To
Sri. Narendra Modi
Honourable Prime Minister
Govt. of India, New Delhi

Dated, 12th September 2019

Dear Sir,

Subject: Societal concerns over the Environmental Clearance (EC) accorded for the expansion of Kaiga Nuclear Power Project, Karnataka

Greetings from Sagar, Western Ghats, Karnataka.

It is with deep distress that I am writing to appeal to you to ask for a diligent reconsideration of the Environmental Clearance (EC) accorded by MoEF&CC (IA Division) vide a communication dated 5th August 2019 to NPCIL, Mumbai for the expansion of the capacity of the Kaiga Nuclear Power Project in Uttara Kannada district, Karnataka. This EC refers to the proposal by NPCIL/DAE to add two nuclear reactors of capacity 700 MWe each to the existing capacity of 4 reactors of capacity 235 MWe each within the core area of Western Ghats which is designated by MoEF&CC as an ecologically sensitive area (ESA), within the ESZ of The Anshi National Park, with the additional status as Dandeli-Anshi Tiger Reserve, and on the bank of the river Kali surrounded by some of the richest biodiversity of tropical forest in a biodiversity hotspot of a global perspective.

Despite massive protests by the locals; despite a detailed submission on the serious associated concerns during the official public hearing as per EIA rules of 2006 on 15.12.2018; despite a detailed representation in this regard to MoEF&CC on 18.12.2018; and despite another representation to Atomic Energy Commission on 23.12.2018, I notice that MoEF&CC has conveyed the EC, which obviously has ignored everyone of the credible concerns, and without even trying to ascertain the associated concerns, or without giving me an opportunity to substantiate my concerns.

The communication dated 6th Sept. 2016 by MoEF & CC, informing NPCIL on Terms of Reference for the project proposal, had clearly stated that the area within 10 kM is predominantly forest land with dense growth of tall and stout trees, and that the forest is categorised as reserve forest. The Anshi National Park, with the additional status as Dandeli-Anshi Tiger Reserve, is at a distance between 718 m to 1,734 m from Kaiga project site as per the EC. MoEF&CC vide its Circular dated 27.02.2007 and Office Memorandum dated 02.12.2009 has delineated a procedure for consideration of developmental projects located within 10 km of National Park/ Wildlife Sanctuary for grant of environmental clearance under EIA Notification, 2006. Hence, it is a clear violation of its own policy that this project proposal,

as a part of the nuclear power project being a red category industry as per the Pollution Control Board norms, should get environmental clearance.

The region around the Kaiga NPP, which also has an important river Kali flowing through it, is ecologically very sensitive, and is considered to be of very high ecological value from the global warming perspective. This area, around Kaiga NPP including the three villages of Kaiga, Mallapur and Virje, which are identified as project area in the EIA, is anyway declared as Ecologically Sensitive Area by a draft notification (3rd Oct. 2018) of the MoEF&CC. The decision to set up the Kaiga NPP in such an ecologically sensitive region in 1990s itself was an enormous policy blunder, which has resulted in incalculable ecological damage to the rich biodiversity here. Three reports from the scientists of IISc, Bengaluru under the title, (i) "Ecological Sustainability of Riverine Ecosystems in Central Western Ghats", 2018; (ii) "Stimulus of developmental projects to landscape dynamics in Uttara Kannada, Central Western Ghats", ELSEVIER, 2016, and (iii) "Salient Ecological Sensitive regions of Central Western Ghats, India", Springer Nature 2018, have all copiously highlighted the ecologically critical importance of the area around Kaiga NPP. Our society should not be seen as continuing with such policy disasters by permitting further destruction of more than 54 hectares of thick forests at a time when these tropical forest are considered by IPCC as the most effective and cost effective option to address the threats of Climate Change.

These issues clearly emphasize the need for MoEF&CC to view all the related issues with the highest level of responsibility as the custodian of the environment, and not to dilute its own Acts, rules and policies. Obviously the MOEF&CC needs a very strong mandate from PMO to carefully review the existing forest and environment related policies to ensure the sustenance of ecological services through the sustainable forest management strategies. I may please be excused to state that the ongoing policy of MoEF&CC to accord EC to almost all such project proposals to divert thick original forest lands, especially for those of the Union and state governments, can be seen as a serious dereliction of it Constitutional responsibilities, when we also consider the fact that all the credible concerns by the civil society groups are being completely ignored, as in the case of my own submission at the associated Public Hearing on 15.12.2018 (a copy enclosed for your kind attention as in Annex 1). My appeal to you is not to allow the trust of the people in MOEF&CC, which is already at a low, to completely disappear.

My detailed submission at the official public hearing on 15.12.2018 had highlighted a large number of issues/concerns in the Environmental Impact Assessment (EIA) of the project proposal (only on which the decision to issue EC seem to have been arrived at), totaling more than 80 issues over a length of 22 pages. These concerns from the perspective of technical, economic, environmental, social, logistics, disaster management, inter-generational, and long term waste disposal have all enormous costs/implications to the local communities and the country as a whole, when compared to a meager benefit of only about 800 MW power (i.e net power when we consider various constraints of the power system) from the project. A diligent application of 'Options Analysis' and 'Costs and Benefits Analysis' from a country level perspective (which EIA has failed to consider), will reveal that there are very many benign options available to our country to obtain the equivalent of 800 MW of net benefit from this

project at much less overall cost to the society without having to cause any serious damage to the ecology of a bio-diversity hotspot.

A close perusal of the EIA has demonstrated that there is no single parameter discussed in it which can remotely establish that this project proposal is essential, and of least overall cost to our society. When we also objectively consider the unmitigated disasters associated with a credible scenario of uncontrolled nuclear radiation emission, however remote it may be, as witnessed in Chernobyl and Fukushima, it should become amply evident that the project proposal is not only unacceptable but also it is totally avoidable.

This EIA is found to be seriously deficient in not considering: (i) the details and costs associated with the additional transmission lines required for the project; (ii) adequate details of disaster management plan to safely evacuate more than 32,000 people of the immediate surroundings (within the emergency-planning zone up to 16 km radius) and rehabilitate them satisfactorily in the case of any unfortunate nuclear accident of the type noticed at Chernobyl and Fukushima; (iii) policy and details associated with the safe disposal and long term storage of spent nuclear fuel; (iv) "options analysis" and " costs and benefits analysis" of various techno-economically feasible options of much less overall cost available to our country to get the same amount of electricity in particular and in meeting the electricity demand in particular; (v) to establish beyond reasonable doubt the project is the best option in the larger context of the region, country and the planet.

This project proposal, if allowed to be executed, will cause enormous damage to the ecologically sensitive region by destroying more than 54 hectares of dense forest land of very high ecological value. In addition to about 8,700 mature tress which will have to be cut in this 54 hectares of thick forest, there will be a need to cut many thousands more of mature trees in order to construct new transmission lines to transport the additionally generated power. The project proposal has conveniently chosen not to mention this additional need for forest land diversion, and the MoEF&CC has failed to take note of the same. Whereas, the EC states that the approval by National Wild Life Board is required, it is a moot point as to why the EC was given hurriedly before the approval by National Wild Life Board is available. Is it intentionally done to put pressure on the National Wild Life Board to accord the approval?

I may please be excused to state that under the prevailing scenario in the country and the planet, as detailed herein, it will be a travesty of social and environmental justice, and the violation of the provision of the country's Constitution and provisions of many relevant Acts of the Parliament to allow the diversion of more than 54 hectares of dense forest land of very high ecological value, and 6,346 cubic meter per hour of fresh water from river Kali, which can meet the daily needs of about 15 lakh people to this enormously risky project, because the main objective of this project can be realized at much less overall cost and vastly reduced burden on the environment and population through many benign options. A high level examination of "options analysis" and "costs and benefits analysis" is also enclosed for your kind information (Annexe 2).

As a person who attended the Public Hearing on 15.12.2018, I am sad to notice that the letter conveying the EC states, wrongly though, that “people’s perception regarding the project in general is favorable specifically due to local infrastructure development, employment opportunities, area and business development etc.” I would like to highlight that the true scenario of that Public Hearing was that out of about 18 people who made the submission, about 16 people clearly stated that they were vehemently against the project proposal. MoEF&CC has allowed the overwhelming opposition to the project to be falsely stated as one of favoring the project. Such intentional falsehood on the part of the concerned authorities amounts to the misuse of the trust of the people in the sanctity of MoEF&CC’s decision making processes.

In the context of such misrepresentation of the overall message of Public Hearing, what might have transpired in the Environmental Clearance process indicates that the associated Public Hearing was a farce, and has amounted to a cruel joke on the participating public, because the overarching mood of the participating public was not only falsified in the EC letter, but the EC appraisal proceedings by Environment Appraisal Committee (EAC) in relation to nuclear projects is also intentionally hidden from the public. Whereas the EAC seem to have blindly accepted the views of the project proponent, even though there is a very high probability of falsehoods and hidden truths in the submissions of the project proponents, it is deplorable that the civil society groups/ project affected people are not allowed to appear before the EAC. In the present case, it is clear that the project proponent has got away with incomplete/incorrect information, and by intentionally ignoring much benign options available to our country to get the same amount of electricity.

A diligent application of the “Options Analysis” and “Costs and Benefits Analysis” would have established that all other options available to meet the growing demand for electricity in our country would be much less costly and much benign than the nuclear power option. By not allowing the civil society groups/ project affected people to respond to the tall claims made by the project proponent, EAC and MoEF&CC may be just permitting themselves to be misguided by falsehood of the project proponent at enormous cost to the country. Hence, I appeal to you mandate adequate transparency in every step of such approval processes of MoEF&CC. The concerned civil society groups/ project affected people /domain expert should be encouraged to participate in the deliberations of EAC at the time when the project proponent makes submissions.

With the proposed increase of about 250% in the overall reactor capacity at the project site, the Kaiga NPP site will face exponential increase in radiation emission risks with the presence of six nuclear reactors in close proximity with each other and sharing many technical services. Nuclear safety experts identify such a scenario as "enhanced risk for NPPs with multiple reactors and shared technical facilities". A serious issue noticed in the EIA was the unanswered questions over the inadequate preparedness on part of the concerned authorities during any unfortunate accident of the type which occurred in Chernobyl (USSR) and Fukushima (Japan).

The EIA is without any action plan in this regard, and seems to be keen to pass on all the associated responsibilities to the local district administration, which shall not be acceptable to the people of the state. It is a general public opinion that the concerned authorities in the country are ill-equipped and ill-prepared to face such industrial level disasters as experienced in the case of Bhopal gas tragedy in 1984. A detailed representation highlighting the serious concerns to the public in this regard addressed to the Atomic Energy Commission as in the Annexe has not resulted in any response (Annexe 3).

Few critical considerations for our country in this context should be: (i) at a time when the country is seeking to be a global leader in combating the threats of Climate Change, it can be said to be a criminal act to destroy 54 hectares of dense tropical forest of very high ecological value; (ii) at a time when the country is finding it hard to fight the water crises impacting many millions of people, and at a time when it is hosting 14th Conference of Parties (COP 14) of the United Nations Convention to Combat Desertification (UNCCD), the MoEF&CC seems to be oblivious of the fact that loosing the natural forest cover is the first step in desertification; (iii) whereas, against the national forest policy target of 33% of the land area to be covered by forests and trees, and the present status is only about 21%, the ministry instead of focusing on increasing this percentage cover, seems to have no qualms in permitting the diversion of large chunks of forest lands, as is evident from the reports of thousands of hectares of forest lands being diverted every year in the name of development projects.

A clear conviction of IPCC w.r.t the forests is represented by two associated statements: “Emissions from deforestation are very significant – they are estimated to represent more than 18% of global emissions”; “Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions.” In this context it may even be termed as a crime against humanity to even consider diverting more than 54 hectares of thick tropical forest lands to the proposed project, whose net benefit to the larger society can also be argued as negative, when we take into account the life –cycle cost of the nuclear power beginning from the nuclear ore mining till the nuclear wastes are safely.

The major concerns mentioned above, in addition to many other concerns raised in the Public Hearing (as in the copy attached), have serious implications to not only the people in the district and adjacent areas, but also to the entire region, if not addressed adequately. I may please be permitted to state that in view of the fact that the concerned authorities, whether it was AEC or MoEF&CC, have ignored to clarify any of these issues, and seem to have ignored every critical issue while according the EC, the entire approval process followed under EIA Rule 2006 can be said to be faulty, and hence should not be relied upon as a diligent economic/ environmental decision making tool.

Whereas, the country recognizes your commitment for the overall welfare of our people through lofty ideals, tough performance targets and untiring efforts to realize them, it appears that the ministers and bureaucrats do not seem to support you adequately in that regard. The escalating number of incidences of forest loss / degradation, pollution / contamination of air, water and soil with disastrous consequences on our community’s overall health and welfare

can all be said to indicate that they are failing in their Constitutional responsibilities. A frequently highlighted slogan of your govt. **"sub ka saath, sub ka vikaas, sub ka vishwaas"** seem to be completely absent in the omissions and commissions of the ministers and bureaucrats. They may kindly be asked to strictly demonstrate the adherence to the letter and spirit of the Constitution, associated Acts of Parliament, and their own policies, rules and norms. They may also be asked to adhere to the minimum courtesy of responding to the serious concerns expressed by the people of this country, and certainly not to ignore the genuine concerns of societal importance.

If desired so by PMO, a group of the concerned civil society volunteers will be happy to make an effective presentation to you on the criticality of the diligent adoption of "Options Analysis" and "Costs and Benefits Analysis" in all the relevant economic decision making processes so as to ensure the sustainable development of our communities, and also on various other related issues.

May I appeal to you to put a moratorium on any kind of diversion of original and thick forest lands to non-forestry purposes until the forest & tree cover in the country reaches the target of 33% of the land area as per the national forest policy?

In the present context, may I appeal to you that the environmental clearance (EC) accorded for the expansion of Kaiga Nuclear Power Project, Karnataka be summarily cancelled, and the project proponent be asked not to consider any such proposal in the Western Ghats?

Regards

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Enclosures:

Annex 1 - my submission at the associated Public Hearing on 15.12.2018
Annex 2 – a high level analysis of costs and benefits of nuclear power plants in India
Annex 3 - a representation to Atomic Energy Commission (AEC) on the issue of absence of disaster management plan for Kaiga NPP

Annex 1

Written submission during the public hearing over EIA of the proposal on Kaiga NPP extension (Units 5&6)

15.12.2018

Mallapur-Virje, Uttara Kannada, Karnataka

To

The Deputy Commissioner
Uttara Kannada, Karwar, Karnataka

&

Chairman, Environmental Public Hearing Committee
On Proposed Nuclear Power Plant Units at Kaiga (V & VI)
E-mail: dckarwar@gmail.com

Copy with complements to:

1. **Chairman**
Karnataka State Pollution Control Board
"Parisara Bhavan", #49, 4th & 5th Floor,
Church Street, Bangalore-560001
E-mail: chairman@kspcb.gov.in

2. Secretary
MoEF & CC, Govt. of India, New Delhi

Dear Sir,

Subject: Submission for the Public Hearing as per EIA Rule 2006 on 15th Dec. 2018 over the proposal by NPCIL for adding Units 5 and 6 (2*700 MWe) at Kaiga Nuclear Power Project at Kaiga, Karwar Taluka, Uttara Kannada district, Karnataka.

I, Shankar Sharma, live in Sagar, in the adjacent district of Shimoga within the Western Ghats (WGs) of Karnataka, and I am concerned about the seriously adverse impacts of the proposed project on the people of this county in particular, and in conserving the natural wealth of WGs in general.

I have gone through Environmental Impact Assessment (EIA) report prepared for the proposal by NPCIL for the capacity expansion (adding Units 5 and 6) at Kaiga nuclear power project, Karnataka. Whereas multiple deficiencies in the EIA report are glaring from different perspectives, few things stand out, and can be treated as adequate grounds to summarily reject the EIA and the EC to the project.

Environmental, ecological and water usage Concerns:

1. The section 3.6 of the executive summary of EIA states: "The project site is located in the interior part of Western Ghat of peninsular India. Kali (Dandeli-Anshi) Tiger Reserve (KTR/DATR) extends from NE to NW. The minimum distance observed varies between 718 m to 1,734 m from Kaiga site Exclusion zone boundary." The communication dated 6th Sept. 2016 by MoEF & CC, informing NPCIL on Terms of Reference for the project proposal, had clearly stated that the area within 10 kM is predominantly forest land with dense growth of tall and stout trees, and that the forest is categorised as reserve forest. Since a Tiger Reserve area must have 10 kM of buffer zone, the proposed project area is clearly within the buffer zone of Kali (Dandeli-Anshi) Tiger Reserve. In this context, it is shocking that about 54 Hectares of thick forest lands of very high ecological value from the Climate Change perspective, and within a forest reserve, and in the buffer zone of a Tiger reserve is being proposed to be diverted to the project against all known wisdom of environmental upkeep. This is clearly against the critical need of the hour to preserve and enhance the vastly important tropical forests, as per IPCC (even though this much of forest land is said to be already under the possession of NPCIL). Since the ownership of the forest land is not of any relevance as long as it is allowed to continue to provide the associated ecological services, the diversion of this forest land and additionally few sq. kM of the adjoining thick forest lands required to construct the additional transmission lines will be completely against the interest of not only of the local communities, but also against India's global obligations w.r.t Climate Change.

2. The Gazette notification no. 3956 of 3rd October, 2018 (as applicable to MoEF&CC) proposing to implement the recommendations of the High Level Working Group (also generally referred to as Kasturi Rangan Committee) has notified the identified area of 56,825 square kilometre which is spread across six WGs states as the Western Ghats Ecologically Sensitive Area. As per Annexure C, (Page 161) of this Gazette notification, the villages of Kaiga, Mallapur and Virje, which are identified as the proposed project areas in the EIA, are declared as ecologically sensitive areas to be completely protected. Hence, the question of environmental clearance for this project should not be entertained at all.

3. The National Forest Policy of 1988 and the draft National Forest Policy of 2018 have unequivocally advocated the relevant need as: “In the hills and mountainous regions, the aim will be to maintain two-third of the area under forest & tree cover in order to prevent soil erosion and land degradation and also to ensure the stability of the fragile eco-systems”. The district of Uttara Kannada in Karnataka, where the project site is located, is largely a hilly district within the core area of the Western Ghats, which the MoEF&CC has committed to protect and conserve. The forest and tree cover area is already reported to be less than 45% in this district. Hence, diversion of more than 54 Hectares of thick forest lands in this district for the proposed project will negate the very objective of MoEF&CC.

4. At a time when the forest & tree cover in the country and in Karnataka is only about 20% as against the national forest policy target of 33% of the total land area, and against the target of 66% of the land area in hilly districts, the proposal to divert more than 54 Hectares of thick forest land in the hilly district of Uttara Kannada (Karwar) district in addition to many sq. kM of forest required to build the additional transmission lines may be termed as against the letter and spirit of

our Constitution and of the relevant Acts of Parliament on environment and forests. It will also be in negation of India's commitment to the global community to being a leader in addressing the Climate Change, wherein the conservation and enhancement of tropical forests is clearly acknowledged as one of the most effective solutions by IPCC.

5. A clear conviction of IPCC w.r.t the forests is represented by two associated statements: "Emissions from deforestation are very significant – they are estimated to represent more than 18% of global emissions", "Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions." In this context it may even be termed as a crime against humanity to even consider diverting more than 54 hectares of thick tropical forest lands to the proposed project, whose net benefit to the larger society can also be argued as negative, when we take into account the life –cycle cost of the nuclear power beginning from the nuclear ore mining till the nuclear wastes are safely.

6. Recently on 11th Dec. 2018 the Supreme Court has directed the Union government to declare 10 kilometres areas around 21 national parks and wildlife sanctuaries - including three from Karnataka - as an eco-sensitive zone, restricting and regulating commercial, industrial and other and other activities over there. "Under the circumstances, we direct that an area of 10 kM around these 21 national parks and wildlife sanctuaries be declared as an eco-sensitive zone by the Ministry of Environment and Forest". The latest order from the Supreme Court should indicate the gravity of the environmental protection in the country, and the importance of conserving the core bio-diversity regions.

7. In view of all these facts and developments, it may be construed even as an act of criminal negligence/indifference on part of all the concerned to approve/encourage the diversion of any forest lands in such ecologically sensitive areas. Hence, the environmental clearance for this project should not be even considered.

8. The region around the Kaiga NPP, which also has an important river Kali flowing through it, is ecologically very sensitive, and is considered to be of very high ecological value. The decision to set up the Kaiga NPP in such an ecologically sensitive region in early part of this century itself was an enormous policy blunder, which has resulted in incalculable ecological impact. A study report by a team of scientists from IISc, Bengaluru under the title "Ecological Sustainability of Riverine Ecosystems in Central Western Ghats" in 2018 by T.V. Ramachandra and team has done a detailed analysis of the ecological impact of large human intervention in the region around Kali river in Uttara Kannada district between 1973 and 2016. This report states that the cover of evergreen to semi evergreen forest in this region has come down from about 62% to 39%. In view of the ecologically sensitivity of this region, this study report has strongly recommended the prohibition of certain human activities, which includes the setting/expansion of nuclear and hydro power stations, where withdrawal of large mass of water from Kali river in involved. The area around Kaiga village is anyway declared as Ecologically Sensitive Area by a recent notification (3rd Oct. 2018) of the MoEF&CC. In this context, withdrawal of additional large quantity of water from the river Kali (as needed for the Units 5 & 6) should be prohibited even though the EIA says that the

state govt. of Karnataka has earlier approved the withdrawal of Kali river water needed for the entire Kaiga NPP.

9. EIA states that there will be additional fresh water demand of 9,000 cubic meters per hour (out of which about 6,346 cubic meter per hour will be for consumptive use) for the proposed project. Two other reports from the scientists from IISc, Bengaluru under the title, "Stimulus of developmental projects to landscape dynamics in Uttara Kannada, Central Westen Ghats", ELSEVIER, 2016, and "Salient Ecological Sensitive regions of Central Western Ghats, India", Springer Nature 2018, have copiously highlighted the ecological importance of the area around Kaiga NPP. Among other things these reports say: *"Spatially 52.38% of the district represents ESR 1, while 14.29% of area represents ESR 2, 13.1% of area represents ESR 3 and about 20.23% of the district is in ESR 4. Regions under ESR 1 and 2 are "no go area" for any developmental activities involving large scale land cover changes. ESR 2 has eco-sensitiveness similar to ESR 1 and has the potential to become ESR 1 with the appropriate eco-restoration measures. Persistence of the endemic (rare, threatened, etc.) species in ESR 1 and 2 calls for serious attention from conservationists and decision makers to initiate programs immediately for conservation. Forests with innumerable streams (i.e., water course forests) in the Western Ghats, offer tremendous potential for carbon stocking per unit area while also bettering the hydrology of these mountains, which form the main watershed for the entire Indian peninsula. These water course forests are not only rich with biodiversity, but are also with high biomass, which highlights the greater carbon sequestration potential and their prime role towards mitigation of impacts of global warming. This emphasizes the need for the review of existing forest policies to ensure sustenance of ecological services through the sustainable forest management strategies."*

10. Keeping all these factors in proper perspective, it is evident that the area in and around the proposed project area is ecologically of very high value to the nature, and sensitive too, not just for the forest dependent locals, but also for the global concerns on Climate Change. MoEF&CC has been very emphatic that such areas must be protected, and hence must be insulated from all kinds of developmental projects. The state, the country, and the planet as a whole, cannot afford to lose more than 54 Hectares of tropical rain forest of very high ecological value to the nation's and planet's environment for the sake of an inconsequential additional power, as in the case of this project proposal.

11. The availability of water for a nuclear power project has always been a major problem, particularly for those nuclear plants located far from the coasts and dependent on freshwater. Another associated problem is the temperature of the water that's available for cooling purpose. It is well known that many nuclear power plants in US and Europe were forced to shut-down due to either low water levels in the rivers and/or due to increased inlet water temp. The phenomenon of Climate Change, which is credibly projected to impact a tropical region like India, will have enormous impacts on both the availability of fresh water and the temperature of water in the Kali river. The heat wave that struck Europe in the summer of 2018 forced utilities to scale back electricity production at nuclear plants in Finland, Germany, Sweden and Switzerland. In France the utility EDF shut down four reactors in one day for this reason. Such risks, not only from the perspective of the loss of electricity generation but also from the perspective of the loss of cooling

system for the reactors, must have been analysed diligently in the case of Kaiga NPP too, which can be realistically projected to face such problems in its economic life time. And hence, the risk of failure of the safe shutdown of the reactor cannot be underestimated.

12. The fresh water demand for nuclear plants should be of particular concern for a water deficient nation like India, and for a drought prone state like Karnataka. Nuclear reactors are known to require about 720 gallons of water per megawatt-hour of electricity they produce, according to data from the National Energy Technology Laboratory in West Virginia cited in 2012 by the magazine New Scientist. That compares with the roughly 500 gallons coal requires and 190 gallons natural gas needs to produce the same amount of electricity. Solar plants, by contrast, use approximately 20 gallons per megawatt-hour, mostly for cleaning equipment, according to the Solar Energy Industries Association. In his context, can the state of Karnataka, which has faced drought scenario in about 50% of its revenue sub-divisions in most of the years since year 2000, afford to divert 6,346 cubic meter per hour of fresh water, as consumptive use, for the said project (as per EIA report, page 93) ?. At the rate of 6,346 cubic meter per hour the water consumption in a day will be 152,304 cubic meters, which is 152,304 kilo litre of fresh water. At about 100 litre per day this can meet the daily water requirement of about 15 lakh people.

13. EIA (section 02.16) states: "Power evacuation scheme will be finalized by Central Transmission Utility (CTU) in consultation with Central Electricity Authority (CEA) and constituents of Southern Regional Grid." Additional Transmission line works and the associated environmental impacts seem to have not been mentioned in the EIA intentionally; probably because the project proponent seems to believe that MoEF&CC can be subsequently lobbied to view it as 'inevitable' after the works for the power plant begins and after having spent a lot of money. Such a ploy by project proponents to segregate the forest land requirement for generation site and for transmission lines is reported to have occurred few times in the past, and hence can be considered to be an irresponsible act. The project proponent is making efforts to hide the fact that it will also need diversion of many sq. kM of thick forest lands for additional transmission lines. This is a major concern as a large number of dense, tall & stout trees are likely to be cut for the transmission lines. How many additional transmission lines, at what voltage, and for what lengths will be needed/planned? How much of the forest area to build such lines will have to be diverted? How many tress need to be cut? It is deplorable that without planning the evacuation paths for the generated power the environmental clearance for a large size project is being sought. Knowing well that the increase in the overall generating capacity will be about 250%, there will be clear need for additional transmission lines. Without considering all such aspects of the environment the entire project EIA is incomplete and hence the application for EC should be summarily rejected.

14. The MoEF&CC, in its previous avatar, had dealt a policy blow to the people of this region and the country by allowing such a high impact project in the thick forests of Western Ghats, and has consciously allowed diversion of 120 hectares of thick tropical forest land to set up Units 1 to 4 at Kaiga NPP. It must not aggravate the same blunder by allowing an expansion in this project area which will be more than the double the size of the original capacity at enormous costs to the region and to the global ecology.

These issues alone must be sufficient reasons to summarily reject the project proposal in its entirety and in the particular, this EIA. Hence I strongly urge MoEF&CC to reject the project proposal.

However, there are more concerns on economic, technical and logistical front.

Risk Analysis, Logistics and Safety Issues: concerns on radiation, waste management and disaster preparedness

15. Without an effective risk analysis and disaster management plan (as should be applicable to the scenario such as the disasters at Chernobyl and Fukushima) the project proponent, through this EIA, has failed to assure the local communities of the safety of their lives.

16. In engineering parlance, the term 'risk' is described as "the product of the magnitude of a risk and the consequences of such a risk". In the case of a nuclear power reactor, such as the ones at Kaiga, though the authorities claim that the risk of a catastrophic nuclear accident is low, the consequences of any such unfortunate accident to the locals and the country as a whole can be horrendous. Hence, the risk analysis for such a site with multiple reactors connected to few common technical facilities should have been done diligently and appropriate remedial actions should have been clearly planned.

17. Without an effective risk analysis and disaster management plan (as should be applicable to the scenario such as the disasters at Chernobyl and Fukushima) the project proponent has failed to assure the local communities of the safety of their livelihood/lives. The addition of two nuclear reactors of 700 MWe capacity each at the existing site with four of 220 MWe capacity reactors shall mean that the total reactor power capacity at the site will go up by about 250% with the corresponding increase in normal radiation levels and the catastrophic failure risk also by similar margin, if not more. Our communities deserve much better considerations on their welfare aspects than being subjected to such avoidable risks for the sake almost negligible benefits.

18. There is already a considerable amount of literature on the analysis of risks arising on account of catastrophic nuclear accidents similar to Chernobyl and Fukushima, and due to multiple reactors and shared technical facilities. Many such studies indicate an "enhanced risk for NPPs with multiple reactors and shared technical facilities". The existence of 4 reactors has already enhanced the cumulative risk of an accident at Kaiga. Adding two more units of 700 MWe capacity each further compounds the risk. It is very sad to find that the EIA report is totally silent on the rich research literature that exists on the subject and its application to the proposed expansion project. A public hearing based on such a sketchy EIA document does no justice to the purpose for which it is supposed be held.

19. Radioactive releases are mentioned as estimates only for Unit 5 & 6. What is required is the estimated maximum value of the total release when all the 6 units in the plant operate simultaneously at the maximum output. Will this value be well within the safety limits for the humans and other species as accepted by the international standards?

20. Long term management of nuclear wastes is not adequately described in EIA. Will the mentioned procedure of disposing the nuclear waste at the bottom of earth trenches and RCC trenches/vaults, and suitably sealed permanently as per established practices, will also be the long term storage plan? What actions will be taken/planned to keep such wastes adequately cooled and safe for hundreds of years, and how will the same be guaranteed?

21. Executive summary of EIA states: "During operation of the reactors, spent fuel bundles are removed from the reactor core and transferred to Spent Fuel Storage Bay (SFSB), where it is stored till it cools down to dry storage level (about 10 reactor years). SFSB can accommodate 10 years of spent fuel and one full core load. Subsequently, the spent fuel will be stored in an Away From Reactor Facility (AFR) or Additional Away From Reactor Facility (AAFR) to be constructed at the site. Further action on the spent fuel is governed by the policy of the Department of Atomic Energy/ Government of India. (Section 2.2)".

22. This is not a responsible statement and hence cannot be accepted. Spent fuels are reported as being accumulated in respective reactor sites in India since about 50 years. The fact that there is no long term storage policy for spent nuclear fuel, even after 50 years, will not assure the locals and the people of the region that they are adequately safe from nuclear radiation beyond 10 years. Until these issues are clarified in adequate details, and the guarantee of safety of all procedures and the end result are convincing enough the environmental clearance should not be given.

23. Emergency evacuation procedure for the public, in the case of a large scale release of radiation, is not detailed in EIA. It is important to know at what stage of any unfortunate nuclear accident will the affected communities be evacuated and what are the proposed arrangements? Where are the hospitals to treat the maximum of 30,252 persons (as per section 3.9) and how will these people be evacuated and transported? Have all the families and habitats, who are likely to be affected, accurately identified, and whether adequate number of all weather roads available to evacuate them at a short notice, say in mid-rainy season? What sort of radioactive danger communication facility to each one of these people is available at present in the unfortunate scenario of a Fukushima type accident? Where are the safe nuclear shelters to house these people? Are the local authorities such as the Deputy Commissioner, Tahsildars, Panchayats, Doctors etc. trained and provided with necessary equipment to detect any radiation leakage and to take the necessary safety measures immediately? Have sufficient number of vehicles identified and available at short notice to evacuate these people to safety?

24. Section 07.06.04of EIA "Off-site emergency" states: "An off-site emergency occurs when the radiological consequences of an emergency situation originating from Nuclear Power plant (NPP) are likely to extend beyond the site boundary (exclusion zone) and into the public domain. For the purpose of planning off-site emergency, an emergency-planning zone up to 16 km radius is specified. There are defined criteria to determine an off-site emergency in terms of the release of radioactivity as indicated by the radiation monitoring system/radiation survey results. The protective measures in public domain shall be implemented by the district officials under the supervision of the district collector or the divisional commissioner, who shall be designated as the

Off-site Emergency Director (OED). If there is an escalation in the site emergency situation warranting an off-site radiation emergency, the SED advises the OED to declare off-site emergency. District commissioner, Uttara Kannada takes over the charge of OED and initiates appropriate actions. Off-site emergency is declared by the OED on the advice of SED." In this context there is a critical need for the state govt. to diligently examine whether there is necessary arrangements to intimate the OED as early as possible of the radiation emergency, and whether OED, who is Deputy Commissioner of Uttara Kannada district in this case, is equipped with all the necessary infrastructure at his disposal to take the appropriate measures on a war footing. These infrastructures include the proper training for all the concerned district level and taluka level officers, including medical staff, adequate number of passenger vehicles, clear identification of the concerned inhabitants, their habitats, all weather roads, hospitals and medicines, long term shelters, proper communication to inform these inhabitants etc.

25. The EIA has not addressed these issues in any detail other than transferring responsibility to the Deputy Commissioner. In this context it has become critical for the state govt. to deliberate on all the associate issues to adequately safeguard the legitimate interest of the concerned inhabitants in the case of a radiological emergency.

26. 16 km radius as safe zone, as identified in EIA, shall mean an area of about 800 sq. kM. How will such a large densely forested and hilly terrain be covered under safety/disaster management plan; how many emergency disaster management staff and medical staff are needed for such an operation; and whether these measures are permanently in place for effectively dealing with the emergency situation? EIA has failed in this context, which seem to indicate that the project proponent may abrogate its primary responsibility in the associate issues, including the bearing of the costs, and provide the expert medical care, which will not be available in the local hospitals.

27. "There's no reason to keep throwing good money after bad on nuclear energy," Lauren Lantry, a Sierra Club spokeswoman, has said on nuclear power. "It's clear that every dollar spent on nuclear is one less dollar spent on truly safe, affordable, and renewable energy sources like wind, solar, energy efficiency, battery storage, and smart grid technology."

28. In view of the insignificant/irrelevant contribution of nuclear power to Indian scenario (the installed nuclear capacity is less than 2% of the total power capacity in the country as on today, and the same will be most likely to be less than 0.5% by 2026, which is completion target for this project as per EIA), the local community, the state of Karnataka and the entire country should not be burdened with the unacceptable costs and risks associated with the financial, social and environmental/ecological aspects of building, operating, decommissioning and safe disposal of nuclear wastes.

The nuclear safety concerns in India

29. Whereas the Chernobyl accident in 1975 was a grim reminder of the reality of the dangers associated with nuclear power, the Fukushima accident in 2011 shook the world from its stupor. Since then many countries (Germany, Japan, Italy, and Switzerland) have announced the plans to

move away from nuclear power. France, US and South Korea have announced plans to drastically cut the share of nuclear power.

30. The credible risk perception of any unfortunate nuclear accident should be a matter of great concern to any community close to a nuclear power project. A cursory look at the social and environmental impacts of two calamitous nuclear reactor disasters in human history at Chernobyl and Fukushima should be enough to indicate the grave risk facing the communities near and far around Kaiga NPP (and of course the other nuclear power projects in the country). It is reported that due to the nuclear accident an area of about 650,000 acres around Chernobyl has become unfit for human habitation even after a lapse of 30 years. It will be a horror even to imagine the consequences of an unfortunate nuclear accident on a densely populated country like India, which is already facing serious issues of land availability. Addition of two nuclear reactors at Kaiga NPP will only increase the probability of such an accident, the consequent cost of which can never be calculated and recovered. Since the communities around Kaiga NPP are distributed over a large forested and hilly area, the evacuation of every one of them in case of a nuclear emergency will be a huge challenge. A diligent study of this scenario by the National Disaster Management Authority may throw up many challenges. This may be true in many other existing or planned project locations too in India.

31. Hence, due diligence with all possible seriousness and accountability is critical but the EIA has failed miserably in this expectation.

32. In view of the increased probability of a nuclear mishap at Kaiga NPP because of multiple reactor proposal, and in many other project locations in the country, it is essential to take note of what Dr A Gopalakrishnan, former Chairman of Atomic Energy Regulatory Board (AERB) has to say on safe practices in nuclear industry in India: "Japan (*which could not prevent the Fukushima disaster*) is a country that has a superb disaster management organisation throughout their nation, and an often-rehearsed working team to handle such emergencies. In contrast, in India, we are most disorganised and unprepared for the handling of emergencies of any kind of even much less severity. The Atomic Energy Regulatory Board's (AERB's) disaster preparedness oversight is mostly on paper and the drills they once in a while conduct are half-hearted efforts which amount more to a sham."

33. An insightful article, "The missing safety audits" by Dr A Gopalakrishnan poses many serious concerns on the safety aspects in the nuclear establishment of the country. What Dr. A. Gopalakrishnan has recommended as safe operating practices for Indian nuclear industry may be seen as real concerns to the existing nuclear reactor sites, on the apprehension that these recommendations might not have been implemented. He has recommended that the nuclear power policy of the government should be thoroughly debated in parliament and openly discussed with energy specialists in the country. "It should be preceded by a re-look of the overall energy policy of our country to assess whether all viable non-nuclear electricity generation schemes have been given their due priority, before we jump-start an extensive nuclear power programme."

34. It is very unfortunate that the considered opinion of such a nuclear power expert of our own country has not been heeded to by the nuclear industry and the Union govt., because of which the apprehension of various communities around the country has only been increasing with the addition of each nuclear reactor. Those who are concerned with the nuclear energy related issues in the country seem to be right in their apprehension that with the addition of each nuclear reactor the cumulative risk to our communities is only increasing exponentially, basically because the concerned authorities have refused to engage the public in confidence building measures on the safety of the nuclear facilities. In such a scenario DAE/NPCIL should have displayed lot more diligence in preparing its EIA than that can be seen in this case.

35. The leaders of Russia and Japan, who were at the helm of affairs at the time of nuclear disasters at Chernobyl and Fukushima, have expressed similar concerns about the safety of nuclear power technology and have also cautioned the global communities to be extra careful before investing in nuclear power technology.

36. As welfare oriented society with dense population, India cannot afford not to take cognizance of such concerns by a former Chairman, AERB, and many other civil society leaders. We cannot expect the civil society either to be rest assured until all the concerns raised by such experts are addressed satisfactorily before we consider building more nuclear reactors.

The Climate Change perspective

37. One of the recent arguments by the proponents of nuclear power is that it is clean and green, and hence should be a suitable option to address to reduce the GHG emissions at the global level. Whereas the nuclear power plants are generally not associated with any GHG emissions during their operation, the life cycle CO_2 emissions (which are linked to various stages from nuclear ore mining till the spent nuclear fuels/wastes are safely disposed of after thousands of years) are generally recognized as considerable. The energy related cost of keeping the spent nuclear fuel safe for hundreds of years, if not for thousands of years, cannot be inconsiderable and can be seen as unjust burden on the future generations, because all the associated benefits of nuclear power, however meager they may be, would have come to the present generation alone. Taking all these direct and indirect costs and CO_2 emissions into objective account the nuclear power technology has been ranked by credible analysis as one of the least beneficial to human kind among various sources of electricity. There have been a large number of credible studies from different parts of the world to analyse whether nuclear power can be a suitable technology in order to minimize CO_2 emissions.

38. Nuclear power is considered as one of the most expensive ways to reduce the CO_2 emissions. Also, in terms of cost-effectiveness in reducing CO_2 emissions, nuclear power fairs very poorly. It is reported that in 1995, after a year-long, exhaustive review of the case for nuclear power, the UK Government concluded that nuclear power is one of the least cost-effective ways in which to cut CO_2 emissions. In the US improving electricity efficiency is considered to be nearly seven times more cost effective than nuclear power for obtaining emissions reductions.

39. In a press release on May 8, 2005, the NGO, Friends of the Earth, had issued few interesting facts. On a study of the CO_2 abatement options, in order of cost-effectiveness, the nuclear power technology was ranked as 16^{th} out of 17 options studied. The nuclear wastes are piling up in huge quantities, as there are no proven strategies exist for the permanent safe storage of nuclear waste. Producing long-lived radioactive wastes, with no solution for their disposal, leaving a deadly legacy for many future generations to come is contrary to the principle of sustainability, and will be sheer injustice to the future generations, who have to bear all the future costs/risks. Since nuclear power is also known to be uneconomic, unsustainable and unsafe, the very concept of viewing it as a green source of energy should be viewed as irrational.

40. An ELSEVIER paper on energy policy under the title "Valuing the greenhouse gas emissions from nuclear power: A critical survey" by Benjamin K. Sovacool, June 2008, has screened 103 lifecycle studies of greenhouse gas-equivalent emissions for nuclear power plants, and on the basis of which he concludes: "The first conclusion is that the mean value of emissions over the course of the lifetime of a nuclear reactor (reported from qualified studies) is 66 g CO2e/kWh, due to reliance on existing fossil-fuel infrastructure for plant construction, decommissioning, and fuel processing along with the energy intensity of uranium mining and enrichment. Thus, nuclear energy is in no way ''carbon free'' or ''emissions free,'' even though it is much better (from purely a carbon-equivalent emissions standpoint) than coal, oil, and natural gas electricity generators, but worse than renewable and small scale distributed generators."

41. As per Nuclear Energy Institute (NEI), the nuclear power plants provided 11 % of the world's electricity production in 2014, which could have only come down since then due to massive additions to renewable energy. One global estimate indicates that in order to have any discernible benefit from the Climate Change perspective, nuclear power needs to be about 33% of the total installed power capacity at the global level. This estimate also indicates that about 2,500 nuclear reactors of average capacity of 1,000 MW would be required, and nearly four new reactors would have to begin construction each month until 2075. If nuclear power were to play more than a marginal role in combating global warming then some nuclear-power reactors would have to be operated even in those countries, where there is no nuclear power as of now. Looking at the past experience of slow electricity demand growth, the increasing public opposition, the safety issues, and the threat of nuclear terrorism etc. such a huge addition of installed capacity is impossible. Since India's nuclear power capacity is unlikely to reach even 2 % of the total in the foreseeable future, the rationality of even considering the Climate Change perspective of nuclear power should come under diligent scrutiny.

42. As per a less known Department of Atomic Energy (DAE) document of 2008 "A Strategy for the Growth of Electricity in India", the plan was to increase the nuclear power capacity in the country to about 275,000 MW by 2050. Even if we were to consider this highly unrealistic plan, it will require about 390 nuclear reactors of average capacity of 700 MW. The enormity of the task of constructing 368 additional reactors in the next 33 years should become evident when we compare the fact that only 22 nuclear reactors, which are in operation, were constructed in duration of about 50 years. Keeping in view the enormous quantities of water required for these reactors it is most likely that the future reactors will be on the coast. Even assuming that 4

reactors of 700 MW of capacity each will form a single nuclear project, the country's 6,000 kM coastline will have to be dotted with a nuclear power project at every 60 kM. Though this stupendously ambitious plan (may mean adding on an average 8,000 MW of nuclear power capacity every year during next 3 decades) sound hilarious to say the least, looking at what has happened in the last 50 years, it should be a matter of grave concern to our society because it indicates the determination of DAE to seek huge budgetary support to try and expand nuclear power capacity exponentially, and the scope for the denial of adequate financial resources to develop renewable energy sources which are the sustainable sources.

43. Allowing for an average of 1.5 sq. kM area around each reactor as safety zone, 390 reactors may require a minimum of about 585 sq. KM area as a whole in addition to the vast stretches of land for dedicated transmission lines, and the associated mining/milling operations. The affordability of diverting such a vast land area for nuclear power sector in a densely populated country should be another matter of concern requiring diligent approach. In this context, the very policy of DAE to plan for additional nuclear reactors must be satisfactorily explained to the public.

44. An article published in Australasian Science, July 2005, under the title "Can nuclear energy reduce CO_2 emissions?" by Mark Diesendorf has highlighted many of these associated issues. It says: "Nuclear power stations themselves do not emit CO_2. But most of the energy inputs to the full life cycle of nuclear fuel come from fossil fuels and so are responsible for CO_2 emissions. The nuclear fuel cycle is a complex process with the following steps, some of which are large energy users:" The article list many steps including: mining and milling to produce an oxide of uranium known as 'yellow-cake', U3O8; enrichment to increase the concentration of the isotope U-235; fuel fabrication; power station construction; operation and maintenance of power station; interim storage of spent fuel; long-term waste management (which only exists in theory); and power station decommissioning (which has never been done for a large nuclear power station).

45. "The energy inputs of several of these steps of the nuclear fuel 'cycle' have been investigated by authors who are independent of the nuclear industry: e.g. in 1991 by Nigel Mortimer, now Head of the Resources Research Unit at Sheffield Hallam University, UK; and independently in 2003 by Jan Willem Storm Van Leeuwin, a senior consultant in energy systems, together with Philip Smith, a nuclear physicist, both of whom are based in Holland. They find that, especially for mining and milling and enrichment, the results depend sensitively on the grade of uranium used. For high-grade ores (i.e. those with at least 0.2% uranium oxide, U3O8) the energy inputs are indeed much less than the electricity generated. But the nuclear power station must operate for 7-10 years to generate its energy inputs. (For comparison, wind power requires only 3-6 months.) For a power station with lifetime 30-35 years, this is acceptable, although it introduces a limitation on the rate of growth of the nuclear industry, as discussed below. For low-grade ores (less than about 0.01-0.02% U3O8, i.e. 10-20 times less concentrated than the high-grade ores), Van Leeuwin and Smith find that the fossil energy consumption in mining, milling and enrichment becomes so large that nuclear power emits more CO_2 than an equivalent gas-fired power station. Furthermore, the quantity of known uranium reserves with ore grades richer than this critical level is very limited. If 16% of the world's electricity production came from nuclear energy (i.e. the current situation),

these high-grade reserves would only last about 19 years. This is hardly sufficient for a sustainable substitute for coal or any other energy source."

46. Whereas, the section 08.05 in the primary EIA makes a very poor case on the nuclear power plant's relevance in the reduction of CO_2 in the energy sector. EIA has made a poor attempt to say that the additional power from the project will help in our efforts in the Climate Change efforts, it has conveniently ignored the considerable CO_2 emissions associated with various processes of nuclear ore mining, milling, fuel rods, construction, transportation, spent fuel disposal after thousands of years etc. In the case of Kaiga NPP, the destruction of more than 54 Hectares of thick forest land will result in not only the perpetual loss of a highly effective carbon sink but also will lead to CO_2 emissions when the forests are destroyed to set up the reactors. Sadly, it considers only the CO_2 emissions during the normal operation of a reactor, but conveniently ignores the CO_2 foot print in the entire life cycle of a nuclear fuel. As discussed above, the actual carbon foot print of a nuclear fuel/reactor to the atmosphere will be quite considerable if all the associated issues are objectively considered.

47. Has this argument of DAE/NPCIL been published in any international magazine, and has it been peer reviewed and accepted?

Energy return on energy investment (EROEI)

48. When we refer to an energy source suitable for the future from the perspective of Climate Change, the energy return on energy investment (EROEI) of such a source should be of primary importance. The same can be defined as the ratio of the energy delivered to grid over the energy investments, both measured over the full cradle-to-grave (c2g) period. The energy return on energy investments of the world averaged nuclear energy systems are reported to be EROEI = 2 - 3 under the current conditions, but it is also projected that it will decline over time when leaner uranium ores are to be exploited as detailed above while discussing the full life cycle costs.

49. In the case of India, the quality of the uranium mined is reported to be in the range 0.02 - 0.03% U3O8, which is far lower than the international uranium minerals, because of which the fossil energy consumption in mining, milling and enrichment becomes so large that India's nuclear power is likely to emit more lot more of CO_2. Also, in view of the fact that Uranium mineral reserve in India is very limited (reported as sufficient to support only about 10,000 MW of nuclear capacity), the nuclear power authorities have a lot to explain to the people, as to how the ambition to add a large number of nuclear reactors is techno-economically viable.

50. Additionally, the total amount of energy required to keep the nuclear waste safe and cooled for hundreds of years is likely to be enormous. In the context of all the discussions above, it can be stated that the potential contribution of nuclear power to the reduction of CO_2 emissions is quite limited in quantity.

Technical and Economic Issues: an analysis of alternative technologies

51. EIA, under the title "Analysis of alternatives", has said that DAE considers only nuclear power technology. It says: "The Department of Atomic Energy (DAE) has an ongoing programme for

development of nuclear power by pursuing different technologies. Accordingly, three stage programme for generation of nuclear power has been adopted." EIA (page 9) also says: "The development of the power sector in the country, since independence has been predominantly through thermal and hydro power plants. Power generation through nuclear power plant is one of the alternative source and need of the hour as the coal reserves are limited and hydro power plants have reached the maximum potential and stagnated. Hence, setting up of new nuclear power plants is inevitable to bridge the gap between demand and supply of electricity. The industrial growth, in turn significantly contributes to economy of the nation and region as it generates employment and infrastructure. Hence, it is expected that the proposed Kaiga unit 5&6 will play an important role to the country as well as to the region."

52. These statements clearly indicate that DAE/NPCIL has not even considered various technology options which are known to be techno-economically viable in the electric power sector. The only objective of DAE/NPCIL seems to be the addition of nuclear reactors without having any concern on the multiple impacts of the same policy on the economy, ecology, flora, fauna and the people of this country. This approach is completely unacceptable, and should be viewed as the dereliction of duty on part of all those officials directly involved in the associated decision to add more nuclear reactors. It is against all canons of financial, economic and ecological responsibilities entrusted by the Constitution of the country to the concerned senior management staff, to come up with such a ghastly project proposal without objectively considering various options available for our country to meet the growing electricity needs.

53. Section 08.03 of the EIA indicates that some operational cost comparison is made with that of a coal power plant only. But the true relevance of such a comparison becomes obvious when the comparison of all the direct and indirect costs to the society of nuclear power is done in the case of all the techno-economically viable technologies. The comparison of overall costs with solar and wind technology, and with hydro power plants should have been detailed. Additionally, it is generally known that many costs of a nuclear power plant such as the costs associated with the land, water, long term storage of spent nuclear fuels, catastrophic accidents, mining/milling/fuel rod fabrication etc. are not considered in the cost of nuclear power. In the present case even the cost of additional transmission lines are not estimated. Hence, the cost comparison in this section is not credible, and hence not acceptable.

54. The overall objective of the project to set up Kaiga Units 5 and 6 can be assumed to be the production of additional electrical power to meet the growing demand for electricity in the country. A modest knowledge of the country's power sector and of the associated developments within the country and across the world should have clearly demonstrated to the concerned people that there are much benign options available to generate additional quantity of electricity in the country or to close the gap between demand and supply of electricity.

55. It has to be emphasized at the outset of this discussion what National Electricity Policy, 2005 had said:
"Section 5.8.10: It would have to be clearly recognized that Power Sector will remain unviable until T&D losses are brought down significantly and rapidly. A large number of States have been

reporting losses of over 40% in the recent years. By any standards, these are unsustainable and imply a steady decline of power sector operations. Continuation of the present level of losses would not only pose a threat to the power sector operations but also jeopardize the growth prospects of the economy as a whole. No reforms can succeed in the midst of such large pilferages on a continuing basis."

Section 5.9.1: There is a significant potential of energy savings through energy efficiency and demand side management measures. In order to minimize the overall requirement, energy conservation and demand side management (DSM) is being accorded high priority."

Section 5.8.10 It would have to be clearly recognized that Power Sector will remain unviable until T&D losses are brought down significantly and rapidly. A large number of States have been reporting losses of over 40% in the recent years. By any standards, these are unsustainable and imply a steady decline of power sector operations. Continuation of the present level of losses would not only pose a threat to the power sector operations but also jeopardize the growth prospects of the economy as a whole. No reforms can succeed in the midst of such large pilferages on a continuing basis."

56. Sadly, it must be noted that, since then (2005) there has been no adequate improvements w.r.t the efficiency, demand side management and conservation in the existing electricity infrastructure in the country. If sufficient focus had been given to these areas, there would not have been the large gap between the demand and supply of electricity in the country, or the need to add so much of power capacity, as we see today. Hence, it can be said that without focusing adequately on optmising the utilization of the existing electricity infrastructure, and without objectively considering various techno-economically attractive options to meet the growing demand, it would be a gross mis-utilisation of the already stressed resources of the country to invest in the costly/risky nuclear power technology.

57. There is a critical need to first invest wisely in achieving the highest possible efficiency, optimal demand side management, and responsible conservation of energy before looking to add to power generation capacity. The integrated cost minimization approach through "options analysis" and "costs and benefits analysis" for choosing the appropriate generation technology while ensuring the environmental sustainability and compliance with all the relevant Acts of the Parliament has become essential and urgent for the country.

58. Sadly the project proposal and EIA in the present case seem to have ignored such fundamentals of engineering management. Hence, this deficiency has to be addressed by asking the project proponent to satisfactorily demonstrate as to why the capacity expansion proposal in Kaiga NPP is the best option, and why other options available to our country have not been diligently considered.

59. The estimated cost (as per EIA) of Rs. 21,000 crores (excluding the transmission line (TL) costs) for the 1,400 MW of additionally proposed capacity shall mean the capital cost of much more than Rs. 15 Crores per MW (when we also include the TL costs and unimaginably high ecological costs), which is also the highest per MW cost among all the known technologies (as compared to about Rs. 8 -10 Crore per MW of fossil fuels and about Rs. 8 -12 per Crore MW of dam based hydel

plants). The capital costs of solar and wind power technologies are already lower than that of nuclear power technology, and are projected to continue plunging with the passage of each year for next 10-15 years. Having conveniently and intentionally ignored to compare this risky nuclear technology with other known, established and low cost technologies (as a study of alternatives required under EIA rules), the EIA has not bothered to establish as to why our society should be even be expected to be burdened with this risky and high cost project.

60. What is the estimated cost of transmission lines needed for the evacuation of the additional power to be generated? Please ask the project proponent to provide all the relevant details. What is the estimated cost of decommissioning? Has this been included in the estimated project cost of Rs. 21,000 Crores? If not, why? What is the estimated long term storage cost of the spent nuclear fuel? If this cost is not included in the project cost, what is the reason?

61. When we objectively consider various associated constraints such as about 80% of annual PLF, station auxiliary consumption of about 12%, the T&D losses of about 20% in the national grid, the proposed additional capacity of 1,400 MW at Kaiga NPP shall basically mean a net availability of about 800 MW only for the consumers. Many times more than this net benefit can be accrued to our society at almost negligible cost and nil environmental impacts, if we invest wisely in efficiency improvements at various levels of the existing electricity infrastructure.

62. As per a compilation of associated costs for various technologies in US, the Energy Information Administration (EIA) in its report "Capital Cost Estimates for Utility Scale Electricity Generating Plants", 2016 has listed the capital cost of the advanced nuclear power plant as much higher than any other technology power plants.

63. In a study by Lappeenranta University of Technology (LUT), Finland and the Energy Watch Group (EWG), Germany under the title "Comparing electricity production costs of renewables to fossil and nuclear power plants in G20 countries", the authors have established that the cost of nuclear power technology as in 2017 was the highest of all the known technologies, with solar and wind power technologies being the lowest in life cycle cost. On the basis of this study it is said: "There is no reason to invest one more Dollar in fossil or nuclear power production", EWG President Hans-Josef Fell said. "Renewable energy provides cost-effective power supply. All plans for a further expansion of coal, nuclear, gas and oil have to be ceased. More investments need to be channeled in renewable energies and the necessary infrastructure for storage and grids. Everything else will lead to unnecessary costs and increasing global warming." Other issues highlighted in this study are: "Despite their current position in global energy systems, traditional fossil fuel and nuclear power generation are becoming increasingly uncompetitive to renewable energy on environmental, social and economic grounds when the full cost of generation is accounted; Levelised costs of electricity derived from solar and wind resources already show full competitiveness in many G20 countries, and will emerge as the least cost solutions for all G20 countries in 2030 and LCOE of wind and solar PV will start outcompeting all other forms of power generation much before 2030 and possibly as early as 2020; Huge fossil fuel and nuclear power subsidies contribute to an unequal playing field, distort power market economics, promote wasteful production, and undermine efforts to mitigate climate change; Stronger efforts must be

made to internalise the high social, environmental and economic burdens of fossil fuel and nuclear power, which have often been neglected."

64. Several international reports and academic studies indicate that high shares of renewables, especially solar and wind power, can be achieved in global energy systems, without the need to rely on nuclear power technology.

65. Between 2007 and 2017 the percentage of nuclear energy produced in India to the total electrical energy has been between 2.3 % and 3.06%, as per Energy Statistics, 2018 by the Union Govt. This percentage will go down further drastically by 2030 and beyond because of the vast additional capacity of other sources and the long gestation periods/time overruns of nuclear power plants. In view of such insignificant/irrelevant contribution of nuclear power to Indian scenario (the installed nuclear capacity is about 2% of the total power capacity in the country as on today, and the same will be most likely to be less than 0.5% by 2026, which is the completion target year for this project as per EIA), the local community, the state of Karnataka and the entire country should not be burdened with the unacceptable costs and risks associated with the financial, social and environmental/ ecological aspects of building, operating, decommissioning and safe disposal of nuclear wastes.

66. There are many benign and more attractive options available to our country to meet the legitimate demand for electricity of our communities. There have been a plethora of technical and economic reports/analysis from around the world indicating how the nuclear power technology is the economically the costliest and ecologically the worst technology, as highlighted by the disasters at Chernobyl and Fukushima.

67. Lazard's annual Levelized Cost of Energy (LCOE) analysis (version 11.0) has reported that the solar photovoltaic (PV) and wind costs have dropped an extraordinary 88% and 69% since 2009, respectively. Meanwhile, coal and nuclear costs have increased by 9% and 23%, respectively. Even without accounting for current subsidies, renewable energy costs can be considerably lower than the marginal cost of conventional energy technologies. Additionally, Year 2018's LCOE analysis reported new onshore wind costs $29-$56 per megawatt hour (MWh) to build without subsidies and $14-$47/MWh to build with subsidies. New utility solar PV costs $36-$44/MWh to build without subsidies and $32-$41/MWh to build with subsidies. Comparatively, marginal costs—the cost to operate existing plants—are $27-$45/MWh for coal and $24-$31/MWh for nuclear. When we also objectively consider the traditional and ongoing subsidies of various kinds to the nuclear power technology all over the world, the clear cost disadvantage of nuclear power will become crystal clear.

68. The National Renewable Energy Laboratory projects utility solar PV costs will decline 60% by 2050 under mid-level forecasts assuming continued industry growth, and technological breakthroughs could cut costs up to 80% by 2050. Similarly, its onshore wind analysis forecasts a 30% cost decline by 2050, which could be up to 58%-64% with breakthroughs.

69. The Australian Power Generation Technology Report (Nov. 2015) – a collaborative effort from more than 40 organisations, including the CSIRO, ARENA, the federal government's Department of Industry and Science and the Office of the Chief Economist – has demonstrated that solar and wind will be the cheapest low carbon technologies in Australia ahead of nuclear and coal even though it has large coal and nuclear fuel reserves.

70. As per a Stanford University study of 2009 referred to in an article titled "A path to Sustainable energy by 2030", in Scientific American in November 2009, the authors have referred to a ranked energy systems according to their impacts on global warming, pollution, water supply, land use, wildlife and other concerns. The very best options were wind, solar, geothermal, tidal and hydroelectric power— all of which are driven by wind, water or sunlight. It was found in this analysis that the nuclear power and coal with carbon capture were all poorer options.

71. The Integrated Energy Policy of the then Planning Commission in 2008, had indicated that the known Uranium reserve in India can support only 10,000 MW of nuclear power capacity. The same document had projected nuclear power capacity by 2032 as 63,000 MW and there was not much of a discussion as to how this much of nuclear power capacity will get its fuel from. The obvious implications of the need to import the nuclear fuel/technology, such as the security of energy and economy, need to be taken into account while planning for a large nuclear power capacity base.

72. As per a news article in Wall Street Journal of 12 May 2017, there are about 450 nuclear power plants worldwide, more than half of which are nearing the end of their planned lives. The massive task of dismantling them will require years of risky work and tens of billions of dollars. It is estimated that dismantling just one of them may cost upto $1.5 Billion. This eventuality also brings in to question whether the projected cost of such dismantling and safe storage of the nuclear wastes associated with the large number of nuclear reactors planned for the country have been objectively included in the overall cost of the plant while determining the price of its electricity in India.

73. Since the role of nuclear power cannot be of any relevance to our country from any perspective, whether it is technical, economic, environmental and logistic, the options left to meet the legitimate demand for electricity in future must be based on an optimal combination of highest possible energy efficiency, optimal demand side management, responsible energy conservation, peak load management, and effective harnessing of various renewable energy sources (REs) available in the country. As per many credible estimates, both from domestic sources and international sources, including from the Union govt. the potential of REs in India is enormous, and it is techno-economically feasible to meet the total energy requirements of the entire country on a sustainable basis from these REs, if suitable policy interventions are made. There have been many credible reports/analysis to this extent.

74. IPCC's 5th Assessment Report is considered to be the most comprehensive report yet on mitigation and adaptation on Global Warming. It has recommended: (i) two-thirds of all known fossil fuel reserves will need to stay unburned if dangerous warming is to be avoided, (ii) rapid de-carbonisation of the electricity system is a key component of cost-effective strategies,

starting from conventional coal power plants, (iii) growing number of Renewable energy technologies have achieved a level of technical and economic maturity to enable deployment at significant scale, (iv) only through such decisive action such as increase by three or four times the use of renewable power plants can carbon dioxide levels in the atmosphere be kept below the critical level of 480 parts per million (ppm), before the middle of the century, (v) using energy more smartly plays a fundamental role in emission cuts, and efficiency potential is large and can unleash important co-benefits.

75. An article titled "A Plan to Sustainable energy by 2030", in Scientific American in November 2009, has illustrated a plan as to how wind, water and solar technologies can provide 100 percent of the world's energy by as early as 2030, eliminating all fossil fuels and nuclear power. It has referred to a Stanford University study which ranked energy systems according to their impacts on global warming, pollution, water supply, land use, wildlife and other concerns. The very best options were wind, solar, geothermal, tidal and hydroelectric power. Nuclear power, coal with carbon capture, and ethanol were all poorer options, as were oil and natural gas.

76. An article under the title "Cost-minimized combinations of wind power, solar power and electrochemical storage, powering the grid up to 99.9% of the time" in Journal of Power Sources in March 2013, has referred to the modeling of many combinations of renewable electricity sources. A major finding of the study was that at 2030 technology costs and with excess electricity from REs displacing natural gas, the electric system can be powered 90% – 99.9% of hours entirely on renewable electricity, at costs comparable to today's—but only if we optimize the mix of generation and storage technologies.

77. Even a country like Australia, which has been predominantly dependent on fossil fuels for electricity generation (75 % of coal and 15% on natural gas), and which is the largest exporter of coal, has a clear road map to minimise its dependence of fossil fuels. It is also interesting to note that while it is the second largest exporter of Uranium, it has a clear 'no nuclear policy'. The Energy White Paper 2012, from the Australian govt. says Australia's energy future will be dominated by the need to become more energy efficient across the economy and to dramatically reduce carbon emissions and transform to a clean energy economy. According to it, the renewable energy will account for at least 20% of its electricity generation by 2020 and this may rise further to around 40% by 2035. By 2050, most of Australia's conventional fossil fuel power generation is likely to have been replaced with clean energy technologies in the form of wind power; utility-scale and distributed solar power; geothermal energy; and coal- and gas-based carbon capture and storage systems.

78. Two study reports: (i) "Action Plan for Comprehensive Renewable Energy Development in Tamil Nadu", by WISE, 2012, (ii) The Energy Report – Kerala: 100% Renewable Energy by 2050, by WISE and WWF, 2013 have focused on Indian scenario, and have described as to how the REs can have very high penetration into our electricity system without any major concerns, provided there are suitable policy interventions at all levels of governance. Many other reports, including one from PGCIL, have come to the conclusion that there are no technical hurdles for higher penetration of REs, but only suitable policy interventions are required.

79. Whereas the nuclear power capacity seems to be struggling to go beyond 2% of the total capacity in India even after five decades of massive budgetary support by the successive governments, the renewable energy capacity (other than hydro power) has already gone beyond 13% of the total capacity in less than 15 years. The renewable energy capacity, especially the solar power and wind power capacity, itself is expected to grow beyond 300,000 MW by 2030 as compared to 6,780 MW of nuclear power capacity as on date (India's INDC to UNFCCC). Even though it is unrealistic to assume that the large number of nuclear power projects planned for the country (such as Units 3 to 6 at Kudankualm NPP (4 of 1,000 MW each), and the ten of 700 MW each PHWR as planned for Kaiga 5&6) will be commissioned by 2030, the nuclear power capacity as a percentage of total electricity capacity at the national level cannot be much more than 0.5% when we consider the fact that a large number of fossil fuel based, solar and wind power projects are being implements and planned. Looking at the past experience of Indian nuclear reactors getting commissioned within the budgeted cost & time, it seems unlikely that the nuclear power capacity in the country will be even 0.5% of the total capacity by 2030. The two PHWR type reactors of 700 MW each under construction in Rajastan have already registered cost and time over-run.

80. In this context, the question that should be objectively addressed is the simple economic rationality of costs and benefits of nuclear power w.r.t the other sources of electricity available to India, while taking into account all the direct and indirect costs and benefits to the society. Our communities of present and future generations should not be burdened with enormous cost/risks associated with such nuclear power plants, because the society will be bound to bear all the associated costs/risks for decades and even centuries to care for the nuclear waste.

81. Whereas, satisfactorily meeting the peak hour demand has been the challenge for the country since more than a decade, its power supply system is already sub-optimally biased in favor of thermal power capacity that caters to steady demand. Compounding this is the fact that during the last decade or so, a large capacity of thermal generation has been cleared, worsening this problem further. Since nuclear power is largely a base load power generation technology, its relevance in the future should be diligently questioned. An analytical study conducted in August, 2011 by Pune-based NGO, Prayas, has showed that the thermal capacity in the pipeline would result in "three times the capacity addition that would be required to meet the needs of the high renewables-high efficiency scenario for year 2032 projected by the Planning Commission's Integrated Energy Policy report". As a result, the average PLF of thermal power plants in the country has steadily declined, leading to many new thermal power plants becoming unviable and the consequent NPAs burdening the banks. The addition of nuclear power plant, which is basically a thermal technology plant, should be viewed from this context. Adding nuclear reactors capacity at Kaiga and elsewhere would, therefore, be economically and operationally inadvisable, and hence should not be pursued.

82. When we objectively consider various associated constraints such as about 80% of annual PLF, station auxiliary consumption of about 12%, the T&D losses of about 20% in the national grid, the proposed additional capacity of 1,400 MW at Kaiga NPP shall basically mean a net availability of about 800 MW only for the consumers. Many times more than this net benefit can be accrued to

our society at almost negligible cost and nil environmental impacts, if we invest wisely in efficiency improvements at various levels of the existing electricity infrastructure.

83. Whereas, the capital and LCOE for solar and wind energy technologies keep plunging, as per many credible projections, such costs have been increasing considerably in the case of nuclear power technology, and during next 10-15 years it is likely to be seen as astronomically high for India due to various reasons. In view of these and many other concerns I am of the considered opinion that the EC for the proposed project should be denied completely. Also, since the project is prima-facie non-viable, DAE/NPCIL should be advised not to go ahead with the expansion of the Kaiga NPP.

Summary of observations on EIA:

A. The EIA for the proposed project is incomplete and lacks the seriousness needed for such a high impact project. It has not addressed many important issues needed to take a diligent decision on the project proposal.

B. The land around the project area is covered with thick tropical forests of very high ecological value within the core area of the Western Ghats in Karnataka, which are one of eight hottest of biodiversity hotspots. MoEF&CC has already described this area as reserve forest covered with "dense growth of tall and stout trees" in its ToR letter of 6th Sept. 2016 to NPCIL.

C. EIA states: "The project site is located in the interior part of Western Ghat of peninsular India. Kali (Dandeli-Anshi) Tiger Reserve (KTR/DATR) extends from NE to NW. The minimum distance observed varies between 718 m to 1,734 m from Kaiga site Exclusion zone boundary." Since a Tiger Reserve area must have 15 kM of buffer zone, the proposed project area is clearly within the buffer zone of Kali (Dandeli-Anshi) Tiger Reserve.

D. The Gazette notification no. 3956 of 3rd October, 2018 (as applicable to MoEF&CC) proposing to implement the recommendations of the High Level Working Group) has in its Annexure C, cealry indicate that the villages of Kaiga, Mallapur and Virje, which are identified as the proposed project areas in the EIA, are declared as ecologically sensitive areas to be completely protected.

E. The National Forest Policy of 1988 and the draft National Forest Policy of 2018 have unequivocally advocated the relevant need as: "In the hills and mountainous regions, the aim will be to maintain two-third of the area under forest & tree cover in order to prevent soil erosion and land degradation and also to ensure the stability of the fragile eco-systems". The district of Uttara Kannada in Karnataka, where the project site is located, is largely a hilly district within the core area of the Western Ghats, which the MoEF&CC has committed to protect and conserve. The forest and tree cover area is already reported to be less than 45% in this district. Hence, diversion of more than 54 Hectares of thick forest lands in this district for the proposed project will negate the very objective of MoEF&CC.

F. Such diversion of thick forest lands is clearly against the critical need of the hour to preserve and enhance the vastly important tropical forests, as per IPCC (even though this much of forest land is said to be already under the possession of NPCIL). Since the ownership of the forest land is not of any relevance as long as it is allowed to continue to provide the associated ecological services, the diversion of this forest land and additionally few sq. kM of the adjoining thick forest lands required to construct the additional transmission lines will be completely against the interest of not only of the local communities, but also against India's global obligations w.r.t Climate Change.

G. At a time when the forest & tree cover in the country and in Karnataka is only about 20% as against the national forest policy target of 33% of the total land area, and against the target of 66% of the land area in hilly districts, the proposal to divert more than 54 Hectares of thick forest land in the hilly district of Uttara Kannada (Karwar) district in addition to many sq. kM of forest required to build the additional transmission lines may be termed as against the letter and spirit of our Constitution and of the relevant Acts of Parliament on environment and forests. It will also be in negation of India's commitment to the global community to being a leader in addressing the Climate Change, wherein the conservation and enhancement of tropical forests is clearly acknowledged as one of the most effective solutions by IPCC. A clear conviction of IPCC in this regard is represented by two of its associated statements: “Emissions from deforestation are very significant – they are estimated to represent more than 18% of global emissions”, “Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions.”

H. Recently on 11th Dec. 2018 the Supreme Court has directed the Union government to declare 10 kilometres areas around 21 national parks and wildlife sanctuaries - including three from Karnataka - as an eco-sensitive zone, restricting and regulating commercial, industrial and other and other activities over there. “Under the circumstances, we direct that an area of 10 kms around these 21 national parks and wildlife sanctuaries be declared as an eco-sensitive zone by the Ministry of Environment and Forest. The declaration be made by the MoEF at the earliest,”. The latest order from the Supreme Court should indicate the gravity of the environmental protection in the country, and the importance of conserving the core bio-diversity regions.

I. Many credible reports from leading institutions like IISc, Bengaluru, which have done many studies of this region in Uttara Kannada district, have unequivocally come to the conclusion that the biodiversity there is of very high, and ecologically it is of critical for peninsular India, which shall establish the critical need to conserve the same.

J. In this context, it may be termed as a crime against humanity to even consider diverting more than 54 hectares of thick tropical forest lands to the proposed project, whose net benefit to the larger society can also be argued as negative, when we take into account the life –cycle cost of the nuclear power beginning from the nuclear ore mining till the nuclear wastes are safely disposed off.

K. The enormous quantity of fresh water (6,346 cubic meter per hour) for consumptive use as per EIA , to be drawn from the river Kali, will have considerable impact on the local environment. The state of Karnataka, which has faced drought scenario in about 50% of its revenue sub-divisions in

most of the years since year 2000, cannot afford to divert such a large volume of fresh water in the context of projected drop in river water flow due to Climate Change. At the rate of 6,346 cubic meter per hour the water consumption in a day will be 152,304 cubic meters, which is 152,304 kilo litre of fresh water. At about 100 litre per day this can meet the daily water requirement of about 15 lakh people.

L. Hence, the question of environmental clearance for this project should not be entertained at all.

M. At the estimated project cost of Rs. 21,000 crores for the proposed 1,400 MW additional power capacity, the per MW cost of the project will come to more than Rs. 15 Crore, when we also take into account the intentional omission of additional transmission line costs. This cost is the highest among all the suitable technologies available to India, and hence should not be acceptable as a viable project for the country, when awe also consider that there are very many other direct and indirect costs to the society from this project, which are intentionally not mentioned in the EIA.

N. EIA is found to be seriously deficient in not considering: (i) the details and costs associated with the additional transmission lines required for the project; (ii) adequate details of disaster management plan to safely evacuate more than 32,000 people of the region and rehabilitate them satisfactorily in the case of any unfortunate nuclear accident of the type noticed at Chernobyl and Fukushima; (iii) policy and details associated with the safe disposal and long term storage of spent nuclear fuel; (iv) “options analysis” and “ costs and benefits analysis” of various techno-economically feasible options of much less overall cost available to our country in meeting the electricity demand; (v) to establish beyond reasonable doubt the project is the best option in the larger context of the region, country and the planet.

O. As per the global experience, recent developments, and India’s own scenario of vast population base, which is already facing acute stress on its land, forest, water and the general environment nuclear power is the costliest, technically not highly suitable, least friendly to the environment and to the people, and hence should not be thrust on vulnerable communities. There are very many techno-economically feasible options of much less overall cost available to our country in meeting the legitimate electricity demand on a sustainable basis.

P. Considering all these issues in the overall welfare perspective of the people of the area, region and the country, and in the context that nuclear power is the costliest and least favored electricity option around the world, and that there are much benign and much less costly options to meet the legitimate demand for electricity in our country, Environmental Clearance to this project proposal should be summarily rejected.

Q. It will be a travesty of social and environmental justice, and the violation of the provision of the country’s Constitution to allow the diversion of more than 54 hectares of dense forest land of very high ecological value, and 6,346 cubic meter per hour of fresh water which can meet the daily needs of about 15 lakh people to this enormously risky project.

Yours sincerely

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Annex 2

High level analysis of costs and benefits of nuclear power plants in India

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1. Preface

India has embarked on plans for a massive addition to its nuclear power capacity. The Parliament was informed by the concerned minister on 3rd January 2019 that 21 nuclear power reactors, with an installed capacity of 15,700 MW was under implementation, envisaged for progressive completion by the year 2031. Whereas it looks very ambitious to plan to add 15,700 MW of nuclear power in the next 12 years as against about 6,780 MW which was actually added in the last 60 odd years, what is even more astounding is the plan to take India's total nuclear power capacity to 250,000 MW by 2075, as per an official plan by the department of atomic energy (DAE).

Such a plan to add enormously large capacity in the next few decades at humongous financial, economic, social and ecological costs to the country should make anyone worried about the overall impacts on our communities. Whereas, the global experience since the Fukushima nuclear disaster has been one of the decision to decommission many operational reactors on the basis of safety aspects alone, and vastly reduced capacity addition plans because of the overall economics of the technology, it is only India and China which have continued with the their plans to increase their total nuclear power capacity by vast margins.

When we also consider the credible concerns on other related issues such as the safety of nuclear reactors, demand for diversion of large chunks of land and water, nuclear fuel availability and nuclear waste management, and disaster preparedness etc. the critical need for a diligent examination of the very policy to continue to invest in nuclear power in the country should become evident. In this context, the absence of a legal mandate for the govt. to undertake the "options analysis" and "costs and benefits analysis" of adding more nuclear reactors in India has become a very serious impediment for the common man to appreciate the true relevance of the ongoing nuclear power policy of the government.

It is also a matter of grave concern to the civil society groups, who have been working for decades on various related issues, including the interaction with the project affected communities, that the concerned authorities have been persistently ignoring the request to provide effective clarification on very many associated policy issues. The complete absence of any diligent analysis of the true costs and benefits of the nuclear power in effective comparison with other techno-economically viable options available to our country by the concerned authorities is the primary concern in this regard.

While advocating a diligent and transparent economic decision making process before adding to the nuclear power capacity, this paper looks at high level issues of costs and benefits of nuclear power reactors in Indian scenario; compares them with other available options; and hopes that the same will enable the civil society groups to effectively persuade the government to arrive at a suitable decision making apparatus based on a diligent analysis of all the associated factors from the overall welfare perspective of the society.

2. High level issues of concern to the civil society

Probably, the most important issue from the perspective of a common man in the case of a enormously costly power project like a nuclear power project is the financial cost of the project and the estimated price of electricity from such a project. It is well known that the capital cost of a nuclear power project is the highest among all the known technologies. One commentator even has remarked that nuclear power technology is the costliest and riskiest technology to boil water. The Environmental Impact Assessment (EIA) report of the recent proposal to expand the capacity of Kaiga nuclear power project in Karnataka has mentioned that it will cost Rs. 20,000 crores for two additional units of 700 MW each at the existing site. This comes to about Rs. 14 crore per MW. But this cost estimation is exclusive of the cost of land required and fresh water supply from the nearby river, which were already given to the existing project in 1992 by the state of Karnataka. The cost estimation also excludes the cost of additional transmission lines required, which has been conveniently left out of the EIA report. If all these costs are taken into account the total cost per MW of this nuclear power project may not be less than Rs. 20 Crores.

Whereas, it is highly deplorable that there is no official estimate of the cost of the proposed Jaitapur nuclear power project (Jaitapur NPP with 6 reactors of 1,650 MWe each) in Maharastra, various estimates on the basis of the experience of similar technology reactors indicate that per MW cost can be anywhere between Rs. 30 crore to 60 crore. This project was originally mooted in 2009 at an estimated cost of Rs. 200,000 Crores. It is also reported by the news agency IANS on 15th Nov. 2017 that the project developer, EDF of France, is reportedly insisting on a hike in per MW cost of around 25 percent from the original quotation of Rs 30 crore per MW. When we also take into account the fact that there have been many safety modifications to the nuclear reactors around the world subsequent to the Fukushima disaster, it will be not be an exaggeration to state that per MW cost of the Jaitapur NPP may not be less than Rs. 40 crore.

As compared to such a huge capital cost, the per MW cost of other power producing technologies in India is estimated to be much lower. Coal power (@ Rs. 6 - 8 Crore/MW), Dam based hydro (@ Rs. 7- 10 crore/MW), Solar and Wind (@ Rs. 5 -8 crore/MW) all can come at much lower capital cost. Even if we make provision for the battery backed energy storage facility for the renewable energy sources (REs), their capital cost cannot be much more than Rs. 10-12 crore per MW, as per the global experience. The true relevance of REs is in the average life time cost of energy or the levellised cost of energy, which is less than or competitive to the per unit energy cost from nuclear power.

The recent international developments also confirm such stark capital cost difference. Credible estimates from various agencies such as (i) Lazard, the investment bank headquartered in New York, (ii) California Energy Commission, US, (iii) DOE and the National Renewable Energy Laboratory (NREL), US, (iv) Energy Information Administration (EIA), US, (v) Department for Business, Energy and Industrial Strategy (BEIS) of UK, (vi) Fraunhofer Institute for Solar Energy Systems ISE, Germany, (vii) Bloomberg New Energy Finance, (viii) International Renewable Energy Agency (IRENA), (ix) European Bank for Reconstruction and Development (EBRD), (x) International Energy Agency (IEA), all indicate that both the capital cost and the levelized cost of energy (LCOE) for nuclear power is generally the highest among various energy sources, even without taking into account the long term waste management costs and the unacceptably high societal costs of any nuclear disaster as happened at Chernobyl and Fukushima.

Such levelized cost of energy in India for any new nuclear power plant is estimated to be not less than Rs. 15 per kWH as has been estimated in the case of Jaitapur NPP, whereas the tenders for solar and wind power parks in 2017-18 have attracted energy prices of less than Rs. 3.00 per kWH. On the basis of the experience from various parts of the world even if the energy storage costs (through batteries) are added to stabilize the steady availability of the new and renewable energy, the levelized cost of renewable energy sources in India may not be much more than Rs. 5 per kWH. The cost of RE technologies and the energy storage systems are credibly being projected to drop further, whereas the nuclear energy price can only increase.

Whereas such high level cost comparison alone should be enough to view the nuclear power with much skepticism because of very many societal level concerns, an effective comparison of various direct and indirect costs and benefits of this technology to the entire nation w.r.t other established technologies can make it even starker.

Other issues of concerns to the larger civil society in the case of nuclear power technology are: (i) the availability of affordable and abundant amounts of nuclear fuel; (ii) true cost to the society of the large tracts of land and water needed, (iii) safety issues in various logistical and operational stages, (iv) safe disposal of various nuclear wastes including the spent fuel, (v) long term safe storage and the associated costs of spent nuclear fuel; (vi) decommissioning costs, (vii) disaster preparedness and the costs associated with any unfortunate nuclear accident of the type in Chernobyl and Fukushima.

3. The critical need to consider various options available to our country

The official stance of the Indian authorities all along has been that the nuclear power plants are required for meeting the growing electricity demand of the people of this country, and it is also implied that that producing electricity is the only objective of a nuclear power project. If it is really so, there should be no reason as to why all the options available to our country to bridge the gap between supply and demand for electricity should not be considered objectively.

But when we consider the long lasting and obstinate silence of the concerned authorities to satisfactorily clarify various concerns of the civil society for decades on nuclear power, it can be said that the defense analysts may not be wrong in assuming that the nuclear material required for the nuclear weapons may be the main objective behind or nuclear power policy. Even if it is so, the question that gets thrown up is: how

many more nuclear reactors (in addition to 20 odd reactors we already have) will be required to meet such a demand for spent nuclear fuel for the nuclear deterrence purpose. The defense analysts are of the opinion that India may already have more than enough of such nuclear weapons to destroy the entire humanity many times. So why do we need additional nuclear reactors?

Going by the official line of thinking that nuclear reactors are required to meet our energy needs, let us consider the relative merits/costs of various technologies available to our country. A diligent analysis of all such options/technologies w.r.t their comparative costs and benefits should be the primary economic decision making tool in choosing the nuclear power technology; or for that matter, any relevant technology.

The true relevance of nuclear energy will become evidently clear only when its cost is realistically compared with other sources of electricity; such as from coal and other fossil fuels, hydro, and from renewable energy sources (REs). Its marginal cost should also be compared with other options available to our society, such as the efficiency improvement and demand side management (DSM) options in the existing power demand/supply system.

It should not be acceptable for the people of this country that the nuclear power policy is being pursued at enormous societal costs without establishing the real need for the same through such diligent analysis of costs and benefits, and in realistic comparison with other sources of electrical energy.

4. Costs and benefits analysis

In undertaking a diligent analysis of costs and benefits, fairly accurate data on different components of various direct and indirect costs and benefits are necessary. Sadly, since the government has no mandate to publish such data, many assumptions have to be made, and hence, only a high level analysis is feasible. But even in such a scenario the real costs and benefits of nuclear power to Indian society should be become crystal clear, whereas the definitive numbers of such costs and benefits can only consolidate such results.

In case of some of the costs and benefits, which are intangible, brief mention of the same in words can be listed.

4.1 Financial costs: While some of these costs can be quantified, many of them can only be listed until the official figures are made available. Whereas the scenario of Jaitapur Nuclear Power Project, in coastal Maharastra is kept in focus for such a discussion, the issues are generally applicable to any nuclear power plant site in India.

4.1.1 Capital cost: In the case of Jaitapur NPP (proposal for 6 X 1,650 MWe Reactors), whereas the total cost was reported in the media as estimated to be about Rs. 200,000 crores in 2009, the same has been estimated to be Rs. 360,000 crores by MV Ramana and Suvrat Raju in an article "Cost of Electricity from the Jaitapur Nuclear Power Plant" in EPW of June 2013. It is not known whether the costs associated with the land acquisition, transmission lines, disaster management preparedness, decommissioning, safe disposal of spent fuel etc. are all included. Keeping in objective consideration various developments w.r.t the capital cost of very few additional reactors reported from around the world since then, it seems to be safe to assume that the per MW capital cost in the Indian scenario can be in the range of Rs. 30 to 60 Crore.

4.1.2 Operational cost: Fuel cost, much of which may not be recurring in the case of nuclear power, is the primary component. Other costs such as salaries, water withdrawal from the nearby river or the ocean and purification, spares, transportation costs etc during the operation will have to be included.

4.1.3 The costs of short term and medium term safe keep of nuclear waste, both the ones with low radiation level and ones with the high radiation level, have to be included.

4.1.4 **Reactor decommissioning costs**: Whereas the nuclear reactors were initially thought to be fit for safe operation for about 40 years, there are many cases where the operational life of a reactor are being extended to 60 years, and also intended to be planned for 80 years. Since there is no example of complete dismantling operation of any nuclear reactor as of now, only a rough cost estimate for dismantling an Indian reactor can be assumed. One recent estimate from Japan indicates that the cost for decommissioning 53 commercial nuclear reactors in Japan (excluding the failed reactors at Fukushima) is estimated to total about ¥3.58 trillion, for an average at ¥57.7 billion per reactor. This comes to about 37.5 Billion Rupees per reactor or about Rs. 3,750 Crores per reactor. Another research paper by the title "Cost Estimating for Decommissioning Nuclear Reactor in Sweden", 2014, has provided a list of US reactor decommissioning projects, according to which the cost of decommissioning for Pressurised Water Reactors vary between $ 0.38 – 3.64 million per MW. At the exchange rate of Rs. 71 per US$, this works out to between Rs. 3 – 26 crores per MW. For the Jaitapur NPP reactors (which are planned to be of 1,650 MWe capacity each) the decommissioning cost per reactor may range between Rs. 4,950 – 42,900 crores.

4.1.5 The costs associated with the **long term storage of spent nuclear fuel** at a site away from the reactor site, such as a deep geological repository for hundreds of years, cannot be ignored, because of the enormous financial/economic costs and risks associated. The fact that there is no proven technology for safe storage of the spent nuclear fuel until its radiation level reduces to a safe level fit for release into atmosphere, should throw up very serious challenges for our country. Only Finland is reported to have been working on such a definitive plan of constructing a deep geological depository, whereas the major nuclear power countries such as US and France have failed to come up with a suitable technology. Even though a deep geological depository is theoretically considered to be the best option, the issues such as the stability of rock or the hard soil surrounding it over thousands of years, the uncertainties associated with the earth quakes in the nearby earth crust, the possibility of subterranean water sources getting contaminated, the suitable language to be used in a warning to the future generations about the burial of nuclear waste at the given location, the willingness of the local communities to accept such a burial site in their community etc. have proved to be intractable. The fact that such spent nuclear fuel has to be kept safe from the atmosphere for hundreds of years (may be even thousands of years) and that the heat due to such radiation should be safely dissipated for such long periods can pose intractable problems for any society. While the total financial cost for such a facility can be horrendous, what is even more worrisome is the total amount of energy required to safely dissipate the heat from the spent fuel for hundreds of years. Undoubtedly, such an eventuality shall mean burdening the future generations with horrendous costs, as well as unacceptable risks, but without an iota of benefit to them. We must not ignore the immorality of such an eventuality. The fact that the half-life of uranium-235/238 (which is used as a common nuclear fuel) is estimated to be few million years, should settle all the issues in this discussion, because the spent nuclear fuel is supposed to be kept away from the atmosphere at least for this period.

The case of The Yucca Mountain Nuclear Waste Repository, as designated by the Nuclear Waste Policy Act amendments of 1987 in US, which was originally scheduled to be developed as a deep geological repository storage facility within Yucca Mountain, Nevada state can be an appropriate example to judge the

kind of issues to be faced. The Department of Energy (DOE), US, had estimated in 2008 that the project as a whole would require up to $96 billion for completing. It is reported that already it has cost taxpayers $15 billion. It is also reported that the state of Nevada has already filed more than 200 objections to the DOE's application to build this repository, all of which would have to be resolved — at a cost of up to $2 billion — before the project could go forward.

4.2 Economic Costs: Whereas many of the direct financial costs can be quantified, the economic costs are not easy to quantify, and can only be judged by the kind of impacts they may pose to the local population.

4.2.1 Agricultural production loss: The loss of agricultural and horticultural produces due to the loss of agricultural lands (about 970 hectares in the case of Jaitapur NPP) can only be perpetual.

4.2.2 Loss of livelihood: Not all the people who are forcibly displaced for this project can get suitable compensation because they may not have legal land hold rights; but they will become dispossessed and destitute. Denial of access for the fertile fishing grounds near the plant (in the name of security) for the local fishermen, and the reduced loss of fish population or radiation contaminated fish population (due to the release of vast quantity of hot/warm water from the cooling system to the nearby sea) will not be inconsiderable.

4.2.3 Loss due to loss of export market: the export value of the famous Alphonso mangoes and other horticultural/agricultural products of the region around Jaitapur will face serious threat due to radiation contamination issues.

4.2.4 Loss due to bio-diversity destruction is another major issue on this bio-diversity rich region of Western Ghats wherein Jaitapur is situated. It is hard to estimate the financial value of such a loss but the various reports of the Union govt. on the importance of Western Ghats should raise serious concerns on the overall ecological impacts.

4.2.5 **Costs associated with nuclear accidents**: Such costs alone, when objectively considered from the perspective of the overall welfare of our communities, should make any rational person to become completely antagonistic about the nuclear power plants. Whereas such costs will vary w.r.t different nuclear power plant sites, many credible reports having done research into such costs to the larger society, especially to the project affected communities have indicated unimaginably high costs of any such nuclear accidents. The sites/countries where the two major accidents took place (at Chernobyl and Fukushima) are reported be incurring such associated costs even after many years (more than 30 years since Chernobyl accident). It may never be known as to what is the total cost in each of these cases, but even after many years of the accident the counting of costs is not completed, as more and more of additional costs are being incurred.

While there will be no international concurrence on such costs, the cost of Chernobyl nuclear disaster has been estimated at 1.5 billion euros, with the total cost of the New Safe Confinement Project exceeding 3 billion euros. It took nine years after the fall of the USSR to close the Chernobyl Nuclear Power Station and more than a quarter century to build a new shelter over the damaged reactor.

The cost of Fukushima nuclear accident: Japan's government estimates the cost of cleaning up radioactive contamination and compensating victims of the 2011 Fukushima nuclear disaster has more than doubled, reports say. The latest estimate from the Japanese trade ministry put the expected cost at some 20 trillion yen ($180bn, £142bn, as in Nov. 28, 2016). As per Japan Center for Economic Research**,** this cost can go upto $626 billion**.**

In order to realistically include the projected cost of any unfortunate nuclear accident to a given project, it may be acceptable to adopt the probability analysis to determine the credible risk of a nuclear accident and spread the cost of such a factor over a number of reactors.

4.2.6 **Environmental, Health and other social costs:** It is seems almost impossible to put a figure for such costs, because the respective governments either refuse to reveal the actual costs or provide vastly diminished costs. However, there can be no doubt that these costs to the project affected communities and the nation as a whole will be horrendous. The environmental health alone whether during normal operation or due to a nuclear accident of the type happened at Chernobyl and Fukushima can be horrendous. The area around the failed nuclear reactors at Chernobyl and Fukushima are declared as unfit for human habitation for hundreds of years; the agricultural crops grown in the region are known to be contaminated with radioactive substances.

As per Inter Governmental Panel on Climate Change - IV Assessment Report "Emissions from deforestation are very significant – they are estimated to represent more than 18% of global emissions"; "Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions." Large conventional power projects are all major contributors for deforestation either through dams, buildings, transmission lines and pollutants like coal dust, coal ash and acid rains.

What our society is doing at present is to supply inefficiently derived electrical energy from limited conventional sources at subsidized rates for highly inefficient and /wasteful end uses, for which the real subsidy cost will be debited to the account of future generations.

In this context Mikhail Gorbachev's caution of wisdom cannot be ignored by a resource constrained country like India: "First of all, it is vitally important to prevent any possibility of a repetition of the Chernobyl accident. This was a horrendous disaster because of the direct human cost, the large tracts of land poisoned, the scale of population displacement, the great loss of livelihoods, and the long-term trauma suffered by individuals yanked from their homeland and heritage. Victims of the tragedy were confronted by a crisis which they could scarcely understand and against which they had no defense. The material damage inflicted by Chernobyl, although enormous, pales in significance when compared to the ongoing human costs. The true scope of the tragedy still remains beyond comprehension and is a shocking reminder of the reality of the nuclear threat. It is also a striking symbol of modern technological risk."

4.3 Benefits: It is quite common that the project proponents put a high value to the society from such benefits. Major benefits, which get highlighted, are as follows.

4.3.1 Benefits due to additional power to be generated, and its impact on the local and national economy. Although the installed capacity of Jaitapur NPP is scheduled to be 9,900 MW, the net power available to the end consumers of the grid can be only about 5,700 MW after allowing for the 80% capacity utilization factor (PLF), the station auxiliary consumption (10%), and the T&D losses (20%). Out if this net power of 5,700 MW, Maharastra may get only 2,850 MW as its share from a central sector power station. The issue for the people of Maharstra will be whether this additional net power availability of 2,850 MW is worth various costs and risks associated with a nuclear power plant.

4.3.2 Employment opportunities during the construction and during normal operation. Whereas the employment opportunities during operation can run to few thousands, the actual number of people

required during the normal operational regime will be quite less, because of the specialised nature of training required and due to the automation/robotics employed in many activities.

5.0 Options Analysis

In order to achieve the same objective, which is to close the gap between electricity demand and supply, there are very many options available to India. Each of these options should be objectively compared with other options w.r.t to the total costs and benefits. Whereas such costs and benefits in the case of each such options will vary from location to location, a diligently arrived at comparison of all the credible options can provide a very good indicator of the most suitable option for a given location.

5.1 Efficiency improvement measures

The overall efficiency of the power sector as a whole in the country can be said to be one of the lowest as compared to the global best practices. The National Electricity Policy (2005) had stated: "It would have to be clearly recognized that Power Sector will remain unviable until T&D losses are brought down significantly and rapidly. A large number of States have been reporting losses of over 40% in the recent years. By any standards, these are unsustainable and imply a steady decline of power sector operations. Continuation of the present level of losses would not only pose a threat to the power sector operations but also jeopardize the growth prospects of the economy as a whole. No reforms can succeed in the midst of such large pilferages on a continuing basis". It can be said that this scenario even in 2019 has not improved considerably. It is also a known fact that the cost associated with efficiency improvement measures can be as low as 25% of the costs of a new power plant, while such measures can provide the virtual additional power capacity. A high level estimate indicates that taking the efficiency of the Indian power sector at all levels of the sector (generation, transmission, distribution and utilization) to the global best practice levels can provide virtual power to the extent of 10-20 % of the total installed power capacity in the country. When we also consider the fact that the total installed capacity in the country as of January 2019 is about 350,000 MW, efficiency improvement measures alone can provide the equivalent of 35,000 to 70,000 MW without any of concerns on social, environmental and economic aspects. Whereas such efficiency improvement measures have one time cost but will provide perpetual benefits, any of the conventional technology power plants have long time recurring costs, and some of the environmental and social impacts, such as land degradation and pollution/contamination, can be perpetual.

The erstwhile Chairman of Infrastructure Development Finance Corporation had said in September 2004: "India's power sector is a leaking bucket; the holes deliberately crafted and the leaks carefully collected as economic rents by various stake holders that control the system. The logical thing to do would be to fix the bucket rather than to persistently emphasise shortages of power and forever make exaggerated estimates of future demand for power. Most initiatives in the power sector (IPPs and mega power projects) are nothing but ways of pouring more water into the bucket so that consistency and quantity of leaks are assured." Hence, it goes without saying that efficiency improvement measures alone can prevent enormous costs to our country in the form of avoided losses to set up new power plants such as Jaitapur NPP.

5.2 Demand Side Management (DSM) and energy conservation measures

As per Bureau of Energy Efficiency, a unit of energy saved is considered equal to four units generated as it saves losses on production, transport, transmission and utilisation.

It is pertinent to note that the expenditure for such energy efficiency and DSM measures is estimated to be about 25 to 40% of the cost of new power stations. These measures also require no additional land or natural resources; they also do not contribute to environmental pollution. Instead, by directly/indirectly reducing the electricity demand on the integrated electricity network they eliminate the need for additional conventional power projects, which in turn will reduce the total GHG emissions, and the need for additional transmission lines.

Keeping all these technical, social, economic, and environmental issues in proper perspective we have to diligently address the question: how desirable it is to invest in the construction of more of conventional power projects, including the nuclear power plants, without optimizing the usage of the existing electricity assets.

As per IREDA, under the Ministry of Non-Conventional Energy (NCE) Sources: "Promotion of energy conservation and increased use of renewable energy sources should be the twin planks of sustainable energy policy."

5.3 Other conventional technology sources of electricity

The true relevance of nuclear power to India will become clear when the overall costs and benefits of the same is diligently compared with that of other options such as thermal power (coal, natural gas and diesel power plants), hydro power plants, and renewable energy sources. Whereas each of the conventional type of electricity sources have many serious concerns associated with the demand for diversion of large tracts of agricultural and/or forest lands; huge quantities of fresh water; production of major GHG emissions such as CO_2, Methane and water vapor; reduction in forest and tree cover leading to the loss of bio-diversity; pollutants such as mountains of ash; health issue due to pollution/contamination of air, water and soil etc. the overall costs/benefits due to each of such technologies, when diligently compared with that of a similar capacity nuclear power plant in a given region, can provide a vivid picture of the relative costs/benefits to the society, which in most cases will indicate the highest cost in the case of a nuclear power plant.

Although the other conventional technology power plants (coal, natural gas, diesel power plants, and hydro power plants) have many of the major concerns to the society, similar to that of nuclear power plants, they are without the enormous radiation leakage / contamination risks.

5.4 Renewable energy sources

As compared to any of the conventional type of electricity sources, including the nuclear power, renewable energy sources such as wind, solar, bio-energy, tidal/wave energy, geothermal, have no major concerns listed in section 5.3 above, and are established as least damaging to the environment and sustainable. Initially they were viewed as uneconomical and not reliable; but in recent years they have been found to be much less costly because of their benign nature to the environment.

With the technological improvements in energy storage technologies such as batteries, it has been demonstrated that the overall cost of renewable energy source along with suitable energy storage devises/systems, is much less costly than any of conventional type of electricity sources, including the nuclear power. Not just in capital costs but also in life cycle cost consideration.

Renewable energy sources also have many other advantages such as not needing diversion of agricultural and forest lands/large quantities of water; being suitable to distributed communities; democratic in nature since sun and wind are available everywhere; not requiring complicated grid networks; giving control over their need to the local communities, renewable in nature etc.

The renewable energy sources also have enormous potential, as compared to the potential of the conventional energy sources, and are projected to be able to comfortably meet the entire global energy needs on a sustainable basis.

Whereas the cost of renewable energy sources and energy storage devices are plunging every year, the cost of nuclear power is escalating due to the concerns associated with the safety/waste management.

> An assessment of two large nuclear power parks proposed in India by the Institute for Energy Economics and Financial Analysis (IEEFA) finds that: "Given that both projects are first-of-a-kind designs, the government's plan to invest in 12 units of untested GE and Westinghouse nuclear plants will entail significant and unnecessary economic, financial and technological risks. Even the conservative "best-case" scenarios we have considered reveal that the capital costs of building the new power plants and, consequently, the costs of power from them would be far higher than solar sources of electricity. Given that the reactor designs are untested and that there are other risks associated with land acquisition and nuclear accident liability, cost- and schedule-overruns are a near certainty. Even if no significant problems are experienced during construction, IEEFA estimates that the levelized tariffs for the two projects will range from INR 9.05 to INR 26.04 per KWH. This range reflects the substantial uncertainty in the actual cost of building the plants. These tariffs would mean significantly higher electricity prices for consumers unless the Indian government provides long-term and probably unsustainable subsidies."
>
> In an article titled "A path to Sustainable energy by 2030" in Scientific American in November 2009, the authors have illustrated a plan as to how wind, water and solar technologies can provide 100 percent of the world's energy, eliminating all fossil fuels and nuclear power. It has quoted a 2009 Stanford University study which ranked energy systems according to their impacts on global warming, pollution, water supply, land use, wildlife and other concerns. The very best options were wind, solar, geothermal, tidal and hydroelectric power— all of which are driven by wind, water or sunlight. It was found in this analysis that the nuclear power, coal with carbon capture, and ethanol were all poorer options, as were oil and natural gas.
>
> Another article under the title "Cost-minimized combinations of wind power, solar power and electrochemical storage, powering the grid up to 99.9% of the time", as reported in *Journal of Power Sources* in March 2013, has referred to modelling of many combinations of renewable electricity sources. A major finding of the study was that at 2030 technology costs and with excess electricity from REs displacing natural gas, the electric system can be powered 90%– 99.9% of hours entirely on renewable electricity, at costs comparable to today.
>
> Of huge importance in this overall context is a written testimony to the United States House of Representatives Committee on Energy and Commerce Democratic Forum on Climate Change (November 19, 2015, Washington D.C.) by Mark Z. Jacobson, a Professor of Stanford University under the title "Road maps for 139 Countries and the 50 United States to Transition to 100% Clean, Renewable Wind, Water, and Solar (WWS) Power for all Purposes by 2050 and 80% by 2030", which provides a highly relevant study for India. This paper indicates that the researchers at Stanford University and the University of

California have developed road maps to transition the energy infrastructures of 139 countries (including India) and the 50 United States to 100% clean, renewable infrastructures running on existing-technology wind, water, and solar (WWS) power for all purposes by 2050, with 80% conversion by 2030. In this study all-purpose energy includes electricity, transportation, heating/cooling, industry, and agriculture/forestry/fishing. It says that converting the 50 states, 139 countries, and remaining countries of the world will reduce the social cost (business + health + climate costs) of energy by 60%. It is interesting to note that this study has mentioned that t*he main barriers to such a conversion are neither technical nor economic; rather, they are social and political.*

6.0 Other technological and logistics issues

Whereas the thermal and nuclear power plants are more suited as base load power plants, with a requirement to run at optimal load all the time, nuclear power plants are even more so, and they are known to be highly sensitive to variations in the grid parameters. They are, hence, most suitable for societies with much higher per capita energy consumption and for wealthy societies. Hence, it is hard to understand how a nuclear power policy is considered suitable to Indian conditions, where the per capita energy consumption is one of the lowest in the world, per capita income is very low, and grid parameters vary widely.

Since the modern nuclear power plants are all of large size because of the associated economics, they invariably need large size and complicated power network to function. Such large size power grids have failed to meet the electricity needs of the people in poorer sections and remote places, and hence, are not ideally suited to Indian scenario where, small and dispersed loads are common.

Nuclear power plants also need vast quantities of fresh water for cooling purpose, which are in severely short supply in India. Whereas the coastal power plants may draw such water supply through desalination plants, the ecological impacts of the massive wastes from such desalination plants on marine ecology cannot be ignored.

The availability of nuclear fuel in India is not adequate because of which the country has to depend on import of not only the fuels but also of the associated reactor technology. The erstwhile Planning Commission's Integrated Energy Policy (2011) document has stated that the Uranium reserve in the country can support only 10,000 MW nuclear power capacity, whereas the Union govt. has plans to take the total capacity to 63,000 MW by 2032 and to 250,000 MW by 2075. The import dependence will not only lead to concerns on the energy security, but also will lead to enormous foreign exchange outgo.

In view of the fast changing electricity demand pattern even within a day, the modern power grids are required to be much more flexible than the nuclear power plants can manage.

Whereas the risks associated with nuclear accident are considered as unacceptable, the risks due to terror attacks on the nuclear installations and the theft of nuclear fuels to be used for nuclear weapons by the non-state actors cannot be ignored either. A new dimension to the public safety is the 'nuclear terrorism'. In this regard Mikhail Gorbachev had expressed his concern in his article "Chernobyl 25 years later: Many lessons learned". He says: "…. I also remain concerned over the dangers of terrorist attacks on power reactors and terrorist groups' acquisition of fissile material. After the heavy damage wrought by terrorist groups in New York, Moscow, Madrid, Tokyo, Bali, and elsewhere over the past 15 years, we must very

carefully consider the vulnerability of reactor fuel, spent fuel pools, dry storage casks, and related fissile materials and facilities to sabotage, attack, and theft. While the Chernobyl disaster was accidental, caused by faulty technology and human error, today's disaster could very well be intentional."

The debate as to whether nuclear power is a safe, suitable and essential option for India has been going on for many decades. While the proponents of the nuclear power have been offering many arguments in favour of the option, there have been any numbers of issues raised by those who consider it to be not the best solution to meet the legitimate energy requirements of our society on a sustainable basis. The fact that despite massive funding of nuclear establishment in the country for over last 6 decades, the installed nuclear capacity as on January 2019 was only 1.9% of the total installed power capacity, may indicate the true relevance of nuclear power to India.

When we objectively consider the oft-repeated nuclear power advocacy from the context of Climate Change, the associated fallacy becomes crystal clear. In the Indian context the prospect of a much higher percentage of nuclear power to effectively combat the phenomenon of Climate Change looks highly improbable. A Department of Atomic Energy (DAE) document of 2008 has projected a nuclear power capacity of 275,000 MW by 2050. Assuming an average power capacity of 1,000 MW each this means a total of about 275 reactors. In view of the need for a large quantity of water to run these plants, it is natural to expect that they are located close to the coast. With the main land coast line of about 6,000 kM this works out to approximately 22 kM between two reactors. Even assuming that 2 or 4 reactors are placed in a straight line perpendicular to the coast, the distance between two nuclear power projects can only between 44 to 88 kM. Assuming a circular safe zone with a radius of 2 kM around each reactor, 275 reactors would require a total of approximately 3,500 Sq. kM of un-inhabitable land. Can such a situation be feasible in a densely populated country? The very projection of nuclear power capacity of 275,000 MW for India is unrealistic, given the fact that the import of nuclear fuel and technology to support 275,000 MW of projected capacity is fraught with unacceptable levels of economic cost and energy security risks.

7.0 Sensitivity Analysis

In order to minimize the uncertainties associated with the variation in values of many parameters of the costs and benefits, a method called sensitivity analysis can also be deployed, if considered essential.

In this method the costs and benefits are increased and decreased by 10% in separate calculations, and the costs increased by 10% and benefits decreased by 10% simultaneously in another calculation. In each of these steps, the IRR, NPV and payback period should be calculated. Such a rigorous approach will most probably reveal the true economics of the project, on the basis of which the feasibility of the project can be arrived.

8.0 Conclusions

When we objectively take into objective account various technical, economic, social, and environmental, logistics, and inter-generational issues, the true relevance of nuclear power to India should emerge unequivocally.

Hence, a diligent analysis of costs and benefits associated with each nuclear power project proposal in comparison with all other techno-economically viable options available to our country has become critical.

Such a diligent analysis at a policy level is a must before the country can continue with the nuclear power policy. A specific case of high level costs and benefits analysis, as may be applicable to Jaitapur NPP, is included to highlight the numbers associated as annexure to this discussion.

Since many of the numbers used in this high level CBA are assumed on the basis of the available information in the public domain, the focus should be to get an idea of the magnitudes associated instead of focusing on the accuracy of the numbers themselves.

References:

An overview of nuclear power in the context of additional capacity to Kaiga NPP
http://www.countercurrents.org/2017/07/01/an-overview-of-nuclear-power-in-the-context-of-additional-capacity-to-kaiga-npp/

Nuclear Power in the Context of Global Warming; Vol. 49, Issue No. 17, 26 Apr, 2014
http://www.epw.in/search/site/shankar%20sharma

Electricity Governance in India", 2014
http://ksm.sagepub.com/content/3/2/109.abstract

The total cost for scrapping the nation's nuclear power facilities - excluding Fukushima No. 1 nuclear power plants and other facilities under construction - is estimated to be about ¥6.72 trillion (S$84.2 billion), according to a tally by The Yomiuri Shimbun. The cost for decommissioning 53 commercial nuclear reactors is estimated to total about ¥3.58 trillion, for an average at ¥57.7 billion per reactor.
http://www.asiaone.com/asia/costs-scrapping-japans-nuclear-facilities-estimated-842-billion

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Cost Estimating for Decommissioning Nuclear Reactor in Sweden
https://www.stralsakerhetsmyndigheten.se/contentassets/6fcc4e0aea80454bb5adfa51e171dcfe/201401-cost-estimating-for-decommissioning-nuclear-reactors-in-sweden

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After the Shutdown: Oyster Creek Nuclear Generating Station
https://njmonthly.com/articles/politics-public-affairs/after-the-shutdown-oyster-creek-nuclear-generating-station-forked-river/

Former top regulator now says nuclear power 'hazardous'
https://www.wtae.com/article/former-top-regulator-now-says-nuclear-power-hazardous/25888972

"I now believe that nuclear power is more hazardous than it is worth," Greg Jaczko writes in his debut book, "Confessions of a Rogue Nuclear Regulator," which is based on his three years as chairman of the Nuclear Regulatory Commission under President Barack Obama. "Because the industry relies too much on controlling its own regulation, the continued use of nuclear power will lead to catastrophe in this country or somewhere else in the world. This is a truth we all must confront," Jaczko wrote.

Nuclear Power Stations Are Not Appropriate for Australia – and probably never will be

https://www.climatecouncil.org.au/nuclear-power-stations-are-not-appropriate-for-australia-and-probably-never-will-be/

Storage of nuclear waste a 'global crisis': report
https://www.france24.com/en/20190130-storage-nuclear-waste-global-crisis-report

The 100-page report, compiled by a panel of experts, dissected shortcomings in the management of voluminous waste in France, which has the second largest nuclear reactor fleet (58) after the United States (about 100). "There is no credible solution for long-term safe disposal of nuclear waste in France," the report said.

The True Cost of the Chernobyl Disaster Has Been Greater Than It Seems

http://time.com/5255663/chernobyl-disaster-book-anniversary/

" … the ultimate Chernobyl mortality toll, though difficult to estimate, may yet turn out to be significantly higher. Current estimates place it between the 4,000 deaths estimated by United Nations agencies in 2005 and the 90,000 suggested by Greenpeace International. The cost of the steel arch planned over the old sarcophagus has been estimated at 1.5 billion euros, with the total cost of the New Safe Confinement Project exceeding 3 billion euros. The new shelter over the damaged reactor No. 4 notwithstanding, the area around the nuclear plant will not be safe for human habitation for at least another 20,000 years.

CHERNOBYL disaster

http://chernobyl.undp.org/russian/docs/belarus_23_anniversary.pdf

"Economic damage of the Chernobyl accident is estimated at $235 billion for 30 years on after the explosion, making up 32 national budgets as of 1985. Chernobyl disaster vastly damaged the agricultural sector of the Belarusian economy, which is worth over $700 million annually. Due to radioactive fallout, Belarus lost one fifth of all agricultural lands. It also led to contamination of around a quarter of the Belarusian forests, 132 deposits of mineral resources and nearly 350 industrial enterprises."

Is Yucca Mountain back from the dead?

https://www.hcn.org/articles/is-yucca-mountain-back-from-the-dead

Yucca Mountain, the project to permanently store high-level nuclear waste underground in southern Nevada, has been considered dead since then-President Obama defunded it in 2012. But now, President Trump has moved to revive it. The Department of Energy estimated in 2008 that the project as a whole would require up to **$96 billion** to complete; it's already cost taxpayers **$15 billion**. The state has already filed more than 200 objections to the DOE's application, all of which would have to be resolved — at a cost of up to $2 billion — before the project could go forward.

The True Cost of the Chernobyl Disaster Has Been Greater Than It Seems

http://time.com/5255663/chernobyl-disaster-book-anniversary/

But the ultimate Chernobyl mortality toll, though difficult to estimate, may yet turn out to be significantly higher. Current estimates place it between the 4,000 deaths estimated by United Nations agencies in 2005 and the 90,000 suggested by Greenpeace International.

Japan Fukushima nuclear plant 'clean-up costs double' - BBC News

https://www.bbc.com/news/world-asia-38131248

In September, 2017, Tepco and the national government were reported as reaffirming their previous timeline for the cleanup, estimating the decommissioning process would take 30 to 40 years to complete.

Near site of Fukushima nuclear disaster, a shattered town and scattered lives

https://www.washingtonpost.com/world/asia_pacific/near-site-of-fukushima-nuclear-disaster-a-shattered-town-and-scattered-lives/2019/02/02/0dea7886-1e8c-11e9-a759-2b8541bbbe20_story.html?utm_term=.1dab3e85d3b0

Table of summary

High level indication of Costs and Benefits of Jaitapur Nuclear Power Project (JNPP) Proposal

(Proposal: 6 X 1,650 MWe Reactors @ 250,000 Crores project cost estimation)

	Societal Costs	Benefits	Comments
Option I (NPCL option for a Nuclear power Project)	About Rs. 250,000 Crores for the main project, without transmission line costs ?	Max. power (net) to the Western Region grid = 5,700 MW	10% of power goes to auxiliary consumption; about 20% T&D loss in Western Region (WR); assumed PLF = 80%
	Additional land for and cost of transmission lines: 6 * 765 kV lines ??	About 50,000 MU annual energy	@ 80% PLF
	Impact on Agricultural /horticultural production & due to radiation fears	Employment for about 500 people during operation?	Export demand for Alfonso mangoes and othe export product may come down because of radiation contamination fears
	Fisheries production loss		Anecdotal evidence of loss of fishes near Tarapur NPP
	Diversion of agricultural lands for the project		
	Denial of access to thousands of acres of land for grazing; wood and fodder collection		
	Impact on fresh water Sources		
	Impact loss on areas of ecologically very high value (bio-diversity hotspot)		
Option II			
Efficiency improvement In the existing system (T& D loss reduction)	@ 25% of cost of a new Coal power plant: about Rs, 12,000 Crores	About 5,500 MW can be saved; OR a virtual additional generation	T&D loss reduction from 20% to about 9% in Western Region; demand met in WR was 50,500 MW in 2017-18 (as per CEA)
		And about 40,500 MU per year of saved energy	Available energy in Western Region during 2017-18 was 368,000 MU (As per CEA)
		None of the other costs JNPP	
Option III			
(i) LEDs in place of incandescent lamps	Not estimated; but will be much less than	Estimated to be about 3,000 MW and 5,500	Replacement of incandescent lamps by LEDs in Western region

	Rs. 200,000 crores	MU per year of energy Saved	
(ii) Loss reduction in IP sets	Not estimated; but will be much less than Rs. 200,000 crores	Estimated to be about 3,500 MW and 42,000 MU per year energy Saved	IP set loss savings can yield about 18 % of the t energy consumption in WR (and at national lev 18% of 233,000 MU
		None of the other costs of JNPP	
Option IV			
(i) PLF improvement in thermal power plants	Not estimated; but will be much less than Rs. 200,000 crores	About 5,000 MW	Thermal power capacity in WR = 81,415 MW in 2018-19; increase in PLF from 61% to 70%
(iii) Loss reduction in domestic and commercial uses	Not estimated; but will be much less than Rs. 200,000 crores	About 1,000 MW	Replacement of inefficient domestic appliance as fans, TV, refrigerators, water pumps etc.
		None of the other costs JNPP	
Option V			
Renewable Energy (RE): About 15,000 MW of wind PLUS about 5,000 MW of solar power PLUS Energy efficiency Measures	About Rs. 160,000 crores @ Rs. 8 crores per MW for RE sources PLUS Rs. 15,000 Crores for efficiency	About 50,000 MU of annual energy AND None of the other costs (environmental, social and intergenerational costs) of nuclear power	In view of the lower utilization factor for RE Sources, much higher installed capacity will be required. Combined with the efficiency measures this RE option can provide much more benefits than the nuclear power and at much lower overall costs.

Annex 3

A representation to Atomic Energy Commission (AEC) on the issue of absence of disaster management plan for Kaiga NPP

---------- Forwarded message ---------

From: **Shankar Sharma** <shankar.sharma2005@gmail.com>
Date: Sun, 23 Dec 2018 at 21:54
Subject: An open letter to AEC on the issue of Kaiga NPP expansion plan
To: <chairman@dae.gov.in>, <agrawal.sk@dae.gov.in>, <ranajitk@dae.gov.in>
Cc: <dr.harshvardhan@sansad.nic.in>, <drjitendras@gmail.com>, Secretary (MoEF) <secy-moef@nic.in>, <cabinetsy@nic.in>, <appt.pmo@gov.in>, cs <cs@karnataka.gov.in>, acs <acs@karnataka.gov.in>, Principal Secretary Energy <prs-energy@karnataka.gov.in>, <prs-fee@karnataka.gov.in>

An open letter to AEC on the issue of Kaiga NPP expansion plan

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To
The Chairman and Members
Atomic Energy Commission
Anushakti Bhavan, C.S.M. Marg,
Mumbai - 400 001

Copy to:
(1) Dr. Harshvardhan
MoEF&CC, Govt. of India, New Delhi

(2) Dr. Jitendra Singh,
Union Minister of State, Prime Minister's Office,
Govt. of India, New Delhi

(3) Prime Minister,
Govt. of India, New Delhi

Dated, 23rd Dec. 2018

Dear Sirs,

Greetings from Sagar, Western Ghats, Karnataka.

This has reference to the public hearing under the EIA Rule 2006 of MoEF&CC, which was held on 15.12.2018 at Mallapur-Virje, Karvar Taluk, Uttara Kannada district, Karnataka over the

Environmental Impact Assessment (EIA) report of the proposal on Kaiga NPP extension (Units 5&6).

Having gone through that EIA report, and having made both written as well as oral submission at this public hearing, I notice that there are very many concerns to the local stakeholders as well as for the state and the country as a whole from the proposed project.

Whereas multiple deficiencies in the EIA report are glaring from different perspectives, such as safety, technical, economic, environmental, logistics etc., few deficiencies clearly stand out, and can be treated as adequate grounds for the MoEF & CC to summarily reject the EIA and the EC to the project. EIA is found to be seriously deficient in not considering: (i) the details and costs associated with the additional transmission lines required for the project; (ii) adequate details of disaster management plan to safely evacuate more than 32,000 people of the region and rehabilitate them satisfactorily in the case of any unfortunate nuclear accident of the type noticed at Chernobyl and Fukushima; (iii) policy and details associated with the safe disposal and long term storage of spent nuclear fuel; (iv) “options analysis” and “ costs and benefits analysis” of various techno-economically feasible options of much less overall cost available to our country in meeting the electricity demand; (v) to establish beyond reasonable doubt the project is the best option in the larger context of the region, country and the planet.

One can notice a lack of professionalism in the way EIA has been prepared, and hence, the same cannot be treated as fully establishing the true relevance of the project for the overall welfare of the society.

A serious issue noticed during this public hearing was the unanswered questions over the adequate preparedness on part of the concerned authorities during a scenario of uncontrolled radiation emission beyond the exclusion zone as can be expected in a large size nuclear reactor site such as in Kaiga NPP, and in a scenario similar to what happened in Chernobyl (USSR) and Fukushima (Japan). During my oral submission I raised this issue with the Deputy Commissioner (DC) of the district, who was at the Chair during that meeting. DC chose not to respond to this issue, and hence, it is not clear whether district administration has realised the huge importance of this particular issue of adequate preparedness on disaster management associated with a nuclear accident.

The EIA is without the necessary details in this regard, and seems to be keen to pass on all the associated responsibilities to the district administration, which shall not be acceptable to the people of the state. The following is the corresponding text in EIA.

EIA Section 07.06.04: Off-site emergency

"An off-site emergency occurs when the radiological consequences of an emergency situation originating from Nuclear Power plant (NPP) are likely to extend beyond the site boundary (exclusion zone) and into the public domain. For the purpose of planning off-site emergency, an emergency-planning zone up to 16 km radius is specified. There are defined criteria to determine an off-site emergency in terms of the release of radioactivity as indicated by the

radiation monitoring system/radiation survey results. The protective measures in public domain shall be implemented by the district officials under the supervision of the district collector or the divisional commissioner, who shall be designated as the Off-site Emergency Director (OED)."

Action plan for declaration and termination of off-site emergency

"If there is an escalation in the site emergency situation warranting an off-site radiation emergency, the SED advises the OED to declare off-site emergency. District commissioner, Uttara Kannada takes over the charge of OED and initiates appropriate actions. Off-site emergency is declared by the OED on the advice of SED. Off-site emergency is terminated by off-site emergency director on the advice of off-site emergency response co-ordination committee."

With the proposed increase of about 250% in the overall reactor capacity at the project site, the Kaiga site will face exponential increase in radiation emission risks with the presence of six nuclear reactors in close proximity with each other and sharing many technical services. Nuclear safety experts identify such a scenario as "enhanced risk for NPPs with multiple reactors and shared technical facilities".

The impact of the vastly increased radiation density (because of the 250% increase in nuclear reactor activity?) on the bio-diversity and the people working and living in the project area cannot be anything but negative. Additionally, the risk of any unfortunate nuclear accident can only multiply because of the need to store on site the vastly additional quantity of highly radioactive spent fuel for hundreds of years (India has no known policy, as yet, to store the spent nuclear fuel and other wastes away from the nuclear reactor site).

It is a general public opinion that the concerned authorities in the country are ill-equipped and ill-prepared to face such industrial level disasters as experienced in the case of Bhopal gas tragedy in 1984. Our authorities seem to become complacent over a period of time with the view that such a disaster may not happen in our country. Whereas, the nuclear power authorities may continue to claim the low probability of an uncontrolled nuclear radiation emergency in India, such statements from our authorities do not enjoy the trust of the people because of the plethora of reports from around the world on the unmitigated nuclear disasters experienced at Chernobyl and Fukushima. The EIA, itself admits that such an emergency cannot be completely ruled out. Even though the probability of an uncontrolled nuclear radiation emergency in Kaiga NPP may be low, as per the claims of EIA, the overall consequences of a nuclear disaster to the district and to the state of Karnataka as a whole can be horrendous. Hence, we cannot afford to ignore the need for taking all possible precautions, including even the minutest step, in disaster preparedness.

In view of the increased probability of a nuclear mishap at Kaiga NPP, it is essential to note what Dr. A Gopalakrishnan, former Chairman of Atomic Energy Regulatory Board (AERB) has to say on safe practices in nuclear industry in India: “Japan (*which failed to avert the Fukushima*

disaster) is a country that has a superb disaster management organisation throughout their nation, and an often-rehearsed working team to handle such emergencies. In contrast, in India, we are most disorganised and unprepared for the handling of emergencies of any kind of even much less severity. The Atomic Energy Regulatory Board's (AERB's) disaster preparedness oversight is mostly on paper and the drills they once in a while conduct are half-hearted efforts which amount more to a sham." An insightful article, "The missing safety audits" by Dr A Gopalakrishnan poses many serious concerns on the safety aspects in the nuclear establishment of the country**.** As a welfare society with a hugely dense population and already stressed natural resources base, we cannot afford not to take cognizance of such concerns by a former Chairman, AERB, who also is recognized as an expert in nuclear power engineering. We cannot expect the Civil Society to be rest assured until all the concerns raised by such experts are addressed satisfactorily before we consider building more nuclear reactors.

Whereas, the project proponent through EIA, seem to have shifted the actual responsibility of off-site emergency measures to DC by the statements as mentioned above, it should be emphasised that as the district administrator and also as the district magistrate, the DC has enormous and varieties of responsibilities even during normal times. It will be seen as the abdication of responsibility on part of the nuclear industry authorities in the country to expect a busy official, such as DC of a district in Karnataka, to appropriately react to a nuclear emergency unless he is ably assisted by a group of competent people, who are well trained and well equipped. EIA has no explanations in this regard.

In this overall context, it is important to know at what stage of any unfortunate nuclear accident will the affected communities have to be evacuated, and what are the proposed arrangements for the same? Where are the hospitals to treat the maximum of 30,252 persons (as per section 3.9 in EIA) and how will these people be evacuated and transported? Have all the families who are likely to be affected, and their habitats accurately identified, and whether adequate numbers of all-weather roads available to evacuate them at a short notice, say in mid-rainy season? What sort of radioactive danger communication facility to each one of these people is available at present in the unfortunate scenario of a Fukushima type accident? Where are the safe nuclear shelters to house these people? Are the local authorities such as the Deputy Commissioner, Tahsildars, Panchayats, Doctors, nurses, community leaders etc. trained and provided with necessary equipment to detect any radiation leakage, and to take the necessary safety measures immediately? Have sufficient number of vehicles identified and available at short notice to evacuate these people to safety? Are all these details properly recorded and made known to the concerned group of officials/people?

AEC should know that the district of Uttara Kannada in Karnataka is largely a hilly area, and the Kaiga NPP is in a valley surrounded by thick forests. The local communities, who are also the project-affected people, are spread over an area of about 800 sq. kM, as identified by the EIA. Since the habitats of these communities are in vastly undulating hills and river valleys, artificial reservoirs etc., and do not have well connected all-weather roads, quick evacuation in an emergency scenario will be a nightmare. As stated by the MLA of Karwar constituency in the public hearing, one of the urgent requirements of the local communities is a good number

of well connected all-weather roads. The Kaiga NPP authorities should be asked to effectively work with the state govt. to share the costs and responsibility of building such a road network on a priority basis.

Since adequate remedial actions are critical during the first few hours of any nuclear emergency to minimise the loss of life, and since NDRF and SDRF teams are unlikely to be at the site during this period, there is a critical need for the state govt. to diligently consider all the associated issues, discuss with the NPCIL/DAE/AEC/NDRF officials, and ensure all the necessary measures are in readiness.

The horrors of Chernobyl and Fukushima disasters must have been the suitable wake-up calls for our authorities to honestly try and reduce the chances of such catastrophes in India, but sadly these authorities are continuing to add more nuclear reactors at an ever increasing pace, thereby escalating the risks associated with nuclear disasters. Since, it will be the people of the Uttara Kannada district and of the state who will bear the brunt of such a nuclear disaster at Kaiga NPP, which has been thrust on the state basically because of the policy blunder of a previous govt. to allow such a risky project in a such a hilly area covered with thick forests, it is of paramount importance for the present govt. to take all possible measures to minimise such risks and impacts.

I also understand from other nuclear project areas in the country, that the project affected people in all such cases have taken the view that the general approach of NPCIL to the disaster management preparedness has been one of clear abrogation of its responsibilities.

In this context, it can be said to be a great disservice to the people of this country that DAE/AEC is going ahead with the addition of many nuclear reactors without ensuring adequate disaster management preparedness.

The claim by the project proponent that there will be no need to acquire additional land and the right to use more of fresh water for the proposed project, since the same have been agreed to in 1990s by the govt. of Karnataka, should carry no real merit because such natural resources belong to the people of this country/planet, and cannot be effectively replaced in any way. The natural resources base in the state, country and the planet as a whole have undergone huge transformation since 1990s, and the scenario now can be described as one of severe crisis as referenced to the Climate Change perspective. Karnataka, as a state, is already water scarce, and is facing drought in more than 50% of its revenue subdivisions every year.

The fresh water demand for nuclear plants should be of particular concern for a water deficient nation like India, and for a drought prone state like Karnataka. Nuclear reactors are known to require about 720 gallons of water per megawatt-hour of electricity they produce, according to data from the National Energy Technology Laboratory in West Virginia cited in 2012 by the magazine New Scientist. That compares with the roughly 500 gallons which coal power requires and 190 gallons which natural gas needs to produce the same amount of electricity. Solar plants, by contrast, use approximately 20 gallons per megawatt-hour, mostly for cleaning

equipment, according to the Solar Energy Industries Association. In his context, can the state of Karnataka, which has faced drought scenario in about 50% of its revenue sub-divisions in most of the years since year 1990s, afford to divert 6,346 cubic meter per hour of fresh water, as consumptive use, for the said project (as per EIA report)?. Additional fresh water demand of 6,346 cubic meter per hour for consumptive use for the proposed project is truly enormous quantity of fresh water from the perspective of the basic needs of the people of the state. At the rate of 6,346 cubic meters per hour the water consumption in a day will be 152,304 cubic meters of fresh water. At about 100 litres per day this can meet the daily water requirement of about 15 lakh people. It will be a great disservice to the people of the state to deny this much of fresh water for them, since more the 53% of the state's geographic area is officially declared as drought prone.

The availability of water for a nuclear power project has always been a major problem, particularly for those nuclear plants located far from the coasts and dependent on freshwater. Another associated problem is the temperature of the water that's available for cooling purpose. It is well known that many nuclear power plants in US and Europe were forced to shut-down due to either low water levels in the rivers and/or due to increased inlet water temp. The phenomenon of Climate Change, which is credibly projected to impact a tropical region like India, will have enormous impacts on both the availability of fresh water and the temperature of water in the Kali river. The heat wave that struck Europe in the summer of 2018, had forced utilities to scale back electricity production at nuclear plants in Finland, Germany, Sweden and Switzerland. In France the utility EDF shut down four reactors in one day for this reason. Such risks, not only from the perspective of the loss of electricity generation but also from the perspective of the loss of cooling system for the reactors, must have been analysed diligently in the case of Kaiga NPP too, which can be realistically projected to face such problems in its economic life time. And hence, the risk of failure of the safe shutdown of the reactor cannot be underestimated.

The region around the Kaiga NPP, which also has an important river Kali flowing through it, is ecologically very sensitive, and is considered to be of very high ecological value. This area, around Kaiga NPP including the three villages of Kaiga, Mallapur and Virje, which are identified as project area in the EIA, is anyway declared as Ecologically Sensitive Area by a recent notification (3rd Oct. 2018) of the MoEF&CC. The decision to set up the Kaiga NPP in such an ecologically sensitive region in early part of this century itself was an enormous policy blunder, which has resulted in incalculable ecological impact. Three reports from the scientists of IISc, Bengaluru under the title, (i) "Ecological Sustainability of Riverine Ecosystems in Central Western Ghats",2018; (ii) "Stimulus of developmental projects to landscape dynamics in Uttara Kannada, Central Westen Ghats", ELSEVIER, 2016, and (iii) "Salient Ecological Sensitive regions of Central Western Ghats, India", Springer Nature 2018, have all copiously highlighted the ecological importance of the area around Kaiga NPP. This emphasizes the need for the review of existing forest policies to ensure sustenance of ecological services through the sustainable forest management strategies.

Many such reports have established that the cover of evergreen to semi evergreen forest in this region has come down from about 62% to 39% between 1973 and 2016. In view of the ecologically sensitivity of this region, such study reports have strongly recommended the prohibition of certain human activities, which includes the setting/expansion of nuclear and hydro power stations, where withdrawal of large mass of water from Kali river in involved. In this context, withdrawal of additional large quantity of water from the river Kali (as needed for the Units 5 & 6) should be prohibited even though the EIA says that the state govt. of Karnataka has earlier approved the withdrawal of Kali river water needed for the entire Kaiga NPP.

In this context, the diversion of more than 54 Hectares of thick forest lands in this district for the proposed project (in addition to the forest lands needed for additional transmission lines) will negate the very objective of MoEF&CC and the state's own ecological considerations, in the context that the proposed project area is in the reserved forest category, and also within the buffer zone of the Kali Tiger reserve. The forest cover in the state and the country is already known to be less than 20% as against the national forest policy target of 33% and 66% in the hilly districts such as Uttara Kannada.

Keeping all these factors in proper perspective, it is evident that the area in and around the proposed project area is ecologically of very high value to the nature, and sensitive too, not just for the forest dependent locals, but also for the global concerns on Climate Change. MoEF&CC has been very emphatic that such areas must be protected, and hence must be insulated from all kinds of developmental projects. The state, the country, and the planet as a whole, cannot afford to lose more than 54 Hectares of tropical rain forest of very high ecological value to the nation’s and planet’s environment for the sake of an inconsequential additional power, as in the case of this project proposal.

Any commitment of the state govt. to allocate the additional quantity of 152,304 cubic meters of water per day to this project should also be seriously viewed in the context of potentially reduced availability of water in Kali river due to the impacts of Climate Change. Once committed, the nuclear power plant will continue to demand this much of water per day even during water availability crisis in the river, leading to a scenario where that much of water has to be given to the project even at the cost of the basic/domestic needs of the local communities.

Objectively considering various constraints of the prevailing state and the regional electricity grids, the proposed capacity of 1,400 MWe from this project will basically mean that on an average only about 800 MW of power will be available for the end use consumption, and that Karnataka's share can only be about 400 MW of additional power. The question that should be carefully discussed is whether the state should lose more than 54 hectares of thick forests and about 152,304 cubic meters of fresh water per day from Kali river for a meager benefit of 400

MW, for which there are many benign alternative options available for the state at much lower overall costs to the state.

The EIA's efforts to project the nuclear power as economically viable, and that it has a relevance in the Climate Change context, can be seen as hilarious to say the least.

These and many other concerns are discussed in the written submission as in the enclosed file. Since decades, AEC/DAE has chosen not to respond to various questions raised by the civil society w.r.t the relevance of nuclear power to India, and hence, they cannot hope to get any support from the larger civil society for the nuclear capacity expansion plans.

Considering all these issues in the overall welfare perspective of the true welfare of the people of Uttara Kannada district, the state of Karnataka and the country, and in the context that nuclear power is the costliest, riskiest and least favored electricity option around the world, and that there are much benign and much less costly options to meet the legitimate demand for electricity in our country, the AEC/DAE should ask NPCIL to withdraw its application for Environmental Clearance to this project proposal.

Under the prevailing scenario in the country and the planet, as detailed herein, it will be a travesty of social and environmental justice, and the violation of the provision of the country's Constitution and provisions of many relevant Acts of the Parliament to allow the diversion of more than 54 hectares of dense forest land of very high ecological value, and 6,346 cubic meter per hour of fresh water which can meet the daily needs of about 15 lakh people to this enormously risky project.

The over ambitious plans of the govt. to expand nuclear power capacity in the country against all wisdom should also be dropped in favor of the vastly attractive, least costly and environmentally sustainable renewable energy sources.

The detailed submission made at the public hearing on all the associated issues is as in the enclosed file.

I am marking this communication to the state govt. of Karnataka, PMO and MoEF&CC.

Regards

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