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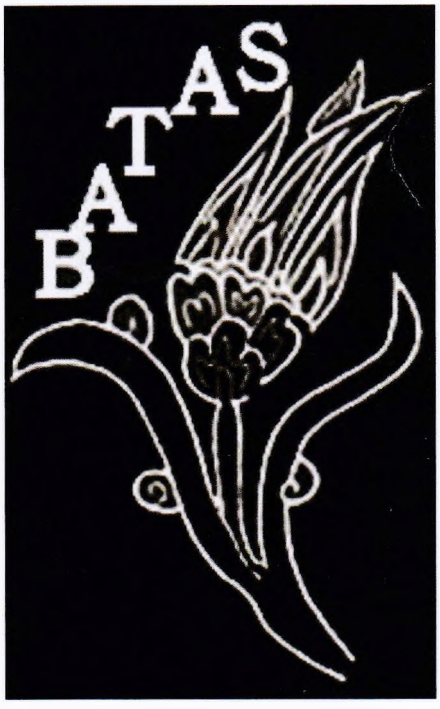

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Pitfalls in the Turkish Nuclear Programme

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The origins of nuclear power go back to 1885 when Röntgen discovered the X-ray and one year later Becquerel identified natural radiation. In 1939 Hahn and Strassman achieved the splitting of the uranium atom in Berlin which initiated fission technology. Three years later in the USA Fermi proved that the fission

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[35] Tele1, 15 October, "*Turkey learnt the Facts about Syria from Tele1*' (in Turkish) https://tele1.com.tr/turkiye-suriye-gercegini-tele1den-ogrendi-92272/, and 14 October, *Turkey and Syria's Five Points Agreement*, https://tele1.com.tr/pyd-ve-suriye-5-maddede-anlasti-92045/g

[36] Given in Turkish at https://tele1.com.tr/pyd-ve-suriye-5-maddede-anlasti-92045/. These details have been mentioned in some Kurdish and Iranian sources but to date not in the mainstream Turkish media.

chain reaction in uranium nuclei could be sustained and controlled, making it feasible to harness this energy. Then nuclear technology developed in two different ways; the creation of a nuclear bomb and the development of a nuclear reactor for power generation. On 6 August 1945 a successfully assembled uranium-235 bomb was dropped on Hiroshima and on 12 August a plutonium bomb was dropped on Nagasaki which ended the war in the Pacific.

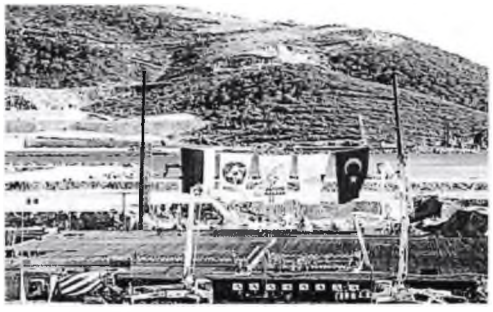
After the war a number of European countries along with the USA decided to use nuclear power for peaceful purposes but there was a problem: insurance cover. Private power utilities disliked nuclear energy because of their liability in the event of accidents which would create damage amounting to billions of dollars. In the USA the Price Anderson Act of 1957 limited the liability for an accident in a nuclear utility no matter how many people are killed or injured, or how many properties destroyed or contaminated. The maximum liability was set at $560 million. With the liabilities reduced to manageable proportions the utilities found the nuclear business to their liking. A similar situation happened in some other countries. Another issue which gave a boost to nuclear power was the argument put forward by the US Atomic Energy Commission that 'nuclear energy was too cheap to meter'.

In 1957 the USA's first nuclear power plant opened at Shippingport, Pennsylvania. Canada, the UK, West Germany, France, the Soviet Union and Japan followed suit. By 1990 there were about 420 nuclear reactors in operations providing about 20% of the world's energy requirement. This figure was much higher in some countries such as France where 70% of its need was supplied by nuclear means. However, the tide was turning against nuclear power in the 1980s as accidents in Three Mile Island and Chernobyl increased public anxiety. Furthermore, a worldwide concern was growing about what to do with the accumulation of vast quantities of nuclear waste. In this respect a number of nuclear power generating units, including the already completed plants were cancelled in the USA. The Swedish government went further by deciding to phase out all nuclear power plants.

The Turkish Case

In the late 1950s the Turkish government, greatly impressed by the argument that nuclear power was 'too cheap to meter', wanted to jump on the bandwagon. To this effect it made a bilateral agreement with the USA for the peaceful development of nuclear power in the country. In 1970 there was a feasibility study about the construction of a small 300 megawatt plant but this did not happen because of a number of technical problems and shortage of highly skilled staff. In 1996 a medium sized 2000 megawatt nuclear unit was considered in Southern Turkey in collaboration with Siemens, Westinghouse, Mitsubishi and some others. This too did not materialise because of lack of money.

Globally the nuclear industry began to enjoy a revival in the early 2000s as the construction of nuclear units gathered pace. The International Atomic Energy Association estimated that in 2010 there were 435 nuclear reactors operating in the world, run by 32 countries. China appears to have been the most enthusiastic country in the expansion of nuclear power as it decided to build 42 new reactors as soon as possible. In 2007 the Turkish Prime Minister Recep Tayyip Erdoğan contended that Turkey was too timid in embracing nuclear power, which is clean, safe and cheap. On 9 November 2007 an act was passed in the Turkish parliament which gave the Turkish Atomic Energy Authority authorisation to establish criteria to build and operate nuclear power plants in the country. The Turkish Electricity Trade and Contract Company would then buy all the generated nuclear electricity from the producers whoever they were under a 15-year renewable agreement. One year later tenders were invited to establish a 4800 megawatt unit in southern Turkey which attracted the interest of many international nuclear power corporations. In 2010 the government signed an agreement with a Russian firm, Rosatom, to build and operate a 4800 megawatt plant consisting of four equal size reactors at Akkuyu, a district of Mersin. Three years later another deal was signed with Mitsubishi Heavy Industries to establish a similar size plant in the northern coastal town of Sinop. The government also wants a third nuclear unit at İğneada, near the Bulgarian border. The Turkish Atomic Energy Authority will be in charge of all regulatory activities including site selection, radiation safety, construction, running and closure. It will also conduct regular site inspections.



Various unrealistic cost estimates for the Akkuyu plant were put forward, mainly by a number of government representatives. Mr Taner Yıldız, a previous Energy Minister in the AKP government, first suggested that this plant could be built at a cost of about $2 billion. In his later statements he gradually increased his estimates. The Turkish Premier's last estimate was $22 billion. More recently the Russian Embassy in Ankara pointed out that the most realistic figure for this investment would be around $25 billion[37]. In fact, the real figure is likely to be much higher, a similar size plant in the UK would cost above $30 billion. When completed and working at full capacity the Akkuyu plant will only provide 5% of Turkey's electricity needs and its power output will be anything but cheap. In fact this amount could be achieved by reducing the waste in distribution and pilferage which is high in Turkey.

Anomalies of Nuclear Power

There is no business like nuclear business for it contains a number of oddities. Unfortunately, Turkey has not made enough preparation for these. First, most people now realise that the expression 'too cheap to meter' has become 'too

[37] World Nuclear Organisation, *Nuclear Power in Turkey*; world-nuclear.org/info/country-profiles/Countries-T-Z/Turkey, 2013

expensive to afford'. Construction costs of nuclear power have been increasing relentlessly mainly for two reasons; tightening of health and safety regulations and delays in getting the projects ready due to technical problems. Research in France, a country which is most dependent on nuclear power, suggests that electricity generated by nuclear means is more expensive than electricity produced by hydro, thermal, solar, wind and fossil fuel even without taking into account closure and waste disposal costs[38]. Expensive power generated by the Akkuyu, Sinop and İğneada projects will undermine the competitiveness of the Turkish industry which relies substantially on exports.

As mentioned above the insurance problem is unique to nuclear power. There is no other sector which relies to this degree on public support. In Turkey it is not clear what kind of initiative has been taken to deal with this oddity.

Another unique problem with nuclear power is decommissioning. When a typical production facility reaches the end of its natural life machinery, tools, buildings and land sold off at a salvage value bring in money. In the closure of a nuclear facility exactly the opposite happens. When a nuclear power plant is operating land, material, machinery and engineering structures get contaminated. When the activity is closed the disposal of contaminated items presents substantial problems. Land, buildings and materials cannot be abandoned or used for other purposes. Buildings cannot be converted into shopping centres; machinery and engineering structures cannot be made into razor blades or other articles. Land cannot be opened up for housing development. Closure of a nuclear facility requires taking down huge structures, cleaning the immediate and nearby districts and transferring highly toxic nuclear waste to permanent nuclear repositories. It takes about 6-7 years to build a nuclear power plant if no serious technical problems occur. But decommissioning takes at least 30 years. For example in Scotland the decommissioning of the Dounreay plant started in the 1980s and is still continuing. For this operation about £4 billion has been allocated which, it is argued, will not be enough. In Sellafield, where large quantities of nuclear waste have been temporarily kept, the cost of management has already exceeded £50 billion with no sign that it will stop increasing.

The decommissioning costs of the Akkuyu unit have not been estimated by the Turkish government nor are they included in a number of reports which have so far been published. In one report the environmental impact assessment which includes decommissioning is mentioned in a couple of sentences, to the effect that the issue will be handled when the time comes[39]. This facility – if it comes into operation in 2023 – will work for about 40 years but the nuclear lobby unconvincingly contends that its working life will be far more than 50 years.

A fourth anormality with nuclear power is the risk of an accident with catastrophic consequences. So far we have witnessed two major accidents –

[38] OECD, *Projected Costs of Generating Electricity: 2010 Edition,* ISBN 978-92-64-08430-8,Paris

[39] DOKAY-ÇED Çevre Mühendisliği Ltd Şti, Akkuyu nuclear power project, Ankara, Aziziye mahallesi Kırkpınar sokak no.18/5, 2011

one in Chernobyl in Ukraine and the other in Fukishima in Japan – where large areas of the territory have been abandoned as a result. Furthermore, there are unusually high levels of cancer and genetic deformities in these areas which will pass onto future generations.

Risk of terrorism is another factor to mention. The theft of plutonium for the purpose of terrorism scares all nuclear countries. Saudi Arabian terrorists who ran passenger planes into the twin towers of New York also considered doing the same thing to nuclear power stations. Today in the UK nuclear power plants are protected by the Royal Air Force and other security groups. Turkey is a country which has suffered badly from terrorism and the risk is far from over.

Perhaps the strangest part of the nuclear undertaking is the disposal of extremely dangerous and longlasting nuclear waste. As a nuclear power plant operates it generates various kinds of toxic substances some of which remain active for millions of years creating dangers for living organisms on our planet. A medium sized facility generates about 30 tons of waste per annum. During its operational life the accumulated waste exceeds 1000 tons. The Turkish plant is going to be a very large one and the waste inventory will be in excess of 2000 tons and this must be safely disposed of in 100% secure nuclear graves. US Senator Howard Baker argues that "The containment and storage of radioactive wastes is the greatest single responsibility ever consciously undertaken by man". To this effect the US Environmental Protection Agency recommends that a nuclear waste storage grave must be capable of isolating nuclear substances for at least 10,000 years. In the UK, however, this figure is one million years[40]. These time scales dwarf recorded human history. It must be obvious that the great risk will fall upon the future of humankind and all the other species living on earth. I have read several environmental impact assessment reports commissioned by the government from groups which are mainly sympathetic to nuclear power and none of them gives any meaningful coverage to the waste disposal issue.

It has been contended that nuclear power does not emit CO^2 and is thus environmentally friendly. This is not so when we consider the entire nuclear cycle which contains thirteen stages from uranium milling and disposal in 'safe repositories' during which time almost the same level of greenhouse gasses are emitted[41].

I believe that renewable energy will enable us to avoid intensifying environmental problems. Nuclear energy is not a renewable resource as it uses highly scarce uranium which – just like fossil fuel – will be exhausted one day. Turkey has an abundance of renewable substitutes such as sunshine, wind, thermal and water power. For example, together with Spain Turkey enjoys an enviable location in Europe for the development of solar power. In the 1950s

[40] Kula Erhun,'Future Generations and Nuclear Power – a pluralistic economic appraisal', *Futures,* 73, 2015, pp.37-47

[41] Shradder-Frachette Kristin S, 'Greenhouse emissions and nuclear energy', *Modern Energy Review 1*, No.1, August 2009, pp.54-57

and 1960s many countries went headlong into the nuclear venture. Some learnt from their mistakes and subsequently kept out of it but some did not. Unfortunately Turkey falls into the latter category.

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