factored in. The study found that nuclear costs (based on Ontario Power Generation's most modern plant, the Darlington Nuclear Station) were 11.708 cents/kWh (1997 $Cdn), and gas-fired industrial cogeneration was 5.521 cents/kWh. When mid-range environmental externalities were added, the corresponding costs were 14.989 cents/kWh for CANDU nuclear and 6.621 cents/kWh for gas-fired industrial cogeneration.[65]

In its final Annual Report,[66] Ontario Hydro stated that its average cost of nuclear generated electricity had reached an all-time high of 7.721 cents/kWh. Ontario Hydro's massive debt of $38 billion and liabilities were largely incurred through its ill-considered nuclear program. This figure includes some provision for the future (as yet unfunded) liabilities associated with the radioactive waste management and decommissioning of reactors of about $2.3 billion.[67] In fact, Ontario Hydro had already identified total future liabilities for reactor decommissioning and nuclear waste management of $18.7 billion (1998$).[68] The Province of Ontario has identified a total Stranded Debt of $20.9 billion, remaining after the restructuring of the utility, which does not include the future liabilities for decommissioning and waste management. This stranded debt is largely a measure of how uneconomic nuclear power has been in Ontario, since it represents the amount of the debt that cannot be serviced by the new commercial company that has been formed to own and operate the nuclear stations.

64. Arjun Makhijani, "Reducing Greenhouse Gases and Creating a Sustainable Energy Supply", *Science for Democratic Action*, Institute for Energy and Environmental Research (IEER), March 1998, p. 7.
65. David Argue Consulting, *A Review of the Economic Cost of Power in Ontario*, Independent Power Producers' Society of Ontario (IPPSO), May 1997.The cost comparisons were based on a standard 20 year life with a 10% discount rate, and a 65% load factor.
66. Ontario Hydro ceased to exist on March 31, 1999, and its generating assets were turned over to Ontario Power Generation.
67. Ontario Ministry of Finance, *Stranded Debt Fact Sheet*, April 1, 1999.
68. Ontario Hydro, "Nuclear Waste Management Booklet Update", 1 page, March 1, 1999.

7. The Turkish Electricity Sector

The Turkish electricity sector is effectively a state monopoly, although technically private companies have been allowed to invest in generating facilities since 1984. At the end of 1996, TEAS owned about 90% of generating capacity in the country.[69] The former Turkish Electricity Authority (TEK) was divided into two state enterprises in April 1994 -- the Turkish Electricity Generation and Transmission Company (TEAS), and the Turkish Electricity Distribution Company (TEDAS). TEAS constructs and operates generating stations, operates the transmission network, and sells electricity to TEDAS and its affiliated companies. TEDAS and its seven affiliated distribution companies distribute electricity to consumers. In 1996, TEDAS was estimated to have purchased 36.4 TWh from TEAS, and the affiliated distribution companies purchased 28.2 TWh.

Turkish electricity generation is mainly derived from hydraulic, coal and lignite sources (see *Table 7*). Installed generating capacity was about 21,000 MW in 1995 -- 52% fossil-fired, and 48% hydroelectric.[70]

Table 7. Turkish Electricity Generation -- 1995

Source	Energy (TWh)	Percentage
hydroelectric	35.7	41.4%
coal and lignite	28.1	32.6%
natural gas	16.6	19.3%
oil	5.8	6.7%

Source: OME/MERKAT, *Report on the Development of the Electricity Sector in Turkey*, Conference "Energy Forum '97", Ankara, April 7-8 1997.

TEAS has evidently made an extravagant forecast of the growth in electricity demand, based on historic growth rates. Although the TEAS forecast in load growth is not available, TEAS forecasts a peak load of 46,219 MW in 2010, and 88,100 MW in 2020.[71] From tables 10 and 11, we can see the generating capacity that TEAS thinks will be necessary to meet demand, and the corresponding amount of energy that will be produced.

TEAS predicts that installed capacity will increase from 21,165 MW in 1996, to 33,699 MW in 2001, to 64,747 MW by 2010 and 108,872 MW by 2020. This includes 2,000 MW of nuclear generating capacity by the year 2010, and 10,000 MW by the year 2020. It is not clear what percentage of planning reserve margin TEAS is using. This is an important factor. For example the difference between a 16 % and a 24% reserve margin on the forecast 2010 capacity of 64,747 MW is over 5,000 MW. The amount of planning reserve margin is calculated on the basis of system reliability, including generating capacity, transmission, and transmission interconnections.

69. Observatoire Méditerranéen de l'Energie, in cooperation with MERKAT (OME/MERKAT), *Report on the Development of the Electricity Sector in Turkey*, Conference "Energy Forum '97", Ankara, April 7-8 1997, p. 21.

70. OME/MERKAT, *ibid.*, p. 20.

71. OME/MERKAT, *ibid.*, p. 22.

Table 8. Turkish Generating Capacity 1970 - 1995 (MW)

	TEAS			Turkey		
Year	Thermal	Hydro	Total	Thermal	Hydro	Total
1970	904.7	534.3	1439	1509.5	725.4	2234.9
1975	1708.5	1520.7	3229.2	2407	1779.6	4188.6
1980	2178.8	1872	4050.8	2987.9	2130.8	5118.7
1985	4147.9	3644.2	7792.1	5244.3	3874.8	9119.1
1990	8261.7	6465.1	14726.8	9550.8	6764.3	16315.1
1995	6364.1	9207.6	15571.7	11089	9862.8	20951.8

Source: TEAS (cited in ibid., OME/MERKAT, p. 20)

Table 9. Turkish Electricity Production 1970 - 1995 (MWh)

	TEAS			Turkey		
Year	Thermal	Hydro	Total	Thermal	Hydro	Total
1970	3915.4	2357.5	6272.9	5590.2	3032.8	8623
1975	8200.6	4644.2	12844.8	9719.2	5903.6	15622.8
1980	9381.8	10032.7	19141.5	11927.2	11348.2	23275.4
1985	19256.7	10992.2	30248.9	22174	12044.9	34218.9
1990	30698.1	22156.1	52854.2	34395.4	23147.6	57543
1995	38438.8	33105.3	71544.1	50706.5	35540.9	86247.4

Source: TEAS (cited in ibid., OME/MERKAT, p. 21)

Table 10. Forecast of Turkish Generating Capacity 2001-2020 (MW)

	2001	2010	2020
Lignite/hard coal	7841	11741	17941
Imported coal	0	2500	9000
Natural gas	10691	18391	33791
Nuclear	0	2000	10000
Fuel oil	2439	4189	8039
Sub-total	13130	27080	60830
Hydro	12628	25336	29101
Renewables	100	600	1000
Total	33699	64757	108872

Source: TEAS (cited in ibid., OME/MERKAT, p. 23)

Table 11. Forecast of Turkish Electricity Generation 2000-2020 (MWh)

	2000	2010	2020
Lignite/hard coal	31817	54700	80454
Imported coal	0	16277	58597
Natural gas	49310	108189	198675
Nuclear	0	14035	70175
Fuel oil	9170	11406	38160
Sub-total	90297	204607	446061
Hydro	44010	85215	100536
Total	134307	289822	583115

Source: TEAS (cited in ibid., OME/MERKAT, p. 22)

Table 12. Turkish Net Electricity Consumption 1989-1998 (TWh)

Year	TWh	Year	TWh
1989	43.2	1994	69.4
1990	50.6	1995	76.6
1991	54	1996	84.9
1992	60	1997	94.6
1993	65.8	1998	102.2

Source: US Department of Energy, Energy Information Administration, Table 6.2, World Total Net Electricity Consumption 1989-1998 http://www.eia.doe.gov/emeu/iea/table62.html

Generally speaking, in the late 1980s, Turkey concentrated on its domestic resources, mainly hydraulic electricity and lignite-fired thermal stations, and to a lesser extent on imported coal. The early 1990s, however, saw a shift to natural gas, for both economic and environmental reasons -- hydraulic and even coal stations are more capital intensive than combined-cycle natural gas plants[72] , and as compared to coal, natural gas has fewer environmental impacts.

Growth of about 45,000 MW in capacity is anticipated up to 2010, at an estimated cost of $45 billion (US) for generating capacity, and a total cost of $56 billion (US), including the transmission network and other infrastructure.[73] The staggering size of the anticipated investment in the electricity sector has led Turkey to promote a role for the private sector, although the public sector continues to be dominant through TEAS/TEDAS. Of the $56 billion investment that TEAS estimates will be required to 2010, it anticipates that $37 billion will be provided by itself and TEDAS (the public sector generation and distribution companies), and the balance of $19 billion will come from private sources operating under BOO or BOT financial models.[74]

Based on the load growth that is implied in Tables 10 and 11, it can be see that TEAS is assuming that there will be little change from historic rates of growth that have taken place in the last 30 years in Turkey. However, the electricity sector restructuring that is underway in Turkey could significantly alter future demand trends. It is inevitable that electricity prices will rise, as state subsidies are reduced, which will in turn reduce demand and stimulate greater efficiency and conservation in electricity use. Because of Turkey's relatively low per capita use of electricity, and its imminent restructuring of its electricity sector, there is an opportunity to "leapfrog" to a more efficient, more environmentally friendly, and more equitable system.

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72. OME/MERKAT, *ibid.*, p. 24.

73. OME/MERKAT, *ibid.*, p. 28.

74. BOO = Build, own and operate; BOT = Build, operate and transfer. BOT is often interpreted to mean "Build, **own**, and transfer", but the Turks have modified this formula through the creation of a joint venture entity between the private sector company and TEAS. Neither TEAS nor the Turkish government provide any financing, even for local costs. Under a BOT contract, ownership of the facility is transferred back to Turkey at no cost, at the end of an agreed period -- typically the construction period plus 15 to 20 years of operation. BOO is a type of privatization, since there is no transfer, and the owner has the advantage of retaining the residual value of the project.

7.1. Integrated Resource Planning

In order to achieve a sustainable energy system, it is necessary to apply Integrated Resource Planning (IRP), sometimes known as "least cost planning" -- a planning methodology that seeks the "least-cost" options to meet customer needs. "Least cost" is determined from the viewpoint of society as a whole, and should include all costs, including environmental costs. IRP compares supply options (such as building generating stations) with demand management (DM) options, such as introducing energy efficiency. Demand management is any action taken to alter the quantity and/or timing of electricity use to benefit the users as well as the implementing agency. Implementing agencies can include utilities, community energy centres, or private energy service companies. An energy efficiency improvement is the reduction in the quantity of energy used per unit of output. Energy efficiency can be achieved through the introduction of higher efficiency equipment, or appliances, the improved management of a process or facility, and reduction of energy waste through products such as insulation.[75]

The Turkish government intends to introduce competition to the electricity sector, including transferring most electricity generation to the private sector, and has stated that legislation is being prepared, for enactment in 2000. The legislation will include the creation of an independent market regulator, and the government claims that the process will take 1.5 years for implementation following the introduction of the legislation. Facilitated by the international arbitration mechanism, the government expects that state-owned distribution utilities and fossil plants will be transferred to the private sector either through concession contracts (i.e. operating rights) or through direct privatization. The government has said that tenders will be launched in the first quarter of 2001 for distribution companies, with the aim of completion by December 2001. Privatization of fossil-fired generating plants is expected to be complete by mid-2002.[76] Electricity sector privatization was originally expected to generate $1.1 billion (US) in revenues in 2000, but it is clear that this goal will not be met.[77] The transmission system will remain a state-owned monopoly.

In August 1999, the Turkish parliament adopted a number of constitutional amendments which created a constitutional basis for (a) privatization and contracting out, (b) international arbitration on concession contracts or other arrangements where a foreign entity is involved in public services, (c) limiting the Council of State (Danistay) to an advisory role on concession contracts or other arrangements where a foreign entity is involved in public services. Pursuant to these constitutional changes, in December 1999, the Turkish parliament passed revisions to the Law on Build, Operate and Transfer (BOT) projects which include electricity generation, transmission, distribution and trading projects, and subjects BOT projects (including electricity, water and transport projects) to civil law under the Commercial Code.[78] The international arbitration provision was highly controversial in Turkey, where it was widely seen as giving up sovereign control of the energy sector. The arbitration provision is even retroactive for firms that already have concession deals.

A Cabinet decree published in the April 4, 2000 Official Gazette broke up TEAS (Turkish Electricity Generation and Transmission Corporation) into three separate entities. The Turkish Electricity Generation Company (TEU) will control nuclear power plants (which the government intends to have under public ownership) and power plants which have yet to be privatized. The Turkish Electricity Transmission Company

75. For a succinct summary of IRP, see: Coalition of Environmental Groups, *Greening Ontario Hydro: Sustainable Energy Lessons*, 1994.

76. Letter of Development Policy from Mr. Recep Onal, Minister of State for Economic Affairs, Government of Turkey, to Mr. James Wolfensohn, President, World Bank, *Turkey: Economic Reform Loan*, March 10, 2000, p. 6.

77. World Bank, *Economic Reform Loan: Republic of Turkey*, Project ID TRPE68792, February 15, 2000, p. 2. http://www.worldbank.org/pics/pid/tr68792.txt

78. Letter of Development Policy from Mr. Recep Onal, Minister of State for Economic Affairs, Government of Turkey, to Mr. James Wolfensohn, President, World Bank, *Turkey: Economic Reform Loan*, March 10, 2000, pp. 5-6. http://wbln0018.worldbank.org/eca/e...cafd6e852568e200745250?opendocument

(TEI) will operate the existing main transmission network. Finally, the Turkish Electricity Trade and Contracting Company (TETT) will be responsible for integrating the private sector into the system.[79] Detailed legislation still has to follow.

The energy sector plays a large part in the deregulation and privatization schemes of the IMF and the Turkish government because the high projections for economic growth and energy consumption would necessitate a huge amount of generating capacity to be constructed (in the absence of any demand management programs). The Turkish government claims that electricity demand growth in the 1990s has been "more than 8% a year on average against a rise in GDP of 5% a year".[80] This projected level of growth in the electricity sector would by far exceed the amount of capital available in Turkey for construction of generating capacity. So, Turkey's strategy involves privatization of state-owned distribution companies and fossil-fired plants, and the encouragement of BOT and BO/O deals for new generating plants.

While BOT deals may be possible for hydraulic and fossil-fired plants, there is no precedent for a BOT arrangement on nuclear plants, which involve much higher costs and risks. On a more general level, it is not clear that the high projected economic growth rates will in fact occur. Even if high growth does take place, growth in electricity demand (and energy in general) will not be directly proportional. As energy/electricity prices rise with the removal of subsidies, there will be a market incentive for efficiency improvement, and demand will be moderated.

In the electricity sector, the government has noted that

> ...the financial condition of TEAS, the state generation and transmission company, has deteriorated over the past year [1999]. A key factor has been the high purchase price of electricity from the newly established BOT operations, but other factors have played a role as well, notably the poor level of collections for electricity sold to TEDAS, the state distribution company.[81]

In the short term, the government has stated that it will "prioritize lower cost generation projects, improve collection performance and reduce TEAS's operational costs [and adjust] wholesale and retail electricity tariffs, which is a last, but necessary, resort."[82] There has apparently been a disagreement between the Government of Turkey and the World Bank as part of their negotiations on payments for the IMF Economic Reform Loan. During loan talks in early 2000, the World Bank apparently urged the Turkish Treasury Department to raise electricity rates by a monthly 3.2% through to 2004.[83] A price increase was in place at the end of 1999, but faced with political pressure, the government withdrew the increase from January to March, and re-implemented a reduced increase of 2-2.5% in April.[84] The inability or unwillingness to implement price increases indicates the political constraints faced by the government in electricity sector restructuring.

As part of its reform measures, the government will presumably introduce regulation on at least the monopoly elements of the electricity sector, including transmission, distribution networks and any direct retailing. However, competition alone cannot guarantee a perfect market mechanism for electricity supply and demand. Mechanisms are needed to ensure that energy efficiency provides it maximum benefits to

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79. "Government takes first step to reform the energy sector", *Turkish Daily News*, April 6, 2000.
80. Turkish Ministry of Foreign Affairs, *Energy Sector in Turkey*, undated, downloaded June 14, 2000, http://www.mfa.gov.tr/grupd/dc/dcb/enegy.htm
81. Letter of Development Policy from Mr. Recep Onal, Minister of State for Economic Affairs, Government of Turkey, to Mr. James Wolfensohn, President, World Bank, *Turkey: Economic Reform Loan*, March 10, 2000, p. 6.
82. *Ibid.*.
83. "Contents of key energy sector reform revealed", *Turkish Daily News*, March 1, 2000.
84. Personal communication with Ustun Reinart, June 30, 2000.

society, including environmental protection. This will not impede the benefits of competition, it will enhance them. The regulatory agency or some other independent public body could be delegated to manage the IRP planning process, and eventually ensure delivery of efficiency programs and renewable energy. This does not necessarily mean a state enterprise for renewable energy and conservation. The delivery mechanisms may be more efficiently provided by independent power producers and energy service companies in the private sector. In the United States and Western Europe, restructuring has been accompanied by two common mechanisms to promote conservation and renewable energy, notably funding for conservation and renewable energy through a levy (sometimes called a System Benefits Charge) and a system quota for renewable energy (sometimes called a Renewable Portfolio Standard).

Turkey's restructuring process has one great advantage over many of the restructuring processes that have taken place elsewhere in the western world, where massive debt for expensive and often inefficient nuclear plants have placed an unsupportable burden on public and private utilities being exposed to competition from cheaper generating sources. This has resulted in so-called "stranded debt" allocations, which removes large amounts of debt from utilities, and spreads the burden amongst all ratepayers. Critics have argued that this amounts to a subsidy for nuclear plants, in many cases allowing them to continue operating and for their lifetimes to be extended.[85]

Through an open and transparent IRP process, Turkey could achieve a national consensus on the electricity future that it wants to build. Plans made behind closed doors by TEAS have led not only to an inefficient and failing electrical system, but created a national conflict over its controversial plans to build nuclear power plants, coal plants, and (in some cases) inappropriate hydraulic plants. An IRP process would prioritize and rank generating options along with demand management options, looking at all economic as well as social and environmental costs. Turkey has a long history of state enterprise, and strong public support for state enterprise, particularly in the energy sector. If the government wishes to implement market reforms, there must be a clear social agenda. Demand management (DM) makes particular sense in Turkey, where energy efficiency measured by energy use in relation to Gross Domestic Product has declined since 1980 -- the opposite of the general trend in Europe.[86] DM should also be seen as an economic opportunity, because with its relatively low per capita electricity consumption, DM can prevent inefficiency from being built into the system. Turkey can avoid the so-called "lost opportunities" that plague many more developed countries, and "leapfrog"past them.

The environmental benefits of IRP planning are very real. Although Turkey has relatively low per capita carbon emissions, its relatively rapid increase in energy use in the last 20 years has resulted in dramatic increases. Turkey's energy-related carbon emissions rose from 18 million metric tonnes in 1980 to 47.1 million metric tons in 1998.[87] Turkey has no binding commitments on reduction of carbon emissions, because it is not a party to the UN Framework Convention on Climate Change (UNFCCC). However, Turkey has created a National Climate Coordination Group to carry out studies. Turkey may be required to accept some level of emissions reduction as a condition of entry into the EU.

DM programs can also address social equity questions. To date, the limited conservation programs in Turkey have been primarily aimed at industry. Aggressive programs should also take place at the residential consumer level -- while rates may rise due to higher per-unit electricity costs, actual bills can be kept down through conservation measures. Most obviously, fuel switching programs should be put in place to eliminate inefficient electrical applications, such as electric stoves, and electrical space and water heating, which can be replaced by natural gas and solar hot water. Such programs will lower social resistance to electricity

85. David H. Martin, *Green Energy: Environmental Aspects of the Energy Competition Act (Bill 35)*, Nuclear Awareness Project, August 11, 1998.

86. Greenpeace, *Turkey at an energy cross-roads*, Summary Report, June 1997, pp. 2-3.

87. US Department of Energy, Energy Information Administration, *Turkey: Environmental Issues*, "Carbon Emissions", March 2000.

restructuring.

TEAS has about 2.7% transmission loss in its grid, and losses in the distribution network amount to 17.4% (including both for technical reasons and theft)[88] , and another 5.4% is given away for street lighting.[89] Reducing these technical losses and theft should be the number one priority in the electricity sector. On TEDAS' 1996 purchase of 36.4 TWh from TEAS, a 17.4 % loss equals 6.3 TWh. Electricity should not be given away. If the state wishes to subsidize municipal electricity use for street lighting, then separate reimbursements should be made.

7.2. Renewable Energy

Turkey also has a large potential for renewable energy development, including solar, geothermal, wind energy and bio-mass. Geothermal energy has a technical potential of 4500 MW for electricity generation, and over 31,000 MWth for lower grade heating purposes. Fifteen promising geothermal fields have been identified, and several generating projects are well advanced. There are already heating and industrial applications in operation.[90]

There is high potential for wind energy development particularly in the Marmara, Aegean, and Southeastern regions of the country. Currently there are about 9 MW of wind turbines in operation since 1998, but another 185 MW are awaiting approval from the government.[91] The projects have been tied up in red tape as they were overtaken by the constitutional law in August 1999, and the new legislation in January 2000. Metin Atamer is a wind developer with Atamer/Interwind, and the Chair of RASSIAD, the Turkish Wind Energy Investors Association in Ankara. He has stated that a government committee has identified about 5,000 MW of wind energy potential that could be built within five years, and feasibility studies have been completed for about 2,500 MW, which could be installed by 2003.[92] Rumours have circulated that wind development is being stalled pending approval of the Akkuyu nuclear station.

Solar development also seems extremely promising. Turkey has an average 2640 hours of sunshine per year. Solar hot water systems are already a major renewable energy success, with over 100 firms engaged in manufacturing and marketing solar hot water systems. In 1994, it was estimated that nearly 1.5 million square meters of flat-plate collectors were in commercial use, and manufacturing capacity was estimated at 350,000 sq. meters per annum.[93] No information was available regarding photovoltaic applications.

7.3. Natural Gas Transition

If more generating capacity is needed in the short term, the clear solution is natural gas. Turkey is an "energy bridge" on the transport routes between the vast oil and gas reserves of the Middle East and Central Asia, and the markets of Europe. Turkey is thus in a unique position to benefit from low-cost fossil fuel, and should aim for use of natural gas as a transition fuel to a sustainable energy future based on renewable energy. Current gas supply is mainly from Russia, via a pipeline through Romania and Bulgaria. Pipeline proposals are under way with Iran, as well as with the Caspian basin through the Baku-Tbilisi-Ceyhan oil

88. Presumably including theft as well as technical losses.

89. OME/MERKAT), *ibid.*, p. 33.

90. OME/MERKAT, *ibid.*, pp. 46 & 52.

91. Sara Knight, "Nuclear pushing wind out of Turkey", *Wind Power Monthly*, March 2000, p. 46.

92. *Ibid.*.

93. OME/MERKAT, *ibid.*, pp. 46 & 51.

pipeline and the Trans-Caspian gas pipeline, which would run parallel to it. Initial agreements for the Baku-Ceyhan pipelines were signed in November 1999. There are also discussions between Russia and Turkey for an submarine gas pipeline beneath the Black Sea, known as the "Blue Stream Project".[94]

Turkey has relatively abundant domestic hydraulic, fossil, and renewable energy resources. Moreover, it has access to relatively inexpensive natural gas, which is an ideal "transition" fuel as Turkey builds a more sustainable energy sector that stresses efficiency and renewable energy. Given this situation, there is little justification for Turkey's proposed development of an expensive and risky nuclear power program.

94. Turkish Ministry of Foreign Affairs, *Turkish Energy Policy*, undated, downloaded June 14, 2000, http://www.mfa.gov.tr/grupa/an/policy.htm

8. The Turkish Nuclear Program

8.1. Turkey's Nuclear Infrastructure

Turkey's first involvement with nuclear power began in July 1955, when it signed a bilateral agreement with the United States to cooperate in the "peaceful uses of nuclear energy". In 1956, the Atomic Energy Commission (AEK) was created. In 1982, AEK was re-constituted as the Turkish Atomic Energy Authority (Turkiye Atom Enerjisi Kurumu -- TAEK), under the authority of the Prime Minister's Office.[95] TAEK is Turkey's nuclear regulatory agency, but it also has a strong and contradictory role in the promotion of nuclear activities, including research of various kinds, and the development of a nuclear power program. The objectives of TAEK are both promotional and regulatory in nature. They are:

> "to determine and progress the basis of the national policy and the related plans and programs and to submit them to be approved by the Prime Minister; to execute and to support scientific, technical and administrative studies; to give approval, permission and license to the nuclear installations; to enlighten the public in nuclear matters; to establish research and educate the personnel in the nuclear field."[96]

TAEK's mandate to carry out and promote nuclear activities as well as to regulate them is an unacceptable conflict. In developed countries with nuclear programs, promotional and actual nuclear activities have long been separated from the regulatory function. This is another important reason why the Akkuyu nuclear plant should not be allowed to proceed.

The four divisions of TAEK include the Licensing and Safeguard Division, the Radiation Protection Division, the Nuclear Technology Division, and the Research and Development Division.[97] Within its R&D division TAEK owns and operates three nuclear research centres: the Cekmece Nuclear Research and Training Centre (Cekmece Nukleer Arastirma ve Egitim Merkezi -- CNAEM-CNRTC), the Ankara Nuclear Research and Training Centre (Ankara Nukleer Arastirma ve Egitim Merkezi -- ANAEM-ANRTC), and the Lalahan Animal Health & Nuclear Research Centre.

Construction began in August 1959 on Turkey's first research reactor -- a pool-type reactor at the site of the Cekmece Nuclear Research and Training Centre (CNRTC), which was not formally established until 1961. The CNRTC is located on a 3,200 acre site on the shores of Kucukcekmece Lake outside of Istanbul. The 1 MW reactor, known as TR-1 (Turkish Reactor-1) went critical in 1962 and was reportedly shut down in September 1977 for financial reasons. It was upgraded to 5 MW by Belgonucleare in 1980.[98] The upgraded 5 MW reactor, known as TR-2, first went critical in December 1981, and was shut down on August 5, 1995. The TR-2 was re-started in 1998.[99] Fuel for the TR-2 was fabricated by Cerca, in France. Prior to shutdown, the TR-2 reportedly experienced an accident in March 1993 involving a release of radioactive contamination into Kucukcekmece Lake.

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95. Nejat Aybers, *Implementation of a Nuclear Power Plant in a Developing Country: The Case of Turkey*, Presented to the Canadian Nuclear Society 17th Annual Conference, June 1996, p. 5. Prof. Dr. Nejat Aybers was the former President of TAEK..
96. Mustafa Kibaroglu, "Turkey's Quest for Peaceful Nuclear Power", *The Non-Proliferation Review*, Spring-Summer 1997, Endnote 21, p. 42.
97. Nejat Aybers, *Implementation of a Nuclear Power Plant in a Developing Country: The Case of Turkey*, Figure 1: Structure of TAEK, p. 9.
98. Thijs de la Court, Deborah Pick & Daniel Nordquist, *The Nuclear Fix: A Guide to Nuclear Activities in the Third World*, World Information Service on Energy, 1982, p. 100.
99. "Demirel Defended Nuclear", *Cumhuriyet*, June 25, 1998.

CNRTC has a number of departments including Nuclear Fuel Technology, Chemistry, Radio-isotopes and Pharmaceuticals, Health Physics, Radiobiology, Nuclear Engineering, Industrial Applications, Physics, and Nuclear Electronics. For concerns relating to the Nuclear Fuel Technology program, please see the proliferation section of this paper.

In 1997, it was disclosed that TAEK had initiated negotiations with Bulgaria and Hungary with the eventual aim of establishing a high-level radioactive waste dump in Turkey, as a long-term solution to the management of spent fuel from all three countries.[100] No specific site for the radioactive waste dump has been disclosed, other than a possible "remote site in the thinly populated Turkish hinterland...".[101]

The Ankara Nuclear Research and Training Centre (ANRTC) was first established by TAEK in 1966 in Ankara, and then was moved to Saray, about 30 km north of Ankara. It was re-organized in 1993, and has five research departments: Radiation Applications, Material Research, Nuclear Electronics, Nuclear Agriculture, and Irradiation. Its mandate is to carry out "fundamental and applied research to use nuclear energy and technology for the benefit of the country and to support the national development program".[102]

The Lalahan Animal Health & Nuclear Research Centre was established in 1981 by TAEK, and it is mandated to use nuclear related techniques in animal reproduction, nutrition, parasitic and infectious diseases and food irradiation.[103]

There are two state agencies involved with the exploration for, and mining of nuclear fuels. The General Directorate for Mineral and Exploration (MTA) was established in 1935, and in 1983 and 1994, its duties were expanded to include "exploration for radioactive ores and related technological research". ETIBANK was also established in 1935, and was later made responsible for mining of radioactive ores and the production of yellowcake. Both organizations are under the supervision of the Ministry of Energy and Natural Resources.[104]

The Turkish state has also supported an academic infrastructure for studies in nuclear science and engineering. As of 1995, there were about 200 students enrolled in these courses. Notable is Hacettepe University in Ankara, which has a Nuclear Engineering Department established in 1978. It is currently headed by Prof. Yalcin Sanalan.[105]

The Institute for Nuclear Energy was established at the Istanbul Technical University in 1961.[106] It has three divisions: Nuclear Applications Division, Nuclear Technology Division, and Nuclear Sciences Division. The Nuclear Technology Division operates a TRIGA Mark-II Training and Research Reactor. Its power level is 250 kW, and it went critical in March 1979.[107] Fuel for the ITU-TRR is fabricated by General Atomics in the USA.[108] Finally, there is also the Nuclear Power Plant Department, which is

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100. Mark Hibbs, "Turkey considers spent fuel deal with Bulgaria, Hungary for Akkuyu", *Nuclear Fuel*, August 25, 1997, p. 8.

101. Mark Hibbs, *ibid.*, August 25, 1997, p. 8.

102. OECD/Nuclear Energy Agency, *Turkey*, 1996, pp. 9-10. See also: Dr. Spyros Traiforos, "Nuclear Policy in Turkey: Is Turkey on its way to becoming a nuclear weapons state?", *Defensor Pacis*, January 1999, p. 79.

103. OECD/Nuclear Energy Agency, *Turkey*, 1996, p. 10.

104. OECD/Nuclear Energy Agency, *Turkey*, 1996, pp. 10-11.

105. Hacettepe University Nuclear Engineering Department, http://www.nuke.hun.edu.tr/department/nemgen.html

106. For more information on the Institute of Nuclear Sciences, see: http://www.nukleer.itu.edu.tr/~appli/

107. *Nuclear Research Reactors in the World*, Reference Data Series No. 3, International Atomic Energy Agency, Vienna, 1995.

108. IAEA, *Ibid.*.

independent, but part of TEAS.

8.2. Turkey's Initial Nuclear Attempts: The 1960s & the 1970s

Nuclear proponents in Turkey have made a number of unsuccessful attempts to initiate a nuclear power program. Unlu reports that work started on a nuclear power plant proposal in 1965, by the Electricity Survey Institute and the Nuclear Energy Institute at Istanbul Technical University.[109] Aybers notes that the "Electrical Resources and Planning Department (EIEI) headed the effort, under the control of the state enterprise ETIBANK, which was then in charge of electricity. Based on a feasibility study by an advisory group that Aybers headed, a 400 MW CANDU plant was chosen in 1970 and a proposal was obtained from AECL.[110] It was proposed that the plant would be operational by 1977. However, the proposal fell victim to Turkey's political and bureaucratic upheavals at the time. A military coup took place on March 12, 1971, deposing the government, and also in 1971, the Turkish Electric Authority (TEK) was created, taking over electricity generation. Unlu also notes that there were problems with site selection.

From its initial foundation in 1970-71, the Turkish Electric Authority (TEK) initiated work on site selection, and eventually narrowed the selection to the Akkuyu site on the Mediterranean coast, 43 km southwest of Silifke. At the time, Akkuyu was thought to have the lowest earthquake risk of the various sites under consideration. Surveys were reportedly carried out in the northwest; Western Anatolia; the Marmara region; and the Black Sea coast as well as the Mediterranean coast.[111] TAEK eventually licensed the Akkuyu site in June 1976, however, it appears that the bulk of work on geology and earthquake risk was only done *after* the site had been licensed (see seismic section of this report). TAEK's main report, the "Detailed Site Investigations Report" was not released until 1983, and several IAEA-sponsored studies took place after that time in the 1980s.[112]

Negotiations began in 1977 with two Swedish companies, ASEA-Atom and Stal Laval for a construction of a 660 MW Boiling Water Reactor.[113] Turkey was asking for 100% financing and that was probably responsible for the collapse of the deal in mid-1980 after a failure to agree on financing. The deal lost its priority following a military coup in September of that year, and a military junta took over the country for the next three years. Just as a previous military coup 1971 had been partly responsible for the failure of Turkey's first attempt to build a nuclear power plant, the 1980 coup led by General Kenan Evren ended Turkey's second attempt to go nuclear.

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109. Kenan Unlu, "Turks take steps to revive their nuclear programme", *Nuclear Engineering International*, January 1995, p. 16.

110. Nejat Aybers, *Implementation of a Nuclear Power Plant in a Developing Country: The Case of Turkey*, Figure 1: Structure of TAEK, p. 2.

111. Unlu, *ibid.*.

112. IAEA-TA-2174, January 6, 1984, IAEA-TA-2188, February 1984, IAEA-TA-2206, April 1984, IAEA-TA-2282, October 1984, IAEA-TA-2305, January 1985, IAEA-TA-2366, May 1986. These reports are all referenced in Turkish Ministry of Foreign Affairs, *Basic Facts Concerning the Proposed Nuclear Power Plant at Akkuyu in Turkey*, "Seismic Conditions at the Akkuyu Site", undated, downloaded June 2000. The Turkish government, the nuclear vendors and the IAEA have refused to make these reports public.

113. Unlu, *Ibid.*.

8.3. Turkey's Third Nuclear Attempt: The 1980s

In 1982, the Atomic Energy Commission (AEK) was replaced by the Turkish Atomic Energy Authority (TAEK), which reports directly to the Prime Minister. In the fall of 1983, TAEK invited bids from seven major reactor vendors for nuclear power plants (see Table 13). Following the preliminary evaluation, letters of intent were issued to three companies:[114] Atomic Energy of Canada Ltd. (AECL) for a CANDU 6 (i.e. a 600 MWe reactor) at Akkuyu; Kraftwerk Union (KWU) of Germany for a 990 MWe Pressurized Water Reactor (PWR) also at Akkuyu; and General Electric (GE) of the United States for one or two 1,185 MWe Boiling Water Reactors (BWRs) at Sinop on the Black Sea.[115]

A research team from GE in consultation with representatives from the International Atomic Energy Agency (IAEA) and Turkey eventually concluded that the Sinop site was unacceptable without much more research because of fault lines in the Black Sea basin, and the possibility of earthquakes. However, negotiations with AECL and KWU extended into 1984. Contract negotiations had proceeded to an advanced stage on the basis of a turnkey agreement, with the vendors responsible for the whole project, including construction, and supplying financing "for the base cost of the plant".[116] In 1983 the media reported that Turkey required AECL to provide financing by Canada's Export Development Corporation[117] of 80 to 85% of the total cost of the plant. It was also reported that Korea Heavy Industries (now known as Hanjung, a subsidiary of the Korea Electric Power Corporation -- KEPCO), and another supplier of the turbine/generator would be partners in the deal.[118] By 1987, partners in the AECL deal were identified as NEI Parsons of Britain (turbine/generator set), and the Turkish engineering company Enka Insaat.[119]

However, Turkey altered its position in 1985 to a Build, operate, and transfer (BOT) financial model.[120] Turkey proposed to have the nuclear vendor build and operate the plant for 15 years as part of a "Joint Venture Utility" -- a "vendor/operator" partnership with TEK.[121] The advantage for Turkey was that it would get the nuclear plant with very little upfront cost, plus the training on how to use it, and the country's borrowing capacity in both the public and private debt markets would not be affected. It was later reported that as part of the deal, AECL would have to accept the risk of poor performance - reportedly a minimum 75% capacity factor.[122] Clearing the way for a possible sale to Turkey, a Nuclear Cooperation Agreement had been signed with Canada in 1985.[123]

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114. Unlu, *ibid.*.

115. The `Sinop' site is at Inceburun, the most northern point in Turkey, on the cental Black Sea coast, about 25 km west of Sinop.

116. Nejat Aybers, *Implementation of a Nuclear Power Plant in a Developing Country: The Case of Turkey*, Figure 1: Structure of TAEK, p. 2.

117. The Export Development Corporation (EDC) is a federal Canadian crown corporation, and is Canada's governmental export/import finance bank.

118. Robert McDonald, "Canada may sell Turkey CANDU reactor", *Toronto Star*, November 1, 1983.

119. CP, "Turkey set to accept new CANDU proposal", *Globe & Mail*, January 13, 1987, p. B7. Enka is working with the Westinghouse/Mitsubishi consortium in Turkey's 1997 bidding process.

120. *Financing of CANDU Bid to Turkey*, "Memorandum to Cabinet from Minister if Natural Resources and Minister of International Trade", December 1993. [confidential Canadian Cabinet document leaked to the public in December 1998]

121. A. Kutukcuoglu, "Turkey's joint venture scheme", *Nuclear Engineering International*, March 1986, p. 29.

122. CP, *ibid.*, January 13, 1987, p. B7.

123. CP, "Sale of CANDU a step closer" *Globe & Mail*, July 19, 1985.

Table 13. Vendor Proposals to TAEK, January 1983

Vendor	Reactor Type	Power (MWe)	Cost ($million US 83)
AECL (Canada)	CANDU	635	986
Asea Atom (Sweden)	BWR	990	943
Framatome (France)	PWR	1000	951
KWU (Germany)	PWR	970	896
NNC (UK)	GCR	2 X 300	1037
GE (US)	BWR	1185	1402
		2 X 1185	2452
Westinghouse (US)	PWR	625	749
		940	910

CANDU = CANadian Deuterium Uranium reactor
BWR = Boiling Water Reactor
GCR = Gas Cooled Reactor
PWR = Pressurized Water Reactor

Source: Nejat Aybers, *Implementation of a Nuclear Power Plant in a Developing Country: The Case of Turkey*, p. 12.

In late 1984, KWU had withdrawn its bid, reportedly because Turkey was unwilling to give a sovereign (i.e. state) guarantee on loans required to finance the project. AECL, however, was willing to accept the high financial risk, and agreed to the BOT/Joint Venture Utility scheme, and signed a preliminary agreement in 1985.[124] As usual, AECL did not release details of the negotiations and simply announced "the start of detailed negotiations and proposals for the construction of a CANDU unit in Turkey".[125] The AECL proposal was facilitated by Nuclear Project Managers, a joint venture between AECL, SNC, Lavalin, and the Montreal Engineering and Foundation company. The Balance of Plant (non-nuclear side was to be supplied by NEI Parsons (UK), Voest-Alpine AG of Austria, and Snamprogetti of Italy.[126] The *AECL Annual Report 1985-86* referred only to "a proposal to supply a CANDU 600 system to Turkey" and to "prolonged negotiations for the construction of a CANDU station in Turkey".[127] At this time AECL established an office in Ankara, the Turkish capital.[128]

In 1985, concerns were also raised in Canada about the possibility of corruption in the Turkish deal. "Finders fees" -- an euphemism for bribes, have apparently been an accepted practice in Turkish megaprojects.[129] James Donnelly, then president of AECL stated, "We have a representative in Turkey,

124. Unlu, *Ibid.*.

125. *Atomic Energy of Canada Limited Annual Report 1984-85*, p. 6.

126. "Canadian consortium is denying European reports", *Nucleonics Week*, August 14, 1986, pp. 7-8.

127. *AECL Annual Report 1985-86*, pp. 2 & 6.

128. The existence of this office is noted in AECL's Annual Reports for 1986-87 and 1987-88.

129. Diane Francis, "Let's scrutinize financing for $1 billion reactor", *Toronto Star*, November 12, 1985, pp. D1 & D2.

which is the only way to do business in Turkey". Donnelly said that AECL's agent in Turkey gets "a consultant's fee and he will get a percentage of the deal".[130]

However, despite AECL's payment of agent fees, and despite three years of steady media reports about probable closure on the CANDU deal, the Canadian government and the EDC balked at the combination of a BOT deal and the absence of a sovereign guarantee. Several reports in the summer and fall of 1986 stated that AECL Turkey had suspended the project, and that talks with AECL had been suspended.[131] Although clearly the project was in serious trouble AECL denied the reports, and accused its competitors of spreading lies.[132] The Turkish ambassador to Canada suggested in January 1987 that another Canadian proposal would be entertained.[133] At the end of 1987, AECL was still trying to make the BOT arrangement work, looking for financing outside of Canada to reduce Canadian government exposure as part of a $1.2 billion package.[134] AECL Vice President for marketing Jean-Claude Paquin said the project was not dead, but that it would need to be financed within the year. AECL's hoped-for breakthrough would never happen, but with the support of subsidies from Canadian taxpayers, AECL continued to keep its office in Ankara open, and provided training for Turkish officials on safety, licensing and CANDU fuel. While the Canadian government was willing to ignore legitimate proliferation concerns, financial issues were ultimately responsible for the failure of the deal. A confidential 1993 Canadian cabinet document did not reveal any proliferation concerns, but did identify concerns about the BOT structure and the absence of a sovereign guarantee.[135] Meanwhile, Turkey decided to look elsewhere for the acquisition of nuclear technology.

8.4. Turkey's Fourth Nuclear Attempt: Argentina

Following the collapse of negotiations with GE, KWU and AECL, in its third attempt to start up a nuclear program, Turkey turned to Argentina as a source of nuclear technology. On May 3, 1988, the two countries signed a 15 year nuclear cooperation agreement. Turkey was hoping to duplicate the Argentinean drive for nuclear fuel cycle independence. Argentina agreed to study the feasibility of building a 300 MWe PWR, known as "Argos" designed by Empresa Nuclear Argentina de Centrales (ENACE)[136] . TEK and its Argentinean counterpart, the Comision Nacional de Energia Atomica (CNEA) were designated to look at the possibility of the siting an Argos reactor at Akkuyu. Negotiations also took place on transferring a wide range of fuel cycle technology to Turkey.[137]

Turkey was also interested in a 25 MW version of the Argentinean CAREM-15 light water reactor. The reactor had been designed by Investigaciones Aplicadas (INVAP, a company majority owned by CNEA) but no prototype had been built. In April 1989, Atilla Ozmeni, President of TAEK, had visited Buenos Aires and

130. *Ibid..*

131. "Turkey has halted talks with AECL", *Nuclear News*, July 1986, p. 21. See also: "Turkish decision shelves sale of Canadian nuclear plant" *Toronto Star*, October 16, 1986, p. E3.

132. "Canadian consortium is denying European reports", *Nucleonics Week*, August 14, 1986, pp. 7-8. See also: "AECL says that it is still negotiating with Turkey", *Nuclear News*, November 1986, p. 21.

133. CP, "Turkey set to accept new CANDU proposal" *Globe & Mail*, January 13, 1987, p. B7.

134. Ray Silver & Carol Reed, "AECL says money for Akkuyu deal is being negotiated worldwide", *Nucleonics Week*, January 7, 1988, pp. 1-2.

135. *Financing of CANDU Bid to Turkey*, "Memorandum to Cabinet from Minister if Natural Resources and Minister of International Trade", December 1993. [confidential Canadian Cabinet document leaked to the public in December 1998].

136. ENACE is 75% owned by the Comision Nacional de Energia Atomica (CNEA), and 25% by KWU of Germany.

137. Richard Kessler, "Argentina says nuclear accord with Turkey sets stage for exports", *Nucleonics Week*, May 12, 1988, pp. 8-9.

stated that Turkey wanted to follow the example of Argentina and obtain independence in nuclear technology.[138]

In October 1990, TEK and the Turkish company Sezai Turkes-Fevzi Akkaya (STFA), along with the Argentine nuclear vendor Comision Nacional de Energia Atomica (CNEA) and Investigaciones Aplicadas (INVAP) formed a joint engineering firm to develop the reactor.[139] It was agreed in October 1990 that two CAREM reactors would be built -- one in each country, with construction beginning in Argentina in 1991, and in Turkey in 1992. Argentina would provide the technology and know-how, and Turkey would provide the financing.[140] Former Turkish Prime Minister Turgut Ozal and Argentine President Carlos Menem personally expressed support for the deal.[141]

If the rating for the CAREM was 25 MW thermal, the electrical rating would have probably peak at about 9 or 10 MW, making it relatively insignificant in terms of electricity generation. The Argentines, however, suggested that the reactor could also be used for district heating or desalination.[142] Yalcin Sanalan, a former Director of TAEK was more frank when he said that the CAREM-25 was "...too small for electricity generation and too big for research or training, however, very suitable for plutonium production", thus making it a very real proliferation risk. American opposition to the joint Argentine/Turkish project was made clear, and Sanalan "concluded that such an ambiguous project would decrease the chances of Turkey in its current and future quest for large-scale nuclear power plants...".[143] Although the nuclear cooperation agreement between Turkey and Argentina has remained in place, Turkey cancelled the project in 1991, following pressure from the United States and others.

8.5. Turkey's Fifth Nuclear Attempt: The 1990s & the New Millennium

Turkey's fifth attempt to initiate a nuclear power program began when TEK sent out a request for preliminary proposals in October 1992. AECL received this request on October 28, 1992, and promptly delivered a preliminary proposal on December 1, 1992, establishing the "basis for an offer".[144] AECL reported that the basis of an offer was "for one or possibly two" CANDU-6 reactors. The TEK plan called for the first plant to be in service by 2000.[145] In addition to AECL (CANDU-6), there were initial responses from Westinghouse (AP-600), Asea Brown-Boveri–Combustion Engineering (ABB-CE) (BWR-90), and Nuclear Power International (Convoy PWR-1400).[146] AECL formed a consortium with John Brown Engineers and Constructors BV Europe, from the Netherlands, and two Turkish construction firms, Gama

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138. Richard Kessler, "Argentina said near deal with Turkey for 25-MW LWR", *Nucleonics Week*, May 11, 1989, p. 5.

139. CNEA is the operator of Argentina's CANDU reactor at Embalse (Cordoba), and INVAP designed the CAREM reactor, working out of Argentina's Bariloche Nuclear Centre.

140. Richard Kessler, "Argentina and Turkey to form nuclear A/E to build small PWRs", *Nucleonics Week*, October 25, 1990, pp. 12-13.

141. Telam (Buenos Aires), "CNEA chief discusses cooperation with Turkey", *Nuclear Developments* (CNS Nuclear Databases), October 22, 1990.

142. "Reactor venture entered with Turkey", *Nuclear News*, December 1990, p. 46.

143. Cited in: Kibaroglu, *ibid.*, p. 38.

144. *Financing of CANDU Bid to Turkey*, "Memorandum to Cabinet from Minister if Natural Resources and Minister of International Trade", December 1993, p. 23. [confidential Canadian Cabinet document leaked to the public in December, 1998]

145. *AECL 1992/93 Annual Review*, p. 13.

146. Nejat Aybers, *Implementation of a Nuclear Power Plant in a Developing Country: The Case of Turkey*,

and Guris.[147] The consortium apparently re-established an office in Ankara and prepared to supply a bid for a CANDU-6 on short notice, once the actual request for bids on the project was issued.[148]

In the summer of 1994, the Turkish Electric Authority (TEK) was divided into two companies -- the Turkish Electricity Generation and Transmission Company (TEAS), and the Turkish Electricity Distribution Company (TEDAS).[149] That same year, TEAS issued a request for bids for consultancy services on the new nuclear project. It was subsequently reported that on December 29, 1994, TEAS awarded the consultancy contract to the Korea Atomic Energy Research Institute (KAERI) in partnership with two other Korean companies -- Hidec and HEC -- and the Turkish company GAMB. Tasks include evaluation of various reactor types; review previous bids, and aid in bid and contact negotiations.[150] At $350,000 (US), KAERI's bid for the project was reportedly the cheapest of 18 bids received by Turkey.[151] The hiring of KAERI prompted a flurry of opposition to the proposal which slowed down progress. Serious local opposition to the proposal erupted when 24 Mayors in the region objected to the plan, saying it would damage tourism and agriculture, the two current economic mainstays of the area.[152]

In March 1996, it was suggested that the bidding for Akkuyu would be opened in a matter of weeks[153] , However, a significant delay was announced until May in order to put in more "technical data" and "commercial specifications".[154] In fact, bid specifications were not finally released by TEAS until December 17, 1996.[155] Perhaps the most significant change was that it would be a turnkey project with 100% financing required. Another key financial aspect of the deal was that Turkey would provide a sovereign guarantee on the deal. It had previously been suggested that TEAS would require a BOT [build-operate-transfer] model, along with the joint venture scheme[156] , both proposals which (along with the absence of a sovereign guarantee) had resulted in the failure of the 1980s effort to initiate a nuclear program.

Initially, it was announced that bids would be due on June 30, 1997, but this was subsequently changed to September 4, 1997[157] . In late August 1997, the bid deadline was delayed yet again, to October 15, 1997.[158] It was suggested that the delays were granted at the request of the Westinghouse/Mitsubishi consortium, which has reportedly been unable to obtain financing for the local content portion of its bid.[159]

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147. *AECL Annual Report 1993-1994*, p. 6.

148. *Ibid.*.

149. Unlu, *Ibid.*, p. 17.

150. Jack Ashton, "Turkey revives plans for first nuclear power plant", *NucNet News*, December 30, 1994.

151. "Korea prepares for Turkish bid", *Nuclear Engineering International*, May 1995. See also: Jack Ashton, "Turkey close to launching N-plant project", *Nucnet*, March 29, 1996.

152. "Akkuyu plans meet opposition", *Nuclear Engineering International*, March 1995, p. 8.

153. Mark Hibbs, "Turkey expected to request bids for PWR project in coming weeks", *Nucleonics Week*, March 21, 1996, pp. 1-2.

154. "Akkuyu bids delayed", *Nuclear Engineering International*, April 1996, p. 3.

155. Nevzat Sahin, Head of Nuclear Power Plant Department, TEAS, Turkey, *TEAS Akkuyu Nuclear Power Plant Project*, December 17, 1996.

156. Unlu, *Ibid.*, p. 17.

157. *Uranium Institute News Briefing 97.29-15*, "Turkey: Bids for the country's first nuclear power plant will be collected on 4 September and there will be no further extensions, according to an energy ministry spokesman." (Reuters, 17 July, 1997)

158. Mark Hibbs, "Turkey's pro-US regime extends bidding, which may boost Westinghouse bid", *Nucleonics Week*, September 4, 1997, pp. 7-9.

159. Mark Hibbs, *ibid.*, September 4, 1997, p. 8.

It had originally been suggested that the first reactor would be commissioned in year 2000. By 1995, this had slipped to 2002-2003.[160] The official target then slipped further to the year 2005.[161] Following the delay of bids to September 4th, TEAS announced that it would choose a vendor in March 1998, six months after the deadline. Twelve months later, credits were expected to be confirmed, with construction beginning in mid-1999. Allowing for a 6.5 year construction period, completion and start-up would take place in 2005[162] , or possibly 2006.[163]

The TEAS bid specifications are somewhat complex, identifying two alternatives, that provide flexibility for the reactors being offered by the competing vendors:

Alternative I (Main offer): NPP [nuclear power plant] having net output max. 1400+5% MW (1 or 2 units according to size offered)

Alternative II (Optional): NPP having net output max. 2800+5% MW (2 or 4 units according to size offered)

Minimum unit size allowed is 600 MW (net) and minimum NPP plant size 800 MW (net)[164]

Three consortia have been identified as bidding[165] :

- Westinghouse (USA) and Mitsubishi Heavy Industries (Japan); Raytheon (USA); Enka (Turkey)
- Atomic Energy of Canada Limited (AECL)
  Hitachi Ltd. and Itochu Corporation (Japan); Gama, Guris, and Bayindir (Turkey); Bechtel (US); Ansaldo (Italy); Korea Electric Power Corporation (KEPCO), Hanjung (Korea Heavy Industries and Construction Company – KHIC) and Daewoo (South Korea). AECL is keeping secret the list of Canadian companies participating in the bid.[166]
- Nuclear Power International (NPI)
  Siemens (Germany) and Framatome (France); Campenon Bernard; Hochtief AG; Garanti Koza, STFA, Tekfen & Simko (Turkey)

Ansaldo Energia of Italy also attempted to organize a bid with the Russian state nuclear company Minatom, but was apparently unable to arrange financing.[167] TEAS has confirmed that Asea Brown Boveri-Combustion Engineering (ABB-CE) considered bidding, but an American source has stated that the company

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160. Unlu, *ibid.*, p. 17.
161. Nevzat Sahin, *ibid.*.
162. Mark Hibbs, "World finance, regional gas market keys to Turkey's Akkuyu project", *Nucleonics Week*, August 28, 1997, pp. 10-13.
163. Mark Hibbs, *ibid.*, August 28, 1997, p. 12.
164. Nevzat Sahin, *Ibid.*.
165. "Akkuyu Bidders Announced", *Nuclear Engineering International*, March 1997, p. 4. See Also: Anatolia News Agency, June 6, 1997.
166. The original AECL bid included Kvaerner-John Brown (UK) which has since cropped out. Itochu Corp., Bechtel, and Ansaldo have since been added. See: *Letter from Ralph Goodale, Canadian Minister of Natural Resources, to Jim Karygiannis MP*, April 12, 2000.
167. Ansaldo is AECL's partner in Romania, where Cernavoda-1 started operation in 1996, and negotiations are underway to procure financing to complete a second reactor.

thought the project was "not well founded and involved too much political and economic risk".[168] General Electric apparently also considered making a bid, but decided against it.[169]

The reported bids are noted in *Table 14*. Nuclear Power International (jointly owned by Siemens (Germany) and Framatome (France) has the lowest bid at about $2.4 billion (US), followed by AECL (Canada) at about $2.4 to $2.6 billion (US).[170] The Westinghouse bid was significantly higher at about $3.3 billion (US). When the bids were opened on October 15, 1997, TEAS announced the following timetable for project implementation:

April 1998: Bid evaluation.
June 1998: Contract negotiations and signing.
January 1999: Bilateral agreement, financial agreement and coming into force of contract.
June 2006: Commercial operation of the first reactor.
June 2007: Commercial operation of the second reactor (if a two-reactor option is chosen).

Table 14. Akkuyu: Opening Bid Prices

Bidder	Offers	Bid Price*	Power (MWe)	Cost ($/kw)*
NPI	1 (Main)	$2 393 000 000	1482 (1 reactor)	1615
	2 (Optional)	$4 480 000 000	2964 (2 reactors)	1511
AECL	1 (Main)	$2 571 637 552	1339 (2 reactors)	1920
	1 (Optional)	$2 423 622 988	1339 (2 reactors)	1810
	2 (Main)	$4 819 911 000	2678 (4 reactors)	1800
	2 (Optional)	$4 568 810 000	2678 (4 reactors)	1706
Westingouse	1 (Main)	$3 278 658 000	1218 (1 reactor)	2696

* $US 1997 (for Canadian dollars, multiply by 1.47)

Source: "Akkuyu gets 3 bids", *Nuclear Engineering International*, November 1997, p. 2.

It is important to note that even once a vendor was to be selected in June 1998, contract negotiations and financing agreements would take another six months, with a signed contract taking at least one year. Even once a 'winning' vendor is selected, TEAS has stated that it will continue to negotiate with the losing vendors, presumably to improve its bargaining position with the 'winner'.[171] However, the initial step of vendor selection has been repeatedly delayed.

The Canadian government has identified the cost of the main AECL bid at $2.242 billion (US), or $3.563

168. Mark Hibbs, "NPI Sees little hope, AECL edge in Turkish nuclear unit bidding", *Nucleonics Week*, May 1, 1997, p. 5.

169. Mark Hibbs, *ibid.*, August 28, 1997, pp. 10-13.

170. The reason for the distinction between the two categories of "main" and "optional" bids by AECL is not clear.

171. Mark Hibbs, "Turkey will continue talks with all vendors after picking winner", *Nucleonics Week*, September 24, 1998, pp. 2-3.

billion (CDN) (exchange rate of 1.47). The Canadian scope of the bid is 35% of $3.563 billion (CDN) or $1.247 billion. This work would be carried out by AECL, Canatom/Nuclear Project Management, and about 150 Canadian companies.[172] The government and AECL traditionally refuse to name the Canadian companies and their contract amounts, presumably because of fear of public protests and boycotts of the companies. The offshore consortium participants noted above will receive 65% of the business, but there has been no indication of the nature their contracts or their value. AECL officials have reportedly stated that Korean involvement in the Turkish deal would be double the Korean input in the sale of two CANDU-6 reactors at Qinshan to the Peoples' Republic of China.[173]

The Canadian government has committed to $1.5 billion in financing for the Canadian scope of the project, and the foreign companies have to provide their own financing, presumably from their respective countries' export/import banks. Natural Resources Minister Ralph Goodale has stated that "Required financing for the Canadian scope of work could be between CDN $1.247 billion (project cost) and CDN $1.5 billion because other costs, such as administrative fees and currency fluctuations would increase the actual amount of the total loan to Turkey."[174] Goodale has not clarified how much Canadian financing will be provided for the participation of the Turkish partners, Gama, Guris, and Bayindir.

AECL is bidding its standard CANDU-6[175] reactor, in both a two unit and four unit station.[176] Nuclear Power International (NPI – the French/German consortium of Framatome/Siemens) is apparently bidding a 1980s vintage Siemens 1400 MW 'Convoy' model PWR, using Neckarwestheim-2 in Germany as the reference plant. Westinghouse and Mitsubishi Heavy Industries will probably offer a one or two unit PWR station, with Ohi-3 and -4 in Japan as the reference plants.[177] NPI president Ulrich Fischer alleged that AECL and the International Atomic Energy Agency (IAEA) manipulated Turkey[178] into requiring that a reference plant of the kind being bid must have at least five years operating experience.[179] This resulted in the elimination of more advanced, less expensive reactors from the NPI consortium -- Framatome's N4 Pressurized Water Reactor (PWR) and the European Pressurized Water Reactor (EPR). The EPR is still in the design stage and the N4 PWR reference plant has not operated the required five years.

This was not the only unfair aspect of the bidding process that worked in AECL's favour. As noted above, the Korea Electric Power Corporation (KEPCO) as well as Hanjung (formerly known as the Korea Heavy Industries & Construction Company, KHIC) will be major participants in the AECL consortium. KEPCO is the state-owned South Korean utility, and is a major shareholder in Hanjung. There has been a major conflict of interest because the Korean Atomic Energy Research Institute (KAERI), which set the terms for the bidding process and acted as a consultant to TEAS, is also part of the Korean state nuclear

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172. *Letter from Ralph Goodale, Canadian Minister of Natural Resources, to Jim Karygiannis MP*, April 12, 2000.

173. Mark Hibbs, *ibid.*, May 1, 1997.

174. *Letter from Ralph Goodale, Canadian Minister of Natural Resources, to Jim Karygiannis MP*, April 12, 2000.

175. The `CANDU 6' is actually a misnomer. The earlier designs of the reactor were close to 600 MW, but it has been scaled up. The two `CANDU 6' reactors sold to the Peoples' Republic of China for construction at Qinshan are actually closer to 700 MW.

176. Mark Hibbs, *ibid.*, August 28, 1997, pp. 10-13.

177. Mark Hibbs, *ibid.*, August 28, 1997, pp. 10-13.

178. Mark Hibbs, *ibid.*, May 1, 1997, p. 5.

179. The TEAS specifications identify the following main criteria for bidders: previous construction and commissioning of at least two NPPs; designating one "reference plant" similar to the one being offered for Akkuyu; preference shall be given to the ones who have constructed an NPP abroad; the design which has previously had an "accident" shall not be accepted; the NPP offered shall be licensable first in the bidder's country; 5 year operation experience for the type offered; and the offered power plant shall be the newest of its type.

industry. The President of KEPCO is also chairman of the Board of Directors of KAERI.[180] TEAS decided to replace KAERI mid-way through the bidding process, so that while KAERI acted as consultant for the formulation of bid specifications and initial negotiations, a new consultant was hired to evaluate the bids and finish negotiations.[181] Conflict of interest has not been mentioned as a reason for the switch -- it has been suggested that the reason related to a restructuring of the South Korean nuclear industry, implying inadequate resources on the part of KAERI.[182]

It has been suggested that the AECL bid would not likely be able to match the cost of the NPI Convoy plant[183] , however, this evaluation may have assumed that AECL would only be bidding one, instead of two or four CANDU 6 reactors. The two or four reactor bid may have altered the economics, and much will obviously depend on the financing package.

One report has suggested that AECL has lost its earlier edge in the bidding process. AECL was thought to have an advantage, based on the supposedly greater self-sufficiency of the CANDU fuel cycle, since it does not require a high degree of uranium fuel enrichment. However, any perceived fuel cycle advantage for CANDU because of its use of `natural' uranium is deceptive. Although CANDU fuel requires less processing, the heavy water, needed for both cooling and moderation, is expensive to purchase and difficult to manufacture. In addition, given the relatively low cost of uranium, Turkish officials no longer believe that the use of natural uranium is a particular advantage.[184]

It has also been suggested that the forced change in government in Turkey may affect the outcome of the Akkuyu bidding process.[185] Under pressure from the military, in June 1997, the Islamist government of Prime Minister Necmettin Erbakan was replaced by a conservative government under Prime Minister Mesut Yilmaz. The pro-American leanings of Yilmaz may favour the Westinghouse/Mitsubishi bid.

The Turkish government and TEAS have made an embarrassing series of delays since 1998 in choosing one of the three bidding nuclear vendors. TEAS has provided no clear reason for the delays. The initial date announced for selection of a vendor to build the Akkuyu nuclear plant was June 1998.[186] In June, however, an unnamed official at the Ministry of Energy and Natural Resources was quoted saying that the selection "may be finalised in July".[187] A severe earthquake on June 27, 1998 near Adana and Ceyhan (about 150 km from Akkuyu) renewed the controversy over the earthquake safety of the Akkuyu site. On July 15, 1998, unnamed sources said that the announcement would be made "in two to three weeks".[188] Germany opposition to Turkey's EU membership was reported to have soured Turkey's possible support for the NPI bid. The August deadline came and went with no announcement.

On September 22, 1998, Cengiz Yalcin, President of the Turkish Atomic Energy Authority (TAEK), said

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180. "South Korea: Datafile", *Nuclear Engineering International*, January 1997, p. 17.

181. Mark Hibbs, *ibid.*, September 4, 1997, p. 7.

182. Mark Hibbs, *ibid.*, September 4, 1997, p. 7.

183. Mark Hibbs, "Turkey expected to request bids for PWR project in coming weeks", *Nucleonics Week*, March 21, 1996, pp. 1-2.

184. Mark Hibbs, "Turkey considers spent fuel deal with Bulgaria, Hungary for Akkuyu", *Nuclear Fuel*, August 25, 1997, p. 8.

185. Mark Hibbs, *ibid.*, September 4, 1997, p. 8.

186. "Akkuyu gets 3 bids", *Nuclear Engineering International*, November 1997, p. 2.

187. Orhan Coskun, "Turk nuclear plant tender may be concluded in July", *Reuters*, June 15, 2000.

188. Mark Hibbs, "TEAS expected to decide in August on vendor for Akkuyu Bay project", *Nucleonics Week*, July 23, 2000, p. 3.

that the selection would take place in mid-October.[189] However, it was clear that the government was operating without any clear plan in an atmosphere of political crisis. Mesut Yilmaz of the Motherland Party (ANAP) was not elected, but put in power after the military forced out an elected government in a "soft coup". Pressure was mounting for an early election, which he was trying to resist. In mid-October, TEAS General Manager Zeki Koseoglu said that winner of the Akkuyu tender "might be announced next month".[190] On November 18, 1998, Energy Minister Cumhur Ersumer told the Parliamentary Planning and Budget Commission that the vendor would be selected before the end of the year.[191] Once again, however, there was no announcement, and there was widespread speculation that vendor selection would be delayed until after the national election on April 18, 1999.

The national political crisis came to a head in January 1999, when a minority government headed by Bulent Ecevit of the Democratic Left Party (DSP) replaced the Yilmaz government. In February, the new energy minister Ziya Aktas confirmed that the selection of the Akkuyu vendor would be left until after the April election, but he ruled out speculation that the nuclear plant would be cancelled.[192]

Shortly before the election, the Turkish Undersecretary of Energy Yurdakul Yigitguden stated in New York at a forum on the Turkish energy situation that the Akkuyu nuclear plant would definitely proceed after the election, saying, "The nuclear power station is still under evaluation and we hope that this evaluation is finalized in 1999. I can't pronounce a certain date but I'm sure during the time of the new government it will be finalized."[193]

In July, Energy Minister Cumhur Ersumer (reappointed by Ecevit as part of the coalition government) said, "If we cannot reach a decision it will be interpreted that Turkey has given up on nuclear plants for ever."[194] However, time dragged on, and when the new government failed to make a decision, it was overtaken by a new crisis. On August 17, 1999, the Izmit earthquake resulted in over 18,000 deaths. Poor management of the crisis hurt the government's reputation, and also raised again the issue of earthquake risk at the Akkuyu site. However, Turkish officials denied that the earthquake would stop them from proceeding with Akkuyu. The next crisis was that after October 15, 1999, the three bidding consortia would no longer be legally bound to maintain the terms of their original offer, submitted two years previously on October 15, 1997.[195] As in previous delays, however, it became clear that the vendors were willing to tolerate virtually any expense and abuse of process in order to secure the deal, when they all agreed to maintain their bid prices.[196] On October 13, 1999, Energy Minister Cumhur Ersumer acknowledged the October 15th deadline, but said that it was being extended to December 31, with an option for another three month extension.[197] On December 2, 1999, following a summit meeting of leaders in the government coalition, Prime Minister Ecevit said "We will reach a decision within this month on the tender."[198] On December 20th, it was suggested that the vendor decision would be made on Friday December 24, and then the

189. Mark Hibbs, "Turkey will continue talks with all vendors after picking winner", *Nucleonics Week*, September 24, 1998, pp. 2-3.

190. Ercan Ersoy, "Turkey PM pledged to match booming energy demand", *Reuters*, October 15, 2000.

191. "Akkuyu nuclear power plant project", *EBA Report*, November 23, 1998, p. 10.

192. Ercan Ersoy, "Turkey postpones nuclear tender to after elections", *Reuters*, February 19, 1999.

193. Haitham Haddadin, "Firms to build Turkey hydro power plants", *Reuters*, April 19, 1999.

194. "Last chance for Turkey", *Nuclear Engineering International*, August 1999.

195. Mark Hibbs, "Akkuyu project will go ahead, Turkey asserts after big quake", *Nucleonics Week*, August 26, 1999, pp. 1-2.

196. "Turkey says firms agree to delay", *Reuters*, October 20, 1999.

197. "Nuclear plant tender", *Anadolu Agency*, October 13, 1999.

198. "Turkey presses ahead with plans for nuclear power plant", *Agence France-Presse*, December 3, 1999.

government suggested that it would be made by December 31, 1999.[199] Following a month of protests around the country by anti-nuclear forces, Energy Minister Cumhur Ersumer predictably announced that the bid selection had been delayed once more, likely until January.[200]

In January 2000, it was suggested that further delays had been caused by the need to clarify the nuclear weapons proliferation potential of the nuclear program. In particular the CANDU reactor has been accused of being proliferation-prone for a variety of reasons, and this has been seen (particularly by some members of the National Movement Party) as a reason to support AECL's CANDU bid, i.e. as a way of moving towards nuclear weapons capability for Turkey.[201] The expected announcement on January 31st was again delayed, and a request issued to extend to March 1st, and all three vendors confirmed that they would be willing to extend their current bids to that time.[202] Late on the evening of March 1st, Minister of State Sukru Sina Gurel said that the parliamentary council (essentially a cabinet body) met, and all three parties in the governing coalition had given their approval to proceed with the Akkuyu nuclear plant. Oddly, however, they reportedly delegated the decision to the state utility, TEAS, which had already made an evaluation, and is thought to be supporting the AECL bid. Gurel concluded by saying that TEAS would announce its decision within ten days (i.e. March 10 or 11th).[203] To nobody's surprise, another delay was agreed to, again with no change in the bid prices, this time until April 7, 2000.[204]

A further complication arose for Akkuyu in April with an announcement from the Turkish treasury department that it could not provide a guarantee for the loans for Akkuyu until 2003.[205] Treasury State Minister Recep Onal said that he could not provide a guarantee in view of the stability and disinflation program that was a condition of IMF loans.[206] Treasury has suggested that TEAS consider a BOT (Build-Operate-Transfer) financial arrangement for the plant, and Energy is reported to be considering it.[207] The guarantee is a crucial issue for vendors, but apparently not in the first few years of the deal. This situation is reminiscent of the 1980s nuclear deal, which foundered after Turkey switched in 1985 from a turnkey arrangement to BOT, and sought to get out of its sovereign guarantee.

Following the April announcement of concern by the Treasury department about the guarantee there was an interesting reported offer from Westinghouse to forego the guarantee. The Turkish newspaper *Milliyet* reported that Westinghouse project Director W.C. Gangloff had contacted Energy Minister Cumhur Ersumer to say that it would be possible for Westinghouse to start work without a credit guarantee from the treasury.[208] At the same time, Westinghouse also reportedly stated that it would not accept an extension of the deadline for vendor selection beyond July 24, 2000 (see below). *Milliyet* also reported that American Ambassador Parris had been lobbying for Westinghouse, and connecting its bid to American support for

199. "Turkey to announce nuclear contract winner on Friday", *Turkish Daily News*, December 20, 1999. See also: "Turkey to name nuclear deal winner next week: Government postpones long-awaited decision", *Turkish Daily News*, December 25, 1999.

200. "Turk minister says atom tender probably in January", *Reuters*, December 31, 1999.

201. Mark Hibbs, "Turkey set to choose vendor: last minute review caused delay", *Nucleonics Week*, January 27, 2000.

202. Ercan Ersoy, "Turkey seeks news delay to nuclear plant plan", *Reuters*, February 1, 2000. See also: "Consortia extend nuclear plant bids to March 1", *Turkish Daily News*, February 11, 2000.

203. "Council of MPs gives final approval to a nuclear power station", *Hurriyet*, March 2, 2000

204. "Firms agree to sixth extension in Turk nuclear tender", *Reuters*, March 21, 2000

205. "Treasury slams nuclear project for second time", *Turkish Daily News*, April 13, 2000.

206. "Consortia extend bids to April 21", *Turkish Daily News*, April 15, 2000.

207. Ebru Toktar, "Nuclear bid could be canceled", *Cumhuriyet*, April 4, 2000.

208. Fikret Bila, "USA initiative in the nuclear arena", *Milliyet*, May 25, 2000.

the Baku-Ceyhan and Turkmen oil and gas pipelines.[209]

A government news conference on Akkuyu on April 7th was cancelled at the last moment, and the government subsequently said that it would make an announcement on April 21, 2000.[210] In addition to the problem that has surfaced with opposition to the Akkuyu deal from Treasury, AECL and Westinghouse have said they are prepared to launch a legal challenge if Turkey grants the contract to NPI.[211] They object to an apparent lack of financing guarantees, as well as a minor technicality that the size of the proposed plant is slightly larger than the NPI reference plant Neckarwestheim II (GKN-2). Neckarwestheim II is a 1371MWe reactor in Germany that began commercial operation in 1989. Under a Turkish law approved in January, foreign companies doing business in Turkey can now appeal to an international arbitration procedure for commercial disputes.[212]

On April 21, 2000, the government asked the vendors to agree to a further extension of the selection deadline, until July 24, 2000. Energy Minister Cumhur Ersumer has attributed the delay to the objections from the Treasury Department.[213]

8.5.1. A Canadian Environmental Assessment?

The issue of environmental assessments for CANDU sales is an important one. In January 1997, the Sierra Club of Canada filed an application for judicial review to ensure that an environmental assessment is conducted in connection with the $1.5 billion in public financing for the sale of two reactors to China.[214] Just prior to the finalization of the agreement with China, the Canadian government rushed through changes to regulations under the Canadian Environmental Assessment Act that would have required it to undertake comprehensive environmental assessments of overseas projects. The changed regulations were given the force of law the next day without the usual sixty day comment period. This matter is still before the courts, and will have serious implications for the proposed sale of reactors to Turkey.

The leaked Canadian cabinet document from April 1997 stated that the Sierra Club has a good case...

> [the Canadian] justice [department] has advised that its case is not strong and that the Federal Court may well rule in favour of the Sierra Club. If the government loses, Justice expects that the court could issue an order directing the "responsible authority(s)" (RA), DFAIT [Department of Foreign Affairs & International Trade] and Finance, to conduct an environmental assessment which satisfies the Projects Outside Canada Environmental Assessment Regulations (POC).[215]

The Cabinet document is quite explicit that a victory by the Sierra Club "would require an environmental

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209. Fikret Bila, *ibid.*, May 25, 2000.

210. "Scores of anti-nuclear protesters detained", *Turkish Daily News*, April 9, 2000.

211. Ercan Ersoy, "Turk nuclear bid seen marred by questions", *Reuters*, March 7, 2000. See also: "Nuclear deal controversy", *Milliyet*, April 9, 2000. See also: Shawn McCarthy, "AECL threatens suit against Turkey", *Globe & Mail*, March 29, 2000, p. B6.

212. "Parliament approves bill governing international arbitration", *Turkish Daily News*, January 22, 2000.

213. Ercan Ersoy, Reuters, "Turkey seeks bid extension for plant", *Globe & Mail*, April 22, 2000, p. B7.

214. Sierra Club of Canada news release, "Sierra Club files for court review of CANDU deal", January 21, 1997. See also: Sierra Club of Canada news release, "Federal court to hear Sierra Club motion on Tuesday", April 14, 1997.

215. *Financing for Two CANDU Reactors to the Republic of Turkey*, "Record of Cabinet Decision / The Cabinet Committee on Economic Development Policy, Meeting of April 24, 1997, Confirmed by Cabinet on April 27, 1997", August 29, 1997, "Environmental Impact of Proposed CANDU Sale to Turkey", Section 2(a).

assessment of the CANDU sale to Turkey."[216] In the event that AECL wins the Akkuyu contract, this presents some risk of court challenge and delay on the basis that the government has failed to comply with the Canadian Environmental Assessment Act. In order to minimize this risk, the government has identified several possible courses of action that would involve conducting a "shadow" environmental assessment. This would involve following procedures as if the Projects Outside Canada Environmental Assessment Regulations (POC) were in place, including possibly the public registry requirements, which allow the public access to the records of the assessment.

8.5.2. Opposition to Nuclear Power in Turkey

Local fishermen and farmers in the Akkuyu Bay area have been protesting nuclear plans since the time when the land was expropriated in 1976. In the last five years, however, there has been widespread organized grass roots opposition.[217] Beginning in 1994, opposition has focused on annual national anti-nuclear rallies that have been held on Hiroshima-Nagasaki Days (August 6-9) in Buyukeceli, which is the nearest village to Akkuyu Bay, and has about 2,000 residents.

Local opposition to the building of a nuclear plant at Akkuyu Bay has been strong. On December 24, 1994, a number of local municipalities organized 300 people in nine buses to travel to the Turkish capital of Ankara, in an attempt to meet with President Demirel, and former Prime Minister Tansu Ciller. After being refused entry to Parliament, the citizens went to Ciller's party headquarters. After performing traditional folk dances in the street for hours, Ciller finally invited them to a meeting, that was filmed by TV crews and attended by journalists. Ciller offered only glib reassurance that with nuclear power, "The Mediterranean will remain blue".[218] The Mayors of 24 towns in the vicinity of Akkuyu joined the protest against the government's nuclear plan, arguing that it would damage tourism as well as agriculture.[219] The protests did not prevent TEAS from awarding a contract to the Korean Atomic Energy Research Institute (KAERI) to manage the bidding process. However, it seems that the opposition from residents around the Akkuyu site and by environmental groups did result in a delay of the bidding process itself.

On the 50th anniversary of Hiroshima, August 6, 1995, 2,000 environmentalists and villagers gathered at Silifke to protest the nuclear proposal. Silifke is the closest large city, 43 km northeast of Akkuyu Bay.

Environmentalists have also challenged the Akkuyu project legally. Environmental groups from the southeastern Mediterranean region, together with lawyers from the Izmir Bar Environmental Commission applied initially in 1995 at the Administrative Court of Adana for an annulment of the planning and operation of the Akkuyu Nuclear Power Plant (File No. 1995/317). They argued that TEAS acted illegally in issuing its request for bids on December 17, 1996 without conducting an initial Environmental Impact Assessment Study, with its accompanying requirements for public reporting and public participation, according to Turkish Environmental Law No. 2872. Adana Administrative Court rejected the case on April 24, 1996. The plaintiffs applied to be heard before a higher court, the Turkish Council of State (Danistay), but the suit was unsuccessful. Activists have continued to challenge the legality of the Akkuyu plant.[220]

On January 4, 1997, representatives of TEAS, TAEK and the IAEA visited Akkuyu-Buyukeceli along

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216. Record of Cabinet Decision, August 29, 1997, *Ibid.*, Section 1.

217. Background on opposition to nuclear power in Turkey has been obtained from media reports, and through personal communications with activists in the *Anti-Nuclear Platform* (Nukleer Karsiti Platform, which has chapters throughout the country), and the office of Greenpeace Mediterranean in Istanbul.

218. Personal communication from Aynur Sungur Tuncer, September 2, 1997.

219. "Akkuyu plans meet opposition", *Nuclear Engineering International*, March 1995, p. 8.

220. Serdar Kizik, "Akkuyu power station illegal", *Cumhuriyet*, March 1, 2000.

with 20 journalists in a promotional tour. Villagers spontaneously reacted to the unpopular visitors by throwing vegetables at them, stoning their bus, and running them out of town. On January 17, 1997, southeastern environmental associations from Iskenderun, Tarsus and Antakya again applied to the Adana Administrative Court (File No. 1997/86), arguing that TEAS had violated Turkish Environmental Impact Assessment Regulations and General Health Regulations. This case was also rejected by the court on April 29, 1997.

Turkey's Fourth Annual National Anti-Nuclear Meeting took place at Akkuyu-Buyukeceli village on August 9 & 10, 1997 (Nagasaki Day). The 1997 meeting was initiated for the first time by the villagers themselves, and was attended by over 2,000 villagers, and more than 1,000 environmentalists from all over Turkey. The rally drew national media attention in Turkey, and featured speeches of opposition to the nuclear plant from men, women and children of the village. The meeting resulted in a strong, nationally coordinated network of groups opposing the nuclear project.

In March 1998, Greenpeace sponsored an anti-nuclear visit and tour in Turkey, including the author, Ben Pearson, Nuclear Campaigner for Greenpeace International (Amsterdam), Michael Kuehn of Greenpeace Germany, and Melda Keskin, Greenpeace energy campaigner in Turkey. After speaking to the media in Istanbul, the tour flew to Adana in the south-east, then travelled overland to Akkuyu, with meetings en route in Mersin and Silifke. Several hundred villagers turned out in Buyukeceli for the speakers, emphasizing the depth of opposition. The author went on to Ankara, where he spoke at the Middle Eastern Technical University, and at a public meeting sponsored by the Confederation of Progressive Trade Unions of Turkey (DISK).

On March 28, 1998, a national demonstration was held against Akkuyu in Ankara that attracted 5,000 participants. Three busloads of villagers from Buyukeceli attended, as well as people from Sinop on the Black Sea, which is the second proposed location for a nuclear plant in Turkey. The march to Guven Park in Ankara was led by a traditional horse cart, filled with crates of vegetables and fruits grown by the Buyukeceli villagers, who understand very well that their way of life is at risk if the nuclear plant proceeds. The vegetables and fruit were given out to demonstrators, journalists, and police, and the demonstration received positive national media coverage.

Meanwhile, the Nuclear Engineers Society and TAEK had organized public meetings in Mersin, Gulnar and Silifke a few days later to attempt to promote Akkuyu and counteract the effects of the demonstration. However, these meetings also met with strong local opposition.

Opposition to the Akkuyu project is also strong in Germany, home of Siemens, which is part of the NPI consortium. In April 1998, Aynur Sungur Tuncer of the Anti-Nuclear Platform-Istanbul visited Germany for a speaking tour, with support from International Physicians for the Prevention of Nuclear War (IPPNW) and the Green Party. In Germany, Siemens is already the target of a consumer boycott because of the company's involvement in nuclear weapons production. IPPNW has incorporated opposition to Siemens proposal for the Akkuyu nuclear plant into the boycott campaign. IPPNW made June 8-14 an action week to support the boycott and oppose the Siemens (NPI) bid to build Akkuyu.

In early May, the Nuclear Engineering Society, with the support of the governor of Mersin, organized a series of public addresses to secondary school children in six towns and cities surrounding Akkuyu, including Silifke on May 4th. On May 6, Dr. Figen Ozturk, head of the Environmental Association of Adana organized a major public conference at Cukurova University in Adana attended by 350 people. The nuclear energy conference at Cukurova University featured nuclear engineers, Prof. Osman Kadiroglu and Prof. Niyazi Okmen as well as Prof. Tolga Yarman of Isik University, and Melda Keskin of Greenpeace. Prof. Yarman is a nuclear engineer with a doctorate from MIT, and a former member of the Nuclear Regulatory Committee of the Turkish Atomic Energy Authority. He is also perhaps Turkey's most prominent opponent of Akkuyu. He believes that the issue of seismic safety must be "conclusively resolved before the Akkuyu plant is built". He

also believes that alternative energy forms should be exploited before investing in nuclear energy.[221] At the conference he referred to the Akkuyu proposal as "a rotten pilaff that has been endlessly re-heated and served again and again for the last 25 years".[222]

In July 1998, in the wake the Ceyhan earth quake of June 27th, a prominent Turkish geologist, Prof. Dr. Attila Ulug demanded that plans for the Akkuyu plant should be slowed down, saying "At the very least, the Turkish government must conduct further investigations of the Akkuyu Bay area to determine the threat posed by the Ecemic Fault. To go ahead and build a reactor at Akkuyu Bay without further study would be a totally irresponsible, if not a criminal decision."[223] Ulug is the Head of Geophysics Department of the Institute of Marine Sciences and Technology at the Dokuz Eylul University in Izmir. He was co-author of a 1991 report by a team of Turkish marine geophysicists and a British geologist, who concluded that the Ecemis fault runs 20-25 km southeast of Akkuyu Bay and is active.

In July 1999, a referendum on the Akkuyu nuclear plant was held by the municipalities in the area around the site, including the two closest villages, Buyukeceli and Yesilovacik. The process was aided by volunteers from Greenpeace, CETKO Adana (an environmental group), the Turkish Anti-Nuclear Platform, and the Buyukeceli Association for the Environment. In Buyukeceli and area, 84% of the voters opposed construction of the nuclear plant. Before the votes in Yesilovacik could be tallied the Gendarmes (the Turkish police force that operates outside of the urban areas) seized the ballots, and prevented the process from continuing. The Mayor of Buyukeceli, Mr. Hummet Buyuk said, "Because of the nuclear commitment, Akkuyu region has been deprived of investments, especially in tourism. Our coasts are the most beautiful and untouched in the Mediterranean, As municipalities, we have expressed our opposition to TEAS in Ankara, and demanded that they scrap the plans to sacrifice Akkuyu Bay." [224] The Mayor of Yesilovacik, Mr. Halil Ibrahim Yetkin said, "It is cynical of the nuclear industry to sell their technology with the promise of a handful of jobs. We need long-term sustainable jobs, not short-term polluting ones."[225]

On October 16, 1999, an "Anti-Nuclear Congress" was organized in Ankara by the Turkish Anti-Nuclear Platform and the Turkish Association of Chambers of Architects and Engineers (TMMOB). TMMOB is an umbrella organization with 250,000 registered members. Akkuyu villagers were represented at the meeting.

On October 19, 1999, Greenpeace activists from Denmark, Germany, and Holland joined organizers to unfurl a huge banner from the massive Bosphorus bridge in Istanbul . The banner read, "Stop Akkuyu" with a trefoil radiation warning sign.[226] Energy Minister Cumhur Ersumer responded, "I would not give up on this project even if they wrote it on the sky, let alone the bridge. Nobody but God can stop me at this stage of the project."[227]

In anticipation of a year-end announcement of the Akkuyu vendor, a series of demonstrations took place around Turkey...[228]

December 11, 1999

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221. Tolga Yarman, "Turkish coast is no site for nuclear plant", *Toronto Star*, January 20, 1999, p. A16.
222. Personal communication from Aynur Sungur Tuncer, May 9, 1998.
223. "Turkish reactor to be built next to active fault line, according to 1991 study", *Greenpeace News Release*, July 2, 1998.
224. "Local people oppose nuclear power plant at Akkuyu", *Greenpeace News Release*, July 13, 1999.
225. Greenpeace, *ibid.*, July 13, 1999.
226. "Greenpeace unfolds anti-nuke demand on Bosphorus bridge", *Greenpeace News Release*, October 19, 1999.
227. Personal communication from Melda Keskin, Greenpeace, October 21, 1999.
228. Personal communication from Isil Esendir, Anti-Nuclear Platform - Istanbul, December 31, 1999.

The Anti-Nuclear Platform-Istanbul held a "news conference" in Taksim-Mis sokak (one of the most crowded places in Istanbul). The platform protested the barrage of pro-nuclear propaganda released by government officials in wake of systematic electricity black-outs staged by the state utility TEAS. A "news conference" is less likely to be repressed by the police than a demonstration, nevertheless, police detained 24 people for the day.

December 19, 1999
The Chamber of Doctors-Istanbul and the environmental group Doctors for Environment had a news conference in their white uniforms, in Kadikoy-Istanbul with the slogan "Your doctor doesn't want nuclear power plants". They stressed that nuclear power plants threaten peoples' right to live in a healthy environment and that radiation exposure causes many health problems, including thyroid cancers, leukemia, and birth defects.

December 21, 1999
Activists from the Turkish Anti-Nuclear Platform and Greenpeace, as well as representatives of the Buyukeceli villagers, blocked the entrance and chained themselves to the gate of the Turkish Atomic Energy Authority (TAEK) in Ankara. A banner hung from the front gate read, "Nuclear lobby go home!", while another unfurled from the roof of the TAEK building read "No Nukes!". Fourteen activists were detained by police for the day.

December 24, 1999
According to the Turkish Energy Ministry, the winner of the Akkuyu NPP bid was to be announced on this day. In fact there was no announcement, but protests were held throughout Turkey...

* In Ankara, villagers from Bergama (ancient Pergamon), joined in a protest against Akkuyu in front of the energy ministry. The villagers are veterans of a long struggle against the Eurogold mining project in their area, which uses a cyanide extraction process. As in other protests by the villagers, men took off their clothes and remained half-naked in winter cold. Forty villagers were detained by the police.

* A protest was held by the Turkish Association of Chambers of Architects and Engineers (TMMOB) in Kizilay Square in Ankara (one of the central squares in Ankara) with the slogan "Choose life, give up the nuclear adventure". They focused on the fact that out-dated reactor designs are being proposed for the Akkuyu nuclear plant, and stressed that they will not let nuclear 'gangsters' have a nuclear 'adventure' in Turkey.

* In Istanbul, many non-governmental organizations including anti-nuclear groups, and the Chamber of Electrical Engineers held a news conference in Sultanahmet Square. They carried a "nuclear monster" puppet representing the nuclear lobby. They protested Ministry of Energy policies which propose to invest $3 billion (US) in the Akkuyu nuclear plant, while largely ignoring renewable energy and conservation measures such as improvements to the electrical transmission network which currently has 25% losses.

* Students from Istanbul Technical University (ITU) protested the Akkuyu nuclear plant for the second time (the first was on December 10th). They demonstrated in front of Nuclear Energy Institute, which is part of the University and is prominent in the promotion of nuclear power.

* In Antalya, the local chapter of the Anti-Nuclear Platform held an interesting protest. They climbed down into newly dug graves in the state graveyard and played dead, saying that "the nuclear plant at Akkuyu will be a graveyard for 65 million people living in Anatolia" and "We do not want Turkey to be a radioactively contaminated graveyard".

* In Izmir, anti-nuclear protesters staged street theater in Konak Square. People in shrouds, re-enacted the

Chernobyl accident. Radiation-contaminated clouds reached Izmir on the May 5th, 1986, affecting many people.

* In Adana, the Anti-Nuclear Platform protested the Akkuyu nuclear plant. Their theme was that "The Akkuyu nuclear plant is being built to save the nuclear industry, and our energy policy was created for the profit of these multinational corporations."

* In Eskisehir, anti-nuclear groups also protested Akkuyu.

December 25, 1999

Almost three thousand people attended an anti-nuclear rally in Mersin, a large city in the region of the Akkuyu nuclear plant site. Those attending included villagers from Buyukeceli (the closest village to Akkuyu site), anti-nuclear groups, and other non-governmental organizations from all around Turkey. Three symbolic 'death angels' with their scythes in their hands shouted "We were waiting for you, we love nuclear power plants, we come to take your souls". Banners read "We reject the nuclear darkness", "Akkuyu won't be Europe's dump", "No nuclear genocide", "No new Chernobyls", "Akkuyu won't be karakuyu" (Akkuyu means 'white well' and karakuyu means 'dark pit' in Turkish). As a speaker at the rally stressed, "The nuclear lobby knows that the Akkuyu nuclear plant will not be a solution for the energy problem in Turkey, but they want to make our country a nuclear waste dump for profit. We do not want a nuclear plant at Akkuyu, or anywhere else."

Opposition to the Akkuyu nuclear plant has continued to gather support amongst high-profile people in Turkey. In March 2000, Prof. Ibrahim Kavrakoglu publicly denounced the Akkuyu project. His criticism carries significant weight, because he is the former Dean of Engineering at Bosphorus University, and is the Director of the National Energy Committee, and a Director of NATO. In a report presented to the Prime Minister's office, Kavrakoglu stated,

> Not only would a nuclear power station be incompatible with the interests of this country, but it would present many new risks. I urge you to re-think such an investment that would endanger future generations. [...]
>
> As someone who has presented Turkey's National Energy Planning Report to the 10th World Conference on Energy, and who has carried out many projects related to power stations and national energy planning, I consider it a duty to express my views on the bid for a nuclear power station.
>
> Past energy projections have not materialized. It was estimated that in the year 2000 we would consume 200 billion kWh of energy. But consumption has remained at 130 billion kWh, and the cost of building nuclear power stations has risen two or three times. [Meanwhile] ...large reserves of oil and natural gas have been found.

In his report to the Prime Minister, Kavrakoglu made the following warnings:

> Nuclear power is the most expensive form of electricity generation. Natural gas is the most rational alternative to nuclear energy, and since there are abundant resources of natural gas in neighbouring countries, its price is not likely to rise significantly. At present, half of the potential hydro-electric energy in Turkey has not been used. The repair and rehabilitation of transmission lines and power stations could save electricity and increase available energy.
>
> The problem of nuclear wastes hasn't been solved. The transportation and storage of nuclear wastes and the "decommissioning" of old nuclear stations are serious and expensive problems. Accidents occur even in the most experienced and technologically advanced countries.

The construction of a nuclear power station takes longer than the construction of any other power station.

Nuclear energy is a source of fear, and it will cause a significant reduction in Turkey's tourism revenues. Turkey's revenues from tourism amount roughly to $10 billion U.S. a year. Even a 10% reduction in those revenues would represent a loss of $1 billion dollars a year.[229]

8.5.3. Security Threats

Terrorists do not need nuclear weapons if they can trigger a catastrophic radiation release by attacking a nuclear power plant. Security risks at a future nuclear power plant in Turkey are an extremely serious consideration for several reasons. Abdullah Ocalan, leader of the Kurdish Workers Party, PKK, has called off the armed struggle, but factions of the PKK and other organizations remain committed to fighting. Sabotage of energy infrastructure is already an established PKK tactic. On January 24, 1997, the PKK attacked the Mardin-Midyat oil pipeline, near the city of Mardin. After an explosion, the resulting fire was only controlled after 24 hours, and damage was estimated at $700,000 (US).[230] The PKK and others have engaged in suicide attacks, which are extremely hard to defend against.

The possibility that nuclear installations might contribute to nuclear weapons capability has already resulted in military attacks at these sites, and contributed significantly to the risk and escalation of conventional war in the Middle East. In 1981, Israel bombed the Osiraq reactor at Iraq's Tuwaitha nuclear research centre near Baghdad. The Osiraq reactor, purchased by Iraq in 1976 from France, was capable of irradiating uranium targets to produce plutonium for nuclear weapons. The Israeli bombing prevented start-up of the reactor.

With its own nuclear weapons program put on hold as a result of the Israeli bombing, Iraq turned its attention to Iran's restart of its nuclear program which had originally begun under the Shah. On February 12 and March 4, 1985, Iraq launched air bombing raids of Iran's Bushehr nuclear power station, which was about 70% complete at the time. An earlier air raid had taken place on March 24, 1984.[231]

There have also been reports that Israel, the United States, and Turkey have been involved with a plan to bomb Iranian nuclear facilities. In 1996, Israeli Government Press Office head Uri Dromi said it had become a "working assumption" that a "Western-led coalition" will conduct a pre-emptive strike against Iran to stop its nuclear weapons program.[232] One reported target was Iran's Neka nuclear plant, 100 miles north-east of Tehran on the Caspian Sea. According to Egyptian sources, the basis of the 1995 Israeli-Turkish military cooperation agreement may be plans for an air strike against Iran's nuclear facilities. Iran has already made counter-threats against the possible attacks.[233] Another report claimed that Israeli pilots are training in Turkey's Central Anatolia region in preparation to bomb Iranian nuclear reactors and other nuclear weapons facilities.[234]

There has already been some reason for security concerns about a proposed nuclear plant at Akkuyu Bay. The plant would almost be within sight of the divided island of Cyprus. The Turkish ferry port to Cyprus is

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229. Ebru Toktar, "Think again before building a nuclear power station", *Cumhuriyet*, March 11, 2000.
230. Personal communication with Aynur Sungur Tuncer, September 3, 1997.
231. Leonard Spector, *The New Nuclear Nations*, Vintage, 1985, p. 167.
232. Christopher Walker, *Times* (London) *(CNS Nuclear Databases)*, April 19, 1996, p. 13.
233. James Bruce, "Iran warns USA to think twice about an attack", *Jane's Defence Weekly*, June 12, 1996, p. 27.
234. "Report on Israeli plans to attack Iran", *FBIS-NES (CNS Nuclear Databases)*, January 23, 1998.

just outside of Silifke. Cyprus has been divided for over 25 years, since Turkey invaded and occupied the northern third of island in 1974, following a coup engineered by the military junta that ruled Greece at the time. About 30,000 Turkish troops occupy the northern part of Cyprus, which declared itself an independent state in 1983, but is recognized only by Turkey.

In January 1997, the Cypriot government announced that it would buy the Russian S-300 surface-to-air missile (SAM) system as a defence against Turkish air force incursions. The missiles have a range of about 150 km. Turkey, then under the leadership of Necmettin Erbakan of the Islamist Welfare Party, declared that it would consider a military strike against the placement of the missile launchers, and that it would attack ships carrying the missiles to Cyprus.[235] Russia stated that it would consider attacks on its ships to be an act of war, and it would almost certainly initiate a regional war between Turkey and Greece, because of the defence pact between Greece and Cyprus. Turkish/Cypriot relations were already strained by four deaths in Cyprus in 1996.

Exhibiting considerable statesmanship and restraint, following a December 1998 consultation between Greece and Cyprus, the Cypriot government of President Glafcos Clerides decided that it would abandon the proposed missile siting in Cyprus, and deploy them on the Greek island of Crete.[236] In Turkey, the Cypriot decision was commonly seen as a 'victory' for the aggressive position that had been taken against the missile deployment. This 'victory' over Cyprus was a factor contributing to the victory of Bulent Ecevit and the strong showing of the nationalist MHP in the April 1999 election. Ecevit was Prime Minister of Turkey in 1974, when he ordered the invasion of Cyprus. The problem of Cyprus is far from resolved, and the presence of the Akkuyu nuclear plant will pose an additional aggravation and complicating factor if it is built. The plant would pose a tempting target to Turkey's hostile neighbours. Potential conflicts are not just with Greece and Cyprus, but with countries such as Iran, Iraq and Syria, all of whom may perceive a nuclear program in Turkey as a threat to their national security.

235. Reuters, "Turkey set to strike Cyprus, report says", *Globe & Mail*, January 10, 1997, p. A10.

236. *Conflict Averted: The Decision Not to Deploy on Cyprus*, Center for Nonproliferation Studies, 1999.

9. Earthquake Risk at Akkuyu

One of the most controversial issues about the proposed Akkuyu nuclear plant is whether a nuclear station at that site will be acceptably safe from earthquake damage. Independent research has indicated that an active fault line, known as the Ecemis Fault is close to the plant. Ignoring this strong evidence, the government of Turkey and the nuclear vendors have maintained that there is no active faulting in the vicinity of the plant, and that there is negligible danger of a nuclear accident being caused by an earthquake. Earthquakes can simultaneously damage multiple operating and safety systems in nuclear reactors[237] , leading to a catastrophic accident that could cause an unimaginable disaster in the eastern Mediterranean region. One independent team of nuclear experts has already determined that for the Darlington nuclear generating station in Ontario, Canada (which has less earthquake risk than a plate boundary area such as Akkuyu), the most likely cause of a catastrophic accident is an earthquake.[238] The same finding would also likely hold true for a nuclear station built at Akkuyu in Turkey. Canadian earthquake expert Dr. Karl Buckthought has suggested that there is "an unacceptable level of risk associated with the proposal to place nuclear reactors at Akkuyu Bay".[239]

The western nuclear vendors bidding to build the Akkuyu nuclear plant are conspiring with the Turkish government to cover up the real earthquake risk at the Akkuyu site. An acknowledgment of the real risk would result in more delays in construction; increased design costs for the vendors; and increased construction costs for Turkey. Recognition of the real earthquake risk at Akkuyu could result in the cancellation of the Akkuyu nuclear plant. Trade-offs are being made in the nuclear power industry between cost and safety. These trade-offs are even more worrisome in countries such as Turkey with a weak regulatory environment, and a nuclear regulator possessing no experience with large-scale commercial nuclear power projects.

There is little doubt that the earthquake risk at Akkuyu is higher than Turkish authorities first claimed in 1983. Specifications issued by TEAS for the Akkuyu site called for a Design Basis Earthquake (DBE) of 0.25g (i.e. a conservative assumption that the worst earthquake that can be expected will cause horizontal shaking equal to 25% of the force of gravity). However, it seems likely that the DBE for the site should be at least in the range of 0.5g to 0.7g (i.e. horizontal shaking equal to 50% to 70% of the force of gravity). Thus the proposed nuclear plant designs from all three bidding vendors at 0.25g are inadequate and if built, could result in a catastrophic nuclear accident caused by an earthquake. Further independent geo-physical research needs to be conducted in the Akkuyu Bay area. The government of Turkey should put the vendor selection process on hold pending the achievement of a broad scientific and lay consensus on earthquake risk at the Akkuyu Bay site.

Generally speaking, the eastern Mediterranean Sea has the greatest earthquake activity in the whole Mediterranean basin. Most of the earthquake activity is centered in the so-called Hellenic Arc, which cups the Aegean Sea, encircling the Peloponnesian peninsula and Crete, and coming up to the southwestern part of Turkey. Another arc of seismic activity cups Cyprus. These are boundary areas where the African plate is meeting and passing under the Aegean plate in the west and the Anatolian plate in the east ("subduction zones"). The last major earthquake in the southern Hellenic Arc occurred near the southeastern Aegean island of Rodos in 1926 -- an estimated magnitude 8. The extended period of relative calm since 1926 may indicate

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237. Known as a 'common mode' or 'common cause' accident. Common cause accidents can be either external (such as earthquakes or a bombing of the nuclear plant), or they can be internal (such as a fire).

238. Gordon Thompson, Institute for Resource and Security Studies, *Risk implications of Potential New Nuclear Plants in Ontario: Summary (Vol. I)*, Coalition of Environmental Groups, December 1992, p. 15.

239. Dr. Karl Buckthought, Earthquake Forecasts Inc., *Selling CANDU Reactors to Turkey: Earthquakes Risks*, February 1999, p. 15.

that another large earthquake is imminent.[240]

North of the Cyprus, the Akkuyu area on the Turkish coast has in the past been assumed to be one of the lowest risk areas in Turkey for earthquakes.[241] However, based on contemporary analysis of plate tectonics, as well as on an analysis of earthquake activity in the region, experts now believe that the Akkuyu Bay area is likely an area of higher risk than previously thought.[242] While seismicity in the area is less than at the other plate boundaries (for example the north Anatolian fault, where the Izmit earthquake occurred in August 1999), it is high compared to the large areas of central Turkey which form the main body of the Anatolian plate. As Papazachos notes,

> Although only one earthquake with a magnitude greater than or equal to 6.0 occurred in the seismic belt along the coastal region of southeastern Turkey during the present century, the generation of such earthquakes in other areas of this belt, including the Akkuyu area, cannot be excluded because this belt is in continuous tectonic deformation.[243]

On June 27, 1998, an earthquake of magnitude 6.6 occurred with its epicentre about 150 km east of the Akkuyu site.[244] The nearest cities affected were Adana and Ceyhan, which suffered 144 deaths and over 1,000 injuries.[245] Another nine earthquakes followed in the same area on the same day, with magnitudes ranging from 3.5 to 4.4.[246] On July 4, 1998, the largest aftershock occurred with magnitude of 5.3. The nuclear vendor Westinghouse stated that the quake had a accelerogram record of maximum ground acceleration of about 0.28 in one horizontal direction near the epicentre. However Westinghouse noted that "The activity causing this earthquake was in a tectonic formation and localized faults not associated with the Akkuyu Site, which is approximately 150 km to the South West of the epicenter."[247] The second-largest earthquake on record occurring in the same coastal belt as the Akkuyu site occurred on December 9, 1947, with a magnitude of 5.7, about 60 km away from Akkuyu Bay.[248]

A number of earthquakes of lesser magnitude have occurred close to the Akkuyu site. A search of the earthquake data base of the United States Geological Survey reveals that between 1973 and June 30, 2000, 33 earthquakes have taken place within 100 km of the Akkuyu site. The distance of these earthquakes from

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240. Ministry of the Aegean, Hellenic Republic, *Risks Associated with the Construction of a Nuclear Power Plant in Akkuyu Turkey*, Athens, 1998, pp. 7-8.

241. See for example: "Earthquake Zoning Map for Turkey" (http://193.140.203.8/earthqk/zonemap.jpg) in M. Erdik, Y. Alpay Biro, T. Onur, K. Sesetyan & G. Birgoren, *Assessment of Earthquake Hazard i Turkey and Neighbouring Regions*, Bogazici University Kandilli Observatory and Earthquake Research Institute, 1999. http://193.140.203.8/earthqk/gshap.htm

242. V. Papazachos, "Seismotectonics in the Southern Boundary of the Anatolian Lithospheric Plate", F.K. Vosniakos *et al.*, *Radiological Impact Assessment in the South-Eastern Mediterranean Area*, Technological Educational Institution of Thessaloniki, July 1999, pp. 96-97.

243. *Ibid.*, p. 97.

244. US Geological Survey Earthquake Data Base. The quake took place at Latitude 34.35 N and Longitude 32.15 E. Westinghouse reports that the epicentre was 40 km southeast of Adana near the town of Abcioglu. Source: Westinghouse (nuclear division), *Seismic Considerations for Akkuyu Nuclear Plant*, undated; received May 2000.

245. Reuters, "Earthquake rocks Turkey", *Toronto Star*, June 28, 1999, p. A14. See also: "Turkey Quake", *Globe & Mail*, July 2, 1999, p. A14.

246. *Ibid.*, USGS Data Base.

247. Westinghouse (nuclear division), *Seismic Considerations for Akkuyu Nuclear Plant*, undated; received May 2000.

248. V. Papazachos, *ibid.*, p. 96.

the Akkuyu site has ranged from 13 to 99 km. The magnitude of the earthquakes ranged from 2.9 to 4.7.[249]

9.1. Seismic Research on the Akkuyu Site

Emphasizing its contradictory role as both a promoter and a supposed regulator of nuclear power, the United Nations' International Atomic Energy Agency (IAEA) played a significant role in helping Turkey to initiate the Akkuyu nuclear plant by conducting the original geological studies of the Akkuyu area. The studies, identified as Technical Cooperation Project TUR/9/005, were intended to evaluate the seismic risk for the nuclear plant, and began sometime in the mid-1970s. The IAEA provided experts as well as training to staff of the Turkish Atomic Energy Authority (TAEK) and the Turkish Electricity Authority (TEK, the predecessor of TEAS). According to the Turkish government, "Several man-months of expert services per year were rendered [by the IAEA] to either TAEK or TEK during the period 1981-1985."[250] On the basis of this, in 1983 TEK submitted a ten volume study to TAEK entitled *Detailed Site Investigations Report* (DSIR). TAEK subsequently requested assistance from the IAEA to review this document. In October 1983, the IAEA sent a review team of one staff member and four experts, who visited Ankara and Akkuyu for two weeks. The report of this brief visit was apparently produced in a 1984.[251] According to the Turkish government, "The report agreed with the information and evaluations of the DSIR but also recommended further investigations to clarify specific issues and to reduce uncertainty in the calculated parameters."[252] The further investigations resulted in the production of five additional IAEA reports[253] , which TAEK considered a fulfillment of the 1983 IAEA team recommendations. None of these reports have been released by the IAEA.

When Turkey decided to revive its nuclear program in the 1990s, a further IAEA Technical Cooperation Project was carried out for Quality Assurance on the program (identified by the IAEA project number TUR/4/020). More recently, TAEK requested IAEA to review updated Site Reports prepared by TEAS as part of a third IAEA Technical Cooperation report, TUR/9/013.[254]

Because the IAEA, TEAS, the Turkish government, and Atomic Energy of Canada Limited (AECL) have to date refused to release these studies, a thorough evaluation has been impossible. AECL commissioned a limited geological study on the Akkuyu site, dated December 11, 1985, by the Canadian consulting firm Terratech/Canatom.[255] The report noted the poor quality and deficiencies in the research conducted by TEK. It is not clear if TEAS and/or the Turkish government, or AECL have acted to remedy the deficiencies noted in the Terratech/Canatom report. An update to the 1983 study was apparently conducted in 1990, but the author of this study himself has now disavowed it and acknowledged the need for further research (see commentary on Prof. Mustafa Erdik, below). Responding to concerns expressed by the Canadian public,

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249. The US Geological Survey, National Earthquake Information Center, has a worldwide earthquake database which dates from the beginning of 1973. The location of the Akkuyu site is Latitude 36N and Longitude 34E. See: http://wwwneic.cr.usgs.gov/neis/epic/epic.html

250. Government of Turkey, *Basic Facts Concerning the Proposed Nuclear Power Plant at Akkuyu in Turkey*, undated, http://www.mfa.gov.tr/grupa/an/akkuyu.htm

251. IAEA-TA-2174. January 6, 1984. The IAEA has to date refused to release this or any other of the background reports on the seismic risk at Akkuyu.

252. Government of Turkey, *ibid.*, Part II, "IAEA work in relation to the seismic safety of Akkuyu"

253. The reports are identified as IAEA-TA-2188, February 1984; IAEA-TA-2206, April 1984; IAEA-TA-2282, October 1984; IAEA-TA-2305, January 1985; and IAEA-TA-2366, May 1986.

254. Government of Turkey, *ibid.*.

255. Ralph Kall, Supervising Geologist, *Review of Interim Report on Cross-Hole Geophysical Survey at Akkuyu NPP Site, Turkey*, Montreal, Quebec, December 11, 1985. AECL released this study on December 11, 1998.

Canadian Minister of Natural Resources Ralph Goodale has disclosed that AECL commissioned a further study from consultants at Carleton University on the seismic risk of the Akkuyu site. The Canadian government and AECL state that this document is "protected and proprietary", and refuse to make it public.[256]

Meanwhile, in 1988 and 1989, two cruises were undertaken by the research vessel Piri Reis, of the Institute of Marine Science and Technology (IMST) of Dokuz Eylul University, in Izmir, Turkey. The research team was completely independent of the nuclear industry, and consisted of Turkish geophysicists Sungu Gökçen, Attila Ulug, Nuran Gökçen, and Erdeniz Özel of the IMST and British geophysicist Gilbert Kelling of the University of Keele. A paper published by this team in 1991 identified three structural sub-basins in the area, separated by the Ecemis Fault Complex in the east and the Anamur Kormakiti high in the west. The researchers demonstrated that the Ecemis Complex is an active fault.[257] The fault runs from the north-east to the south-west into the Mediterranean Sea, southeast of Akkuyu Bay.

Dr. Attila Ulug, one of the authors of the 1991 study, and head of the Geophysics Department at the Institute of Marine Science and Technology at Dokuz Eylül University, has stated, "At the very least, the Turkish government must conduct further investigations of the Akkuyu Bay area to determine the threat posed by the Ecemis Fault. To go ahead and build a reactor at Akkuyu Bay without further study would be a totally irresponsible, if not criminal, decision."[258]

In June 1998, a workshop was conducted on the Ecemis Fault at Nigde University in Turkey. The workshop concluded that the northern parts of the fault are active, classifying the region as seriously prone to earthquakes, and recommending that building codes be changed to prevent future disasters.[259] In contrast with this recent evidence, AECL still maintains categorically that "There is no evidence of active geological faulting within the vicinity of the Akkuyu site."[260]

The nuclear vendors have accepted the seismic design parameters in the 1983 *Detailed Site Investigations Report* (DSIR) by TEK. Based on those studies, AECL assumes that a magnitude 8 earthquake could only occur at the boundary of the African and Eurasian plates at a distance of 60 km from the Akkuyu site. Prof. Arsalan Mohajer has noted that depending on the angle of dip of the African plate as it passes beneath the Eurasian plate, a magnitude 8 or higher earthquake could actually occur much closer to Akkuyu Bay.[261] Another model used by AECL assumes that, at worst, an earthquake of magnitude 6.5 could occur at a depth of 30 km directly below the Akkuyu site. Based on California data from the early 1980s, TEA and AECL assumed that such an earthquake would produce horizontal ground shaking of no more than 0.25g (horizontal acceleration of 25% of the force of gravity). It is likely, however, that by using California data, TEA assumes much greater attenuation (weakening) of the earthquake's force than is actually the case in Turkey. Moreover, an earthquake of similar magnitude occurring at a depth shallower

256. Letter from the Hon. Ralph Goodale, Minister of Natural Resources, to Mr. Jim Karygiannis MP, December 3, 1999.

257. S.L. Gokcen, G. Kelling, A. Ulug, N. Gokcen and E. Ozel, "Neotectonic Structural Features in the Alanya-Mersin Shelf Area (Southern Turkey), *Jeofizik*, Vol. 5, No. 1, March 1991.

258. Greenpeace Mediterranean, "Turkish reactor to be built next to active fault line, according to 1991 study", *News Release*, July 2, 1998.

259. Greenpeace Mediterranean, *ibid.*, July 2, 1998.

260. AECL, Undated and unreferenced document excerpt, *Technical Summary of Akkuyu Seismic Design*, received 1998. See also: *AECL Briefing Note: Seismic Safety of the Proposed Nuclear Power Plant Site in Turkey*, received September 1998.

261. Mohajer is a professor of geology at the University of Toronto. He had a brief opportunity to peruse the TEK documents at a meeting with AECL officials on November 27, 1998. See his brief summary letter: "Seismic Risk Assessment for the Akkuyu Nuclear Plant, AECL Meeting of Friday, November 27, 1998".

than 30 km could actually produce a greater level of shaking.[262]

The United States Nuclear Regulatory Commission (NRC) has set a standard Design Basis Earthquake (DBE) of 0.3g for all commercial nuclear plants in the central and eastern United States, with a few exceptions.[263] According to the NRC, the DBE (sometimes known as a Review Level Earthquake or RLE) is a level of shaking set sufficiently higher than a Safe Shutdown Earthquake (SSE) to "demonstrate sufficient margin over SSE to ensure plant safety and to find any 'weak links' that might limit the plant shutdown capability to safely withstand a seismic event bigger than SSE."[264] For several American nuclear plants on the south shore of Lake Ontario (Fitzpatrick, Ginna, and Nine Mile Point), the estimated frequency of exceedance for a 0.3g DBE is estimated at 2 to 3 X 10E-5 (i.e. an earthquake with horizontal ground motion exceeding 30% of the force of gravity is likely to occur 2 to 3 times in 100,000 years).[265]

In the Canadian province of Ontario, there are 20 CANDU reactors owned and operated by Ontario Power Generation (formerly Ontario Hydro). A recent exercise to upgrade the seismic qualification of the oldest nuclear station, Pickering "A", has set the Design Basis Earthquake at 0.235g. The estimated frequency of exceedance for a 0.3g seismic event at the station is 5 X 10E-5 (i.e. an earthquake with horizontal ground motion exceeding 30% of the force of gravity is likely to occur 5 times in 100,000 years).[266] As a tectonic plate boundary area, the Akkuyu Bay region has a much higher earthquake risk than central and eastern United States, or southern Ontario. Yet TEA and the nuclear vendors have agreed to a DBE of 0.25g -- roughly equal to that being applied at the Pickering nuclear generating station, and an exceedance frequency roughly an order of magnitude lower (i.e. one in ten thousand years, as opposed to 5 in 100,000 years).

It should also be noted that AECL does not have a good reputation for veracity on this issue. In Canada, AECL President and CEO, Allen Kilpatrick has claimed publicly that CANDU reactors have withstood earthquakes. In letters to Canadian newspapers,[267] Kilpatrick stated that the Gentilly-2 reactor in the Province of Quebec survived a serious earthquake in November 1988, and that the Point Lepreau reactor in the province of New Brunswick survived a serious quake in 1983. In fact, the epicentre of the November 1988 earthquake was 230 km from Gentilly-2. There has been no earthquake near Point Lepreau since the plant began operation in 1983.[268]

More recent research has provided proof that the Ecemis fault is active according to the definition used by the United States Nuclear Regulatory Commission (NRC). A dramatic report by Assoc. Prof. Dr. Hasan Cetin of Cukurova University at Adana was commissioned by Greenpeace, and released in April 2000.[269] Through carbon-14 dating of displaced samples of soils (a science known as paleoseismology) it was possible for Cetin to determine the dates at which major earthquakes had occurred in the past on the Ecemis fault. Paleoseismicity is identified by the US Nuclear Regulatory Commission for use in characterizing seismic

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262. *Ibid.*, Mohajer.

263. Acres International, *Seismic Assessment Systems and Components at Pickering A*, Atomic Energy Control Board, January 11, 1999, p. 2-3.

264. USNRC, *Procedural and submittal guidance for the Individual Plant Examination of External Events (IPEEE) for severe accident vulnerabilities*, NUREG-1407, 1991. Cited in *Ibid.*, Acres International, Appendix A, Letter from Geomatrix to AECB, February 9, 1998.

265. Acres International, *ibid.*, Appendix A, Letter from Geomatrix to AECB, February 9, 1998.

266. Acres International, *ibid.*, Appendix A, Letter from Geomatrix to AECB, February 9, 1998.

267. See: *Le Droit*, August 24, 1998; *Fredericton Daily Gleaner*, August 27, 1999; *Patrides*, November 20, 1998.

268. Karl Buckthought, *Selling CANDU Reactors to Turkey: Seismic Risks*, February 17, 1999.

269. "New scientific research proves Turkish nuclear site is an earthquake zone", *Greenpeace Press Release*, April 8, 2000.

sources in a site-specific evaluation for possible nuclear plants.[270]

Results showed that at least two earthquakes with magnitudes of 6.5 or higher had occurred causing surface ruptures which occurred less than 30,000 years ago in one case, and less than 20,000 years ago in the other.[271] An active or "capable" fault according to the NRC exhibits the following characteristics: movement at or near the ground surface at least once within the past 35,000 years, or movement of a recurring nature within the past 500,000 years.[272] This finding is in direct conflict with one of the original TEK studies on the Akkuyu, which claims "that the Ecemis fault has not displaced or cut any soils, sediments or rocks younger than about 2 million years age."[273]

The NRC also relates fault line lengths to minimum distance from nuclear sites. For a fault with a minimum length of 64 km, the NRC suggests that a nuclear plant should be at a distance greater than 240 to 320 km.[274] In fact the Ecemis fault is a 100 km long left-lateral transtensional fault, trending N20E.[275] The Turkish authorities maintain that the fault is 160 km away from the Akkuyu site[276] , which even if true, would render the site unacceptable by the NRC standard noted above.

In March 2000, following a March 1st decision by the coalition government of Bulent Ecevit to proceed with the Akkuyu plant, Prof. Mustafa Erdik publicly stated that more research should take place before the nuclear plant proceeds. Erdik is one of Turkey's most prominent geo-scientists, with the Seismic Research Institute of Bogazici University and the head of Seismic Engineering at the Kandilli Observatory (Turkey's top earthquake centre). In a November 1999 letter to Lutfi Sarici, head of the Nuclear Power Office of TEAS, Prof. Erdik referred to a 1990 study which he had written on the Akkuyu site and stated, "Due to rapid developments in the discipline of seismic engineering, the methodology used in the 1990 report has become outdated."[277] The report also addressed the proximity of the Ecemis fault line to the Akkuyu plant. Erdik went on to say, "Due to the very limited nature of off-shore geophysical research undertaken for the 1990 report, and to avoid misinterpretations based on inadequate data, it is essential to undertake new off-shore studies in the area south of the Akkuyu Nuclear Station site." TEAS deliberately failed to inform the governing coalition partners of Erdik's concerns and claimed that seismic investigations had been adequately dealt with. In an interview Erdik stated,

> In the design of Akkuyu Nuclear Station, we had based our estimates on a potential earthquake measuring 6.5 on the Richter scale. At that time, we had much less data. Today there is a lot more data on earthquakes. New research has to be done and a new report prepared with that new data. In the former report, there were some vague areas because of the lack of data. If you build a structure to

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270. US Nuclear Regulatory Commission, *Regulatory Guide 1.165, Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion*, Appendix D: Geological, Seismological and Geophysical Investigations to Characterize Seismic Sources, March 1997. http://www.nrc.gov/NRC/RG/01/01-165d/html

271. Assoc. Prof. Dr. Hasan Cetin, Department of Geology, Cukurova University, Balcali, Adana, *Paleoseismology of the Ecemis Fault*, April 2000.

272. US Nuclear Regulatory Commission, *Title 10 of the Code of Federal Regulations, Part 100*, Appendix A to Part 100, III (g)(1). http://www.nrc.gov/NRC/CFR/PART100/part100-appa.html

273. Assoc. Prof. Dr. Hasan Cetin, Department of Geology, Cukurova University, Balcali, Adana, *Paleoseismology of the Ecemis Fault*, April 2000.

274. US Nuclear Regulatory Commission, *Title 10 of the Code of Federal Regulations, Part 100*, Appendix A to Part 100, IV (a)(7). http://www.nrc.gov/NRC/CFR/PART100/part100-appa.html

275. Assoc. Prof. Dr. Hasan Cetin, Department of Geology, Cukurova University, Balcali, Adana, *Paleoseismology of the Ecemis Fault*, April 2000.

276. "New scientific research proves Turkish nuclear site is an earthquake zone", *Greenpeace Press Release*, April 8, 2000.

277. Tolga Akiner, "Nuclear Scandal", *Radikal*, March 3, 2000.

withstand an earthquake, it will withstand an earthquake. In the Akkuyu region, there has already been an earthquake measuring 6.2 at Ceyhan, and there was damage. So we have to at least reduce the anxieties over this issue.[278]

9.2. The AECL Design for Akkuyu

By 1993, there was an active debate in the AECL reactor design team regarding the options and trade-offs of various design alternatives to withstand higher earthquake risks. The 'reference' plant for Akkuyu is the Wolsung-2 reactor in South Korea[279] , which is only qualified to a DBE of 0.20g.[280] It was assumed then, as now, that Akkuyu would only require 0.25g, but that other possible CANDU purchasers would require higher seismic qualification -- specifically, 0.34g to 0.6g for Indonesia; 0.6g for the Philippines; 0.4g (or higher) for Taiwan; and 0.3g to 0.35g for Thailand.[281]

The modifications to upgrade the CANDU-6 from 0.2g to 0.25g DBE for the Akkuyu plant were described as "conceptually simple but extensive" -- design changes that were estimated to cost $35 million.[282] These design changes included: changes to civil engineering; process equipment and piping; control and instrumentation; and reactor fuel channels and fuel handling equipment.[283]

Essentially these changes represented a "stiffening and strengthening" of the earlier CANDU-6 design. Even in 1993, however, it was recognized that the upgrade to 0.25g DBE represented the seismic design limit of the CANDU-6... "The 0.25g represents the envelope design limit of the CANDU-6 with moderate modifications."[284] It was thought that favourable soil conditions, combined with "state-of-the-art" seismic technologies might extend the limit to 0.26g or 0.27 g. However, higher seismic qualification would require conceptual or lay-out changes.

AECL engineers concluded that a 'fixed-base' CANDU-6 with "major redesign involving features similar to those used in the CANDU-3 design" could be qualified to 0.3g. However, this was characterized as a "drastic" design change, and "its similarity with current CANDU-6 will be only in name. It would appear that the 0.3g represents, perhaps, the envelope limit for a fixed base completely redesigned CANDU-6."[285]

The alternative to a fixed base design was a reactor with so-called "base mat isolation" or "seismic isolation" -- essentially floating a foundation pad using alternating steel and rubber disks to absorb the energy of an earthquake. AECL engineers considered base mat isolation as a necessity for any DBE over 0.3, enabling the CANDU-6 design to be used on sites requiring up to 0.6g DBE or more.[286] AECL engineers argued successfully that seismic isolation should be used for the Akkuyu design, since the design cost would be no more than the cost of the fixed base modifications, and it would be a one-time design investment that

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278. Tolga Akiner, "Nuclear Scandal", *Radikal*, March 3, 2000.

279. Personal communication from Melda Keskin, May 27, 1998. The reference plant for the NPI bid is Neckarwestheim-2 in Germany, and the reference plant for the Westinghouse/Mitsubishi bid is Ohi-3 in Japan.

280. S.A. Usmani, *Seismic Design Envelop Limits of CANDU-6 and Recommendations to Enable Offer of CANDU-6 to Higher Seismic Sites*, AECL July 14, 1993, p. 1.

281. *Ibid.*, S.A. Usmani, p. 1.

282. *Ibid.*, S.A. Usmani, p. 1.

283. *Ibid.*, S.A. Usmani, pp. 2-3.

284. *Ibid.*, S.A. Usmani, p. 3.

285. *Ibid.*, S.A. Usmani, p. 3.

286. *Ibid.*, S.A. Usmani, p. 5.

could be used in proposals to other countries with a high earthquake risk.[287]

There are a number of serious engineering problems associated with seismic isolation. Solutions must be found for a movement of plus or minus 12 to 15 inches between isolated and fixed base structure connections such as pipes and conduits. Flexible bellows or articulated couplings will be needed for large pipes such as the steam mains and feed water lines. There are major licensing issues since there is "unfamiliarity and lack of long term experience with base mat isolation particularly in the nuclear industry".[288] Thus there are risks associated with seismic isolation, which has not been used in any CANDU plant to date. With no reference plant using this design feature, there is a real risk that untried design modifications will cause problems, possibly resulting in higher costs and ultimately the risk of poor performance under accident conditions. Moreover, since the floating foundation represents a fundamental change in the CANDU-6 design, AECL is in violation of the original TEAS terms of reference for the Akkuyu bid. The terms specified that bidders should designate a reference plant "similar to the one to be offered for Akkuyu", and that there should be "5 year operation experience for the type [of nuclear plant] offered".[289] That is clearly not the case with AECL's Akkuyu bid. The Wolsong-2 reactor in South Korea, designated as the AECL reference plant, is a fixed base design with a lower DBE.

9.3. The Izmit Earthquake

On August 17, 1999, at 3:01 a.m. local time, Turkey experienced another in a long line of devastating earthquakes. Known as the 'Kocaeli' or 'Izmit' earthquake, it took place in north-western Turkey about 11 km south-east of the city of Izmit near the Sea of Marmara. While the earthquake was well-removed from the Akkuyu area, it teaches several important lessons for the Akkuyu nuclear plant. As well as Izmit, some of the most severely affected cities included Adapazari, Duzce, Sakarya, Kocaeli, and Golcuk. The earthquake registered a magnitude of 7.4 on the Richter scale, and took place at the western end of the Northern Anatolian Fault. This fault has seen a series of seven massive earthquakes (over 7 magnitude) moving progressively westward from 1939 to 1999, which led to predictions of another serious earthquake in the area. In the two weeks after the earthquake, more than 1,000 aftershocks occurred, some of them strong enough to cause death and injury among the survivors of the original quake.[290] Another significant earthquake occurred on November 12, 1999, centered in Duzce. Deaths totaled over 550, with about 3,300 injured.[291]

Despite its predictability, the Izmit earthquake resulted in over 18,000 deaths[292] and over 42,000 injuries[293] . Over 300,000 households were affected by the earthquake[294] , leaving 600,000 people homeless[295] and property damage is estimated at up to $30 billion (US).[296]

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287. J. Biswas & R. Ricciuti, *Memo to A. Usmani*, AECL, July 15, 1993, p. 3.

288. *Ibid.*, S.A. Usmani, p. 6.

289. Nevzat Sahin, Head of Nuclear Power, TEAS , *TEAS Akkuyu Nuclear Power Plant Project*, p. 2.

290. AP, "Aftershock kills one, injures 166 in west Turkey", *Toronto Star*, September 1, 1999, p. A12.

291. Seth Sutel, AP, "Istanbul gripped by earthquake panic", *Toronto Star*, November 17, 1999, p. A13.

292. Peter Calamai, "Earthquake prediction takes a jolt", *Toronto Star*, September 12, 1999, p. F8. See also: "Top story of the year: The August 17 Turkish earthquake", *Turkish Daily News*, January 1, 2000.

293. Reuters/AP, "Hope Fades for Missing", *Toronto Star*, August 25, 1999, p. A14.

294. Selcuk & Kemal Ilter, "Aydin: Earthquakes revealed deficiencies in the system", *Turkish Daily News*, January 6, 2000.

295. AP, "Aftershock kills one, injures 166 in west Turkey", *Toronto Star*, September 1, 1999, p. A12.

296. Selcan Hacaoglu, AP, "146 hours in darkness", *Toronto Star*, August 24, 1999, p. A12.

There has been widespread outrage in Turkey that deaths have been needlessly caused by failure of local and national governments to enforce existing building standards in one of the world's most earthquake-prone countries. The causes are a combination of corruption and incompetence. Despite repeated warnings of a large earthquake in precisely the area in which it occurred, the government also failed to mobilize a prompt and effective emergency response effort.

Instead of admitting its mistakes and trying to rectify them, the government lashed out at its critics. On August 25, 1999, Prime Minister Bulent Ecevit attacked the media for criticizing the government. On August 24, state regulators had shut down the private TV station Channel 6 for a week for criticism of the government and corrupt contractors who had built sub-standard buildings that collapsed in the earthquake.[297] Private Turkish aid groups sponsored by Islamic organizations have also been harassed and shut down by Ecevit's secular government.[298]

The Izmit earthquake was a tragic natural disaster. However, the impacts of the disaster were made incomparably worse through multiple failures of the Turkish government...

- The government ignored predictions of the Izmit earthquake. The same government is ignoring the real earthquake risk at the proposed nuclear plant site at Akkuyu Bay.

- The government failed to enforce building regulations despite the well-known earthquake risk in north-western Turkey. If the government proceeds with a nuclear power program, a similar failure in nuclear regulation could result in another disaster with even worse consequences -- the radioactive contamination of the eastern Mediterranean region.

- The government also failed to provide an effective and timely emergency response in the crucial period immediately following the earthquake, thus dramatically escalating the number of fatalities and adding greatly to human suffering. A similar failure in the context of a nuclear accident would be unacceptable. Effective emergency planning is a recognized and necessary part of operating a nuclear plant.

297. AP/CP, "PM says media source of low morale", *Toronto Star*, August 26, 1999, p. A12.

298. Lori Montgomery, "Islamic quake aid hampered", *Toronto Star*, August 27, 1999, p. 10.

10. Nuclear Weapons Proliferation

Turkey ratified the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) on April 17, 1980, and the safeguards agreement went into force on September 1, 1981.[299] Turkey also signed the Comprehensive Test Ban Treaty on September 24, 1996, although it has not ratified the Treaty.[300] Despite its lack of a nuclear power program, Turkey has also become a full member of the Zangger Committee, and has stated that it intends to become a member of the Nuclear Suppliers Group.[301] The NPT Exporters Committee (known as the "Zangger Committee" after its former Swiss Chairperson) is a group of NPT state parties who are major nuclear suppliers. The Committee has a set of "Common Export Guidelines" including a 'trigger list' for nuclear-specific materials and equipment that require IAEA safeguards. The Nuclear Suppliers Group (NSG) is an informal group 35 major nuclear supplier countries. The NSG has a set of Export Guidelines with a list of nuclear as well as dual-use[302] items, along with conditions for their sale or transfer. Since 1992, non-nuclear weapons states purchasing items on the list had to allow full-scope safeguards from the International Atomic Energy Agency (IAEA). In 1995 the guidelines were extended to include technology transfer for items on the list.[303]

While Turkey has acceded to the NPT, this is not an ironclad guarantee that it will abstain from nuclear weapons development. At least three other signatories of the NPT are infamous for their clandestine nuclear weapons programs, namely the Democratic Peoples Republic of Korea (DPRK, or North Korea), Iran, and Iraq. It is disturbing that two of those countries share a border with Turkey, and a third Middle East country with confirmed nuclear weapons capability, Israel, is a military ally of Turkey. While outright fraudulent evasion of NPT treaty obligations is a real concern (as with North Korea, Iran and Iraq), the exit provision from the NPT is straightforward and has no prescribed penalties. Article X of the NPT allows any party to withdraw with only three months notice if "extraordinary events... have jeopardized the supreme interests of its country".[304]

10.1. The Middle East

The proposed development of a nuclear program in Turkey takes place in the highly complex and strained political context of the Middle East. The Middle East is a breeding ground for nuclear-armed confrontation. Israel, Iraq and Iran have already demonstrated their aggressive commitment to the development of nuclear weapons. Moreover they have the advanced missile delivery systems and other means to deliver these weapons.

Israel's longstanding possession of nuclear weapons, and its refusal to sign the NPT has been a primary impetus for nuclear weapons development among the states of the region (which can be broadly interpreted to include North Africa, the Persian Gulf, and the Middle East, including Turkey). Iraq deliberately subverted the NPT, and Iran is doing likewise, if we are to believe the intelligence agencies of the United States and

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299. United Nations, *The United Nations and Nuclear Non-Proliferation*, UN Department of Public Information, 1995, Document 46, p. 183.

300. *Weapons of Mass Destruction in the Middle East*, Center for Nonproliferation Studies, May 1998, http://cns.miis.edu/research/wmdme/turkey.htm

301. Turkish Ministry of Foreign Affairs, *Arms Control and Disarmament*, undated, downloaded June 14, 2000, http://www.mfa.gov.tr/grupa/ai/01.htm

302. "Dual use" refers to material or technology that has a nuclear weapons application as well as a conventional application.

303. Rodney Jones et al., *Tracking Nuclear Proliferation*, Carnegie Endowment for International Peace, 1998, Appendix F, pp. 307-310.

304. United Nations, *ibid.*, p. 62.

Israel. The United States continues to rely on its nuclear weapons umbrella for deterrence in the region, with nuclear weapons reportedly stationed at Incirlik Air Base in Turkey.[305]

Since 1945, Egypt, Iran, Iraq, and Libya have all used chemical weapons. In the 1980s, the international community stood by (and even continued to provide conventional weapons) while Iraq used chemical weapons against Iranian troops, as well as its own citizens, Kurdish civilians, in 1988.[306] This sets a chilling precedent for the current willingness of the world community to remain inactive while there is a further spread of nuclear technology in the Middle East. It is worthwhile to briefly review the nuclear capability of Israel, Iran, and Iraq.

Israel -- Since it first constructed a nuclear bomb as early as 1967, Israel has gone on to build anywhere from 100 to 200 nuclear weapons. These include a variety of weapons, such as "boosted" weapons using tritium, as well as smaller tactical nuclear weapons for delivery by aircraft or artillery. Israel also has sophisticated missile systems for delivering nuclear weapons, including the 660 km range Jericho I and the 1,500 km range Jericho II.[307] Along with the other so-called "undeclared nuclear weapons states", India and Pakistan, Israel has refused to sign the NPT.

Iran -- Although a party to the NPT since 1970, it is believed that Iran began its clandestine nuclear weapons program in the 1980s, after the Islamic regime of the Ayatollah Khomeini took power in 1979. Two German-supplied reactors were under construction at Bushehr on the Persian Gulf in the late 1970s, but they were severely damaged by Iraqi bombing during the 1980-88 Iran-Iraq war. There was also a nuclear research establishment which continued work into the 1980s, including the Tehran Research Centre where a 5 MWt US-supplied research reactor continues to operate. In 1984, in the midst of the war with Iraq, an new nuclear research centre was opened in Esfahan.

In the mid-1980s, China began to supply nuclear technology to Iran. This included several research reactors for Esfahan as well as other devices.[308] In 1992, the US prevented China from selling Iran a plutonium-producing research reactor, and also prevented Argentina from selling fuel-cycle and heavy water technology.[309] China also agreed in 1992 to supply two 300 MW reactors to Iran, based on China's Qinshan I reactor. In 1995, Russia signed an $800 million (US) deal with Iran to complete one of the two partly completed reactors at Bushehr. It should be stressed that all of these deals were/are perfectly legal under international non-proliferation guidelines. Nevertheless, the United States opposed the sales strongly, which led to a western nuclear embargo, as well as US sanctions. The US has since persuaded China to cancel its nuclear deals as a condition of dropping its own nuclear sanctions against China.[310] Despite political pressure from the US and Israel, Russia refused to withdraw from the Bushehr project. However, Iran and Russia have had business disagreements and the project is behind schedule. Iran has reportedly

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305. *Weapons of Mass Destruction in the Middle East*, Center for Nonproliferation Studies, May 1998, http://cns.miis.edu/research/wmdme/turkey.htm CNS notes the presence of 15 B-61 nuclear gravity bombs deployed by the United States at Incirlik Air Base.

306. Michael Barletta & Amin Tarzi, *Nonproliferation Regimes at Risk: Challenges in the Middle East to Nonproliferation Regimes*, Center for Nonproliferation Studies, 1999, p. 2. http://cns.miis.edu/pubs/opapers/op3/bartar.htm

307. Leonard Spector, *Nuclear Proliferation Outside the Nuclear Weapons States*, Carnegie Endowment for International Peace, January 5, 1996. http://www.ccip.org/programs/npp/npaussie.htm

308. This includes the so-called "Miniature Neutron Source Reactor" (MNSR), a 27 kw reactor using high enriched uranium for fuel, which is a knock-off of the Canadian Slowpoke reactor. China has been accused of stealing this design from Atomic Energy of Canada Limited (AECL). See: Jeff Sallot & Andrew Mitrovica, "Beijing's spies stole Canadian nuclear secrets", *Globe & Mail*, January 24, 2000, pp. A1 & A6.

309. Rodney Jones et al., *Tracking Nuclear Proliferation*, Carnegie Endowment for International Peace, 1998, p. 170.

310. "Iran admits Chinese link severed", *Nuclear Engineering International*, January 2000, p. 4.

asked Russia to build three more reactors at Bushehr.[311] Despite its apparently slow progress on nuclear development, Iran has expanded its missile and chemical and biological weapons capability. It is thought that Iran needs five to ten years to complete a nuclear bomb.[312]

Iraq -- Despite having ratified the NPT on October 29, 1969, in the wake of its defeat in the 1991 Gulf War, it was discovered that Iraq had secretly pursued a multi-billion dollar nuclear weapons program, with thousands of workers in a number of facilities. Iraq was pursuing sophisticated boosted nuclear weapons, and had a parallel missile delivery system program. The Iraqis had a variety of uranium enrichment programs, as well plutonium separation taking place at the IAEA safeguarded facility at Tuwaitha. In 1995, it was learned that following the August 1990 invasion of Kuwait, Iraq had launched a "crash program" to develop a nuclear bomb. However, it has been generally agreed that when the 1991 Gulf War began, Iraq was three to five years away from building a nuclear bomb.

10.2. The Indian and Pakistani Bombs

On May 11, 1998, India exploded three nuclear bombs at the Pokhran test site in Rajasthan: a thermo-nuclear bomb of about 43 kilotonnes; a fission bomb of about 12 kilotonnes; and a sub-kilotonne bomb. Two days later on May 13, two more sub-kilotonne bombs were exploded with yields of 0.2 to 0.6 kilotonnes. A response came before the end of the month. Pakistan stated that five bombs were exploded on May 28th, and one on May 30th at the Chagai test site in Baluchistan province. The tests were conducted simultaneously, and although Pakistan suggested yields of 20-30 kilotonnes, US sources suggest a combined yield of 5-10 kilotonnes each day.

Canada was connected to the development of the Indian bomb, and has also made a major contribution to the Pakistani nuclear program. Canada's first reactor export was to India in 1956. It was a "research" reactor called CIRUS, that was modeled on the NRX reactor operated by Atomic Energy of Canada Limited (AECL) at its Chalk River Nuclear Laboratory near Ottawa. CIRUS went critical in 1960, and became infamous as the source of plutonium used by India in the nuclear bomb it exploded in 1974. CIRUS is still in operation, and likely provided plutonium for the bombs that were exploded in May 1998. In addition to the CIRUS reactor, Canada sold two 200 MW CANDU reactors (known as RAPS -- the Rajasthan Atomic Power Stations) to India that were modelled on the Douglas Point reactor at Ontario Hydro's Bruce Nuclear Power Development on Lake Huron. AECL also sold the design and technology for the manufacture of these reactors to India. Most of India's current nuclear capacity is based on this same reactor design, with six more CANDU 'clones' of the same size in operation, and four more under construction.

India now has other 'research' reactors, in addition to CIRUS, to use for plutonium production. Although the two RAPS reactors are safeguarded (outfitted with surveillance devices, and inspected by the International Atomic Energy Agency), its other CANDU clones are not. Each of India's six other 200 megawatt CANDU reactors are capable of making 50 to 60 kg of weapons grade plutonium annually. It is estimated that 5 to 8 kilograms of plutonium is the minimum required for a basic fission bomb.

Canada has also had a long history of nuclear relations with Pakistan. In 1964 an agreement was made between Canadian General Electric and Pakistan to build a 137 MWe CANDU reactor on the coast, 30 km west of Karachi. The reactor, known as the KANUPP (Karachi Nuclear Power Project), became operational in 1971. Concessional financing was provided by Canada for the reactor. Like the Indian RAPS reactors, this one was modeled on the Douglas Point reactor in Ontario. After the 1974 Indian nuclear test, Pakistan also refused to adopt improved safeguards against proliferation, and Canada ended cooperation at the same time

311. "Tehran and Moscow fall out over Bushehr", *Nuclear Engineering International*, October 1999, p. 4.

312. Leonard Spector, *Nuclear Proliferation Outside the Nuclear Weapons States*, Carnegie Endowment for International Peace, January 5, 1996, p. 2. http://www.ccip.org/programs/npp/npaussie.htm

as it did for India in 1976.

Without any public consultation or parliamentary debate, Canada's non-proliferation restrictions for India and Pakistan have been eroded under pressure from the Canadian nuclear industry. In 1988, Hugh Irvine, former Chairman of the CANDU Owners Group (COG), stated that "...discussions were opened with the Canadian government on the possible participation of India and Pakistan in the COG Information Exchange Program."[313] COG is an alliance of CANDU reactor operators around the world, funded largely by Ontario Power Generation and AECL. In 1989, India and Pakistan were allowed to join the COG Information Exchange Program on nuclear technology. COG described the event as "ending 12 years of isolation [of India and Pakistan] from the Canadian nuclear industry". Logically, the 1986 Chernobyl accident should have provided a good reason to shut down the ailing CANDU reactors in India and Pakistan, but the Canadian nuclear industry used it as an excuse for restarting nuclear relations with India and Pakistan -- eroding the safeguards and nuclear sanctions that Canada had put in place 12 years earlier. Both India and Pakistan were eager to obtain Canadian nuclear aid.

10.3. The Turkey/Pakistan Connection

The Indian and Pakistani nuclear weapons tests have undoubtedly already had a significant impact on the Middle East, where some states and individuals support an 'Islamic bomb' as a counter-weight to Israel's nuclear weapons capability. The image of Pakistan facing a much larger and militarily superior foe with a nuclear deterrent is a powerful one. Chinese nuclear dealings with Pakistan were the main cause of an American nuclear trade boycott of China prior to its being lifted in 1998. So it is not surprising that allegations of a Turkey/Pakistan nuclear connection raise concern. The first such allegation was in 1981. The former Turkish ambassador to Canada, Omer Ersun (then Chief of Policy Planning at the Turkish Ministry of Foreign Affairs under the military junta) has confirmed that the US administration protested a $30,000 shipment of "inverters" from a Turkish textiles firm to Pakistan, for use in the Pakistani uranium enrichment program.[314]

Relations between Turkey and Pakistan became increasingly close after the military coup in Turkey on September 12, 1980. The respective military leaders of Turkey and Pakistan, President/General Kenan Evren, and President/General Zia ul-Haq exchanged a series of official visits that only ended with Zia's 1988 death in a plane crash. In the early 1980s, Greek Prime Minister Papandreou charged that "Pakistan expected Turkey to act as a trans-shipper of material for a nuclear bomb and would reciprocate by proudly sharing the nuclear bomb technology with Turkey".[315]

In 1977 Senator John Glenn and Senator Stuart Symington amended the U.S. Foreign Assistance Act so that no foreign country could receive American aid if it imported or exported unsafeguarded nuclear enrichment or processing materials or technology. Subsequently, the Pressler amendment required the president to certify that Pakistan did not have a nuclear bomb in order to receive American aid. In 1992, John Glenn charged that US laws were being ignored and that aid to Pakistan allowed it to fund its nuclear program. Glenn also indicted the US government for its failure to use the Glenn-Symington amendment to end economic aid to Turkey for its aid to Pakistan in allowing the shipment of technology used in uranium enrichment.[316]

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313. *CANDU Owners' Group 1988 Annual Report*, p. 1.

314. Mustafa Kibaroglu, "Turkey's Quest for Peaceful Nuclear Power", *The Non-Proliferation Review*, Spring-Summer 1997, p. 35.

315. "Turkey's role in Pakistan's nuclear program", *Worldwide Report*, March 20, 1987, p. 14. Cited in: Kibaroglu, *ibid.*, p. 35.

316. John Glenn, "This Country Encouraged the Spread of Nuclear Weapons", *Washington Post*, June 24, 1992, p. A19.

In 1995, a Greek foreign ministry official, Thanos Dokos repeated concerns about "nuclear cooperation between Ankara and Islamabad... and reports that Turkey might try to acquire nuclear weapons material and technology and recruit nuclear scientists from the Muslim republics of the former Soviet Union."[317]

Perhaps the most alarming evidence of possible Pakistani support came in a report on a meeting of the Economic Cooperation Organization (ECO) summit held in Almati Kazakhtstan, May 11-12, 1998. The meeting included former Pakistani Prime Minister Nawaz Sharif, and former Turkish President Suleyman Demirel as well as an unnamed cabinet member. During a meeting between Demirel and Sharif, Sharif reportedly discussed the Indo-Pakistani conflict, and their respective nuclear programs, and went on to say, "Let's work together on nuclear weapons".[318] Given the initial Indian tests, which had occurred on the first day of the Almati summit, Turkey reportedly put nuclear weapons on the agenda of the meeting. The unnamed Turkish cabinet minister reportedly discussed the record of Turkey's neighbours in their use of chemical weapons, and their nuclear programs, and stated, "We must acquire these technologies in the next ten years. The necessary investments are unavoidable."[319] The article went on to note that there is strong advocacy for development of nuclear weapons, although Ankara had publicly advocated a regional forum to promote the elimination of weapons of mass destruction.

There is some reason to think that the Turkey/Pakistan connection may be closer than ever before. The current dictator of Pakistan, General Pervaiz Musharraf, ousted Prime Minister Nawaz Sharif in a military coup in October 1999. Musharraf was partly raised in Turkey, where his father was stationed as a Pakistani diplomat. Musharraf speaks Turkish, and grew up hero-worshipping Kemal Ataturk, founder of the Turkish Republic, himself a general and first world war hero under the Ottomans.[320] Just one month after the coup in Pakistan, Musharraf visited Turkey to enlist support for his regime, and described Turkey and Pakistan as "sailing in the same boat concerning the military's role".[321] He was referring of course to the ongoing dominant role of the military in Turkey. Musharraf also praised former Turkish General Kenan Evren who seized power in a military coup in 1980 in Turkey, saying that Turkey owed much of its progress to him.[322] Turkish Prime Minister Bulent Ecevit, elected in April 1999, was imprisoned when Evren seized power in 1980.

10.4. The Turkey/Argentina Connection

Concerns about Turkey's potential involvement in nuclear weapons proliferation have continued in the 1990s. International pressure was required in 1990-91 to force an end to joint plans by Argentina and Turkey to build the CAREM-15, a 25 MW reactor in their respective countries. If the rating was 25 MW thermal, the electrical rating would have probably peaked at about 9 or 10 MWe, although the Argentine representatives suggested that the reactor could also be used for district heating or desalination.[323] Yalcin Sanalan, a former Director of TAEA was more frank when he stated that the CAREM-25 was "...too small for electricity generation and too big for research or training, however, very suitable for plutonium production" thus making it a very real proliferation risk. American opposition to the joint Argentine/Turkish project was made

317. Thanos Dokos in "Greece", in Harald Muller, ed., *Nuclear Export Controls in Europe*, Brussels, European Interuniversity Press, 1995, p. 208. Cited in: Kibaroglu, *ibid.*, p. 39.

318. Deniz Zeyrek, "Pakistan's offer for cooperation", *Radikal*, June 1, 1998. *Radikal* is a large Turkish daily newspaper with a liberal political position.

319. Deniz Zeyrek, *ibid.*.

320. Paul Koring, "Commonwealth leaders prepare to give coup a chance", *Globe & Mail*, October 28, 1999, p. A17.

321. Reuters, "Pakistani chief in Turkey stresses own goals", *International Herald Tribune*, November 9, 1999, p. 7.

322. AFP, "Turkey's trust in military falls", *Kathimerini [Herald Tribune]*, November 9, 1999, p. 2.

323. "Reactor venture entered with Turkey", *Nuclear News*, December 1990, p. 46.

clear[324] , and Sanalan "concluded that such an ambiguous project would decrease the chances of Turkey in its current and future quest for large-scale nuclear power plants...".[325] Although the nuclear cooperation agreement between Turkey and Argentina has remained in place, Turkey cancelled the reactor project in 1991, following pressure from the United States and others.[326]

10.5. Nuclear Trafficking Involving Turkey

Based on numerous reports of nuclear smuggling incidents, there is no doubt that Turkey has become a major trans-shipment route for nuclear smuggling out of Russia and former Soviet republics. There have been 18 incidents reported involving nuclear material seized in Turkey, nuclear material seized en route to Turkey, or seizure involving Turkish citizens.[327] Turkish official have denied that any plutonium or high enriched uranium (HEU) has been seized in Turkey, but one report says that several grams of plutonium were seized in Bursa, Turkey in 1998. In another incident, 12 grams of HEU were seized in Zurich, and a Turkish national was arrested. The Center for Nonproliferation Studies has stated,

> Public reports indicate that Turkish and other international authorities thwarted each of the nuclear smuggling schemes recounted in this study. However, other more sophisticated attempts may have escaped detection. The possibility that proliferation-relevant nuclear materials may be smuggled via Turkey continues to merit international attention.[328]

10.6. Support for Nuclear Weapons in Turkey

While the Turkish government continues to officially deny that it is interested in developing nuclear weapons, there has been support expressed for nuclear weapons development by the Turkish Atomic Energy Authority (TAEK) and by several prominent people.

On May 18, 1998 retired Turkish General Erdogan Oznal was interviewed on a news program called "Pasaport" on the television news channel NTV. Oznal was the Lieutenant General formerly in charge of the NATO's Balikesir Air Base, where nuclear-armed fighter/bombers were stationed during the cold war. The interview was posed in the context of the Indian nuclear weapons tests that had taken place May 11-13. Oznal commented cooly on the importance of NATO's nuclear weapons and possibility of nuclear conflict during the cold war period. He then described the nuclear threats around Turkey's borders, including Israel's and Iran nuclear weapons programs, and how Israel had bombed Iraq's Osiraq reactor in 1981. He then went on to state that "Turkey must develop its own nuclear policy". The interviewer asked him again, and he repeated this statement, which was clearly intended to support Turkey's development of nuclear weapons.[329] There can be little doubt that Oznal's support for Turkish nuclear weapons development represents the viewpoint of a significant part of the Turkish military.

Perhaps most worrisome is official support for nuclear weapons development coming from the Turkish

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324. "'Secret talks' with Argentina on nuclear plant", *Nuclear Developments (CNS Nuclear Databases)*, October 6, 1989, pp. 31-32.

325. Kibaroglu, *ibid.*, p. 38.

326. "Argentina to help acquire nuclear technology", *Nuclear Developments (CNS Nuclear Databases)*, June 21, 1988, p. 39.

327. *Overview of Reported Nuclear Trafficking Incidents Involving Turkey*, 1993-1999, Center for Nonproliferation Studies, July 1999. http://cns.miis.edu/research/wmdme/flow/turkey/index.htm

328. *Ibid., Overview of Reported Nuclear Trafficking Incidents Involving Turkey*, 1993-1999

329. Personal communication from Aynur Sungur Tuncer, May 20, 1998.

Atomic Energy Authority (TAEK). In June 1998, TAEK submitted its annual report to the Turkish National Assembly / State-Owned Utilities Commission, following hard on the heals of the Indian and Pakistani nuclear weapons tests. Even in that context, the overt support for nuclear weapons development was astonishing, given the government's official opposition. The report was prepared under the leadership of former TAEK chairman Mehmet Ergin. The report stated, "Nuclear technology...makes the country honourable and powerful, and it allows the country to advance one step further because nuclear technology has scientific, technological, strategic and economic components."[330] The report laments that Turkey has not made much progress in nuclear technology despite being one of the first countries to start work on it. TAEK goes on to express admiration for the achievements of India in its nuclear weapons program...

> "India constructed reprocessing plants by itself. Only a few countries have these plants that reprocess nuclear fuel, the transfer of which is strictly forbidden. In the last years, India has been in a race with developed countries. In addition to this, on the one hand it is aiming to double its nuclear power capacity, and on the other hand to continue to test atomic bombs and endeavouring to develop hydrogen bombs."[331]

The report also emphasized that since 1997, Turkey has started research and development on a domestic reactor design, as well as development of nuclear fuel facilities, including thorium fuel.

Support for nuclear weapons continues to be expressed in Turkey's halls of power. In the minds of politicians, even at the cabinet level, there is clearly a link between nuclear power and nuclear weapons. In March 2000, Enis Oksuz, the Minister of Transport in the Ecevit coalition government was publicly attacking the critics of Akkuyu, as well as defending Turkey's development of nuclear weapons, as if it were simply a given. He stated, "When you mention the atomic bomb, they are scared that it kills people [but] it has not been used since the second world war. Having such a bomb in Turkey's hand is security. It provides deterrence."[332]

10.7. Nuclear Fuel Cycle Independence

While most of the public focus is often on nuclear reactors, in fact reactors are only one stage of a process often referred to as the 'nuclear fuel cycle'. It starts with the mining and milling of uranium to produce yellowcake, a uranium oxide with the chemical formula U_3O_8. which is then refined and converted, and often enriched to increase the amount of fissile uranium-235. Enrichment is very difficult, because of the chemical similarity of uranium-235 and uranium-238. The enriched uranium is then fabricated into fuel for use in reactors. A controlled chain reaction is established in reactors, which results in the release of energy, which is used to generate electricity. Once the fissile material in the fuel is used up, the spent fuel is sometimes referred to as "high level radioactive waste". It is extremely radioactive, hazardous and long-lived (for practical purposes forever). In theory, the spent fuel can be reprocessed to extract the plutonium, which can be used again for fuel in a reactor, and it is for this reason that the process is referred to as being cyclic. In practice, the process is often not cyclic. Because of economic, environmental and proliferation concerns, many countries (such as the United States) have decided not to reprocess spent fuel, and instead opt for a "once through" system, in which the spent fuel is stored, awaiting the determination of a future management strategy. Regardless of whether reprocessing is carried out, there is a very serious radioactive waste problem. Reprocessing leaves an even more serious waste problem, because the waste is in a highly acidic liquid form, as opposed to solid spent fuel. All stages of the nuclear fuel cycle result in radioactive contamination of people and the environment, and result in the production of various types of radioactive waste.

330. "Atom Bomb Report to Parliament", *Anka News Agency*, June 8, 1998.

331. "Atom Bomb Report to Parliament", *Anka News Agency*, June 8, 1998.

332. "Oksuz challenges the environmentalists", *Sabah*, March 9, 2000.

There are proliferation concerns with the nuclear fuel cycle, because nuclear weapons can be made in two basic ways: by the enrichment uranium, or by the production of plutonium. So-called "peaceful" nuclear power programs can provide both of these technologies, or alternately the knowledge and skills that are needed to re-create the technologies for nuclear weapons production. Nuclear reactors were originally manufactured not to generate electricity, but to produce plutonium for nuclear bombs. It is possible to construct a basic 1 kiloton nuclear fission weapon, using techniques that are now part of the open literature, with as little as one kg of weapons grade plutonium, or about 3 kg of high enriched uranium.[333]

The international non-proliferation system enshrined in the Nuclear Non-Proliferation Treaty (NPT), and administered by the United Nations International Atomic Energy Agency (IAEA) have the task of promoting nuclear power, while trying to prevent the spread of nuclear weapons. It is a task that is condemned to failure by its inherent contradiction. And so the world drifts towards increasing numbers of nuclear armed states, and even the possibility of nuclear-armed, sub-national organizations.

It should be noted that a nuclear power program is not an absolute necessity if a state wishes to develop nuclear weapons, as can be seen by the example of Israel, which has developed a very significant nuclear weapons program without having nuclear power. However, as can be seen by the example of states such as South Africa, Sweden, India, Pakistan, Iraq and Iran, a "peaceful" nuclear power program is a convenient and legal means of developing the expertise that is needed for a nuclear weapons program, while camouflaging the nuclear weapons work as it is being done. Countries such as North Korea, Iraq, and Iran are signatories of the NPT, and have thus deliberately subverted the treaty and acted illegally. However, other states such as India and Pakistan, never signed the NPT and thus (they argue) have never acted illegally.

In theory, a state could be a signatory of the NPT, and both adhere to its treaty obligations, *and* develop nuclear weapons. The key would be to develop an indigenous fuel cycle that would not be subject to proliferation controls or possible political or economic sanctions. That means developing the ability to produce your own nuclear fuel, and/or enrich your own uranium, as well as building your own reactors to produce plutonium, and the capability of reprocessing the spent fuel to extract plutonium. Admittedly, this is a tall technological order, however, it has been done, and it is *being* done.

The international nuclear industry has a strong financial incentive to subvert the international non-proliferation regime. Various states subvert or enforce the non-proliferation regime according to the political motivations of the day. The IAEA, because of its contradictory mandate will inevitably preside over the increasing spread of nuclear weapons.

Turkey has already committed to the development of an independent fuel cycle. The Nuclear Fuel Technology Department of the Cekmece Nuclear Research and Training Centre (CNRTC) operates a Nuclear Fuel Pilot Plant designed and constructed by staff, and in operation since 1986. The pilot plant conducts a range of fuel cycle activities including uranium refining and fuel fabrication. CNRTC reportedly purchased 1.5 tonnes of uranium concentrates (yellowcake) from Canada in 1986.[334] The pilot plant does not follow the common practice of converting the uranium to uranium hexafluoride (UF6) and then subsequently 'enriching' it using a gaseous diffusion process. Instead it uses a modified PUREX (Plutonium-URanium-EXtraction) chemical separation process, which has been widely used for nuclear weapons production since the 1950s. PUREX is typically used to separate plutonium and uranium from fission products in irradiated reactor fuel.[335]

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333. Thomas B. Cochran, *Nuclear weapons Proliferation: What is in Store for the Next Millennium*, Presentation to the Atlantic Council of the United States Global Seminar on the Future of Nuclear Power, May 10-12, 1998.

334. Dr. Spyros Traiforos, "Nuclear Policy in Turkey: Is Turkey on its way to becoming a nuclear weapons state?", *Defensor Pacis*, January 1999, p. 79.

335. Thomas B. Cochran et al., *Nuclear Weapons Databook: US Nuclear Warhead Production*, Vol. II, 1987, pp. 139-140.

While the CNRTC is safeguarded by the IAEA, the development of this level of fuel cycle activity and experimentation with reprocessing technology certainly raises concerns. Clearly, if Turkey does purchase a nuclear power plant, the reactor vendors could provide fuel much more cheaply and reliably than Turkey could possibly produce it using their own technology. Even if the Nuclear Fuel Pilot Plant is safeguarded, the activity is *inherently* proliferative insofar as the expertise and knowledge could be applied to nuclear weapons technology -- specifically plutonium reprocessing.

If Turkey is able to mine, refine and fabricate its own fuel, and manufacture its own reactor then safeguards are largely irrelevant. What little meaning that safeguards have under bilateral and multi-lateral non-proliferation agreements only applies to material and technology that is sold or transferred. Fuel cycle independence provides the option of nuclear weapons development, 10, 15 or 20 years down the road, once the expertise and infrastructure have been obtained through perfectly legal means, and in accordance with all current non-proliferation agreements.

In addition to the nuclear fuel pilot plant technology, another way in which Turkey is heading towards an indigenous nuclear fuel cycle is through development of a thorium fuel cycle. Turkey has relatively small uranium reserves (about 9000 tonnes yellowcake equivalent) but it has very large thorium reserves (about 380,000 tonnes).[336] To quote Nejat Aybers, the former President of TAEK, "It may therefore be wise to select a policy for nuclear fuel cycle before the choice of a reactor type. For Turkey's vast thorium resources used in conjunction with a suitable reactor system, may offer the prospects of energy independence for centuries."[337] Natural thorium is almost entirely Thorium-232, which is not a fissile material, but is called "fertile". When it is bombarded with neutrons in a reactor, it transmutes into the fissile materials plutonium-239 and uranium-233, which can sustain a chain reaction. All it needs is an original "seed" fuel to initiate the reaction. For this reason, Atomic Energy of Canada Limited (AECL) proudly describes the CANDU as a "near breeder".[338]

AECL has an ongoing program in thorium fuel fabrication, test irradiation, and studies of thorium-fuelled CANDU cores.[339] AECL is using this technology as a marketing tool to sell CANDU reactors to Turkey. India has also done advanced work on thorium fuel cycle for their 'CANDU clone' reactors. Turkey is very interested in developing a thorium fuel cycle.[340]

Turkey is also committed to developing its own nuclear reactor technology, although the type of reactor design favoured by Turkey has not been disclosed. In June 1998, Emin Ozbas, then co-director of TAEK announced that a program had been initiated to design its own reactor. The initial phase of the project, up to 2001, was funded in the amount of 1.1 trillion Turkish Lira (TL) ($4.2 million US).[341]

The speech of Turkish Ambassador to the IAEA, Fuegen Ok, to the September 1998, 42nd IAEA Conference was summarized in part as follows...

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336. Kenan Unlu, "Turks take steps to revive their nuclear programme", *Nuclear Engineering International*, January 1995, p. 17.

337. Nejat Aybers, *Implementation of a Nuclear Power Plant in a Developing Country: The Case of Turkey*, Figure 1: Structure of TAEK, p. 3. Aybers was a strongly partisan supporter of the CANDU reactor.

338. Ralph Hart, *CANDU Technical Summary*, AECL, October 1997, p. 57.

339. J.H.K. Lau et al. "The Canadian CANDU fuel development program and recent fuel operating experience", *Canadian Nuclear Society Bulletin*, Vol. 20 No. 3, October 1999, p. 12.

340. See for example: Sinan Goktepely, *Thorium Utilization in CANDU Reactors*, Hacettepe University Nuclear Engineering Department, July 1996. http://www.nuke.hun.edu.tr/document/sinan-tez.html

341. "TAEK starts research to design Turkish reactor", *Anatolia News Agency*, June 21, 1998. See also: "Atomic Authority to develop domestic reactor", *Yeni Yuzyil*, June 22, 1998.

> ...Turkey is in the process of taking steps in developing further peaceful nuclear technology. The national model reactor that is planned to be established using mostly indigenous sources will have an important role in the transfer of nuclear technology.[342]

At the same time as the reactor development announcement, further work on nuclear fuel technology was announced, including an undisclosed project on nuclear fuel technology, which will cost 175 billion TL ($660,000 US). This project was scheduled to be completed in 1999. In addition, the construction of a new nuclear fuel facility is being planned. The projected cost was 3 trillion 600 billion TL ($13.6 million US), for which 2 trillion 130 billion TL ($8 million US) foreign credit was to be used. Turkey is also cultivating connections in the former Soviet Union...

> "Being in close connection and technical cooperation with the Turkic states in Asia which have experience with nuclear power plants, TAEK has started various projects for the use of nuclear technology..."[343]

Turkey already understands the value of developing fuel cycle independence. The United States apparently instituted a "secret" embargo on high enriched fuel to Turkey in the late 1980s for use in Turkey's research reactors. Atilla Ozmen, director of TAEK told the daily newspaper *Hurriyet* that companies in seven different countries (US, France, Canada, UK, Japan, Argentina and Germany) had been approached to supply fuel before COGEMA (France) agreed. Apparently referring to Turkey's nuclear deal with Argentina, Ozmen stated. "The technology we are going to use now will give us the possibility of depending very little on others.".[344]

10.8. CANDU: A Proliferation-Prone Reactor

The CANDU (CANadian Deuterium Uranium) reactor (also know generically as the Pressurized Heavy Water Reactor, PHWR) can be considered to be 'proliferation-prone' for several reasons. As a general rule, more plutonium is produced in reactors that use heavy water as a moderator than by most other reactor types. While there are several design reasons for the CANDU being an efficient plutonium producer (including the higher amount of U-238 in the 'natural uranium' CANDU fuel) perhaps the most important is the high neutron economy that allows the CANDU to operate with natural uranium – quite simply, more neutrons are more effective than in other reactor designs, and more plutonium is produced. Burn-up time in the reactor is a factor, since fuel for electricity production is left in the reactor about ten times longer than if the goal was plutonium production.

AECL has argued that there is a distinction between so-called reactor-grade plutonium (with a higher amount of Pu-238, as opposed to Pu-239), and weapons-grade plutonium. It should be clear however, that reactor-grade plutonium can be used effectively in nuclear weapons...

> While reactor-grade plutonium results in a lower probable yield in pure fission weapon designs due to pre-ignition of the nuclear chain reaction, modern boosted fission nuclear weapons and boosted primaries of thermonuclear weapons are designed so that pre-ignition is impossible.[345]

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342. Speech of Turkish Ambassador to the IAEA, Fuegen Ok, to the September 1998, 42nd IAEA Conference (Summary) http://www.iaea.org/GC/gc42/statements/turkey.html

343. "TAEK starts research to design Turkish reactor", *Anatolia News Agency*, June 21, 1998.

344. Aziz Utkan, *Hurriyet*, April 12, 1989. (From *Nuclear Developments*, May 5, 1989; *CNS Nuclear Databases*).

345. Thomas B. Cochran, *Nuclear weapons Proliferation: What is in Store for the Next Millennium*, Presentation to the Atlantic Council of the United States Global Seminar on the Future of Nuclear Power, May 10-12, 1998.

The CANDU reactor has other technical attributes that would be helpful to potential proliferators.

10.8.1. CANDU On-power Refuelling

Unlike Light Water Reactors (either Pressurized Water Reactor or Boiling Water Reactors), CANDU reactors possess on-power refuelling capability. Because the CANDU has hundreds of fuel channels, instead of one large reactor vessel, fresh fuel bundles can be inserted while used ones are removed from the opposite end of the fuel channel. Typically, either 4 or 8 of the 12 fuel bundles in a CANDU-6 reactor are exchanged in a refuelling operation. In a CANDU-6, about ten fuel channels per week are re-fuelled. There are 380 fuel channels in a CANDU-6 reactor. The channels are horizontal, with fuelling machines on both ends, and either machine can load or receive fuel.[346]

CANDU fuel bundles are also much smaller, and therefore more numerous than fuel bundles for Light Water Reactors. CANDU fuel bundles weigh about 20 kg., and there are over 4,500 in a CANDU-6. By comparison, a typical Light Water Reactor fuel assembly is about 4 metres long and weighs about 650 kg. This makes monitoring and verification of CANDU fuel much more difficult. Thus it is theoretically possible to use dummy fuel bundles, and possible to run through some fuel channels at a faster rate in order to maximize plutonium production. With a Light Water Reactor, because the entire reactor has to be shut down to refuel, it is easy to determine the shutdown period even by satellite monitoring, because the thermal effluent is easily discerned.

10.8.2. Natural Uranium Fuel & Fuel Cycle Independence

CANDU reactors use so-called natural uranium at a level of about 0.7% uranium-235, as compared to Light Water Reactors that require fuel enriched to a level of 2% to 4%. There is a trade-off however. In Light Water Reactors the fuel is enriched, but the system does not need to use a very good moderator to slow down the neutrons and create a chain reaction (it simply uses ordinary 'light' water). However, in heavy water reactors like CANDU, the fuel does not need enrichment, but in effect, the moderator needs to be enriched. Thus heavy water, or deuterium oxide (D2O) is used as a moderator. In order to increase the efficiency even more, heavy water is also used as the coolant.

While AECL likes to promote that fact that CANDU fuel is easier to produce, it often fails to mention that heavy water is difficult and expensive to manufacture. However, for a country aspiring to the production of plutonium-fuelled nuclear weapons, and aiming for its own safeguard-resistant independent fuel cycle, natural uranium fuel simplifies the task -- it means that uranium enrichment is not necessary.

AECL is also notorious for its willingness to provide technology transfer. For example, AECL provided India with the design and technology for the construction of its fleet of 200 MW 'CANDU clones' that are modelled on the Douglas Point reactor in Ontario, Canada. AECL has also transferred technology to South Korea. The South Korean state utility, KEPCO, and its subsidiary Hanjung are major partners with AECL in its sale of two reactors to China, as well as the proposed sale to Turkey. If client states want to expand their nuclear reactor fleet, they do not want to buy turnkey plants indefinitely, so technology transfer is a powerful marketing tool. However, technology transfer is a key to fuel cycle independence, and thereby a key to safeguards-resistant nuclear weapons proliferation.

Two other pieces of technology that AECL has designed will also be marketed. These include a tritium extraction plant and a heavy water production plant. These a vital elements of fuel cycle independence for the CANDU reactor and its fuel cycle.

346. Ralph Hart, *CANDU Technical Summary*, AECL, October 1997, "Fuel Handling System", pp. 10-11.

In the 1980s, AECL partially completed a Tritium Extraction Plant at its Chalk River Laboratories. The plant was never operated for financial reasons, and it has now been modified into a so-called Combined Electrolysis and Catalytic Exchange Upgrading/Detritiation (CECEUD) facility.[347] The facility is intended both to upgrade the quality of heavy water (reactor-grade quality is at least 99.75wt% D2O), and for detritiation, i.e. to remove or lower the content of tritium in heavy water that has been contaminated through use in CANDU reactors.

A unique problem associated with CANDU reactors is the contamination of heavy water coolant and moderator with tritium. This tritium poses a risk to workers, as well the surrounding population and the environment. Detritiation is a way of reducing the radiation dose to workers and surrounding populations. However, tritium is also a key substance used in nuclear weapons, both in "boosted" fission weapons, and along with deuterium in thermonuclear bombs. The "H" in H-bomb, stands for hydrogen, and the "hydrogen" actually refers to deuterium and tritium, which are both heavier isotopes of hydrogen. AECL has also created a new plant for production of heavy water known as the Combined Industrial Reforming and Catalytic Exchange (CIRCE).[348] Presumably this technology, or modified versions of it will be offered for sale or as part of a technology exchange agreement along with the main CANDU reactor technology.

10.9. Proliferation Conclusions

It is not surprising that vendor countries such as the United States and Japan, Canada, France and Germany are dismissing proliferation concerns about Turkey in the face of powerful lobbying efforts from their respective nuclear industries. However, the potential for nuclear weapons proliferation through the sale of nuclear reactors to Turkey remains a valid concern. In the short term, the development of a reactor program in Turkey will reduce the legitimacy of the western effort to prevent Iran from developing its nuclear power and nuclear weapons programs. Iran's nuclear weapons capability is only five to ten years away. Similarly, it will provide further incentive for Iraq to revive its nuclear program. It will reinforce Israeli dependence on its nuclear weapons capability. It will weaken Turkey's relationship with NATO as its need for the American nuclear deterrent is reduced. It may lead to clandestine cooperation between Turkey and Pakistan, or possibly even Israel. There is little doubt that Israel collaborated in nuclear weapons development with the former apartheid regime in South Africa.[349]

India and Pakistan's nuclear weapons tests are a clear precedent for the Middle East, which has already been set on the path to nuclear confrontation by Israel. More important, the issue is not one just for today. Existing safeguards are far from foolproof, but Turkey is already laying the foundation for an independent fuel cycle that will make safeguards irrelevant. Perhaps the most worrisome aspect of the linkage between nuclear power and nuclear weapons is that the plutonium in spent reactor fuel is available virtually forever. Even if current governments resist the temptation to develop nuclear weapons, there can be no guarantee that a subsequent government, five, ten or 100 years later will not choose to build bombs. Certainly, in the volatile politics of Turkey and the Middle East, there can be no guarantee of stability, in the short-term or the long-term.

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347. Atomic Energy Control Board, *Amendment to the AECL Site Licence to authorize Operation of the Combined Electrolysis and Catalytic Exchange Upgrading/Detritiation Test Facility*, BMD 97-89, June 9, 1997. See also: BMD 97-89.1 and BMD 97-126.

348. Atomic Energy Control Board, *AECL Prototype Heavy Water Production Plant - Application for Licence Exemption*, BMD 97-109, June 10, 1997.

349. Steve Weissman & Herbert Krosney, *The Islamic Bomb*, Times Books, 1981, p. 302.

11. The Monk Seal

The Mediterranean Monk Seal, *Monachus monachus*, is a critically endangered species with a world population in the low hundreds, and the total Turkish population estimated at between 50 and 100 seals.[350] In Turkey there are small populations on the Black Sea coast (possibly extinct), and the populations in the Marmara Sea are thought to be extinct. The main populations are on the Aegean coast, and there are also scattered populations along Turkey's Mediterranean coastline.[351] The Mediterranean coast range includes three sectors: between Datca and Kemer; between Gazipasa and Tusucu; and between Samandag and the Turkish-Syrian border.[352]

The seals live in small semi-autonomous colonies with only limited interchange, and an individual's range extends typically to about 40 km (and up to as much as 100 km) of coastline. Monk Seals have been protected in Turkey since 1977 – hunting and captures are prohibited. However, it is generally agreed that there has been a disastrous collapse in the numbers of Monk Seals in Turkey over the last 20 years. The reasons for the decline include deliberate killings by fishermen who see the seals as competition for fish, habitat degradation from tourist development for summer homes, the reduction of fish stocks due to over-fishing, and pollution.

The Akkuyu Bay site is in the Gazipasa-Tusucu sector, about 40 km west of Tusucu. Monk Seals are known to inhabit the Beshparmak Island in the mouth of Akkuyu Bay. Fishermen in the area know the seals, and recognize one large animal, whom they call 'Bomber'.[353] The islands are relatively undisturbed and are considered one of the last good seal habitats on the coastline. The seals often use coastal caves to haul out and rest, to mate and for post-natal care. Opponents of the Akkuyu nuclear plant have joined marine wildlife biologists in calling for protection of the area.[354]

Protection efforts have met with some success. In April 1998, the Turkish Council for the Protection of Cultural and Natural Heritage decided to protect 11 areas as "first degree" protection sites on the Mediterranean coast between Alanya and Mersin. These include Narlikuyu, Beshparmak Island (in the mouth of Akkuyu Bay), Aydincik-Yncekum, Boyzyazi area, Tekeli region, Silifke coast, Tissan and Aphrodisias near Silifke, Akdere village, and the coast between Anamur and Gazipasa.[355]

However, while Beshparmak Island is protected, the construction site for the nuclear plant on the coast is not included. Because the coastal highway is very small and precarious, it has always been assumed that transport and supplies for construction and ongoing maintenance of the nuclear plant will be by sea. To that end, a large earthen pier into Akkuyu Bay has already been built. If construction of the nuclear plant proceeds, the increased marine traffic will almost certainly doom the Monk Seal population on Beshparmak Island. Moreover, the cooling water intake for the nuclear plant will also pose a serious threat to the seals. Seals have been trapped in the forebay of the cooling water intake at the Point Lepreau CANDU plant, which is a single CANDU-6 reactor located on the Bay of Fundy in the Canadian province of New Brunswick.

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350. International Union for the Conservation of Nature red list of threatened animals, 1986.

351. Didier, Marchessaux, *The Mediterranean Monk Seal in Turkey: A Survey*, Parc National de Port-Cros, 1987, pp. 18-19.

352. C.O. Kirac et al., *Status and Distribution of Monk Seals Along Turkish Coasts*, Underwater Research Society-Mediterranean Seal Research Group, Ankara (SAD-AFAG), World Marine Mammal Science Conference, Monaco, January 1998.

353. The author visited Buyukeceli in March 1998 and talked to local fishermen.

354. "Seals may thwart Turkish nuclear plans", *Reuters*, February 11, 1998.

355. Personal communication from Melda Keskin, from a report in *Cumhuriyet*, April 12, 1998.

12. Financing the Akkuyu Deal

Nuclear power plants have a high capital cost and a relatively low operating (variable, including fuel) cost. By comparison, fossil-fired power plants have a lower capital cost, but a higher operating cost. Nuclear power has a number of additional unique financial characteristics, which tend to make it a higher risk investment:

- a longer lead time for design, approvals, and construction (typically six to ten years or more);
- higher operating risks due to the complexity of the technology (the risk of poor performance and/or premature shutdown);
- the risk of a serious accident (with both on-site and off-site consequences);
- a requirement for third party liability coverage, with a legislative limitation on liability due to the potential for catastrophic accidents; and
- huge (and often underestimated) `back end' costs for decommissioning and long-term radioactive waste management.

Given that the cost of nuclear power is significantly higher than, for example, high efficiency natural gas-fired plants (see "The Economics of Nuclear Power") it is clear that purchasers are looking for something other than cheap electricity. The perceived prestige of mastering a `high technology' such as nuclear power may provide some rationale, or more ominously, the development of nuclear know-how for military applications may be a factor. However, the ability of AECL and other reactor vendors to provide financing, with generous terms, is crucial, since most developing countries have a distinct shortage of capital. With respect to the bidding process for the Akkuyu nuclear plant, AECL President Reid Morden has stated,

> This will be the first time in living memory that we [AECL] have been in a true, competitive, international competition. Clearly, price will be a critical element... We have a strong consortium and expect to have a competitive bid. As always, financing will be a major challenge, and we are working hard to maximize the amount that we obtain in Canada.[356]

In the November 1996 sale of two CANDU-6 reactors to China, Canada provided an unprecedented $1.5 billion (Cdn) loan through the Canada Account of the Export Development Corporation (EDC, Canada's state export/import bank). That loan remains the largest loan in Canadian history, public or private. The total cost of the two reactors was reportedly $4 billion (Cdn).[357] The US Export-Import Bank provided $250 million (US) in financing, the Japanese Export-Import Bank provided $200 million (US)[358] , and much of the balance will be coming from South Korea's export-import bank. The total sources of financing have never been disclosed, and the terms and conditions have also been kept secret.

It is now known that the Canadian government has committed to also provide $1.5 billion in Canada Account financing for the proposed sale of two CANDU reactors to Turkey if AECL wins the contract. This information was only made public through the 'leak' of two top-secret cabinet documents. The leak of the documents is under a security investigation. In November 1997, the following document was made public:

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356. Reid Morden, "CANDU Exports and Opportunities", *Canadian Nuclear Society Bulletin*, Vol. 18, No. 1, May 1997, p. 26. The two CANDU 6 reactors sold to the Peoples' Republic of China cost $4 billion, of which the Canadian government financed $1.5 billion.

357. AECL News Release, *AECL sells two CANDU 6 units, worth $4 billion to China*, November 26, 1996.

358. Ray Silver, "Wolsung-2 on grid next month; confirmation of China loans near", *Nucleonics Week*, February 27, 1997, p. 20.

Financing for Two CANDU Reactors to the Republic of Turkey, "Record of Cabinet Decision / The Cabinet Committee on Economic Development Policy", Meeting of April 24, 1997, Confirmed by Cabinet on April 27, 1997", August 29, 1997. One year later, a more historic, but very important document was made public: *Financing of CANDU Bid to Turkey*, "Memorandum to Cabinet from Minister if Natural Resources and Minister of International Trade", December 1993.

The December 1993 Cabinet document provided an extensive 43 page background document on the proposed sales of CANDU reactors to Turkey, and on January 13, 1994, Cabinet approved...

> ...in principle the provision of the US$ equivalent of up to $C400 million under the Canada Account of the Export Development Act as a component of the financing of a bid by AECL for a CANDU reactor in Turkey, the actual amount and the vehicle (loans, guarantees, or a combination thereof) to be determined...[359]

It should be noted that this was just financing for one reactor, based on the request for preliminary proposals that AECL received from the Turkish state utility TEAS on October 28, 1992.[360] At that time, AECL estimated that the total cost of the single CANDU-6 project would be $1.661 million (CDN). It was estimated that of this total amount nearly $1 billion of it could be handled by Canadian suppliers. The Export Development Corporation (EDC) estimated that it could finance $250 million from its Corporate Account, and that possibly, $100 million could be financed by Canadian commercial banks. However, the government deemed that even the balance of $650 million was too much to be financed from the Canada Account. In the words of the Cabinet document, "It would likely put a severe strain on the resources available for Canada Account financing of export projects generally, and would unbalance EDC's portfolio."[361] the government therefore opted to reduce the amount to $400 million.

Four years later, the Canadian Cabinet would consider another request for financing, this time for an additional $1.1 billion (CDN). This was in addition to the $400 million that was still available from the January 1994 decision. In addition there was a provision for risk coverage that would cost about $110 million over the 7 year disbursement period.[362] It is astounding to note that the government in 1994 had only been willing to provide $400 million in financing for one reactor, but four years later was willing to increase the provision to $750 million for *each of two* reactors. One can only speculate that the government has become increasingly desperate to ensure some minimal level of sales for AECL, in order to justify its ongoing annual subsidies with public monies.

Natural Resources Minister Ralph Goodale said about the proposed CANDU deal with Turkey that "Rates will be commercial"[363] . Goodale's predecessor described the financing for the Chinese CANDU deal as being "at a non-concessional interest rate as set under the International Consensus Agreement by the Organization for Economic Cooperation and Development."[364] However, it must be emphasized that while the EDC administered the loan to China (and would do so for Turkey), the funds and guarantees

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359. *Financing of CANDU Bid to Turkey*, "Memorandum to Cabinet from Minister if Natural Resources and Minister of International Trade", December 1993, p. 1. [confidential Canadian Cabinet document leaked to the public in December 1998]

360. *Ibid.*, p. 23.

361. *Ibid.*, p. 29.

362. *Financing for Two CANDU Reactors to the Republic of Turkey*, "Record of Cabinet Decision / The Cabinet Committee on Economic Development Policy, Meeting of April 24, 1997, Confirmed by Cabinet on April 27, 1997", August 29, 1997, Sections 1 & 2. [confidential Canadian Cabinet document leaked to the public in November 1997]

363. *Letter from Ralph Goodale, Canadian Minister of Natural Resources, to Jim Karygiannis MP*, April 12, 2000.

364. Hon. Anne McLellan, Minister of Natural Resources, letter to Mr. Rich Krechowicz, May 4, 1995. The actual interest rate reported in the industry press was 7.5%.

actually came from the Government of Canada. Like other export credit agencies, the EDC has risk limits for various countries, which, in the case of most developing countries, would be exceeded by a mega-project such as AECL's two-reactor CANDU sale. When this occurs, special deals must be cut by channelling loans through the EDC's "Canada Account", as opposed to the "Corporate Account", which is carried on the EDC's own books. The EDC's "Canada Account" loans are carried on the books of Canada's Department of Foreign Affairs and International Trade. The government must make the loan for two reasons: it would be far too large a loan for the EDC to handle, and longer-term sovereign loans to developing countries are too risky for the private sector financial community.

Even if Turkey provides a sovereign (i.e. state) guarantee of the nuclear loans, it should be recognized that countries can go bankrupt. In fact, Mexico defaulted on loans in 1980, and that is the reason that the private sector has been very wary of this type of business. In other words, the taxpayers of Canada will be forced to accept the risk of a loan to Turkey for $1.5 billion dollars. It is clear that the private sector would never consider such a loan. As a crown corporation, the EDC's mandate is to promote Canadian export trade and foreign investment. Although the EDC operates on a financially self-sustaining basis according to commercial principles, it does borrow money at the low fixed rates of the Canadian government, and therefore can lend less expensively and for longer periods than commercial banks, and at fixed rates.

12.1 OECD Consensus Rules

At the time of the November 1996 CANDU sale to China, as well as for the proposed sale of reactors to Turkey, the Canadian government has been at pains to point out that the financing was under the Organization for Economic Cooperation and Development (OECD) Consensus Agreement. At the time of the Chinese sale, the agreed consensus rate was reportedly 7.5%.[365] In addition to setting a minimum interest rate, the OECD consensus rules also stipulate that the maximum term length for the loan is 15 years. The consensus agreement is intended to promote fair competition and discourage subsidization. However, it should be noted the consensus rate is non-binding, and is easily breached – typically by so-called *crédit mixte* of aid and loans. The *crédit mixte* approach has been used extensively by the French, and it is widely suspected that Framatome's Daya Bay plant in China was financed in this way. Because of the stiff competition for the Akkuyu project (also involving Framatome through their NPI consortium), it is reasonable to demand full disclosure on the financing arrangements for the Turkish CANDU deal. Such information has not been forthcoming. The public is aware of the proposed amount of Canadian government financing because of two leaked Cabinet documents, but other terms of the proposed deal have been kept secret. Financing arrangements for the other two consortia are equally sketchy. The only certainty is that Turkey will not be financing much of the project, since 100% financing has been specified as part of the bidding requirements. This will include financing even the local costs, which will be of direct economic benefit to Turkey.

There is strong reason to believe that the CANDU deal may not be conducted on the basis of the OECD consensus rules. One of AECL's partners in the Turkish deal is Hanjung (Korea Heavy Industries and Construction -- a subsidiary of the Korea Electric Power Corporation (KEPCO). In October 1996, the Banque Nationale de Paris revealed that South Korea (which is not a member of the OECD) violated the OECD consensus agreement by agreeing to finance 100% of capitalized interest for the Qinshan Phase II

365. Ray Silver, "AECL executive rejects claim that Canada subsidizes China sale", *Nucleonics Week*, August 22, 1996, p. 3. The minimum interest rate under the OECD Consensus Agreement is tied to the Special Commercial Interest Reference Rate (SCIRR), which represents "final commercial lending rates of interest in the domestic market of the currency concerned" and "correspond[s] to a rate for a first class domestic borrower" Source: *OECD Consensus Agreement*.

station[366] , rather than 15% as stipulated by the consensus agreement. Faced with this decision by the South Koreans, France and the other financing parties simply decided to violate the agreement as well.[367] Financing of local costs and capitalized interest is a tremendous incentive to countries such as China and Turkey, which need capital desperately, particularly for electricity projects. However, depending on construction time, the potential cost to the financing parties is huge. It has also been disclosed that French financing for the Daya Bay plant included 30% financing of capitalized interest -- a doubling of the OECD consensus rate.[368]

12.2. Risk

Canada's financing of AECL's sale of reactors to the Peoples' Republic of China had neither political risk insurance, nor an Enhanced CoFinancing (ECO) guarantee (essentially a guarantee of the guarantee).[369] Political risk insurance is provided by most export credit agencies, including the EDC. The Multilateral Investment Guarantee Agency (MIGA) of the World Bank, formed in 1988, is another popular source for political risk insurance. Political risk insurance typically covers areas such as currency transfer/foreign exchange; expropriation; breach of contract; and war/civil disturbance. Insurance for these contingencies would seem to be prudent in the case of any large scale loan to Turkey, which is subject to significant political unrest. The country is in a virtual state of civil war, and has experienced three military coups in the last 40 years. The Turkish military also forced a change of government in 1997. Coups or forced changes in government may result in dramatic policy swings on controversial and expensive mega-projects such as nuclear power plants. As noted above, the 1971 and 1980 military coups were an important factor in the failure of earlier Turkish attempts to build nuclear reactors. The 1997 "soft coup" and the ensuing political instability have been largely responsible for the seemingly endless delays in the selection of a vendor for Akkuyu.

12.3. Technology Transfer

As in the case of the sale of reactors to China, it is virtually certain that AECL will negotiate some degree of technology transfer in order to promote a sale. At the very least, AECL will commit to technology transfer as part of any subsequent or incremental part of the deal. Typically, there would be less technology transfer in an initial reactor sale, with a correspondingly greater benefit to the vendor. AECL has already proven itself willing to part with CANDU design information for modest fees.

South Korea and China are only countries that have bought more than one CANDU reactor, and technology transfer has been a big part of AECL's strategy to negotiate further sales.[370] With a buyers' market in effect for so long, Korea was able to negotiate increasingly greater technology transfer for the second, third and fourth reactors. Only Wolsong-1 (ordered in 1976) was a turnkey project. For example, the last two reactor sales to South Korea (ordered in 1992) created only $250 million each worth of business for Canadian-based companies, since the Koreans built roughly 75% of the reactors themselves.

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366. Hanjung is also a subcontractor in the Qinshan Phase II deal in which CNNC is building two 600 MW PWRs using technology transferred from the French reactor vendor Framatome.

367. Ann MacLachlan, "South Korea's Qinshan-II financing forces other countries to follow", *Nucleonics Week*, October 17, 1996, pp. 15-16.

368. *Ibid*..

369. Personal communication from Rhea Cohen, AECL, October 8, 1996.

370. Romania has nominally ordered 5 reactors, however, only one reactor has proceeded with financing from Canada. A second reactor at Cernavoda is about 40% complete, but is not proceeding pending negotiation of a financing agreement with Canada.

AECL is under tremendous financial and political pressure to come up with sales, and faces stiff competition for the Turkish deal. Turkey is thus in a good position to demand generous terms for a loan, and to obtain technology transfer as part of the deal. AECL and nuclear power supporters in the government and federal bureaucracy are undoubtedly prepared to make large sacrifices in order to obtain the public relations victory of another reactor sale.

Technology transfer is not only an economic concern, which lessens returns for the vending country, it is also a nuclear weapons proliferation concern. For more information on proliferation and technology transfer, please refer to the section in this report on *Nuclear Fuel Cycle Independence*, under *Nuclear Weapons Proliferation*.

12.4. Performance Guarantees and Warranties

Another question about the CANDU deal with China is whether AECL will be providing performance guarantees of any kind. In the case of the proposed BOT (build, operate, and transfer) deal with Turkey in the 1980s, AECL reportedly had to guarantee a 75% capacity factor. This would pose a significant risk for AECL, since CANDU reactors have a very poor performance record. In Canada, the 22 operable CANDU reactors ran at an average capacity factor (load factor) of 49.25% in 1999 (see Table 5). When CANDUs outside of Canada are included, the average is 55.38% (see Table 6). Even under a 100% financed turnkey deal, Turkey may be requiring a performance guarantee.

Regardless of possible performance requirements, a warranty is being required by Turkey for spare parts during a two year warranty period plus an optional 3 year warranty.[371] What part of this liability (if any) will be born by AECL's partners? In multi-billion dollar nuclear mega-projects, such considerations can involve hundreds of millions, even billions of dollars.

12.5. 100% Turnkey or BOT Financing

There have been conflicting reports about Turkey's demands for financial arrangements in the current bidding process. It is clear that Turkey is demanding 100% financing of the project, *including the local costs*. Depending on the terms of the contract, the current deal may present an even higher risk to AECL and the Canadian government than the BOT arrangement which the Canadian government turned down in the 1980s. It is not entirely clear if a BOT arrangement has been ruled out as an option. It has been reported that Asea-Brown Boveri-Combustion Engineering (ABB-CE) decided not to bid on the current Turkish project because it was

> ...not well founded and involved too much political and economic risk, in part because Turkey seeks 100% foreign financing...[372]

Despite the fact that AECL received $15.8 billion (CDN $1998) in subsidies from Canadian taxpayers from 1952 to 1998[373] , and continues to receive an annual subsidy of at least $100 million, AECL will keep the terms of its bid secret, on the grounds of commercial confidentiality. However, AECL's attempt to sell a reactor to Turkey in the 1980s reportedly foundered on the requirement of a BOT arrangement and the refusal of the Turkish government to give a sovereign guarantee of the Canadian loans.

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371. Nevzat Sahin, *ibid.*, p. 2.

372. Mark Hibbs, "NPI sees little hope, AECL edge in Turkish nuclear unit bidding", *Nucleonics Week*, May 1, 1997, p. 5.

373. David H. Martin, *Federal Nuclear Subsidies: Time to Call a Halt*, Campaign for Nuclear Phaseout, 1998.

Traditional international lending is based on the covenant of a credit-worthy corporation or nation to repay, as well as the worth and income-generating capacity of the assets acquired with the loan. However, many developing countries have a shortage of capital and are trying to develop their electricity infrastructure through various types of project financing. Project financing has either `non-recourse' to the traditional covenant (the project is the sole source of repayment) or `limited recourse' (the `sponsor' will have only partial liability for certain payments).

The BOT (Build, operate, and transfer) approach supported by Turkey[374] is a variation on a BOOT model (Build, own, operate and transfer). The Turkish BOT model reportedly originated with former Turkish Prime Minister Turgut Ozal.[375] BOT is often interpreted to mean "Build, **own**, and transfer", but the Turks have modified this formula through the creation of a joint venture entity between the private sector company and TEAS. Neither TEAS nor the Turkish government provide any financing, even for local costs. As part of the negotiations in the 1980s, Turkey required AECL to be responsible for building the plant and jointly owning and operating it for 15 years, through a "Joint Venture Utility" (JVU) owned by the vendor and TEK (now TEAS). TEK would then purchase and distribute the electricity produced. Under a BOT contract, ownership of the facility is transferred back to Turkey at no cost, at the end of an agreed period -- typically the construction period plus 15 to 20 years of operation.

The main advantage for Turkey of both the 100% financing arrangement and the BOT model is clear: Turkey obtains the asset with no upfront costs, and therefore no impact on its borrowing capacity -- it is not on the balance sheet. Moreover, Turkey is the beneficiary of significant technology transfer and training in how to use it. Both types of arrangements could require a guarantee of performance from AECL. Both types of deals ultimately depend on cash flow financing from the sale of electricity, and a serious accident or poor performance of the nuclear station would be disastrous. Good performance at a CANDU reactor is by no means guaranteed. Two reactors at the Pickering "A" nuclear station were only 12 years old when they and two older reactors had to be shut down for retubing following a major pressure tube rupture. The average capacity factor of Canadian CANDU reactors in 1999 was 49.25% (see Table 5).

Sovereign/government support from Turkey for a reactor deal is certainly not a given – the absence of such a guarantee was reportedly the reason for the Canadian government withdrawing its support for a CANDU sale to Turkey in the 1980s. If it were offered, however, sovereign support from Turkey could take several forms: guarantee of the obligations of purchaser; guarantee of the debt; or a `softer' guarantee to provide funds in the currency of payment (i.e. foreign currency, typically US dollars). Naturally, vendors would prefer a safer traditional guarantee, while purchasing countries negotiate to make softer commitments. It is not clear if Turkey is even willing to provide a `softer' guarantee, for example, to provide funds to TEAS or its distribution companies.

12.6. Public Disclosure

From the public interest point of view, transparency and disclosure are very important. If AECL's CANDU deal with Turkey is truly a straight commercial agreement as claimed, then the Government of Canada should be willing to disclose its terms. The agreement is, after all, being made by a publicly owned crown corporation, with funding and backing provided by the Government of Canada. Under the OECD Consensus Agreement, parties must notify all other participants ten days before a final decision, and provide the following information:

374. BOT usually stands for Build, own and transfer, although the Turks have characterized it as "Build, operate and transfer". See: Kibaroglu and Unlu, *ibid.*.

375. Robert McDonald, "Turkey to press Ottawa for nuclear plant backing, report says", *Toronto Star*, February 18, 1986, p. D3. See also: [Financial Times, London] "Turkey seeks joint-venture investment", *Globe & Mail*, January 7, 1987, p. B18.

a) cash payments;

b) repayment term (including starting point of credit, frequency of instalments for repaying principal amount of credit, and whether these instalments will be equal in amount);

c) currency and value rating of the contract;

d) interest rate;

e) support for local costs (including the total amount of local costs expressed as a percentage of the total of goods and services exported, the terms of repayment, and the nature of the support to be given);

f) portion of project to be financed, with separate information for initial fuel load, when appropriate;

g) any other relevant information including references to related cases.[376]

This information will be disclosed to AECL's partners and subcontractors in Canada, Turkey, Japan, South Korea, United States, and Italy as well as the governments of Japan, South Korea, United States and Italy, who will supply financing for the deal through their export credit agencies. The same information should be disclosed to the Canadian taxpayers, who (however involuntarily) are AECL's shareholders.

Furthermore, AECL should disclose: the names of all participants in its consortium; the goods and/or services being provided by all participants; and a list of the agencies/banks providing financing, along with the amounts provided, rates of interest, and other terms.

376. *OECD Consensus Agreement*,"Appendix: Prior Consultations on Terms of Export Credits for Nuclear Power Plants", p. 41.

13. Human Rights in Turkey

Turkey has a long history of gross human rights abuses, but several events in 1998 and 1999 should have improved the human rights situation -- first, the capture of PKK leader Abdullah Ocalan in February 1999, and his advocacy of ending armed struggle; and second, the acceptance of Turkey in December 1999 for membership in the European Union. However the progress has at best been limited. In some areas such as incidence of torture, the situation in 1999 actually worsened as compared to the previous two years...[377]

* Torture of prisoners continues to be widespread, and torturers in the police, Jandarma (Gendarmerie), and military continue their horrifying activities with virtual impunity.

* Deaths of prisoners by torture, extra-judicial executions, and disappearances have continued.

* Human rights advocates, writers, publishers, trade unionists, teachers, and politicians have been systematically harassed, attacked, tortured and imprisoned for the non-violent exercise of their right to freedom of expression.

* Although it became legal to speak and print Kurdish in 1991, broadcasting and education in Kurdish (used by about one fifth of the 65 million population) remain illegal.

* The Chief Public Prosecutor opened cases to ban two significant political parties, Fazilet[378] (the Islamist "Virtue Party" known by the Turkish acronym FP) and the pro-Kurdish People's Democracy Party (HADEP). Another smaller party, the Democratic Mass Party (DKP) was shut down in February 1999 by the Constitutional Court.[379]

* After being snatched from Kenya by Turkish security forces in February 1999, Abdullah Ocalan, leader of the armed opposition group Kurdistan Workers' Party (PKK) was sentenced to death in June after what has been characterized as an "unfair trail" by Amnesty.

Despite 50 years of ostensible democracy in Turkey, the security forces continue to dominate politics. The combined strength of the Turkish army, navy, air force, and Gendarmerie was 573,800 in 1996, including 410,200 conscripts (military service is compulsory) – one of the world's largest standing armies.[380] There have been three military *coups d'état* in 1960, 1971, and 1980. The forced resignation of the Erbakan government in June 1987 may be considered a 'soft coup', since the military did not take power directly, but instead installed a compliant government under the Motherland Party (Anavatan Partisi ANAP) of Mesut Yilmaz.

On May 27, 1960, the military ended the rule of the Democratic Party under Prime Minister Adnan Menderes, and executed him and two of his cabinet ministers. On March 12 1971, a second coup was aimed at parliament and a "radical movement of intellectuals, students and trade unionists".[381] Following a

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377. Amnesty International, *Annual Report 2000: Turkey*, http://www.web.amnesty.org/web/ar20...820418802568f200552979?OpenDocument, p. 2.

378. The predecessor of Fazilet was Refah (the Welfare Party, or RP), which was officially outlawed on February 22, 1998. Under Necmettin Erbakan, Refah had taken power in June 1996 as leader of a coalition government. In a "soft coup" Erbakan was forced out of government by the military in June 1997.

379. U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, *1999 Country Reports on Human Rights Practices: Turkey*, February 25, 2000, p. 33. http://www.state.gov/www/global/human_rights/1999_hrp_report/turkey.html

380. Amnesty International, *No Security Without Human Rights*, AI Briefing, 1996. This total does not include the `Village Guards' -- paramilitary forces funded by the government whose numbers are estimated at 55,000.

381. Amnesty International, *Turkey: No Security Without Human Rights*, AI, 1996, p. 126, FN 1.

period of political violence in the late 1970s, another coup took place in 1980. Martial law was declared throughout the country, and a military junta under General Kenan Evren ruled until 1983. The military relinquished direct control and a general election put ANAP in power with Turgut Ozal as Prime Minister. However, General Evren stayed as President until 1990, when he was replaced by Ozal. Since 1960, elected national governments in Turkey have had little or no control over the Interior Ministry (police), the Defence Ministry (the army), the intelligence agencies, or the regional governors. The military junta's 1982 constitution gives the security forces a great deal of power through the National Security Council (MGK). As Amnesty International has stated,

> Martial law courts have hanged a prime minister and two other ministers, tried members of parliament and imprisoned thousands of civilians, some of whom have been in jail since the 1980s. Army officers still prosecute and judge civilians in State Security Courts.[382]

In August 1984, the Kurdistan Workers' Party (Partiya Karkeren Kurdistan -- PKK) initiated armed attacks against government military installations in south-east Turkey, where most of the country's estimated 12 to 15 million Kurds live (out of a total Turkish population of about 65 million in 2000). There are about 25 million Kurds in total in Turkey, Iraq and Iran. The original goal of the PKK was the establishment of an independent Marxist Kurdish state, but that goal was reduced to a degree of autonomy for the southeast region. Turkey fell into a virtual state of civil war with the PKK, and this resulted in widespread abuses of human rights, by both the government forces and their proxies, as well as by the PKK. According to President Suleyman Demirel's 1999 year-end address, the conflict with the PKK has resulted in 36,445 deaths.[383]

Between 3,000 and 4,000 villages and hamlets in the south-eastern provinces have been forcibly evacuated and many of them burnt to the ground by security forces, often in retaliation for refusal to join the Village Guards. The Turkish government claims that they have forced out 362,915 persons, although more reliable estimates put the number at 560,000 to 800,000, and range as high as 3 million.[384] One indication of the enormity of the problem is the fact that the largest city in the area, Diyarbakir, has increased in population from 300,000 to 900,000 in the last ten years.

According to the Human Rights Foundation of Turkey, more than 400 prisoners or detainees died in custody from torture-related causes during the 14 year period between the coup of 1980 and September 12, 1994.[385] Torture continued in the late 1990's. In 1996 torture caused at least 25 deaths in custody[386] ; in 1997 torture was known to still be widespread and systematic in police stations and Gendarmeries, but new legislation on detention procedures was thought to be responsible for reducing the number of deaths in custody to at least six.[387] In 1998 there were at least 10 reported deaths in custody due to torture.[388] It

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382. Amnesty International, *ibid.*, p. 2.

383. U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, *1999 Country Reports on Human Rights Practices: Turkey*, February 25, 2000, p. 19. The Turkish government alleges that since 1984, 25,139 PKK "members", 5,882 security force members, and 5,424 civilians have been killed. http://www.state.gov/www/global/human_rights/1999_hrp_report/turkey.html

384. U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, *1999 Country Reports on Human Rights Practices: Turkey*, February 25, 2000, p. 19. See also: Amnesty International, *Annual Report 2000*, p. 1.

385. Amnesty International, *Turkey: Human rights and health professionals*, AI Index EUR 44/159/96, December 1996, p. 8.

386. Amnesty International, *AI Report 1997: Turkey*, p. 1. http://www.amnesty.org/ailib/aireport/ar97/EUR44.htm

387. Amnesty International, *AI Report 1998: Turkey*, p. 1. http://www.amnesty.org/ailib/aireport/ar98/eur44.htm

388. Amnesty International, *AI Report 1999: Turkey*, p. 1. http://www.amnesty.org/ailib/aireport/ar99/eur44.htm

has been reported that incidence of torture has increased following the arrest of Ocalan.[389] The use of brutal torture by security forces remains widespread, routine and systematic...

> Torture is regularly applied to extract confessions, to elicit information about illegal organizations, to intimidate detainees into becoming police informers or as informal punishment for presumed support of illegal organizations. Torture methods in Turkey repeatedly reported to Amnesty International include severe beatings, being stripped naked and blindfolded, hosing with pressurized ice-cold water, hanging by the arms or wrists bound behind the victim's back, electro-shock torture, beating the soles of the feet [falaka], death threats, rape and other sexual assaults.[390]

Since 1990, the human rights situation in Turkey has fluctuated. The number of extra-judicial executions by death squads associated with government security forces have been documented at more than 1,000 between 1991 and 1996.[391] In March 1995, 23 people were shot dead by plainclothes police officers at an Istanbul demonstration against death squad killings. In 1996, Amnesty reported that "scores of people were killed in the mainly Kurdish southeastern provinces in circumstances suggesting they had been extrajudicially executed by members of the security forces".[392] In 1997 at least 20 people were extrajudicially executed[393] ; in 1998 at least 15 were extrajudicially executed[394] . On September 26, 1999, ten political prisoners were killed in Ankara Closed Prison in disputed circumstances, four other possible extrajudicial executions took place, and at least 29 killings were attributed to armed opposition groups.[395]

To this horrific record has been added the terror of disappearances. In 1991 and 1992, there were only a few reports, but in 1993, there were at least 26, in 1994, more than 50, and in 1995, at least 35.[396] In 1996, Amnesty reported 23 disappearances in security force custody; in 1997 at least nine; and in 1998 at least five.[397] Disappearance, without the closure of confirmed death or cause of death is a way of torturing the whole family of the victim.

In May 1995, mothers and other relatives of persons who have disappeared in police custody since 1991 began a weekly Saturday vigil in Galatasaray Square in Istanbul.[398] Their peaceful and moving vigil has attracted international attention and is credited with being responsible for a reduction of disappearances, which peaked in 1994.[399] Since May 1998, the Saturday Mothers have been the victims of heavy repression by the police. On May 9,1998 (the eve of Mothers' Day) police detained 12 people including several elderly mothers. On August 22, 1998, police buses occupied the Mothers' customary sit-in space and

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389. Amnesty International, *Annual Report 2000: Turkey*, p. 1. http://www.web.amnesty.org/web/ar20...820418802568f200552979?OpenDocument

390. Amnesty International, *Turkey, Torture: A Major Concern in 1999*, EUR44/18/00, March 2000, p. 1. http://www.amnesty.org/ailib/aipub/2000/EUR/44401800.htm

391. Amnesty International, *Turkey: Student killed in extra-judicial execution*, AI Index: EUR 44/183.96, December 1996.

392. Amnesty International, *AI Report 1997: Turkey*, p. 1. http://www.amnesty.org/ailib/aireport/ar97/EUR44.htm

393. Amnesty International, *AI Report 1998: Turkey*, p. 1. http://www.amnesty.org/ailib/aireport/ar98/eur44.htm

394. Amnesty International, *AI Report 1999: Turkey*, p. 1. http://www.amnesty.org/ailib/aireport/ar99/eur44.htm

395. Amnesty International, *Annual Report 2000: Turkey*, pp. 3-4. http://www.web.amnesty.org/web/ar20...820418802568f200552979?OpenDocument

396. Amnesty International, *Turkey: No Security Without Human Rights*, AI, 1996, p. 45.

397. See AI annual reports, 1997 to 1999.

398. Amnesty International, "Listen to the Saturday Mothers", AI Report: EUR 44/17/98, November 1998.

399. Amnesty International, "Turkey: The Duty to Supervise, Investigate and Prosecute", AI Report: EUR 44/24/99, April 1999, p. 20.

harassed the participants as they attempted to hold their vigil nearby. On August 29, 1998, uniformed and plainclothes policemen surrounded the participants and order them to disperse. Police held about 100 people for three days, and another 58 were held for four days. Several elderly mothers fainted and one was taken to hospital. Police also beat and detained members of the Human Rights Association who were present.[400] On September 26, 1998, 31 detainees were placed in a bus, which was filled with pepper spray. When the victims tried to open windows for air, they were beaten.[401] The United Nations Declaration on the Protection of All Persons from Enforced Disappearance recommends that "authorities carry out prompt, thorough and impartial investigations into every report of disappearance".[402] The Turkish government has failed to adhere to this UN declaration. Instead, Turkey established the "Bureau for the Investigation of Disappearances" in December 1996, which has been denounced as a public relations tool to deflect public criticism and discredit the families of the disappeared.[403]

Free speech is also an ongoing human rights issue in Turkey. In 1983, during the direct rule of the military junta, Law 2932 made the use of the Kurdish language (used by about one fifth of Turkey's population) effectively illegal. After the end of military rule in 1984, most prisoners of conscience were prosecuted under the infamous Articles 141, 142, and 163 of the Turkish Penal Code, which specified long prison terms for advocating communism, Kurdish separatism, and religion-based government. By 1990, after six years of nominal democracy, however, pressure for basic democratic norms had increased. In April 1991, Articles 141, 142 and 163, as well as Law 2932 were repealed. Kurdish newspapers and books were allowed, although education and broadcasting in Kurdish remained illegal.

Unfortunately, at the same time as these reforms, the Anti-Terror Law (Law 3713) was enacted. Under Article 8 of the Anti-Terror Law, any expression of separatism, whether peaceful or violent, was made punishable by long prison terms and heavy fines. In 1993, as fighting in the southeast intensified, the prime minister and the military called for "total war" against separatism. Prosecutions and detentions increased, not just of political activists, but of lawyers, doctors, trade unionists, journalists, academics and publishers. At the same time, incidence of torture, death in detention, death squad killings, disappearances, and deaths in armed conflicts between the security forces and the PKK all increased. When martial law ended in 1987, a state of emergency was declared in the ten provinces of the southeast where fighting was most intense. In 1999, a state of emergency remained in effect in five provinces (Diyarbakir, Hakkari, Sirnak, Tunceli, and Van) and a sixth was lifted only in December. The state of emergency gives the regional governor wide power over the security forces, police and civil administration in the area. The regional governor may "Censor news, ban strikes or lockouts, and impose internal exile". Under the emergency decree, sentences for those convicted of "cooperating with separatists" can be doubled, and judicial review of the emergency governor's decisions is limited.[404]

Reform of Turkey's 30 day detention period was a major campaign of human rights organizations, in order to reduce the incidence of torture and murder of those in custody of the security forces -- particularly those being held for offenses within the jurisdiction of the State Security Courts (i.e. those courts operated by the military). On March 6, 1997, a legal amendment was announced by the Turkish government which shortens the maximum 30 day detention period to ten days in the nine provinces under a state of emergency, and from 14 to seven days in the rest of the country. However, the law still allows prisoners to be held four

400. Amnesty International, "Saturday Mothers' vigil under threat", AI News Release: EUR 44/41/98, September 4, 1998.

401. Amnesty International, "Turkey: The Duty to Supervise, Investigate and Prosecute", AI Report: EUR 44/24/99, April 1999, p. 20.

402. *Ibid.*.

403. *Ibid.*.

404. U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, *1999 Country Reports on Human Rights Practices: Turkey*, February 25, 2000, p. 20.

days incommunicado, without access to a lawyer. Former Deputy Prime Minister and Foreign Minister Tansu Ciller claimed at the time of the law amendment in 1997 that "from now on, Turkish norms conform with European norms on detention periods".[405] However, neither European or international human rights law allow four days' incommunicado detention without access to a lawyer. The UN Special Rapporteur on torture has stated categorically that incommunicado detention should end, and has recommended that anyone arrested "should be given access to legal counsel no later than 24 hours after the arrest". The European Court of Human Rights (recognized by Turkey) has acknowledged that the failure to grant access to counsel during the first 48 hours after arrest is a violation of Article 6 of the European Convention.[406]

405. Amnesty International, "Turkey: Unacceptable law on detention procedures unlikely to prevent torture", AI Index: EUR 44/18/97.

406. Amnesty International, *Turkey, Torture: A Major Concern in 1999*, EUR44/18/00, March 2000, p. 5. http://www.amnesty.org/ailib/aipub/2000/EUR/44401800.htm

14. The Political Situation in Turkey

14.1. Corruption

The Kurdish conflict is intertwined with corruption in Turkey, as state funding in the 1990s flowed to right-wing militias in eastern Turkey opposing the PKK, and the government has ignored the involvement of militia chiefs in international drug smuggling. The issue received high public profile when an automobile accident in Turkey on November 3, 1996 (known after the town where it occurred as the "Susurluk" incident), resulted in the death of Husseyin Kocadag, former deputy police chief of Istanbul; an internationally wanted criminal, Abdullah Catli; and the injury of Sedat Bucak, a militia chief and member of parliament for Tansu Ciller's conservative True Path Party. The car also contained unlicensed machine guns, silencers, police identification cards, forged passports and traces of cocaine. Catli was wanted by Interpol for 18 years, for the 1978 torture and murder of seven left-wing Turkish students; for involvement in the 1981 assassination attempt on the Pope; and for his 1990 escape from a Swiss jail while serving time on heroin charges. Tansu Ciller, then Turkish Foreign Minister shocked the Turkish public with her tribute to Catli... "Those who shoot, as well as those who are shot, for the sake of a nation, a people, a state, are always remembered with honour."[407] Bucak, the politician who survived the accident, reportedly received over $1 million per month from the government to run his personal section of the Kurdish militia known as the Village Guards, which has opposed the PKK since 1985.[408] The Village Guard system was created by the government in the mid-1980s as a paramilitary force, and it now numbers about 55,000.[409] Originally intended to 'defend' villages from the PKK, the Guards have been used in operations against other villages, in roadblocks, in interrogations, and even for incursions into Iraq.

Reports of various abuses of power in the security forces, ties with organized crime, and corruption have continued, and trials related to these charges began in 1998 involving former Interior Minister Mehmet Agar and Sedat Bucak. However, these trials were stopped in April 1999, when both men were re-elected to parliament an re-gained legal immunity (their immunity had been lifted by the previous parliament).[410]

Prior to being implicated by association with Sedat Bucak in the Susurluk incident, Tansu Ciller had become Turkey's first female Prime Minister in 1993, before entering into a coalition with rival Motherland Party (ANAP) of Mesut Yilmaz. Ciller was accused of massive corruption and amassing great wealth and property while in power. Ciller, who was staunchly secularist and western-educated, shocked the Turkish public by entering into another coalition that brought the Islamist Refah Party of Necmettin Erbakan to power in 1996. Before that government was forced out of power by the military in June 1997, it voted down the corruption charges against Ciller. Ciller denied wrongdoing, although her husband was convicted of fraud in 1998 for presenting false information in a corruption investigation.[411] There is little doubt, however, that Ciller and her True Path Party have been found guilty in the court of public opinion, since they have subsequently been relegated to the role of a minor opposition party.[412]

In a political feeding frenzy, Ciller also subsequently accused former Prime Minister Mesut Yilmaz of

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407. Amnesty International, *Turkey: The Duty to Supervise, Investigate and Prosecute*, AI Report: EUR 44/24/99, April 1999, p. 9.

408. Jonathan Ewing, "Turkish media demanding answers in scandal", *Globe & Mail*, December 18, 1996, p. A18. See also: Gwynne Dyer, "Corruption and Turkey's coming coup", *Toronto Star*, May 7, 1997, p. A25.

409. Amnesty International, *Turkey: No Security Without Human Rights*, AI, 1996, p. 55.

410. U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, *1999 Country Reports on Human Rights Practices: Turkey*, February 25, 2000, p. 34.

411. Reuters, "Ex-Turkish PM's husband guilty of fraud", *Toronto Star*, May 7, 1998, p. A17.

412. After the April 18, 1999 election, the DYP received 12.01% of the vote. Under Turkey's system of proportional representation, this resulted in 85 seats in the 550 member parliament.

corruption. Yilmaz, and his Motherland Party (ANAP) were put in power by the military in June 1997.

14.2. The Soft Coup

An inconclusive election on December 24, 1995 left the Islamic Welfare Party (Refah -- headed by Necmettin Erbakan) with 21% of the vote (158 seats in the 550 member parliament); the Motherland Party (ANAP) a close second with 19.65% (headed by Mesut Yilmaz); and the True Path Party (DYP, headed by Tansu Ciller) with 19%.[413] Following the election, a coalition headed by Yilmaz took power briefly at the head of a shaky minority government. However, in June 1996 that coalition collapsed, and a new coalition, headed by Refah, under Prime Minister Necmettin Erbakan took power. In return for the support of True Path, Tansu Ciller was to alternate on a yearly basis with Erbakan as Prime Minister, and her party held influential positions in control of foreign affairs, and defence and interior -- giving DYP control of the security forces. It was the first Islamic government to ever take power in Turkey, since the foundation of the modern secular Turkish state by Kemal Ataturk in 1923. The unprecedented election of an Islamic government in the traditionally secular Turkey sent shock waves through the military leadership in Turkey and through western countries. Turkey (a NATO member) has supported the western alliance by competing for influence with Iran in the newly independent Turkic states of Asia and the Caucasus. The Turkish military -- conservative but strongly secular in outlook -- had effectively banned Erbakan from politics from 1980 to 1987.

After taking power, several moves by Erbakan made western powers (and presumably the Turkish military) nervous. He made a trip to Libya to meet with Moammar Ghaddafi, as well as to Iran, where in August 1996, a $23 billion gas deal was signed; he urged the construction of several new mosques in the heart of Istanbul; he proposed the repeal of laws forbidding the use of veils and scarves by women in the civil service; and he encouraged the establishment of religious schools, and the admission of their graduates into the military.[414] Greek/Turkish relations also worsened as a result of Erbakan's threatened use of force in response to Cyprus' intention to buy Russian anti-aircraft missiles.[415]

In March 1997, rumours of an impending military coup began to circulate.[416] The rumours followed an ultimatum in February from the National Security Council, through which the military has constitutional power over the Turkish government. The Council made the following demands: a ban on the hiring of Islamic activists; closure of Koranic schools; maintenance of a ban on Islamic clothing for women in the civil service; and a halt to funding of Turkish parties by foreign Islamic groups.[417] Following a National Security Council meeting on April 26th, Prime Minister Erbakan agreed to the military's demands.[418]

The crisis was further heightened when, on May 11, 1997, 300,000 people attended an Islamic rally in Istanbul in support of the Refah government. However, despite Refah's Islamic bias, a defence training pact with Israel was signed in the first week of May, along with an agreement for the upgrading of Turkish jets by Israeli technicians. The agreement made other Muslim states since (unlike European or American aid) Israeli military aid cannot be blocked by concerns about human rights violations in Turkey.[419]

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413. Doug Struck, "Islam flexing its muscles in Turkey", *Toronto Star*, January 11, 1996, p. A17.

414. Stephen Kinzer (NY Times), "Secular Turks wary of government", *Globe & Mail*, February 14, 1997, p. A14.

415. Nicholas Doughty, Reuters, "US, Europe fret about Turkey", *Globe & Mail*, January 10, 1997, p. A10.

416. Stephen Handelman, "NATO member struggles to stay democratic", *Toronto Star*, March 2, 1997, p. F6.

417. Editorial, "Turkey's `soft' coup", *Globe & Mail*, March 6, 1997, p. A20.

418. AP, "Erbakan irks party by bowing to military" *Globe & Mail*, April 28, 1997, p. A15.

419. Jonathan Lyons (Reuters), "Turkish generals continue to flex muscles", *Globe & Mail*, May 12, 1997, p. A14.

In an attempt to stay in power, Prime Minster Erbakan agreed in early June to make his coalition partner Tansu Ciller the Prime Minister, and suggested that an early election would be called. However, President Suleyman Demirel, supporting the military's position, refused to allow the manoeuvre.[420] The position of the USA was ambivalent... the Americans did not like an Islamic government in power, but also dreaded the public relations problem of a military coup, and reportedly advised the Turkish generals that a military regime might not be tolerated in NATO.[421] US Secretary of State Madeleine Albright called on Turkey to remain both democratic and secular.[422]

Thus, on June 18, 1997, Erbakan resigned, and Demirel subsequently named Mesut Yilmaz, leader of the conservative Motherland Party, Prime Minister.[423] Yilmaz became a parliamentary deputy for the Motherland Party in 1983 under the leadership of Turgut Ozal, following the re-establishment of democracy. He took over the leadership of Motherland after Ozal's death in 1993.

In an attempt to convince the military that they should not ban himself and his party, in November 1997, Erbakan expelled several of the more radical Islamic deputies in the Welfare Party.[424] However, in January 1998, Turkey's constitutional court outlawed the Welfare Party for sedition, and banned Erbakan from politics, despite the fact that the party continued to have the largest support in parliament.[425] In May 1998, the Welfare Party (Refah) re-formed itself into the Virtue (Fazilet) Party, with Recai Kutan as its head of a deliberately more moderate party.[426] The more logical choice for leadership would have been Recep Tayyip Erdogan, the Mayor of Istanbul, but in April, Erdogan had been tried under Article 312 of the Turkish Penal Code for a speech delivered in December 1997. Article 312 of the Anti-Terror Law deals with "incitement to hatred", and has been widely used against both Kurds and Islamists. Erdogan was found guilty and sentenced to ten months imprisonment, and was imprisoned from March 26 to July 25, 1999.[427]

Although Yilmaz wanted to stay on in his un-elected position until the end of 2000, pressure from a coalition partner forced an earlier election that was set in July 1988 for April 18, 1999.[428]

Corruption scandals continued to spread at the highest levels. On November 10, 1998, a once obscure developer and minor media mogul Korkmaz Yigit (pronounced Yee-eet) went on national television on two of his own stations to accuse Prime Minister Yilmaz and the Finance Minister Gunes Taner of corruption by offering him money and political support if he bought a $600 million (US) state-owned bank. Yigit is widely known to be associated with organized crime, and the allegations resulted in 15% plunge in the Turkish stock market.[429] The $600 million (US) sell-off of a majority stake in Turk Ticaret Bankasi (Turkbank) was part of the privatization of the massive state holdings in Turkey that are a legacy of its quasi-socialist (or state capitalist) past. The government had targeted the sell-off of $4.5 billion in assets in 1998, and at the time had

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420. AP, "Turkish PM cedes power to deputy, will call early vote", *Toronto Star*, June 3, 1997, p. A12.

421. Stephen Kinzer (New York Times), "Turkish army rattling sabres under Prime Minister's nose", *Globe & Mail*, June 13, 1997, p. A13.

422. AP & Reuters, "Turkish PM agrees to hand over power", *Globe & Mail*, June 14, 1997, p. A18.

423. AP, "Turkish president picks pro-western PM", *Globe & Mail*, June 21, 1997, p. A2.

424. Reuters, "Turkish Islamist disavows radicals", *Globe & Mail*, November 20, 1997, p. A23.

425. Alastair Bell, "Turkish government plays for time in polls race", *Reuters*, April 3, 1998.

426. AP, "Turkish party picks moderate as leader", *Globe & Mail*, May 16, 1998, p. A14.

427. Amnesty International, *Annual Report 2000: Turkey*, p. 3. Erdogan quoted four lines on Islam from a poem by Ziya Gokalp, which did not advocate violence, and which appear in a book recommended by the Ministry of Education. http://www.web.amnesty.org/web/ar20...820418802568f200552979?OpenDocument

428. Reuters, "Election call a blow to Turkey's government", *Toronto Star*, July 31, 1998, p. A16.

429. Hugh Pope (Wall Street Journal, Istanbul), "Turkish market in freefall: 15% plunge is linked to murky dealings", *Globe & Mail*, November 12, 1998, p. B11.

sold $4.6 billion of state assets since 1986, when it initiated its privatization program.[430]

As the Turkbank scandal grew, the Yilmaz government collapsed after a censure motion on the corruption charges.[431] In a separate motion Finance Minister Gunes Taner had been voted out of office. In the wake of the government's collapse, the Turkbank privatization was put on hold, as was the general privatization program. It was not until January 11, 1999, that President Suleyman Demirel declared another unelected "government" coalition, led by veteran politician Bulent Ecevit of the Democratic Left Party (Demokratik Sol Parti, DSP). Ecevit's so-called "caretaker government" was the sixth in three years.

The period prior to the April 18, 1999 election was very unstable in Turkey, with a revolt in parliament among deputies that had not been chosen for re-election by their parties and several bombings attributed to the PKK, and other armed leftists groups. A nationalist attitude had been encouraged by the bellicose attitude of the government in ordering Syria to expel Abdullah Ocalan and threatening Cyprus over its proposed deployment of surface to air missiles (Syria did expel Ocalan and Cyprus did back down). Most significant however, was the capture of Ocalan in Kenya in January by Turkish security forces, which unleashed the pent-up nationalistic chauvinism generated by 15 years of bitter civil war with the Kurdish population. Moreover, there was a strong sense that Turkey had been betrayed by the west for the rejection of Turkey's bid to become part of the European Union. Together with the situation in Kosovo, these events sparked a surge in Turkish nationalism that would determine the outcome of the election. Defence of the Islamic Kosovars against the Serbs was a very emotional issue in Turkey, where Ottoman rule in the Balkans is not forgotten, and millions of Turks have Balkan ancestry.[432]

It was not surprising that the election saw a dramatic fall in support for the corruption-tainted parties of both Mesut Yilmaz (ANAP) and Tansu Ciller (DYP), who were relegated to fourth and fifth spots respectively. Ecevit and the DSP benefited greatly just from being in charge during this volatile period. Although nominally a social democratic party, the DSP is noted for its secular nationalism.[433] The DSP came first in the election with 22.19% of the vote and 136 seats of the 550 seat parliament.

The truly surprising outcome of the election however, was the extremely strong showing by the National Movement Party led by Devlet Bahceli (Milliyetci Hareket Partisi, MHP), which put them in second place with 17.98% of the vote and 129 seats. The MHP is an ultra-rightist and nationalist party still strongly associated with its youth group known as the Gray Wolves, infamous for their street fighting and brutal attacks on its political opponents. The MHP is also noted for its strong support of initiating a nuclear power program, and various representatives have supported the development of nuclear weapons. Ecevit subsequently formed a coalition government with MHP and ANAP. Under Mesut Yilmaz' leadership, ANAP had come in fourth in the election with 13.22% of the vote and 86 deputies.[434]

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430. Hatice Aydogdu, "Turkish privatisation on hold until polls", Reuters, November 30, 1998.

431. Reuters, "Turkey's PM quits over graft claims: Government's fall sparks fears for stability, ailing economy", *Toronto Star*, November 26, 1998, p. A26.

432. An election slogan of the ultra-right National Movement Party (MHP) was "Stand by Kosovo! We are coming!". Turkish troops did participate in the NATO intervention in Kosovo. See: AP, "Scandal-weary Turks back Ecevit's party", *Toronto Star*, April 19, 1999, p. A9.

433. Ecevit was the prime minister in 1974 who ordered Turkish troops to invade Cyprus.

434. For election results, see: "Official tally out, Parliament to convene Sunday", *Turkish Daily News*, April 28, 1999, p. A1.

14.3. Relations with the European Union

Turkey became a full member of NATO in 1960, became a partner in the European Economic Community (EEC) December 1964, and applied for full membership in the European Union (EU) in April 1987.[435] However, it was not until January 1996 that a customs union between Turkey and the EU went into effect, under which both sides dropped most tariffs and trade restrictions. Despite an intense lobbying campaign in 1996-97, Turkey was not granted EU membership. A March 4, 1997 meeting in Brussels of the Christian Democratic parties of Europe was unanimous in opposing Turkish membership.[436] Human rights violations in Turkey have been a major stumbling block to EU membership, although Turkish heroin connections, and economic questions have also been raised.[437] Former German foreign minister Klaus Kinkel stated that Turkey was rejected because of "human rights, the Kurdish question, relations with Greece, and of course, very clear economic questions".[438] In April 1997, Greece announced that it would continue to block $424 million (US) worth of EU aid to Turkey because of its human rights record.[439]

At the summit of the European Union in Luxembourg in December 1997, Turkey was excluded from candidacy. Prime Minister Mesut Yilmaz accused the 15 member EU of being discriminatory and favouring its rival Greece, and threatened to sever relation with the EU . Yilmaz made thinly veiled threats towards Cyprus, stating that the EU would be "Responsible for any negative developments on the island".[440] He also squarely blamed Germany and Greece... "It was only German and Greek opposition that stopped us."[441]

Turkey was also not included as a candidate for EU enlargement at the June 1998 EU summit at Cardiff, which confirmed the strategy from the Luxembourg summit. However, in the following year, Turkish relations with both Germany and Greece were to change dramatically. In Germany, the September 1998 election of the Social Democratic government of Gerhard Schroeder set the stage for improved relations with Turkey. Following the Izmit earthquake on August 17, 1999, a thaw in relations with Greece had occurred as a result of 'earthquake diplomacy'. Turkey continued to play a game of brinkmanship. In his speech to the EU General Affairs Council in September 1999, Foreign Affairs Minister Ismail Cem said that the EU summit in Helsinki in December would be the last chance to end "discrimination" against Turkey and keep it in Europe.[442]

At the Helsinki summit on December 10, 1999, Turkey was acknowledged as the 13th candidate for EU membership. However, the conditions for Turkey's membership and the timeline for its accession remain vague and controversial. It is clear that generally speaking, the terms and conditions will revolve around the following: human rights improvements; democratic improvements; reform of laws and regulations; economic reforms; resolution of territorial disputes with Greece in the Aegean; and resolution of the conflict in Cyprus. Although made a candidate for membership in December 1999, Turkey will not be allowed to join the other 12 candidates in accession negotiations until it has made progress on democratic reforms.[443] Addressing

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435. Selcuk Gultasli, "Turks' Adventure with the EU", *Turkish Probe*, December 19, 1999.

436. Gwynne Dyer, "Turks have enough troubles without Helmut Kohl", *Toronto Star*, March 12, 1997, p. A23.

437. Stephen Kinzer (New York Times), "Turkey's ages-old identity crisis deepens", *Globe & Mail*, February 25, 1997, p. A10.

438. "Turks told not to expect early EU membership", *Globe & Mail*, March 27, 1997, p. A14.

439. Reuters, "Turkish generals boost pressure on PM", *Globe & Mail*, April 30, 1997, p. A14.

440. Washington Post, "Turkey vows to cut ties after EU rejection", *Toronto Star*, December 15, 1997, p. A7.

441. Alan Freeman, "Turkish government incensed after rejection by EU", *Globe & Mail*, December 19, 1997, p. A24.

442. Selcuk Gultasli, "Turks' Adventure with the EU", *Turkish Probe*, December 19, 1999.

443. The other 12 countries are Poland, Hungary, the Czech Republic, Estonia, Slovenia, Cyprus, Latvia, Lithuania, Bulgaria, Romania, Slovakia, and Malta.

a conference in Istanbul in March 2000, EU enlargement Commissioner Guenter Verheugen stated,

> Fundamental political change [in Turkey] is needed. Regarding political reforms we expect a firm commitment to continue the process which was successfully launched, and to proceed on issues like the revised penal code, the new civil code, and enhanced independence of the judiciary.[444]

14.4. Economic Instability

Beginning in the 1930s, the Turkish state took an active role in economic development with five year plans in various sectors, and state banks provided capital at near-zero interest rates. There was no attempt to actively discourage private enterprise, and the private sector accounted for roughly half of economic activity even at the height of state-owned industry in the 1960s and 1970s.[445] The heavy emphasis on state enterprise changed little until the early 1980s.

During the 1970s there was growing economic instability coupled with political instability. A fiscal crisis was characterized by large public sector wage increases, high agricultural subsidies, and the refusal of the government to pass on the cost of the oil price shock in 1974. By 1977, Turkey was not paying off its commercial debt, the inflow of capital ceased, and inflation began to increase. This situation was aggravated by another oil price shock in 1979-80. There had been five elections and five coalition governments during the decade. The economic crisis and some accompanying political unrest provided an excuse for the military to stage a coup in 1980. The military would remain in direct control until November 1983. The military implemented fiscal restraint and a tighter monetary policy and freed the price of foreign exchange and interest rates, as well as commodities such as petroleum, electricity, natural gas, paper, cooking oil, steel, textiles and cement. The government retained price controls on tea and tobacco (government monopolies) and other basic commodities such as bread, sugar, fertilizer, the state railways, maritime transport, and electricity for iron steel and aluminum manufacturing. Significantly, the military did not try to change the high level of state-owned monopolies in the economy, although levels of subsidy varied in the following years.[446]

There have been at least five programs of fiscal restraint designed to get Turkey's high inflation and volatile economy under control in the 1990s. They have all been relative failures, with inflation averaging more than 80% annually over the last ten years. Inflation ranged from 30 to 50% in the period 1983-87, and rose to 60-70% in the period 1988-91. By 1994, inflation (based on the Consumer Price Index) had gone up to 125%; 79% in 1995; 80% in 1996; 99% in 1997; and an estimated 70% in 1998.[447] Change in the real Gross National Product fell from 8.2% to an estimated 3.8% in 1998, and there was actually negative growth of -2.1% in 1999.[448] This was caused by a combination of more conservative fiscal and monetary policies, as well as the impacts of the Russian economic crisis that reduced Turkish exports to Russia as well as the central Asian countries. There was also reduced tourist income due to concerns about security and earthquakes.

In 1998, the International Monetary Fund initiated a three-year program that consisted of fiscal restraint

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444. Reuters, "EU seeks guarantees from Turkey on reform", March 9, 2000.

445. Richard Barth and William Hemphill, *Financial Programming and Policy: The Case of Turkey,* International Monetary Fund, March 14, 2000, p. 1.

446. Richard Barth and William Hemphill, *Financial Programming and Policy: The Case of Turkey,* International Monetary Fund, March 14, 2000, pp. 3-6.

447. International Monetary Fund, "IMF Concludes Article IV Consultation with Turkey", *Public Information Notice*, No. 00/1, January 3, 2000.

448. IMF, *ibid.*, January 3, 2000.

(reduced government spending), tighter monetary policy (printing less money), limiting wage increases in the huge public sector, increased privatization, and "structural reforms" (such as reducing social security costs and agricultural subsidies, and commercializing and eventually privatizing state banks). The goal was to reduce inflation from 91% at year-end 1997 to 50% at year-end 1998, 20% by year-end 1999, and under 10% by year-end 2000.[449] One year later the target of 10% inflation had been moved back a year until year-end 2001.[450] The IMF blamed the failure of its 1998 disinflation program on the Russian economic crisis, a loss of investor confidence in emerging markets, and "severe slippages in fiscal and incomes policy implementation and political uncertainty".[451]

Table 15. Gross National Product & Consumer Price Index in Turkey

	1994	1995	1996	1997	1998*	1999**	Average
GNP	-- 6.1	8	7.2	8.2	3.8	-- 2.1	3.17
CPI***	125.5	78.9	79.8	99.1	69.7	65.4	86.4

* Estimate
** Projection
*** End of period

Source: International Monetary Fund, *Article IV Reports*

Following the April 1999 election, the coalition government headed by Bulent Ecevit negotiated yet another disinflation/bail-out deal with the IMF and World Bank. On December 22, 1999, the IMF approved a $4 billion (US) Stand-By three-year (2000-2002) bail-out package for Turkey.[452] The deal had earlier been for $3.5 billion, but was increased by $500 million for emergency purposes in the wake of the Izmit earthquake. The first instalment of $300 million (US) was available immediately. Ironically, for a program that involves major privatizations, the IMF decision came only hours after the Turkish Central Bank seized the shares and management of five private banks to enforce compliance with the scheme.[453] The inflation targets in the program are similar to the 1998 projections: 25% by year-end 2000, 10-12% by year-end 2001, and 5-7 % by year-end 2002.[454] Similar to earlier efforts, this program is based on fiscal restraint, a tight monetary policy, wage restraint, and a commitment to a firm exchange rate. Finally there is also the so-called 'structural' reform to social programs and state owned enterprises, including a massive privatization program to finance state expenses and debt reduction. Turkey's foreign debt was $101 billion (US) as at March 31, 1999.[455] Turkey's foreign debt was at $101 billion (US) as at March 31, 1999. The privatization program

449. International Monetary Fund, "IMF Concludes Article IV Consultation with Turkey", *Public Information Notice*, No. 98/59, August 13, 1998.

450. International Monetary Fund, "Turkey: IMF Mission for the 1999 Article IV Consultation Discussions and Third Review of the Staff Monitored Program / Concluding Statement", July 2, 1999.

451. International Monetary Fund, *ibid.,* July 2, 1999.

452. International Monetary Fund, "IMF Approves US $4 Billion Stand-By Credit for Turkey", *Press Release,* No. 99/66, December 22, 1999. http://www.imf.org/external/np/sec/pr/1999/PR9966.htm

453. "IMF endorses $4 billion standby deal with Turkey", *Turkish Daily News*, December 24, 1999.

454. Letter of Intent from Mr. Recep Onal, Minister of State for Economic Affairs, Government of Turkey, to Mr. Michel Camdessus, Managing Director of the IMF, December 9, 1999, p. 2. http://www.imf.org/external/np/loi/1999/120999.htm

455. Department of Energy, Energy Information Administration, *Turkey*, "Economic Overview", August 1999. http://www.eia.doe.gov/emeu/cabs/turkey.html

is expected to generate $7.6 billion (US) in 2000, $6 billion (US) in 2001, and $4 billion (US) in 2002.[456] This is a huge privatization objective of almost $18 billion over three years. By comparison Turkey privatized a total of $6 billion (US) over the entire decade of the 1990s.[457]

While the IMF restraint program was greeted with a rally on the Istanbul Stock Exchange (IMKB)[458] , it is clear that the program will have significant costs and risks. The hardest hit by the programs will likely be the many workers in Turkey's vast state-owned enterprises that are being privatized, where there will undoubtedly be mass firings. The May Day 2000 rallies in Turkey protested the IMF program, with the theme, "IMF: This nation is not for sale".[459] The program will affect vulnerable groups in Turkish society, not only the workers in state-owned enterprises through privatization, but also through the reduction of agricultural subsidies, the reduction of pensions, and other possible price increases resulting from deregulation. For competition and privatization in the electricity sector to succeed, electricity prices will have to increase. This could result in more political instability. Although most commentators refer to Bulent Ecevit's coalition as relatively strong, it is still a minority government that spans a wide political spectrum -- from his own social democratic party, to the centre-right ANAP, to the ultra-right MHP.

Over the last 30 years, few governments have held to a consistent policy of fiscal restraint given the enormous political pressure. This has led to a recurring cycle of economic and political instability, of which high inflation is only a symptom. Given past experience it is questionable whether the current IMF program will be any more successful than its predecessors. The IMF restraint program will also pose serious problems for Turkey's fragile, military-dominated democracy. While the IMF in theory supports democratic institutions, in reality it subverts democracy by imposing its policies on client states. Those policies often have traumatic social consequences, in the form of job loss, reduced real income, and weakening of social programs. Certainly that will be the case in Turkey, where real income has already been reduced by the failure of wage increases to keep up with decades of high inflation. So the IMF program is likely to result in even greater intervention by the military if social unrest threatens the fragile political consensus already weakened by chronic economic problems as well the conflict with the Kurds.

456. Letter of Intent from Mr. Recep Onal, Minister of State for Economic Affairs, Government of Turkey, to Mr. Michel Camdessus, Managing Director of the IMF, December 9, 1999, p. 10. http://www.imf.org/external/np/loi/1999/120999.htm

457. World Bank, *Economic Reform Loan: Republic of Turkey*, Project ID TRPE68792, February 15, 2000, p. 3. http://www.worldbank.org/pics/pid/tr68792.txt

458. Yalcin Simsek, "Reactions to stability program -- from support to fear", *Turkish Daily News*, January 8, 2000.

459. "Turks protest IMF privatisation at May Day rally", *Reuters*, May 1, 2000.

15. Conclusion

There are numerous reasons why Turkey should not buy a nuclear power plant, and the nuclear vendor countries should not allow such a sale to take place. First and foremost, it is an investment on the wrong side of history, since nuclear power is a sunset industry that is now entering a period of sustained and permanent decline. Nuclear power plants were originally designed and built with state subsidies, and sustained with artificially high electricity prices of electricity sector monopolies. Those monopolies are now being dismantled around the world, and nuclear power simply cannot compete in a fair market with cheaper, cleaner and safer energy alternatives. Many existing nuclear plants are only surviving in the restructured markets because of stranded debt allocations (in effect more subsidies) that allow them to operate without the burden of their accumulated debt and long-term future liabilities for decommissioning and radioactive waste management.

Safety is an issue that just won't go away, when the memory of Three Mile Island and Chernobyl are deservedly etched on our collective global consciousness. The probability of a catastrophic accident is small, but the economic, environmental, and human health consequences would be enormous. The myth of 'clean' nuclear power has been shattered along with the myth of nuclear generated electricity being 'too cheap to meter'. Both routine and accidental radioactive pollution from nuclear plants carry the risk of cancer and birth defects. Long-term management of high-level radioactive waste is a problem that no country on earth has yet solved, and the decommissioning of commercial nuclear plants is in its infancy.

CANDU performance is unquestionably the worst amongst its main competitors, the Pressurized Water Reactors (PWRs) and Boiling Water Reactors (BWRs). In 1999, average CANDU capacity factor (the same as load factor) was 59% compared to 80% for PWRs. This is a sad commentary of the quality of CANDU reactors, but it is not an argument for the purchase of PWRs. Rather it should be taken as a warning that what looks good today, may not be good tomorrow. Nuclear power has been called an "unforgiving technology" because even small human errors or technical problems can lead to very serious accidents. Nuclear reactors are also very unforgiving economically. Because of its very high capital cost, poor nuclear performance has even more serious implications in terms of reduced revenue generation.

This report has documented five historic attempts by Turkey to initiate a nuclear power program. The previous four attempts have failed for a variety of reasons. These certainly include political instability (for example, the first and second attempts from the 1960s and 1970s were interrupted by military coups). Political instability in the third attempt in the 1980s was also a factor, but the deal ultimately collapsed because of Turkey's decision in 1985 to withdraw its sovereign guarantee of loans, and to restructure it from a turnkey project to a BOT (Build-Operate-Transfer) project. The attempts to restructure the deal reflect the difficulty of financing expensive nuclear mega-projects. The failure was thus indirectly due to the high cost of nuclear power.

The failure of the fourth attempt to build the Argentinean-designed CAREM and Argos reactors, was almost certainly due to another cause: international pressure because of concern about nuclear weapons proliferation. The CAREM reactor was clearly not a practical or viable means of generating electricity, but it would have been an efficient plutonium producer. The fact that Turkey had signed the Nuclear Non-Proliferation Treaty apparently did not matter much to the various western powers.

This brings us to Turkey's fifth and most recent attempt to go nuclear that has stretched out over most of the last decade. Political instability has unquestionably contributed to the protracted consideration of this project. Controversial decisions are more difficult when governments come and go and when those governments do not have a firm grip on power. As in 1971 and 1980, a military intervention in June 1997 also contributed to the delay of this project. Similarly, financial considerations are playing a role, as the government has reconsidered its ability to provide a sovereign guarantee of loans for the project. The mention of possibly restructuring the deal into a BOT project is *déjà vu,* from the 1985 experience. However,

there has been a tangibly new element in Turkey's current attempt in the nineties and the new millennium to go nuclear -- that is a much greater degree of public opposition. In its quality, quantity, and persistence, the public opposition to the Akkuyu nuclear plant has surprised a series of governments. Opposition runs the full gamut of Turkish society, from the local farmers and fishermen of Buyukeceli and Yesilovacik; to the urban population in the nearest city of Silifke; to the environmental movement around the country; to the professional opposition of engineers, electricians and geologists.

The issue of earthquake risk at the Akkuyu site is controversial, particularly in the light of 18,000 deaths in the Izmit earthquake of August 1999. An earthquake is the most likely cause of a catastrophic accident at a nuclear plant in Akkuyu. A catastrophic accident would affect not only Turkey, but the entire eastern Mediterranean region with a population of about 165 million. Two of Turkey's most prominent earthquake experts, Prof. Attila Ulug (Dokuz Eylul University) and Prof. Mustafa Erdik (Kandilli Observatory) have called for further geological research before the Akkuyu plant continues. There is little doubt that, based on the current seismic specifications, the proposed nuclear plants of all three vendors are under-qualified for earthquakes that might be expected in the Akkuyu area. The Turkish government as well as the nuclear vendors must bear joint responsibility for this problem.

Turkey has already been implicated in providing nuclear arms aid to Pakistan. Its attempts to obtain nuclear technology from Argentina were stopped because of proliferation concerns, and in the late 1980s the United States instituted an embargo on the shipment of enriched uranium to Turkey. So proliferation concerns about Turkey are not just theoretical or speculative. Add to this Turkey's plans for developing an independent fuel cycle (with it own uranium fuel and reactor designs) that would shelter it from International Atomic Energy Agency proliferation safeguards. It is also worrisome that there is widespread support for the development of nuclear weapons among prominent persons, including a former General, and a current cabinet member. The Middle East has already seen the effects of a nuclear arms race which has contributed to the destabilization of that troubled region. Israel has a well established nuclear weapons program, Iraq was well on its way to having one prior to the Gulf War, and Iran is now progressing towards nuclear weapons capability. Turkey's nuclear program will unquestionably fan the flames of this regional nuclear arms race. As can be seen from attacks on Iraqi and Iranian nuclear plants, these facilities themselves become military targets, thus increasing the risk of conventional war, and in the case of functioning plants, the risk of catastrophic accident.

The fate of the Mediterranean Monk Seal is a tragic sidebar to the Akkuyu story. With only 50 to 100 animals left in Turkey, and perhaps as few as 200 left in the entire Mediterranean, the Monk Seal is one of the most critically endangered animals in the world. One of the few Monk Seal colonies is on Beshparmak Island in the mouth of Akkuyu Bay. Since Akkuyu will be built and supplied by ship, there will be intense marine traffic in and out of the Bay. There is also the risk that seals will become trapped by the cooling water intakes for the nuclear plant.

The financial risks associated with the $3 billion (US) Akkuyu nuclear deal are substantial. There are risks for the vendors, for the vendor countries that are providing financing, and for Turkey itself. The private sector financial community has passed judgement on the level of risk associated with nuclear loans, and has found it unacceptable. Thus, in Canada, the entire financing for the Canadian component of the deal ($1.5 billion CDN, or 35% of the total estimated cost) is being provided by the Canadian government. A sovereign guarantee by Turkey was an understood part of the proposal that was first floated with the bid specifications in December 1996. The vendor countries wanted a sovereign (state) guarantee of their loans to TEAS, so that in the even that TEAS were to default, the Turkish government would be required to repay the loans. However, guarantees have their cost as well. Because of its commitments under the 3-year, $4 billion (US) International Monetary Fund loan, Turkey's treasury department in spring 2000 questioned its ability to provide a guarantee for the loans at least in the short-term. Westinghouse has now suggested that it will not demand a guarantee from Turkey (at least initially) this dramatically increases the level of risk for the governmental financial backers of the winning Akkuyu nuclear vendor.

Ongoing human rights violations in Turkey are deeply troubling. These are gross violations, including systematic widespread torture and murder of prisoners in custody; death squad murders; disappearances; restrictions on freedom of speech; and incommunicado detention without legal representation. There have been modest improvements in recent years, but not what would be expected with the capture of PKK leader Abdullah Ocalan, and his subsequent ceasefire call. Restrictions on free speech and overt political repression have continued despite pressure to meet western standards because of Turkey's desire to join the European Union. The incidence of torture actually worsened in 1999 as compared to the previous two years. Given these ongoing problems, it is morally and ethically repugnant to engage in nuclear trade in the absence of tangible human rights improvements.

Turkish political history over the last 40 years has been characterized by a series of unstable governments, interrupted at intervals by four military *coups d'état* -- in 1960, 1971, 1980, and most recently in June 1997, when the government of Prime Minister Necmettin Erbakan, was forced out of office. Allegations of corruption at the highest levels have added to instability. Political and economic instability have gone hand in hand. Inflation has averaged more than 80% per year over the last ten years, and the national debt is over $100 billion (US). It remains to be seen if the current $4 billion (US), three-year anti-inflation program sponsored by the International Monetary Fund will succeed. Five similar programs in the 1990s have failed, and many Turks think that the cure may be worse than the disease.

There are many good reasons why the nuclear vendors and their governments should withdraw their bids to build Akkuyu nuclear plant. Similarly there are many good reasons why the government of Turkey itself should stop the Akkuyu project. Simply put, nuclear power is an outdated technology that is very expensive, and carries real safety, environmental, and security risks. Renewable energy, conservation programs, and high efficiency natural gas plants are cheaper, cleaner and safer. A nuclear power program will only interfere with the hard road ahead for Turkey in building a sustainable energy future, healing its economy, democratizing its political system, and improving its human rights record.