PUBLIC HEALTH ISSUES AND DISASTER MANAGEMENT OF NUCLEAR FUEL CYCLES IN INDIA

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*[**Abstract**: Despite setbacks from the nuclear reactor accidents at Fukushima on March 11, 2011, and Prime Minister of Japan expressing that Japan should wean itself from nuclear power and eventually have no atomic plants, India is determined to carry on with its accelerated nuclear energy programme. Public health issues arising out of nuclear reactor establishments and mining of uranium have been an exclusive domain of the Department of Atomic Energy (DAE). The ultimate responsibility for public health issues rests with the state governments but unfortunately the Directorates of Health are neither sensitised nor well-equipped to deal with such issues. The assurance of DAE that there is nothing amiss with health issues as a result of Nuclear Fuel Cycle cannot be taken on face value because the institutions within DAE are interconnected and the shortcoming of one may be glossed over by the other. There is need for an independent and public-spirited body to monitor the R&D work to instil confidence in the public on this vital aspect whose fall-out may manifest decades later. Public health systems in India need to acquire skills in this direction. Public Health Foundation and other like Institutions need to develop appropriate curriculum for skill development in this area. Unless a robust public health system is developed within the central government and state governments, it is hard to imagine if an appropriate response can be expected from state governments in case of nuclear disasters of the magnitude of Fukushima disaster. The Guidelines placed in position on nuclear disasters by the Disaster Management Authority (DMA) expect the State Governments, local governments and local bodies to play a vital role in tackling off-plant situations. These guidelines would remain on paper if proper evacuation plans in a densely populated country are not worked out and practised.]*

Despite Prime Minister of Japan expressing that Japan should wean itself from nuclear power and eventually have no atomic plants post 11th March 2011 Fukushima nuclear accident, Government of India has reiterated its resolve to continue with its accelerated nuclear energy programmes. While doing so, it has assured its people on the following lines:

i) The Department of Atomic Energy and its agencies have been instructed to take a review of all safety systems of nuclear power plants, particularly with a view to ensuring that they would be able to withstand the impact of large scale natural disasters such as tsunamis and earthquakes.[1]

ii) The institution of the Atomic Energy Regulatory Board would be strengthened and made truly autonomous and independent. All reactors would have to be

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1 M.M.K. Sardana (2011), "Impact of Accident at Fukushima on Nuclear Energy Programmes of India and China," ISID Discussion Note DN1109, July.

certified by the regulatory authority and that this would apply equally to reactors and technologies that are imported from abroad.[2]

iii) There would be greater transparency to India's nuclear establishments, in the interest of society.[3]

Japan has since submitted a 750 page report on the Fukushima accident prepared by its Nuclear Emergency task force to the International Atomic Energy Agency[4]. The report, *inter alia*, gives following findings.

a) Admittedly Japan was ill-prepared for a severe nuclear accident like the tsunami-caused Fukushima disaster and the damage to the reactors and radiation leakages was worse than previously thought.
b) The reactor designs were inadequate.
c) There is a case for more independence of Regulators.
d) There is a felt need for revision of nuclear safety preparedness and response.
e) A national debate on nuclear debate is desirable.
f) The six-reactor Fukushima plant paired up two reactors to share some facilities and equipment, delaying the accident responses.
g) Lack of protection for plant workers early in the crisis and inadequate information about radiation leaks were also problems.
h) The accident has forced 80,000 residents to evacuate from the plant's neighbourhoods.
i) Division of responsibility by several government agencies delayed decision-making.
j) It is not prudent to leave accident management measures to the operators' voluntary effort. It should be made legally binding.
k) Accident management guidelines have not been reviewed or improved since being introduced in 1992.

[2] Devraj, Ranjit (2011), "India: Fukushima Revives Debate Over Nuclear Liability," *Global Issues*, March 30, www.globalissues.org
[3] *Ibid*.
[4] Yamaguchi, Mari (2011), "Japan admits being unprepared for nuclear disaster," *YAHOO! NEWS*, June 8.

l) Japan bears a serious responsibility to provide data to the international community with maximum transparency and actively contribute to nuclear safety.

m) It is believed that lessons learnt in Japan are going to make the industry safer. The same mistakes should never be repeated.

Further, Japanese Government has constituted expert panels to look into a wide range of areas such as: (i) Operator TEPCO's Corporate Culture; (ii) Japan's nuclear safety myth; (iii) Government regulatory functionaries; and (iv) Accident's effect on the economy and food safety.

The findings, arrived at in the above report and the Constitution of expert panels on different aspects, provide serious food for thought for governments like India and China who continue to place their reliance on nuclear energy and take it that accidents like at Fukushima cannot shake their reliance on this source of energy.

Governments need to take note of the need for an informed debate on nuclear energy as brought out in the above report. The exclusiveness of the Nuclear Energy establishments should give way to exchange of dialogues among communities, community leaders, scientists, sociologists, environmentalists, economists, health scientists, political leaderships and nuclear scientists with a view to recommend strategies to harness this source of energy balancing with safety, health and environmental concerns. Further, there needs to be a well-informed guideline, developed in consent with all the relevant groups to respond to the challenge of a disaster if it strikes taking a horizon perspective that the disaster could be of a higher intensity than the one that struck Fukushima. In this connection a note needs to be taken of the experience of the Prime Minister of Japan, who has stated:

> "Given the enormity of the risks associated with nuclear power generation, I have realised nuclear technology is not something that can be managed by

> conventional safety measures alone. I believe we should aim for a society that is not dependant on nuclear power generation."[5]

Taking note of the firm resolve of the Government towards the setting up of nuclear reactors and overcoming the arguments, it becomes necessary to examine the impact of existence of such plant on workers and adjoining populations' and environments. Further, to provide for identification of appropriate measures to mitigate adverse impacts, if any, on short term and long term basis.

The National Power Corporation of India (NPCIL), on its part, has allayed health concerns arising out of nuclear plants[6]. According to it, there has been no measurable increase in the rate of cancers in the population as a result of the operation of the nuclear power plants and radiation dose to the public at all nuclear power plants has been a small fraction of the .limit stipulated by the regulator. It further stresses that the core safety objective in the operation of such a plant (as at Kaiga) is to ensure there is no undue radiation exposure to occupational workers, public and environment. This has been achieved by adopting appropriate technologies, personal protection measures and best practices. Indeed, as mentioned, the radiation dose over the years has been well within the regulatory stipulations. It goes on to mention that systematic baseline epidemiological studies of employees and their family members have been carried out at all nuclear power stations in India. In addition, annual medical examination of occupational workers at each nuclear power plant is carried out in line with the regulatory requirements. The medical reports are maintained at each nuclear power plant and are verified by the regulator during periodic regulatory inspections. Further, a medical examination report in respect of each nuclear power plant is also reviewed by the advisory committee of the Atomic Energy Regulatory Board (AERB), comprising medical experts, which informs nuclear power plants of any observed case of occupational disease and suggests ways to improve the occupational health profile. No rising

[5] "PM wants Japan to bid adieu to N-power," *The Times of India*, July 14, 2011, epaper.timesofindia.com

[6] "NPCIL allays health concerns regarding nuclear plants," *The Times of India*, June 11, 2011, articles.timesofindia.indiatimes.com

morbidity pattern has been observed in any of the nuclear power plants in India. Considering the sensitivity associated with medical history, as per medical ethics, it is shared with individuals only.

This source (see footnote 6) also advises that prior to setting up of nuclear power plants of NPCIL, independent Environment Survey Laboratories (ESL) under the control of Bhaba Atomic Research Centre (BARC) have been set up to collect baseline radiation data of various environmental matrices like air, water, soil, grass, crops, cereals, fruits, eggs, fish, goat thyroid, etc. The ESL monitors these matrices in an area 30 km around the plant. Around 1300 to 1500 samples are collected every year. It is claimed that the data collected since operation of the nuclear power plants in India has not shown any measurable increase over the baseline data thereby evidencing that there has not been any impact on the environment due to operation of nuclear plants. Thus, NPCIL has allayed the fears of the people on Public Health and Environmental Concerns. However, it has been observed[7] that DAE is the apex body to which AERB and research centres like Indira Gandhi Centre for Atomic Research (IGCAR), ESL and BARC report. All these bodies are not independent of each other. Hence, if one is at fault, the reviewing body could turn a blind eye since it belongs to the same brotherhood. There is no reviewing body that can question their functioning. This co-dependency of existing organisations leads to a conflict of interests. DAE functions under the Officials Secrets Act[8]. Therefore, public at large gets to know only through press reports that there are chilling events happening and there are attempts to 'cover-up'. *Tehlka*[9] reports that it found out the following five cases where scientists and workers were exposed to high-level radiation at the Kalpakkam plant situated on the Coromandal Coast 90 km south of Chennai, Tamil Nadu.

1995: Dayanidhi and Khandhasamy, workers at the plant, were tested for gamma radiation levels (that causes organ failures and cancer) in the medical centre

[7] Tehelka Bureau (2010), "The rules are in place. But they are broken all the time," *Tehelka Magazine*, Vol. 7, Issue 39, October 2, www.tehelka .com

[8] *Op.cit.*, 2

[9] *Op. cit.*, 6

inside the plant. It was found to be 50 times more than normal in the Kalapakkam plant.

26th March 1999: There was a heavy water leak in the K5 unit of the Madras Atomic Power Station II. At least seven people were exposed to a radiation dose well above the permissible limit.

30th May 2001: S. Sivakumar, a worker, suffered internal contamination after his neoprene glove got punctured. His body absorbed plutonium which emits alpha rays that got deposited in his teeth. These rays cause bone cancer.

7th July 2002: Selvakumar, a worker, burned his left hand after he picked up a radioactive substance.

27th January 2003: Srinivas Raju, a scientist, was exposed to a high level gamma radiation at Kalapakkam while working on an unknown solution, which he collected from a low-level radioactive tank.

It has been reported by this source[10] that the local community living near the tailings pond in Jaduguda was most susceptible to illness arising from exposure to radioactive and other toxic substances. In the past four years, there have been as many reported incidents of tailing pipes carrying waste bursting, sending the toxic wastes into villages—on 10th April 2007, 16th August 2008 and 21st February 2008. The water from these tailings, leaking steadily into streams, join Subranrekha river, leaving a trail of toxicity. On 25th December 2006, the tailing dam itself broke; a nightmarish situation for villages that lie in the path of toxic fluid.

AERB mandates that there should be sumps (basins) in the uranium mines to store mine water without any overflow. In the Bandhuhurang open cast mine in Jaduguda, it is found that water from mine is allowed to flow beyond the slump to marshes which are connected to streams used by villagers for bathing and washing purposes.

[10] *Ibid.*

AERB standards require that a Nuclear Power Plant should be sited at a relatively low population zone with the area around the plant divided in three zones (Exclusion zone, Sterilized Zone and Emergency Planning Zone). An exclusion zone of 1.5 km radius is established around the plant and no public habitation is permitted in the area. The sterilized zone, on the other side, covers the exclusion zone in a 5 km radius since the area has the potential for extensive contamination in case of a severe accident. The real situation, for example, in Kalapakkam is that within the sterilized zone there are five villages where 30,000 people are residing. DAE township is also within this zone. DAE's claim that there is no increase in incidence of cancer in the township is contested by independent agencies.

This source (*Tehelka*) also refers to the free access to the wood and forest produce gatherers who work dangerously close to the radioactive mine water ponds in the mining areas.

Though AERB rules provide strict guidelines for prevention of spread of radioactivity through air, water and other sources of contamination, yet the trucks carrying uranium ore leave a trail of toxic dust which can be seen settling in small heaps on the road. At Bandhuhurang, debris from the mine is dumped on the outskirts of villages bordering the mine.

Even if reporting by press sources as summarised above is not taken into account, there are overwhelming scientific facts[11] which throw up the issue of health concerns for the workers, scientists and nearby populations in an atmosphere of exposure within and below the permissible limits. The theory of impact of nuclear power on health and environment continues to evolve. There is concrete evidence of adverse impact of Ionising Radiation (IR) on human beings. However, uncertainties lie in precisely quantifying the effects of IR and further that of the ever decreasing doses. The severity of deterministic effects is directly proportional to the absorbed radiation dose. These include skin damage and blood disorders. The higher the dose, the worse, for example, is the skin radiation burn. There are thresholds (<100 msn)

[11] Karamoskos, Peter (2010), "Nuclear Power and Public Health," Briefing Paper 22 (Medical Association fro Prevention of War), energyscience.org.au

below which they do not occur. The lower the dose of IR, the lower is the chance of contracting cancer. However, the hype and eventual outcome of cancer is independent of the dose. There are scientific reports which state that somatic vistas of low dose radiation were appreciable. Such reports command that no level of radiation exposure was certifiably safe. There is evidence of link between increase of childhood leukaemia and proximity to nuclear plants[12]. The long association with uranium mining and lung cancer is unequivocal, due to radon gas exposure. There is also growing evidence of increased rates of solid cancer in the nuclear industry workers throughout the nuclear fuel chain/proportional to their radiation dose[13].

Such a scientific evidence as above would warrant a cautious reliance on the claims of the DAE in regard to the health concerns of people, particularly for those who are residing near the nuclear establishments and also those working within.

The ultimate responsibility of the health matters vests with the state governments. Monica Das Gupta *et al*.[14] have taken an overview of the Public Health Systems of the Central Government and State Governments while commending the system prevailing in Tamil Nadu for other states to emulate. From a reading of this study, it is clear that the state governments including Tamil Nadu, which has nuclear stations and faced tsunami a few years back, are not sensitised about the possible impacts of nuclear establishments on the people living in the vicinity of such establishments. Every State Government has left it to the care of the nuclear energy establishments for whom public health would not be their primary concern. Further, nuclear energy establishments would not have the capability of building up a rapport as appropriate for establishing a long term health protocol. Now that the Prime Minister intends to bring greater transparency to India's nuclear establishments, the states should assume their rightful role in insisting retrieval of data from the nuclear energy establishments which they claim to have accumulated over the years and arrange survey and research to study the state of health of the people around those

[12] *Ibid*.
[13] *Ibid*.
[14] Gupta, Monica Das, B.R. Desikachari, Rajendra Shukla, T.V. Somanathan, P. Padmanaban and K.K. Datta (2010), "How Might India's Public Health Systems Be Strengthened? Lessons from Tamil Nadu," *Economic & Political Weekly*, Vol. XLV, No. 10, March 6–12.

establishments to place in position infrastructure, as appropriate, towards prevention of the adverse impacts and diagnosing the existing impacts and treating the affected.

Institutions like Public Health Foundation of India (PHFI), in their initiatives on public health programmes, should aim to raise awareness among policy makers and implementing agencies to make them more sensitive to public health issues related to nuclear establishments. PHFI may also include in its schedule, programmes towards skill development of public health institutions and their workers to meet the resultant challenges.

In the succeeding paragraphs, it is proposed to examine India's readiness and preparedness in tackling nuclear disasters which may not necessarily be limited in its fury as at Fukushima. It goes without saying that in case of a nuclear emergency, health services would have a crucial role to play in mitigating the resultant miseries. If raising awareness about the public health concerns is not with the public health institutions, no sound medical hierarchy can be envisaged which would be competent to handle a disaster. It is not surprising that the Union Health Secretary deposed before the standing committee of Parliament on the Nuclear Liability Bill that the hospitals are not well-equipped to handle such large-scale nuclear emergencies. Tackling of such a large emergency could have enough repercussions in the nearby areas of radioactive fallout[15]. A sound public health system which includes the impact of nuclear fallout as an essential feature would provide the basic foundation on which a health infrastructure seeking to meet nuclear disasters can be developed. With a sound public health system including the concerns arising out of nuclear energy establishments, the business as usual and associated emergencies can be taken care of with professional competency.

World has witnessed four grave nuclear accidents: Windscale in Britain in 1957 (the one that is not being mentioned); Three Mile Island at the U.S. in 1979; Chernobyl in the Soviet Union in 1986; and now Fukushima (2011). Each accident has been unique and each was supposed to be impossible. Nuclear engineers have learned from each

[15] *Op. cit.*, 2

accident to improve the reactor design so as to diminish the likelihood of that particular accident repeating itself but, as has been said, there are always "unknown unknowns" and so each accident has been succeeded by another, unwinding in a way that was not foreseen[16]. Further there is no guarantee that the reactors would be designed, built and operated correctly. Mistakes do occur and the designers of the reactors at Fukushima in Japan did not anticipate that a tsunami generated by an earthquake would disable the backup systems that were to stabilise the reactor after disaster struck. Therefore, it may be reassuring that the Prime Minister has ordered a safety audit of the existing plants and thus retro fitting these plants, if necessary, to withstand the impact of earthquakes and tsunamis. There has to be a disaster preparedness to meet any eventuality in the event of natural disaster, which can possibly have a bigger impact than the Fukushima crisis. Lessons learned from Fukushima and earlier accidents not only allow improvement with regard to technology and disaster management, but also stress upon the need for better preparedness for any kind of eventuality coming without any warning.

National Disaster Management Authority, Government of India, has issued National Disaster Management Guidelines for Management of Nuclear and Radiological Emergencies. The purpose of these guidelines is to spearhead and implement a holistic and integrated approach to managing nuclear emergencies—whether natural or man-made—through certain pre-planned and established structural and non-structural measures by various stake holders, as to minimise risks to health, life and the environment. These guidelines have been placed in position after intensive deliberations and discussions by experts from Government of India and have the approval of DAE and AERB. There has been no significant participation from state governments and society and also from Ministries like that of Health, Environment and Water Resources, etc. These Guidelines recommend a series of actions on the part of various stakeholders at different levels of administration that would (i) mitigate the accident at source; (ii) prevent deterministic health effects in individuals and limit the probability of stochastic effects in the population; (iii) provide first aid

[16] Gusterson, Hugh (2011), "The Lessons of Fukushima," *Bulletin of the Atomic Scientists*, March 16, www.thebulletin.org

and treatment for injuries; (iv) reduce the psychological impact on the population; and (v) protect the environment and property.

It is expected that the central government ministries/departments, state governments and local authorities would prepare detailed action plans to ensure inbuilt capabilities to handle nuclear emergencies.

The guidelines also state that AERB does not permit the operation of a new or existing power plant or radiation facility unless preparedness plans are in place for the emergency scenarios. The power plant operators are mandated to periodically conduct on-site and off-site emergency exercises. It is also being stated that detailed plant specific emergency plans are in place at all nuclear facilities and are functional for the entire life time of the facility. The most critical type of emergency of a nuclear plant is an off-site emergency where members of the public may get affected. Such plans are to be drawn up by the concerned District Collector in co-ordination with plant authorities. The guidelines do not throw any light on the state of existence and implementation of such on-site/off-site plans and the level of capacity that has been built up, particularly by the off-site stake holders including from amongst the public who would be affected in the first instance. If one were to draw any conclusion on this aspect based on the study of Monica Das Gupta *et al*., it appears that the mandate of AERB regarding off-site plan has not been carried forward otherwise the State Health Directorates would not have been so unaware of the duties that would have devolved upon them.

The Guidelines admit that even after the necessary capacities are acquired by various institutions, the actual implementation would involve the community, in association with individuals, non governmental organisations, community based organisations, private sector, etc., to evolve programmes and strategies to address local needs and priorities. Besides, there would have to be involvement of a host of central ministries and the state governments. Ultimate inspiration and sustenance for an emergency response teams would come from the political leadership who would use their influence of office to provide encouragement to fight impacts of disaster events.

The Guidelines devised by the Disaster Management Authority represent a valuable contribution by the experts and stakeholders. The guidelines may be further refined by having an open debate involving all those groups who would ultimately be called to adopt and assimilate the guidelines and implement in case of actual emergencies. Such a debate should focus on a definite time frame for capacity building at different levels while also looking for funding. Such an exercise would also include regular emergency safety protocol drills so that in case of emergencies the system is 'automatically enabled' as nuclear accidents are the deadliest and ugliest of emergencies and would not brook a delay. In the absence of such inputs as mentioned herein, the guidelines stated by Disaster Management are hardly implemented.

There is a particular issue peculiar to India that would arise in case a nuclear disaster strikes India. In the recent Fukushima Disaster, 80,000 people had to be evacuated from the plant's neighbourhood. In the context of an Indian accident, the figures would be much higher, given that India is one of the most densely populated countries in the world. The nuclear establishment chooses its NPP sites as a compromise between the mutually conflicting criteria of maximum availability of water and minimum population. The IAEA safety guidelines mandate emergency plans that should be known publicly and rehearsed periodically. Appendix V para 2 of "Emergency Exposure Situations" of IAEA Safety Series No. 115 (1996) states, "Emergency plans shall be prepared which specify how the responsibilities for the management of interventions will be discharged on the site (and) off the site...." and in Appendix V para 3(f), "prior information be provided to members of the public who could reasonably be expected to be affected by an accident." The NPP establishments have kept such provisions away from the public who would be affected.[17] Therefore, despite the availability of clear guidelines, the neighbouring population of NPP's has been instilled with a sense of complacency because of the lack of awareness programmes which would help prepare them to act swiftly and responsibly in case of real time emergencies. However, should such an eventuality

[17] Vombatkere, S.G. (2011), "Nuclear Accident Evacuation Blues: Moving India's millions," May 7, Countercurrents.org

arise there would be constraints of space and fast dispersal modes. The past performance of state and district level administration in evacuation of people following the tragedy at Bhopal does not inspire confidence towards tackling of an emergency like a level 7 nuclear accident. Should such a situation arise, as on date, it would paralyze everything. The action plan of the guidelines must deliberate on this aspect and clearly delineate the details with specific responsibilities so that in case of emergency in real time, there is smooth movement for evacuation.

At present, India has about 20 operating reactors. Let experts from DMA, central ministries, state governments, NGO's, etc., put their heads together and based on DMA's Guidelines, work out detailed evacuation plans plant wise which would become a model for upcoming reactors. Working out of such plans should give a fair idea of the magnitude of tasks involved for better preparedness by all the agencies. Such an exercise would also be an indicator for the resources required. Besides, should such an eventuality arise, public health issues would come to the forefront in many ways and a simulated model of emerging issues on health would be in order as part of the management exercise. There is a need for dedicated equipment for taking up monitoring studies on the IR effects on man and environment, including food chain. Such an exercise would provide soul to the otherwise inanimate guidelines of DMA.

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