India commenced its nuclear power programme as early as 1969 with the construction of a 150 MW plant at Tarapur with Russian assistance. Subsequently, several relatively small plants in the range 170 – 220 MW of capacity were built, some with Canadian assistance. The first large plant of capacity 490 MW was commissioned in 2005 at Tarapur, the same location as the first plant. According to the reports of Nuclear Power Corporation of India, India’s current electricity generation capacity from nuclear energy is about 4,100 MW coming from 19 plants, which is nearly 3 % of India’s total generation capacity. One of these plants has been built near the coast at Kalpakkam in Tamil Nadu, about 80 km south of Chennai.

India is currently building 6 nuclear power plants (NPP) with an aggregate capacity of about 4,000 MW. Already in the pipeline with the necessary approvals granted are 18 NPPs with an aggregate capacity of about 17,000 MW to be built across the country. In addition, another 39 NPPs with an aggregate capacity of 45,000 MW have been proposed. Thus, towards the end of the next decade, India’s nuclear power capacity will reach over 70,000 MW. India plans to build these NPPs in clusters, each comprising about 6-8 plants with individual capacities in the range 1,000 – 1,200 MW, or with a total capacity of about 10,000 MW at each cluster (World Nuclear Association (WNA) website: www.world-nuclear.org).

Kudankulam Cluster

The first such cluster of NPPs is to be built at a place called Kudankulam, close to Kanniyakumari town at the southern tip of the Indian peninsula. It is built on the coast for easy extraction of water for boiler and cooling purposes. Work is nearing completion at this site on 2 plants, each with capacity 1,000 MW. These are of pressurized water reactor (PWR) type of Russian design. Hence, these are also described as VVER type which is the Russian acronym for water-cooled, water-moderated energy reactor. These are expected to be commissioned within a year or two, and work on the 3rd and 4th units, each with capacity 1,200 MW, also to commence concurrently. Once completed, Kudankulam will have a total of 8 plants comprising two plants of 1,000 MW each and six plants of 1,200 MW each, thus making a total of 9,200 MW of capacity. However, approvals for the last four are yet to be granted.

All eight units at Kudankulam are to be built with Russian assistance, with Russia financing about half the cost of the plants. The capital costs of these plants are expected to be around US$ 1,600 per kWh. They will be built by India’s Nuclear Power Corporation of India (NPCIL) under Russian supervision and NPCIL will commission and operate the plant. About 80 Russian staff members are expected to be supervising the job. According to WNA website, Russia is supplying all the enriched fuel, though India will reprocess it and keep the plutonium. However, in the recent past, India has not been able to get the required amounts of fuel and some of these plants were not working at full capacity.

Risks of nuclear power

Nuclear power plants when operating under normal conditions are expected to be quite safe and are considered to be a cheap source of electricity with no air or ground water pollution or without any impact on global warming arising out of carbon dioxide emission. Hence, there is a trend to promote nuclear power as a mitigatory measure against global warming. However, due to any malfunctioning of the system, if the plant develops any radiation leak, there will be a catastrophe. Large quantities of radio-active nuclides including long-lived iodine, strontium and caesium could get released into the atmosphere and later return as fall out over a wide area extending beyond borders. These could get into the food chain through cows grazing contaminated grass and people drinking the contaminated milk. In addition, there will be irreparable damage caused to humans when exposed to nuclear radiation, either ending in death or subject to life-long suffering. In view of these risks, NPP manufacturers as well as operators take every precaution to ensure that no malfunctioning whatsoever will take place during the life-time of the plant. Nevertheless, under some unforeseen circumstances, a nuclear plant could malfunction and cause radiation leak.

Chernobyl Disaster

One such instance was the disaster at the Chernobyl NPP which took place almost 25 years ago in April, 1986 in Ukraine when it was under USSR regime. Due to a human error while conducting a test, the reactor went out of control resulting in its explosion and finally its melt down. In the process, large quantities of radio-active nuclides were released into the atmosphere. These were found to spread initially over a 150,000 square kilometers of land across Belarus, Russia and the Ukraine, and subsequently over most parts of Europe. About 350,000 people were resettled from these three countries to avoid direct exposure.

A UN report based on the findings of several UN bodies including IAEA, WHO, UNDP and FAO released nearly 20 years after the accident, that is in 2005, reported that a total number of 4,000 deaths could be attributed to Chernobyl or expected in the future over the lifetime of emergency workers and local residents in the most contaminated areas which is estimated to be about 600,000. According to this report, only about 50 persons had died of direct exposure to radiation resulting from the accident and these were emergency workers who had joined in cleaning the premises. However, these findings were disputed by several independent studies.

According to a Greenpeace report based on findings of several independent studies, at least 200,000 deaths attributable to Chernobyl accident had occurred in Balarus, Russia and Ukraine between 1990 and 2000 (www.greenpeace.to). Of the large number of people who had worked in the clean up operations, at least 25,000 had died of lung cancer, leukemia and cardio-vuscular diseases, rather than 50 as claimed by the UN report (www.eoearth.org). They also attribute a large number of incidences of radiation induced diseases among adults and children exposed to radiation and living in contaminated areas. It was thought that the official report undermined the actual damage because of the fear the real situation could have had on the nuclear power industry. The lack of baseline data in the Eastern European countries was the excuse given for the poor official report.

It is to be noted that living in fear of getting ill with an incurable sickness sometime later in life as a result of the exposure is worse than immediate death. Environment problems include

long-term contamination of water resources and soil and damage to wildlife are still unclear, while the economic cost has been estimated to be in the range of hundreds of billions of dollars. The Ukraine government has still not been able to install a proper shield covering the melted down plant because of the enormous cost involved.

Fukushima Disaster

The earth quake with intensity 9.0 that occurred last Friday in Japan had prompted the shut down of a NPP, comprising 4 units, in Fukushima. But the emergency water circulating system installed for the purpose of cooling the reactor, had not worked after the Tsunami waves came in. Apparently, the stand-by generators had failed to operate to provide power for the circulation system. According to NHK TV service, none of the generators had worked, and as a result, there has been a melt down of one reactor. There had been explosions in some of the units too. This has caused radiation leaking, and people living in the contaminated area, estimated to exceed 210,000, have been ordered to evacuate. The failure of the stand-by generators to work is something that was not foreseen when the plant was designed; that is the possibility of a failure of a safety system installed to take care of an emergency situation. There had been no provision in the system to handle such a situation though efforts had been initiated manually to bring the plant under control. The real damage caused to the Fukushima plant is yet to be assessed.

2004 Tsunami Impact

The 500 MW nuclear power plant built near the shore at Kalpakkam got affected during the 2004 Tsunami. This power plant withstood the giant waves, which engulfed the surrounding area, but got shut down automatically when the water level rose. The rising water had also damaged the cooling water intake facility. The reactor was shut down safely and there was no release of any radioactivity. The reactor was restarted about a week later.

This incident prompted the IAEA to organize an international workshop on the safety and risks of NPPs built near coasts. It is common to build NPPs near coasts enabling the use of seawater to cool the reactor. Specialists from around the world scrutinized the potential impact of natural disasters such as earthquakes and tsunami flooding on nuclear reactors. The workshop was held from 29 August to 2 September 2005 at Kalpakkam itself. The participants deliberated over 5 days to share latest knowledge and research developments and take home lessons learned, from this tsunami, and past flood events. Ironically, Japan was among the several countries which provided resource persons to the workshop. However, it is not known whether the proceedings of this workshop including any recommendations were made public. According to material posted in websites, the power plants in Japan were built to withstand earthquakes, but not designed for quakes of such high magnitudes as occurred last Friday. These specialists had obviously not taken into consideration the combined impact of earthquakes and tsunamis taking place simultaneously on coastal nuclear plants.

Threat to Sri Lanka

The above two cases show that despite every precaution being taken to ensure safety of the

plant and people, NPPs could go out of control due to unforeseen circumstances and accidents could take place causing radiation exposure to people living over a very wide area. Kudankulam is only 240 km from the west coast of Sri Lanka, in line with Puttalam. If any of the 8 nuclear power plants, being constructed or planned there develops a radiation leak due to some unforeseen reason, its impact would be felt directly by Sri Lanka. This is particularly so during the SW monsoon months when the winds blow from the southern tip of India towards the North Central Province for several months. As mentioned before, 2 plants each with capacity 1000 MW will come into operation this year, and 2 more in another 5 or 6 years time. The balance 4 will also come into operation during the next decade. All these plants will draw sea water for cooling purposes, and if the water supply system breaks down due to an earth quake or a tsunami, as happened at Kalpakkam in 2004, there could be a great catastrophe, directly affecting Sri Lanka. Even otherwise, there could be a possibility that an accident could take place due to human error or hardware malfunctioning as happened in Chernobyl and cause radiation leak.

One may argue that an earth quack of similar magnitude may not take place in the foreseeable future. However, there is another danger that may cause concern in the near future. That is the anticipated climate change caused by increasing emissions of green house gases. One consequence is the accelerated sea level-rise and the consequential damage to coastal infrastructure, including NPPs. Along with climate change, extreme events such as cyclones, intense rainfall and storms will also occur more frequently. Under such situations, there will be enhanced wave activity in the sea, causing damage to coastal infrastructure. In the event such a calamity does take place in the foreseeable future, people in Sri Lanka will have to face the consequences of it. There are many sites in the web alerting authorities on this possibility.

There is another aspect of this issue. The NPPs at Kudankulam are being built by Indians under Russian supervision. This is the first time that Indians are building NPPs of this size (1000/1200 MW). Previously, they have built and commissioned smaller NPPs of about 200 MW each. In this situation, who will guarantee the reliability and safety of these power plants and that they are made to conform to international standards? It may be recalled that the disaster-stricken Chernobyl plant was also of Russion design. For some of the other proposed NPPs, India is negotiating with regular manufacturers in the West for their construction. In the West, the construction of a NPP will generally extend to over 10 years, because of the lengthy approval process including public hearings and the need to comply strictly with regulations. However, the Indian programme has not allocated more than 5-6 years for building a single plant, according to schedules given in the WNA website. This fast tracking will naturally be at the expense of reliability. In the event of any accident due to whatever cause – natural disaster or human/hardware error, and if people in Sri Lanka were to get exposed to radiation, who will compensate for the suffering inflicted on the people – or could any monetary compensation take away the suffering?

PS: The Island of Monday the 15th carries an article (which I read just before dispatching mine to the editor) on the India's nuclear power plants saying that these plants were build to withstand earthquakes. It further says that "the Kalpakkam plant in Tamil Nadu did not suffer any damage during the 2004 tsunami". This report conveniently avoids referring to the damage caused by tsunami waves to the plant's cooling water supply and subsequent shut down of the

plant for a week, which prompted the IAEA to organize the international workshop at Kalpakkam in 2005!

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