

***INO response to the 2<sup>nd</sup> article by Mr. V.T. Padmanabhan appeared in countercurrents.org on 24 October, 2012***

***INO responses are given in italics***

***Date : 15.11.2012***

***Mr. V.T. Padmanabhan is generating unwarranted fear in the minds of the people by misquoting and misreporting the findings of some technical papers on neutrino radiation out of context. It is now time to ask what is his real agenda for doing this? We have already responded to all his allegations regarding the location of the INO site and the absence of any effect on dams in the area and how we are going to handle rock debris. We will not respond to those allegations here again. We will mainly respond to the false allegations he is repeatedly making by misquoting and misreporting the hazard due to neutrino radiation .***

**V.T.Padmanabhan writes:**

“The India based Neutrino Observatory [INO] a mega science project of the Department of Atomic Energy [DAE] is an underground laboratory coming up under the hills in Idukki-Theni districts of Kerala and Tamil Nadu. There will be four caves, 16235 sq meter in area and 252,208 cub meter in volume, accessed by 2491 meter long tunnels. The observatory will receive beams of high energy muon neutrinos ‘manufactured’ in neutrino factory in USA . A summary of the potential radiological, geological and ecological hazards from the laboratory was published in Countercurrents [CC] ON 26 Sep 2012. INO has responded to this article on the website hosted by the Tata Institute of Fundamental Research [TIFR]. It is a document worth reading for all those who have an interest in the working of DAE.  
Link: <http://www.ino.tifr.res.in/ino//Padmanabhan-Responses/Padmanabhan-Responses.pdf>

1. Radiological hazards and accidents from factory beam neutrinos.

The CC article warned about the potential radiological hazards from the high-energy, collimated beams from the neutrino factory. I was particularly concerned about the radio-contamination of drinking water of over 5 million people in three districts of Kerala and Tamil Nadu, stored in 12 dams, all within 50 km of the caves. This could have been a radio-ecological catastrophe, unheard of in modern history, perhaps rivaling Chernobyl and Fukushima . To this, INO response is: *‘the author harps on about factory neutrinos. This is wrong. In addition, his science is wrong: the properties of neutrinos .. are the same whether they are produced in the factory or come from space from far-away*

*galaxies in the cosmos. The author has let his imagination run away with him; perhaps he has been influenced by the movie "2012" which took many liberties with facts about neutrinos!"*

My fear was based on technical papers published by institutes like Fermilab and articles published in peer reviewed journals. Incidentally when this issue was broached by Shri VS Achuthanandan, the opposition leader of Kerala on 16 th of October, 2012, Dr NK Mondal said that they [authors of those papers] are a confused lot. Main references for neutrino health physics were given in the original CC article. The latest paper published on this topic by Joseph John Bevelacqua, is available at [www.intechopen.com](http://www.intechopen.com). INO may study them and if they are unscientific, they should sort this issue with the authors and the publishers. The discussions since 17 th of September 2012 and the INO response to CC article reveal that the promoters and their supporters outside the establishment are unaware of the radiological hazards from the high energy collimated beams. Young students who are recruited to work with the detectors have not been told that they will be radiation workers of the future.

Many eminent non-DAE scientists, like R Ramachandran [The Hindu], Prof K Pappooty [Kerala Shastra Sahitya Parishat -KSSP] and Prof T Jayaraman [the Tata Institute of Social Sciences -TISS] have ruled out any radiation contamination from INO activities. Many well-meaning, neutral science writers and other professionals have been misled by the propaganda materials at the INO website, which equates factory-made neutrinos with low-energy, non-collimated solar neutrinos, which are relatively less radioactive. Incidentally while INO leadership insists that neutrinos are harmless, media persons, professional, farmers and non-experts are discussing the potential radiation hazards from INO in a Kerala based discussion forum –Fourth Estate Critique [FEC]. If things go like this, DAE scientists will be fast losing their upper hand over science information. This will be good sign for science.:"

***INO Response : Mr. V.T. Padmanabhan in the present article as well as in his recently published article in the Malayalam weekly Mathrubhumi dated 11 November, 2012 referred to several technical papers from Fermilab as well as from the web to suggest that a muon collider that may come up in the Fermi National Lab, USA in future, will be a source of radiological hazard and accident for the people in and around the INO lab (located more than 10000 km away). Since he is harping on this point again and again by misquoting several technical papers on this subject, it may be necessary to clarify the matter.***

***First of all the authors of these technical papers (listed below) are not a confused lot, it is Mr. Padmanabhan who is either a confused person or have some other agenda for distorting facts.***

***The main theme of the papers referred by Mr. Padmanabhan ( N.V. Mokhov et al, FERMILAB-Conf-98/384 , N. V. Mokhov et al, Fermilab-conf-99/067, B.J.King , arXiv:physics/9908017v1, Joseph John Bevelacqua, available at [www.intechopen.com](http://www.intechopen.com) etc) indeed discusses the possible hazards due to neutrino radiation from a muon collider but not from a neutrino factory. While a neutrino factory will produce neutrino beams of GeV energies, a muon collider is***

*a proposed particle accelerator, extremely sophisticated and technologically challenging, that may come up in future. In this muon collider scientists propose to accelerate muon beams of very high intensity to even TeV energies and collide them head on. Such collisions will create new particles and help to understand the fundamental laws of nature just like the LHC experiment where protons at high energies collide.*

*First of all INO has nothing to do with a Muon Collider to be possibly built at Fermilab at a future date. In addition, even if such an accelerator comes up in USA, there is nothing to fear about it in India. The studies referred by Mr. Padmanabhan point out that a muon collider at extremely high intensity with TeV energy could be a possible source of high flux of neutrinos and may become a radiation hazard for the people who live in the neighborhood of such an accelerator complex, but not for the people in India who live 10,000 km away. The purpose of these quoted studies were to make the scientists aware of this radiation hazard so that they can take appropriate steps to avoid such radiation to people who live in the neighborhood. Such studies are necessary before building any new particle accelerator anywhere in the world. Certainly the people in the neighborhood or for that matter the US government will not build such a muon collider if it becomes a radiation hazard for its own people who live nearby irrespective of what happens to people of India who live 10,000 km away.*

*Mr Padmanabhan without any technical knowledge on the subject being discussed and deliberated in these technical papers, is just misquoting some numbers out of context to create fear in the minds of the public in India. For a muon collider the neutrinos emitted due to muon decay will exit the earth at a distance of about 50-60 km depending upon how much below the earth's surface the collider is located and not at a distance of 7000 km. In addition, this radiation does decrease with distance as  $1/L^2$  where L is the distance from the source of the radiation to the point where the beam exit the surface of the earth. He should read equation 7 or equation 8 in the article by B.J.King listed above to understand this.*

*Once again let us categorically state that a muon collider is not a neutrino factory and there will be no neutrino beam that will be directed towards any direction from the muon collider. A neutrino factory will produce only GeV neutrino beam and the corresponding dose will be even smaller as the*

***interaction probability of GeV neutrinos will be at least 1000 times lower than that of TeV neutrinos and there is no issue of any radiation hazard due to a neutrino beam from a neutrino factory at a distance of 7000 or 10000 km away.***

***Finally a word of caution, no one in the world is making a Muon Collider. These are all theoretical studies to understand the complexities and issues for making such a collider including radiation issues. The technology for making such a collider does not exist today. If at all someone builds such an accelerator, all issues including radiation issues will be addressed.***

***V.T.Padmanabhan writes:***

***"2. Potential damage to the dams from blasts:***

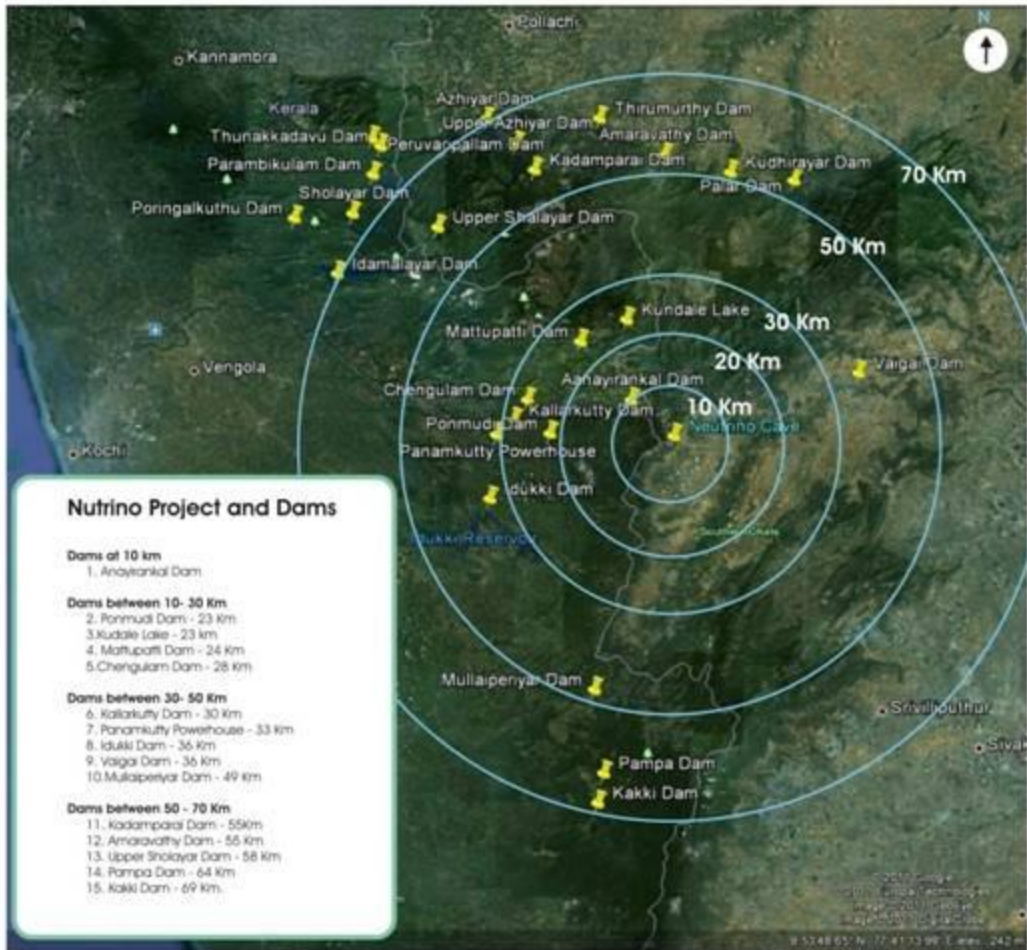
INO says that their 'FAQ has a seismic map of India which shows that the project site is in Zone 2, which is *seismologically* the lowest possible zone in India. So the statement about Idukki (being the district in Kerala adjoining the project site) being in a "geologically sensitive district" is also false and misleading. It should be noted that Idukki dam is about 40 - 50 kms as the crow flies to the project site in Theni district. Mullaperiyar dam is also about 100 kms from the project site."

Crows normally do not fly the shortest distance. The correct phrase to denote the shortest distance between two points is 'as a neutrino flies'. The distance as a neutrino flies from INO cave to Idukki dam is 36 km and Mullaperiyar dam is 49 km. [See map] Planetary processes like earthquake do not obey the political borders created by humans. Even if it is agreed that all the caves will be located in Tamil Nadu, the blasting will have its impacts on the bordering district, Idukki, which is more seismically active. Kerala state is in seismic zone 3 and the central districts of Idukki and Kottayam are known to be more vulnerable due to plate tectonics, reservoir and rain-induced seismicity and other kinds of geological phenomenon like soil piping, rock-burst and landslide. Posting a map showing low seismicity of Tamil Nadu on the INO/TIFR website is not going to change this ground reality."

***INO Response: We have already responded to this allegation.***

***There is no danger for any Dam from the controlled blasting in the INO site. Pl read our response to this allegation in our earlier rejoinder and the FAQ in our web page [www.ino.tifr.res.in](http://www.ino.tifr.res.in).***

## India Neutrino Observatory and the Risks to the Dams of Kerala and Tamil Nadu



### V.T.Padmanabhan writes:

#### “3. Location – in Tamil Nadu or in Kerala?

The contention that the main cavern and two smaller ones are located in Kerala was based on the data and sketches in the environmental impact assessment [EIA] of INO prepared by the Salim Ali Centre for Ornithology and Natural Studies [SACON]. According to EIA the tunnel is 2491 meters long and the Kerala border is at 1700 meters from the portal. INO says that ‘the arithmetic is wrong. All tunnels are not in a straight line, as the figure shows. This is just a sketch. The entire cavern and lab complex will be in Tamil Nadu.’

According to a presentation by Naba K Mondal, the INO spokesperson at the Cochin University of Science and Technology [CUSAT] and an article by R Ramachandran published in the Hindu say that the

tunnel is only 2 km long. This confusion needs to be sorted out. If the details given in EIA is *just a sketch* as stated in INO response, INO must be having a more authentic map by now as the digging will start in a few months. The best would be to give a proper map with geographical coordinates and the blue print of the tunnels and caverns, if they have one. Another question that arises here is about the budget. If budgeting is also based on the data in EIA, will the contractor be paid for 2491 meters or 2000 meters long tunnel? “

***INO Response: We have already responded to this. This is a national facility. It so happened that it is located inside Tamil Nadu state as the location satisfy our site criteria. Why should we locate this secretly inside Kerala? The competent authorities from both Kerala and Tamil Nadu can check whether it is in Tamil Nadu or in Kerala.***

### **V.T.Padmanabhan writes:**

#### **“4. How much rock will have to be blasted out?”**

I estimated the total rock to be extracted as 800,000 tons. INO response: ‘the total amount of rock debris, which is good quality granite, a useful construction material , is about 230,000 cubic metres or about 600,000 tons. In addition, the author seems to have disrespect not only of facts but numbers as well, as he has inflated the numbers.’

INO's estimate of 230,000 cub meters include 17% void. So the actual volume without void will be 190,900 cub meters (230,000x0.83). The finished volume of the caves and tunnels, as per the dimensions given in EIA, works out to 235,974 cub meters. If the structure were carved out using a corer, the total volume of rock extracted will be a little over 236,000 cubic meters with some dust and no void. Since blasting is the method, more rock will have to be extracted. Assuming that this extra material will be 20%, the total volume to be extracted will be about 302,046 cub meters.

According to the Detailed Project Report of INO prepared for the Nilgiri site (Singara), which is in a humid tropic region (precipitation 3000 mm/yr), the roofs of the caves must have one-meter arc-concrete to reduce the water vapour. Three caves including the biggest one in the present site also will be located under the hills in the humid tropic, receiving an annual rainfall of more than 3000 mm. Hence, arc-concreting of the roof will have to be done for the Idukki-Theni caves also. The total area of the 3 caves being 16,135 sq meters, they will have to extract another 16,135 cubic meters of rock from the roofs of the caves. So the total volume of rock to be taken out [without void] is 318,181 cubic meters. Multiply this by 2.75 [tons per cub meter] which is the specific gravity of charnokyte rock. The total rock, a very good construction material to be extracted thus works out of 875,000 tons, as against

the INO estimate of 524975 tons. I did not inflate the number; in fact I underestimated it by 75,000 tons. INO has underestimated the extraction by about 350,000 tons.

Here is a classic case of inflating the input [length of the tunnel] and deflating the output [high quality construction material]. My remit is radiological and ecological safety and I am not discussing the corruption angle. The extraction will be done by a contractor whose main interest will be the profit. Is there any check on the quantity of high quality rock that will be extracted from the underbelly of the Western Ghats? There is a saying in Malayalam which originated in the mid 19th century when large scale felling of trees in the Western Ghats began – 'Trees of the forest and elephants of the Gods [temples]. Pull man, pull.' "

### ***INO Response:***

***Here is the detailed calculation of the amount of rock to be extracted.***

***2km (actually 1.91) tunnel- 7.5m wide, 7.5m (4.5 vertical, 3.00m high with semi-circular shape radius=3.75m) high D shaped.***

***Tunnel volume ~  $2000 \times [7.5 \times 4.5 + 0.5 \pi \times 3.75 \times 3.75 - 7.5 \times 0.75] = 100430$  cubic metres.***

***Main Cavern volume ~  $132 \times 26 \times 32.5 = 111540$  cubic metres.***

***Cavern-2 volume ~  $55 \times 12.5 \times 8.6 = 5912$  cubic metres***

***Cavern-3 volume ~  $40 \times 20 \times 10 = 8000$  cubic metres***

***Intermediate Cavern-4 ~  $29 \times 15 \times 3.5 = 1522$  cubic metres***

***Note that we have overestimated the cavern volumes since they are also D-shaped. However, the crown height is not yet specified so assume this to be cuboid.***

***Total volume of Rock Debris: 227404 cubic metres.***

***To this add about 10% for additional voids so that the total volume is about 25000 cubic metres. This is outer limit of the debris volume.***

***From this we take out about 10% for earth in the initial stages (200m), and the shape corrections which reduce the total muck. The total volume should be around 230000 cubic metres. This is the rounded off figure you will find in the DPR.***

***If you assume a density of 2.7 gms/cc, then the total weight of the rock is in the range of 620 kilo tons. However, since there are voids the average density is less than 2.7 gms/cc. This cannot be estimated easily.***

***It is therefore safe to say that we extract about 600000 tons of rock at maximum.***

***V.T.Padmanabhan writes:***

**“5. Collaboration with USA:**

INO response on the issue of receiving neutrino beams from the factory in USA : “These are all speculative ideas. No such collimated high energy beam of neutrinos exists nor is one expected in the next 20 years. So the possibility of its being used as a tactical weapon does not arise.”

According to the Project Report Volume I [INO/2006/01], the observatory would have been ready by 2012 and the first phase of data taking on atmospheric neutrinos will be done during 2012-17. In the second phase which begins in 2018, neutrinos will be beamed from the Neutrino Factory. A brief description of the neutrino factory is given at page 195 of the project report. The Neutrino Factory – Muon Collider [NF-MC] is a US Department of Energy [DOE] project. The detector at INO is the Indian contribution to this venture and NK Mondal, the spokesperson of INO is a member of the steering committee and the convener of the far-detector of the neutrino factory. According to the latest timeline given at the NF-MC website, the factory will be ready by 2018. If everything goes as planned, INO is also expected to be ready for data-taking by 2018 and its main job will be to monitor the beamed neutrinos. Since INO is the only observatory that can be the far-detector for neutrino factories [above 7,000 km] that will come up in Europe and Japan, the Ludhki-Theni site will be busy entertaining these foreign guests and there will be no time for visitors from the cosmos. [The references for the collaboration with USA are given in the CC article].

For the argument sake, let us accept that NF will be ready after 20 years, ie in 2032 CE and the second phase activities of INO will also begin in that year. The projected life of INO is 120 years. Where will the DAE receive the neutrino beams from the factories as projected for the second phase of INO? Dig a new cave spending billions of rupees.

Science being a global enterprise today, there is nothing wrong in collaborations. USA is the acknowledged leader in modern science and technology and that country has signed more than 800 science collaboration agreements with other nations. There is reason for us to stay away from the global science enterprise. I am not for ghettoizing science in the name of narrow nationalism as it will only hurt our national interests. At the same time, details of all collaboration should be made available and nothing should be hidden. I do not understand as to why this collaboration with USA is kept as a guarded secret by INO and TIFR.”

***INO Response: Mr. Padmanabhan should decide whether he is paranoid about USA or paranoid about the whole world outside India. While Fermilab in USA***



*wishes to build the Muon Collider, which is different from a Neutrino Factory to explore the frontier of particle physics, there are many contenders in the world to build the Neutrino Factory including USA, Europe & Japan. We have already mentioned earlier that if this Neutrino Factory comes in Europe or in Japan then INO could act as a far detector for such a neutrino factory during its second phase. If the neutrino factory is built at Fermilab then it will be of no use for INO as it is located at a distance of more than 10000 km. The International Neutrino physics community (and not Fermilab) had earlier setup an adhoc committee to coordinate the neutrino factory related activities in the world. This is how particle physics research is done internationally. This committee was called "International Design Study Group for the Neutrino Factory" (IDS-NF). Since INO is also keen to get a neutrino beam from such a factory, if it is built either in Europe or in Japan, INO spokesperson Naba K Mondal was a member of this international committee. This is not a Fermilab committee, but an international committee created by the international neutrino community. The full membership of this committee is available at the IDS-NF webpage hosted by Rutherford Lab, UK.*

*<https://www.ids-nf.org/wiki/FrontPage/Organisation/AdHocSteeringGroup/Representation>.*

*The term of this committee is now over and it has now been replaced by a new committee available at this link.*

*<https://www.ids-nf.org/wiki/FrontPage/Organisation/SteeringGroup/Representation>*

*If one looks at the membership of these committees, one can realize that these are international in character, just as science is international. There is no hidden agenda and no hidden US hand. Scientists involved in basic research all over the world belong to a global community. They collaborate and communicate with each other all the time.*

*The fact that Mr. Padmanabhan can access all the papers related to neutrino factories, muon colliders and even so called neutrino anti-weapon points to the fact that there is nothing hidden. Everything is open and transparent. That is how basic science is done everywhere.*

## **V.T.Padmanabhan writes:**

### **“6. The weapon connection:**

The physics of the neutrino weapon has been elaborated in two papers authored by five high- energy physicists who have been working with the mainstream neutrino research facilities in USA and Japan . The idea was discussed in Physics Forums and reported widely in Science magazines like the New Scientist. Nobody questioned the physics possibility and as far as technology is concerned, they are working towards it very systematically on a war footing. INO has denied any weapon connection to the neutrino research. Research and manufacture of new weapons are not discussed in the legislatures or in the media anywhere in the world. These are among the few surprises, kept as closely guarded secrets by the military-industrial-scientific complex. The voters and tax payers get to know about them only when they are used. The case of depleted uranium [DU] weapons used by the US and British army in Iraq , Serbia and Afghanistan are among the recent examples. Modern weapons are more and more complex and millions of people are involved in inventing and fabricating them. A recent report by the International Network of Engineers and Scientists for Global Responsibility [INES] says; “Worldwide, between 1.2 and 1.5 million people work as scientists and engineers in military research and development [over 90% of these are men]. Industry and public research budgets in this field add up to 100 -120 billion US dollars per year”. Majority of these bright young men would not know that the algorithms they write and the nuts and bolts they create will be finally used to assemble the Big Toys of the Big Boys. Neutrino research belongs to the realm of particle physics, phenomenology and cosmology. However, in USA and in India , neutrino research is controlled by the Government departments that make and maintain nuclear weapons.”

***INO Response: There is nothing called a neutrino weapon, but the idea suggested by the scientists may at best be called a weapon destruction technique. But anyway these are just wild ideas and INO lab has nothing to do with these ideas.***

V.T.Padmanabhan writes:

### **“Conclusion**

There are attempts for democratization of science in all advanced countries. Scientists receiving government funds are told to interact with the people and inform them about their projects in languages understood by the people. Journal editors insist to avoid jargons and use simple language that can be understood by non-specialists also. In India , the science managers of the Department of Atomic Energy have insulated themselves from the Parliament and the people. This cannot go on endlessly. A recent example of this disregard for the public is the Kerala visit during the third week of October by Dr Mondal. He met Shri VS Achuthanandan, the Leader of the Opposition in Kerala seeking his support for this mega science project. VS informed him that he was not convinced. After this, there were three events – one with a handful of high school students in Thiruvananthapuram, and seminars at the physics departments of Maharaja's College, Ernakulam and the Cochin University for Science and Technology

[CUSAT]. There were a few embedded journalists with him, but he did not hold any press conference in Kerala.

I love science and that is why I am doing this. In physics, Albert Einstein and Michio Kaku are my heroes. I am only exposing the lack of transparency and disregard for the safety of the people and the integrity of the eco-system shown by the promoters of INO. This project has been discussed by only a handful of high energy physicists in India and USA . Here comes the need for external peer reviews. There are thousands of women and men in India who can follow these issues and make proper scientific judgments. Rather than road-blocking the progress of science, such review will only help the advancement of science in general. The absence of peer review, parliamentary audit and public discussion are the main ills of the Department of Atomic Energy which receives a lion share of research money from the government of India . In discoveries and inventions, India is far behind of our neighbor China and also smaller economies/nations like South Korea . India produces the largest number of scientists and engineers and the brightest among them migrate to USA or Europe because of the unscientific attitude of the dominant science establishment and lack of proper science culture in India . If even half of our scientists abroad come back and work in frontier areas like genomics and nanotechnology, most of our national problems could be solved.

To end this episode of the dialogue, let us underline that peoples' health and integrity of dynamic structures like dams in a geologically sensitive area are too important issues to be left to a handful science managers, who are ignorant about the known qualities of the particles they will be handling and the eco-system dynamics of the place they are digging their caves.

***INO Response: Mr. Padmanabhan was not present in the meeting that took place between INO spokesperson and Leader of Opposition, Kerala, Shri V.S. Achuthanandan. In fact the INO collaboration is extremely happy that Shri Achuthanandan now has a very clear understanding on the exact nature of the INO project.***

***The seminars given by INO spokesperson Naba K Mondal and his colleague Prof. D. Indumathi were widely reported in both print as well as TV media in English as well as in Malayalam. We leave it up to the news reporters who reported these seminars and participated in the discussions to decide for themselves if they were all embedded reporters as suggested by Mr. Padmanabhan.***