THE RISKS TO WATER BODIES FROM THE INDIA BASED NEUTRINO OBSERVATORY –

Internal report shows aquifer impact is inevitable

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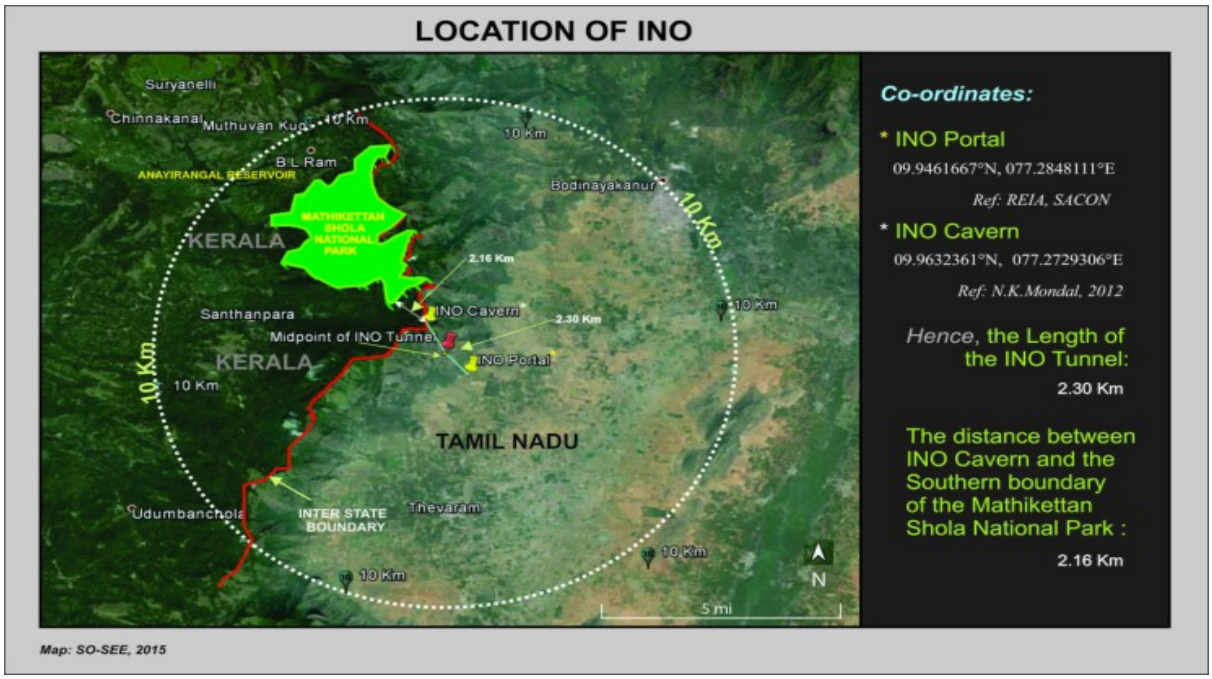
"Scientists are no longer perceived exclusively as guardians of objective truth, but also as smart promoters of their own interests in a media-driven marketplace. The relationship between the scientific community and the general public has never been worse in living memory." Benny Haerlin and Doug Parr, Nature, 1999[1]



The India-based Neutrino Observaory (INO) proposed to be set up under the Cardamom Hills (09.9632361°N, 077.2729306°E) in the Western Ghats, a UNESCO heritage site, near the Kerala-Tamil Nadu border with its entry portal in Pottipuram village in Theni district of Tamil Nadu has been opposed by the local communities and the environmentalists. The first INO Risk Audit Report was published in Countercurrents. [2] The main issues raised in the the Risk Audit Group's articles are:

(a) The construction has the potential to cause hydro-geological calamities which will affect the livelihood of close to 10 million people in six districts of Tamil Nadu and Kerala, who depend on the waters stored in reservoirs within the INO neighbourhood.[3]

(b) Violation of the Federal Principles by the Ministry of Environment, Forest and Climate change as this is an inter-state project (Kerala and Tamil Nadu States) and the Government of Kerala has not even been informed about it.

The appeal against the grant of environmental clearance to INO in the Hon'ble National Green Tribunal, Southern Zone Chennai filed by G Sundararajan is coming up for final arguments in early March 2017. Among the grounds for the appeal was the potential impacts on the aquifer and water bodies. About a year after the filing of the appeal in NGT and some four years after the award of prior environmental clearance by the Government of India, the Tata Institute of Fundamenal Research (TIFR) has kindly uploaded on its website the Detailed Project Report (DPR) of INO prepared in December 2010 by the Tamil Nadu Generation and Distribution Corporation (TANGEDCO). With the publication of the DPR it will be easy for Lawyers Sundarrajan and Vetri Selvan to convince the Hon'ble Tribunal about the impending water related disaster if the scientists are allowed to blast the Ghats. This report clearly mentions that tunnelling can disrupt the aquifers, there will be water loss and elaborate arrangements will be made for pumping the water out.

Water Loss in INO's Detailed Project Report

The INO proponents were aware of the 'inevitability' of aquifer damage as these quotes from INO's Detailed Project Report (DPR)[4] prepared in December 2010 by the Tamil Nadu Generation and Distribution Corporation (TANGEDCO) reveal:

> "During the construction of tunnels and underground openings, the rock mass is disturbed and it undergoes redistribution of stress accompanied by a change of shape. Construction of a tunnel may also change the pattern of ground water movement and therefore pre-measurement becomes an important parameter. *The accurate pre-estimation of these parameters for actual design is another difficult task and hence designs cannot be precise and the element of empiricism is inevitable*." (DPR Page 62)
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> "Drains will be provided on both sides. As the slope is downward, the seepage water collected will be pumped out through Booster pumps." (DPR page 72)
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> There will be "a de-watering sump to collect all the seepage water" which "will be pumped out using a 50 KW pump;" and there will be a "backup diesel generator to meet the exigencies of loss of grid power". (DPR page 73)

INO's position on water loss and aquifer damage

INO delayed the placement of the DPR on its website for five years. Even now, INO proponents are not ready to accept the judgment of the TANGEDCO. For instance Dr V Arvind, eminent computing scientist and Director-in-Charge of Institute of Mathematical Sciences, Chennai, one of the respondents in the NGT appeal stated in his counter-affidavit:

> "The whole project will be located in a very hard massive rock but for a shear zone running across the tunnel, not parallel to it. Water column trapped in shear zone will be known only during tunnelling. It may be insignificant also. The water is

not connected to regular water table and will not affect the aquifers in the area. Since no water is being dammed or held in construction of INO lab, there will be no impact on rivers or water bodies nearby."[5]

TANGEDCO PROFESSIONALS SURVEYING IN IDUKKI DISTRICT OF KERALA

Other Legal Issues

The award of prior environmental clearance (PEC) to the INO project violate at least three provisions of the Environmental Impact Assessment Notification of 2006. These are:

* The project site is located in seismic zone-III[6]. The applicant said it is in zone-II.

** This is an inter-state project as it is located near the Kerala-Tamil Nadu border. Though 40% of the 'impactable' area of the project with more than 60,000 inhabitants lies in Idukki district of Kerala state, the environmental impact assessment (EIA) was not conducted there because the permission for doing fieldwork in Kerala was not obtained.[7] The mandated prior clearance from the Government of Kerala not obtained.

*** The Mathikettan Shola National Park (MSNP) barely two km from the project site. The Salim Ali Centre for Ornithology and Nature Studies (SACON) does not even mention the presence of the MSNP in their Rapid Environmental Impact Assessment (REIA). The 'No-Objection Certificate' from the Chief Wildlife warden of the park (in the Department of Forests, Kerala) was not obtained.

Ecological issues of construction of Deep Tunnels under Great Depth

As per the classification by the International Tunneling Association (ITA), INO is a 'deep tunnel under great depth', "characterized by extreme conditions for risk assessment and risk management", which demands "the early planning and ground investigations; the

design, and other safety features for construction and operation".[8] The US Free High Way Authority (FHWA) says that the investigations for geo-technical study (GTS) for a tunnel "through mountainous terrain, be carried out in several phases" and its cost will be "typically about 3% to 5% of construction cost".[9]. As the construction cost of INO is US$225 million, a proper GTS would have cost about US$ 6.7 to 11.2 million.

For the INO's GTS, one geologist spent three days at the "portal area and initial reaches of the access tunnel" and visually observed 3 km of the "the remaining reaches of the tunnel up to the hill peak from a distance since the hill is too steep". Seven bore holes were drilled near the entry portal only. As "the cores were not arranged run-wise, no depth marking was done for each run, and the driller's log sheet doesn't indicate water loss or water colour details", an "approximate fixing of weathered rock and fresh rock levels" was done.[10]

Hydro-geology and dams

While the eastern portion of the Ghats is a rain-shadow region (mean annual precipitation (MAP) <800 mm/a), the western portion located in the Kerala State (MAP >3500 mm/a) is the water capital for 6 districts of Tamil Nadu and Kerala. There are 15 dams storing over 3 billion cubic meters (m^3)of water within radii of 5 to 70 km from INO. Among these is the Idukki dam, one of the highest arch dams (169 m) in Asia. This is also one of the 53 dams in the world monitored for reservoir-triggered seismicity.[11]. Most of the dams, located in densely populated areas were built when their risk factors were not well known.

Blast Impacts on Aquifers

The complex with a finished volume of 235,000 m^3 will be blasted out using about 400 tons of explosives in 1000 days. About 80% of the excavation area is under an overburden >1000 m. Since the massif is made up of hard and brittle charnockyte rock, the GTS warns about the possibilities of "stress related problems like rock bursts where rock cover is >1000 m". The potential damages to buildings and dams in the western part of the project have not been looked into.

More important is the impact on the aquifers and underground springs as had happened during the construction of Italy's Gran Sasso National Laboratories (LNGS), a neutrino observatory two-third the size of the INO. There, the disruption of the aquifer resulted in death of several workers and a massive flood in the plains. The groundwater level in the area dropped from 1600 m above the mean sea level (MSL) in 1968 to 1060 m MSL in 1990. Water still leaks from the complex and the drainage is '1500 l/s (or about 50 million m3 per year, equivalent to the annual drinking water consumption of 50 million people in the arid tropic). The LNGS website discloses that the dripping water laden with toxic chemicals is drained into the Vomano River. The experiences at Gran Sasso and similar tunnels under great depth were cited in an article published in the journal Current Science in Feb 2013, which underlined the need for conducting a scientific risk assessment of the INO.[12]

Scientists shying away from Debate

In January 2016, the prestigious science journal, Nature, published a report, criticizing the opposition to the INO as ill-informed and politically motivated.[13] The report was written by the journal's London based correspondent who is a particle-physicist, though the journal has its correspondent in Delhi. The report did not mention the article on INO's aquifer impacts published in the Current Science, published by the Indian National Science Academy, Bangalore. The Nature refused to publish my response in print form, but was kind enough to allow me to join the on-line debate in the journal. My comment, which has since been removed from the journal's website is available at the ResearchGate.[14] As usual, none of the hundred odd scientists who are supposed to be working in the INO project or their half a dozen supporters, responded to the comments in the online debate.

The Pluralistic ignorance and the Crisis in modern science

Prof Nabha K Mondal, the Director of INO asked the activists that do they think hundred scientists working in India's National Institutes and Universities will do something which will pose a threat to the livelihood of millions of people. They may not intentionally do it, but their reluctance to read the technical reports related to the project and respond to the comments published in prestigious journals might lead to disastrous consequences. The particle physicists who are part of the INO refuse to see the point of view of other specialties like the earth science. This is the tragedy of the modern science, which was highlighted in an article about the drones and other latest military applications, published in Nature in which Peter Singer says that "our sophisticated inventions and our crude grasp of the consequences continue to widen as academic journals of each field focus inward, professional conferences are attended only by the like-minded, and those who attempt to straddle disciplines or engage the public are viewed as less serious"[15].

The trend of super-specialization and inward focussing by the practitioners is a fact of life, which cannot be reversed easily. The writers and the journals of general science can and should look at the issues holistically without bias, if the rot from inside is to be prevented.

Conclusion

In a speech at the British Science Festival in 2010, Lord Sainsbury said that "scientists must be open about the risks involved in new research if they are going to win the public's trust" while "trying to answer the question of why it is that the public seem to be more suspicious about science the more they know about it". A well educated public, he concluded, will ask questions and the only option is to have a genuine public dialogue and in particular a dialogue about risk.[16]

INO Risk-Audit Group has been raising risk-informed objections only. They are only demanding that the potential ecological and geological impacts of the tunnelling should be revealed through an in-depth study by an independent expert group and all the stakeholders should be convinced.

VT Padmanabhan has conducted health studies among the people exposed to high natural background radiation in the monazite beach villages of Kerala, India, children born to exposed and unexposed parents before and after the Bhopal disaster, environmental and occupational health studies at a viscose rayon factory in Nagda, Ujjain (Madhyapradesh) and the Indian Rare Earths, Aluva, Kerala. He has also reviewed the somatic and genetic studies of Hibakushas of Hiroshima and Nagasaki. He has published in the Lancet, Journal of American Medical Association, International Journal of Health Services, Current Science, Economic and Political Weekly etc. With his colleagues, he has been writing on the safety issues of the Kudankulam Nuclear Power Plant, Tamil Nadu and the India-based Neutrino Observatory. Almost all his published papers are available at the ResearchGate. He has been a regular contributor of the Counter-Currents. E-mail: vtpadman(at)gmail.com

1 Benny Haerlin and Doug Parr, 1999, How to restore public trust in science , Nature, Vol 400 doi:10.1038/22867

2 http://www.ino.tifr.res.in/ino//Padmanabhan-Responses/Padmanabhan-Responses.pdf

3 V. T. Padmanabhan and Joseph Makkolil,Mountain tunnelling, aquifer and tectonics – a case study of Gran Sasso and its implications for the India-based Neutrino Observatory. Current Science, Vol. 104, No. 4, 25 February 2013. http://www.currentscience.ac.in/Volumes/104/04/0414.pdf

4 http://www.ino.tifr.res.in/ino//OpenReports/INO_civil_dpr.pdf

5 Counteraffidavit filed by V Arvind, dated 04 May 2015 in Sunderrajan vs the Government of India, BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL, SOUTHERN ZONE AT CHENNAI, MEMORANDUM OF APPEAL (Under Section 16 of the National Green Tribunal Act 2010) APPEAL NO. OF 2015

6 http://www.bmtpc.org/disaster%20resistnace% 20technolgies/ ZONE%20III.htm

7 http://www.ino.tifr.res.in/ino//reports/REIA-Final_doc.pdf

8 www.ita-aites.org/en/.../working-group-17-long-tunnels-at-great-depth

9 http://www.fhwa.dot.gov/bridge/tunnel/pubs/nhi09010/03.cfm

10 http://www.ino.tifr.res.in/ino//OpenReports/geotechnical-investigation.pdf

11 http://www.currentscience.ac.in/php/toc.php?vol=102&issue=10

12 http://www.currentscience.ac.in/Volumes/104/04/0414.pdf

13 Unfounded rumours delay Indian neutrino detector , Nature, Vol 52, doi:10.1038/529140a

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15 Singer. P. W., 2011, www.nature.com/nature/journal/v477/n7365/abs/477399a.html

16 http://www.sciencewise-erc.org.uk/cms/honesty-about-risk-is-key-to-public-trust-in-science/