July, 2008

Environmental Management Plan: Compliance Report

for the proposed

India-based Neutrino Observatory project

at Singara, Nilgiris District, Tamilnadu

Department of Atomic Energy, Government of India

Environmental Policy Statement

The India-based Neutrino Observatory (INO) is an effort aimed at building a world-class underground laboratory to study fundamental issues in physics. The primary goal of the laboratory is the study of neutrinos from various natural and laboratory sources. The underground laboratory provides special conditions that may also serve other fields like biology, geology, etc. One of the major goals of the project is to enhance the development of detector technology, which can have varied applications such as in medical imaging.

Members of INO are acutely aware that the laboratory is proposed to be located in an environmentally and ecologically sensitive area, namely, in the Nilgiri Biosphere Reserve (NBR). The challenge for INO is to build a world-class science laboratory, keeping in mind the ecological and environmental concerns, especially during the construction phase, and to actively participate in on-going conservation efforts in the region.

- During its normal operation phase, the laboratory is not expected to cause any damage to the environment. All efforts will be made to minimise the disturbance during the construction phase.
- INO will ensure that its activities are in conformity with environmental laws as are applicable.
- All members of the collaboration, executing agencies and their workers will be trained to cooperate in ensuring compliance with environmental guidelines.
- Being part of such a sensitive biosphere reserve will also bestow responsibilities on INO not only to maintain the integrity of the biosphere and but also to actively participate in on-going conservation efforts where possible.

It is imperative to recognise that the study of Nature's innermost workings need not be at loggerheads with Nature itself. Models of S & T development that are sensitive to environmental conservation thus assume importance. The proposed India-based Neutrino Observatory (INO) at Singara in the Nilgiris offers immense opportunities and a challenge for realising such a model.

1 Major Mitigation Measures

This report outlines the proposed measures to be taken by INO in order to comply with the recommendations of the rapid Environmental Impact Assessment (EIA) prepared by Salim Ali Centre for Natural History and Ornithology (SACON), the Environmental Management Plan (EMP) prepared by the Care-Earth organisation and the recommendations of the Ministry of Environment and Forests (MoEF), Government of India.

1. **The transport of heavy construction and detector material** into the site, as well as the transport of the granite debris produced by tunnelling, involves movement along the Singara-Masinagudi road. This road crosses a critical elephant corridor—the Singara-Mavinhalla corridor—about 2 km away from the project site (in TNEB Singara camp).

   Hence, heavy vehicle movement will be carefully monitored on this road. Expert trackers/watchers will monitor wild-animal movement along this road, and suitably advise on the heavy vehicle movement. No more than 6 round trips will be made, during day-light hours, with almost no movement at all during November to February. Caravanning of vehicles may be resorted to in case of need. In the case of critical requirement, movement of heavy vehicles during restricted times may be resorted to, with the permission from local forest officials.

   Permission will be sought to use the causeway at Theppakadu for movement of heavy vehicles for INO-related work.

2. **The granite debris** that will be excavated will be stored, a few hundred metres from the portal, within the Singara TNEB campus, away from the sensitive corridor. About 20% of this will be used by INO for construction purposes and about 50% may be lifted for use elsewhere. The debris will be moved out in a phased manner, at a rate not exceeding the limit of 6 round trips per day during daylight hours on the Singara-Masinagudi road, beyond the construction period. Caravanning of vehicles may be resorted to in case of need.

   The muck store yard will be protected by dry stone masonry wall, all around except for entry and exit points, to prevent contamination of any nearby water sources.

3. **Compliance with the environmental management plan** will be monitored locally by an Environmental Monitoring Cell, to be stationed at the site, that will include INO members, members from the Forest Department, the site engineer, representative of Masinagudi panchayat, and environmental experts.

   In addition, there will be an Environment Management Panel to oversee the activities of the Environmental Monitoring Cell. Members from the Tamil Nadu Forest Department, District Adminitration, TNPCB, TNEB, SACON, Care-Earth, and academic/research institutions, will be ex-officio members, along with INO members.

4. **The INO project is committed to nature conservation** and environmental protection. It plans to adopt the elephant as its nominate species. Funding to the extent permissible by governing laws will be provided for nature conservation and environmental protection.

   It may be noted that about 500–1000 m of land on either side of the Singara-Masinagudi road is privately owned, with some segments owned by the Tamil Nadu Electricity Board. INO will make all efforts, through appropriate negotiations with the concerned, so that additional land can be annexed and dedicated to the existing elephant corridor.

2 Compliance with rapid-EIA recommendations

1. Noise Control:

   (a) Care should be taken to reduce noise generated during construction. Use of well maintained machinery and vehicles could considerably help in this matter. Workshops and such other facilities, which are also source of noise, may be located away from MasinagudiSingara road.

   Compliance Measure: Noted and agreed.
   The workshop is a small repair facility to assist day-to-day maintenance. It will not have any noise generating heavy machinery. In the utility building located next to the portal, modern chillers and blowers, with reduced noise levels, will be used. Silent DG sets will be installed within the utility building. Indigenous trees will be planted around the utility building for further damping of noise during operation phase.

   (b) Blasting may be limited to the bare minimum, especially at the exposed areas such as entry portal and should be avoided if possible. Resorting to other methods may help avoiding the disturbances likely from blasting. Blasting work close to the surface may affect den dwelling species and cause stress to them. However, blasting deep inside the tunnel with delayed detonation and overburden of charnockites and soil above is expected to considerably dampen the sound and the vibrations. Our study on PUSHEP blasting did not show any instance of deserting dens, because of the blasting deep underneath, by common denning of species of animals seen in the area (Azeez et al., 1996). However, the number of blasts should be minimised and temporally spaced out to reduce the reverberations. Also, sophisticated drilling and blasting techniques may be adopted which would save time, resources and protect environment as well. Blasting and such activities may be avoided near by the open area during dawn, dusk and night. Well planned faster execution of construction phase would reduce the impact on environment very much.

   Compliance Measure: Noted and agreed.
   Controlled blasting will be adopted in the intitial reaches to dampen noise and vibrations.

2. Vibrations:

   (a) Blasting to be carried out for excavation of the cavern and associated components, underground is likely to cause low vibrations. However, it is likely to be much low because of the overburden of hard rocks and soils, except in the case of the initial sections of the tunnels. Nevertheless, INO may undertake ground vibration monitoring study during actual execution of the project along with other rock mechanics and instrumentation studies as done in similar underground project already commissioned nearby. The ground vibration may be measured continuously during blasting operations for all the major components of the project. Appropriate blasting pattern and modern blasting techniques based on the actual site geology, may be adopted such that vibration due to the blasting is the minimum.

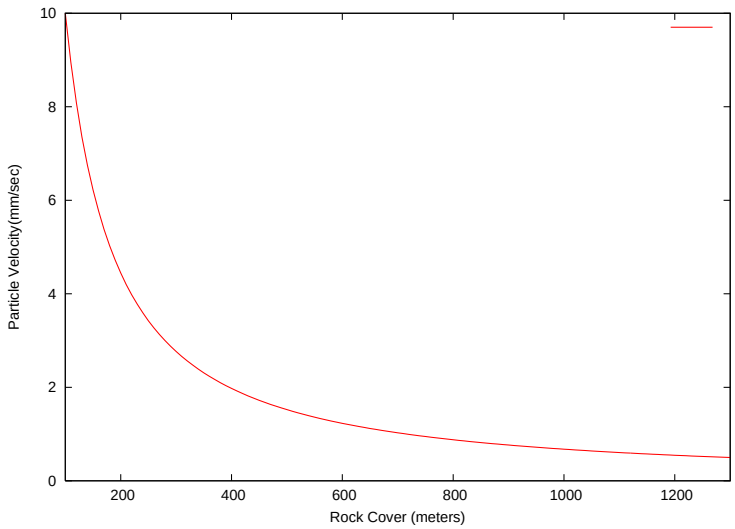

Figure 1: The particle velocity (m/s) as a function of rock cover (in m).

Compliance Measure: Noted and agreed.

Estimated particle velocities are shown in the figure. For example, at the forest boundary (500 m from the portal) it is approximately 3.4 mm/s and on the peak above cavern (2210 m from portal) it is approximately 0.5mm/s.

(b) INO may ensure that the protocol of tunnel and cavern making to be fine-tuned to restrict the ground vibration in such a way that it does not endanger the wild animals, micro habitats and the existing eco-system. In addition, the blasting may be restricted to daytime and not at all during night (dusk to dawn) and the periods when the animals are active, mostly dawn, dusk and afternoon hours.

Compliance Measure: Noted and agreed.

INO is situated deep under ground, about 1300 m below the hill peak (2207). The tunnels and caverns will be excavated through controlled blasting in the initial reaches. A maximum of 2 pulls per day with a progress of about 3 m per pull is planned.

Initial stages of blasting will be two pulls in daylight hours only. When both noise and vibration levels subside, deeper underground, there will be three pulls of blasting per day.

3. Muck Disposal:

(a) Disposal of the muck and other debris is a serious challenge in the case of INO construction. The debris should be taken care of and should be used to the maximum in construction purpose such as for lining the tunnel and laying the road. This will reduce the movement of transport vehicles along the wildlife corridor as well. The balance quantity of the muck and debris should be properly stored so that it does not become an eyesore and do not pose threat to the downstream areas causing siltation and high suspended particulate matter in the air and water. The storage should be with proper retention wall preventing the fine particulate matter from getting washed down during monsoon.

Compliance Measure: Noted and agreed.

The first 300 meters or so (till stable rock face is reached) of the tunnel will be executed through cut and cover method. The top soil removed during this stage will be stored separately and reused for backfilling/greening the dump yard. Most of the muck to be disposed of will consist of rubble stones/boulders debris, which has great use in road re-laying and construction activities.

The total tunnel debris generated during excavation of underground components, including allowance for about 18% voids, is estimated as 224,000 cubic meters shown in the Table. As the tunnel is in stable hard rock, the dust generated will be minimal.

Main access tunnel	1,06,258 cubic meters
Adits	6,339 cubic meters
UG Lab cavern 1	1,07,230 cubic meters
UG Lab cavern 2	4,454 cubic meters
Total	2,24,281 cubic meters

This quantum will be generated over a 3 year period. About 20% of this will be consumed for INO works; for tunnel and cavern floor, for concrete lining and shot creting of tunnels/caverns, levelling and in construction of buildings and facilities. See also item 4 below.

Efforts will be made to utilise the trucks bringing in the materials for construction to evacuate the debris, to reduce the impact of debris transportation.

About 50% will be lifted for various construction works in the Nilgiris, partially meeting the demand for rubble stone in the Nilgiris District. The debris will be moved out of TNEB Singara camp/INO project site in as is where is condition.

The balance 30% ie 67,500 m^3 of debris will be be stored at the PUSHEP dump yard of TNEB, which is located within the TNEB camp at Singara. It is proposed to stack the debris to a height of 4 m, as done for PUSHEP debris. The total area required for storing this works out to 16,875 m^2. TNEB has reserved 20,000 m^2, vide letter No. ED/Projects/SE/PD/A2/DPR/F, INO/D.3 dt.3.1.08. Permission to avail of 40,000 m^2 of area has been requested from TNEB, so that the disposal of the unused debris can take place in a phased manner, and be safely stored in the meanwhile. This additional land of 20,000 m^2 will also take care of any unforeseen traffic bottle necks/ restrictions as well. Favourable reply from TNEB is expected.

The muck will be moved out of the TNEB Singara camp/INO project site slowly, at a rate not exceeding a total of 6 round trips per day during daylight hours. Caravanning of about three vehicles may be resorted to in case of need.

The muck store yard will be protected by dry stone masonry wall, all around except for entry and exit points, to prevent contamination of any nearby water sources.

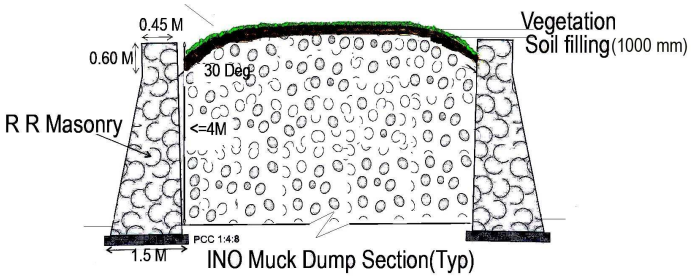

Figure 2: Model of retention wall at the muck yard.

The leach test conducted confirms that toxic heavy metal and other harmful materials are not present in the tunnelling medium (they are below detectable levels).

(b) In house utilisation of the muck and debris need to be strongly promoted to avoid various issues, including transportation and vehicular traffic density.

Compliance Measure: Noted and Agreed.

See item 3a above.

4. Sourcing Materials:

Stone crushers would result in air and noise pollution, which will be highly disturbing to the wildlife. It is suggested that the stone crushers should erected away from forest.

Compliance Measure: Noted.

Modern stone crushers which generate less noise and dust will be provided at the tunnel mouth or dump yard to size and grade the stones used for INO projects. Dust emission from crusher and from dumping will be controlled by water spraying or other approved means.

5. Transportation:

(a) As noted earlier another major impact of the INO is the disturbance to the very critical wildlife corridor across the Masinagudi-Singara road. The disturbance is likely to be serious in view of the large number of transport vehicles that are likely to ply over the stretch. It is expected that with the execution of such a project the vehicle movement will increase many multiples of the present traffic density. This should be avoided and it is an issue the managers executing the INO project need to seriously ponder over. However, the construction machinery movement like earth-movers, dumpers etc., will be between the tunnel and the nearby dump-yard only, and not along the sensitive road. The vehicle movement along the road have to be limited, properly scheduled and should be avoided during the period of the day when animal movement is likely to be high, namely morning, evening and night hours.

Compliance Measure: Noted and Agreed.

There will be a one-time movement of vehicles and construction equipment at the beginning of the construction phase. Thereafter, heavy vehicle movement on this sensitive road will be restricted to 6 round trips per day during day light hours only along the Masinagudi-Singara road, giving allowance for animal movement on this road. Caravanning of about three vehicles may be resorted to. All loose material will be transported in covered vehicles.

In addition, the help of experienced wild-life trackers/watchers will be used to monitor animal movement along this road. This will be used to monitor and control vehicular movement.

The heavy vehicular movement and material transportation outside Singara TNEB camp/INO project site will be confined between 6 AM and 4 PM. However light vehicles for urgent missions and in emergencies will be permitted, taking all possible precautions (like speed restriction, not blowing horn and stopping in case of sighting wild animals), around the clock with authorisation from site in charge.

There will be no heavy vehicle traffic along the Singara-Masinagudi road from November to February so activities will be localised and will be of limited or no immediate impact to wildlife along the Masinagudi-Singara corridor. All efforts will be made to reasonably achieve the goals behind this recommendation. However, in special circumstances, to meet critical requirement, some heavy vehicle movement may occur during daylight hours during November-February, with the permission of the local forest officials.

Details of material movement : About 30,000 tons of construction material need to be moved in 3 years. With the use of 3.5 m^3 trucks, this can be done in 5 trips per day, restricted to day light hours alone and with no traffic from November to February. Of this, about 22,000 tons is sand alone. If 80% of this is replaced by M-sand made from granite debris, as has been suggested, the amount of material to be moved will be very small and can easily be managed.

About 17,000 tons of mainly iron for the detector will be moved in a little over a year, towards the end of construction, with overlap in the movement of construction and detector material, so that no more than 6 round trips of heavy vehicles will be made per day, during daylight hours. In addition, special permissions from the relevant authority may be obtained for transportation of equipment exceeding 8 tons, such as iron. This may help in reducing the traffic stress on the Singara-Masinagudi road.

The remaining 34,000 tons detector material can be easily moved over three subsequent years as construction activity would have ceased by then.

For details about debris movement, see reply to item 3 above.

(b) Posting wildlife watchers along the road to warn about the animal movement also may help further in reducing encounters with the moving animals.

Compliance measure: Noted and Agreed.

(c) Currently, check-posts are operated by the TNEB at the entry point of their installation at Singara. Additional check-posts near the INO portal as required by the project proponent may be erected. However, check-post at the entry point of Masinagudi-Singara road (closer to Masinagudi) may help to record and monitor the people and vehicle movement.

Compliance measure: Noted.

Because of the sensitivity of the local people, this decision regarding the check-post at the entry point of the Masinagudi-Singara road can be taken by the Environmental Monitoring Cell.

6. Workforce:

(a) Number of labourers involved for the construction may be limited to the minimum. They should be made sensitive to the ecological importance of their area of work, nature conservation and be aware of the conservation strategies to avoid untoward effects. Movement of the workforce should be under strict control of the management responsible for environmental protection. Travel and transport should be curtailed strictly during the hours of the days when animal movements are high; morning, evening and night hours. Watchers to warn about animal movement along the corridor will help in accidental confrontation with the animals.

Compliance measure: Noted and agreed.

Local labour will be employed for INO project activities to the maximum possible extent depending on skill and availability.

Members of indigenous population, identified by the local body will be employed for animal tracking and similar purposes. Efforts will be made to improve their skill sets, health and literacy/educational levels.

(b) Strict measures should be taken to avoid use of wood, collected locally. The labourers should be provided with LPG instead of fuel wood. Proper facilities for their temporary residences should be given. They should be educated about nature conservation.

Compliance measure: Noted and agreed.

Labourers will be located in the already existing labour colony. They will be given LPG, pressure cookers, and packaged milk where needed. They will not be permitted to venture into the forest for firewood collection. Cattle rearing will be prohibited.

(c) It is likely to happen that the workforce involved in construction would settle in the area, and may refuse to vacate even after completion of the work. Sufficient provisions should be made to evade this problem. Enough provisions should be given in the contracts with executing companies, regarding this aspect.

Compliance measure: Noted and agreed.

To the extent possible local labourers will be engaged to avoid migration problems.

(d) The staff members involved in construction and during the operation phase needs to be well aware of environmental and wildlife problems and related issues. They should be educated about nature conservation.

Compliance measure: Noted and agreed.

7. Residential and Infrastructure Facilities:

Regarding the residential and other infra-structural facilities it is stated that "the TNEB campus has residential houses as well as offices with recreational facilities like sports complex, children's park, and three well equipped Inspection Bungalows (IB) at different locations. The housing accommodation is in surplus in the area and may be used to accommodate people from other projects. Therefore, further new constructions are limited so that no natural vegetation loss is made. Placing the residences and other infra-structural facilities away from the INO laboratories reduce the pressure on the wildlife corridor along the Masinagudi-Singara road. The INO management may plant local plant species around the infrastructure facilities such as residences.

Compliance measure: Noted.

The EMP suggests (see item 4 of Compliance with EMP) moving the residential and infra-structural facilities in Singara itself to reduce pressure on the Masinagudi-Singara road and the Masinagudi township itself which is experiencing rapid population growth. However, vacant housing/sheds available in the TNEB Masinagudi campus may also be used without resorting to new construction.

In addition, electrical vehicles will be used on site for staff movement during the operation phase to reduce noise pollution and emission levels due to vehicle exhaust.

Local plant species will be planted in consultation with Tamil Nadu Forest Department and environmental experts.

8. Disaster and fire management:

   INO staff should be equipped/ trained to face any accidents such as fire or leakage of gases in the underground laboratory or elsewhere in their work area and or its environs. Sufficient provisions should be made to acquire fire fighting, communication equipments. Importance may be given to develop hospital facilities in the residential area. Suitable training for the staff with frequent refresher programmes should be arranged for them to remain well equipped both mentally and equipment wise to handle disasters such as fires.

   Compliance measure: Noted and agreed.

   Regular training programmes will be held. A disaster management manual has been prepared.

9. Felling of Trees and plantation:

   (a) As mentioned earlier, the proposed project is not expected to fell trees. Felling of trees and clearing vegetation would lead to loss of feeding and breeding habitats to several species inhabiting the environs of the project and should be avoided. The large trees adjacent to the portal entry, in the TNEB quarters area, can be saved by realigning the approach road.

   Compliance measure: Noted and agreed.

   The alignment will be modified to the extent possible to avoid cutting large trees adjacent to the portal entry.

   (b) No forest land is required to be diverted for executing this project; hence no Compensatory Afforestation Programme is mandatory. However, as a commitment for nature conservation and environmental protection, the INO may arrange plantation programme near the portal, along the Singara-Masinagudi road and residential complex in Masinagudi. The Tamil Nadu Forest Department may be consulted in this regard and native vegetations/flora should be considered for planting. Budgetary provisions should be made for such conservation measures.

   Compliance measure: Noted and agreed.

   Also see item 6 in EMP report.

   (c) Some species suggested for planting are given (Table 15 of the EIA report). These species are native to the Nilgiris, commonly seen and grows faster. Saplings of these species are easily procurable from the local nurseries.

   Compliance measure: Noted and Agreed.

   In addition, gardening or beautification activities alien to the natural surrounding or without concurrence of EMC expert will not be taken up in the INO campus.

10. Environmental Monitoring:

    (a) The INO should organise a 'Local Ecological Monitoring Group' that can monitor the construction phase closely to safeguard the environment in general and forest and wildlife in particular. Such a body can help rationalising the INO's environmental management strategy properly. The Local Ecological Monitoring Group needs to include experts in the field along with officials responsible for wildlife protection.

    (b) An 'Environmental Monitoring Cell' overseen by an 'Environmental Monitoring Panel' may be also constituted.

    (c) The Environment Monitoring Panel may be constituted drawing members from agencies such as the Tamil Nadu Forest Department, Pollution Control Board, Academic / Research institutions and TNEB. The broad mandate of this panel may be to oversee the environmental monitoring cell and advise INO management on environment related matter as and when required. The Environmental Monitoring Cell may over see and ensure that the measures to be taken under the Environmental Management Plan is implemented strictly and to ensure the pollution parameters are within the prescribed limits. For the purpose, a monitoring group and a pollution control equipment maintenance group will be placed in the Environmental Management Cell. The EM cell should be started in the initial stage of construction itself and its service should continue during the operation phase.

        i. The EM Cell will be responsible for proper maintenance and operation of the programme and it will over see the following aspects:
        ii. Conduct environmental awareness program to the workers, supervisory staff and contract labourers during the construction period.
        iii. Organize Environmental Audits and report to TNPCB or any such authorities.
        iv. Regularly monitor the environmental parameters and prepare reports as required by the TNPCB and other statutory authorities.
        v. Recommend necessary measures to improve Environmental conditions.
        vi. Advise on any negligence or derelictions on the part of concerned staff or workers in observing EMP or Environmental code of conduct and to advice on the necessary steps to be adopted.
        vii. Conduct safety programmes to create safety awareness among workers/staff.
        viii. Train the staff and other workers on safety measures and conduct safety drills to educate them.

    Looking at the need for science and technology development of the country, the proposed project assumes global importance. Nevertheless, the project construction and operation is likely to have notable impact in the area, especially on wildlife. However, it may be possible to lower the impact on the environment, with proper planning and implementing appropriate measures.

    Compliance measure: Noted and agreed.

    INO project is committed to nature conservation and environmental protection. It plans to adopt the elephant as its nominate species. Funding to the extent permissible by governing laws will be provided at the initial stage and also in the revenue budgets

for nature conservation and environmental protection. This will include provisions for infrastructure and their maintenance for wildlife research, including state-of-the-art field research facilities and student housing, as well as a four-wheel drive vehicle for conducting field studies. Possible tie-up with academic institutions actively involved in wildlife and environmental conservation and research is being explored.

It may be noted that about 500–1000 m of land on either side of the Singara-Masinagudi road is privately owned, with some segments owned by the Tamil Nadu Electricity Board. INO will make all efforts, through appropriate negotiations with the concerned, so that additional land can be annexed and dedicated to the existing elephant corridor.

An Environmental Monitoring Cell (EMC) will be formed before commencement of site works to oversee the implementation of measures both during construction and operation phase as listed above. This will include (a) monitoring the implementation of the environment management plan as well as (b) monitoring the pollution control and equipment maintenance measures.

The EMC, to be stationed at the site, will include INO members, members from the Forest Department, the site engineer, representative of Masinagudi panchayat, and environmental experts.

In addition, there will be an Environment Management Panel to oversee the activities of the Environmental Monitoring Cell. Members from the Tamil Nadu Forest Department, District Adminitration, TNPCB, TNEB, SACON, Care-Earth, and academic/research institutions, will be ex-officio members, along with INO members.

3 Compliance with EMP recommendations

1. In principle, Project INO should adopt the 'Elephant' as its nominate species. Following this, a minimum of 10% of the total project cost should be earmarked as the corpus for the conservation of the elephant. This should be further strengthened by annual grants/budgetary allocation to the initiative (Immediate action).

   Compliance measure: Noted.

   See details in Item 10 of EIA compliance report above.

2. The corpus thus created should be managed by a working group/unit that will develop the norms, guidelines and implementation procedures for the conservation programme. This group will necessarily have the representation of Project INO, the Tamil Nadu Forest Department, reputed non-governmental organisations and academic/research institutions. The conservation programme should not be operated on an ad hoc basis, but be subjected to periodic review, including a community- based review (Short, Mid and Long-term actions).

   Compliance measure: Noted.

   See details in Item 10 of EIA compliance report above.

3. The vulnerability map developed for the EMP highlights Singara Mavinhalla segment of the corridor as one of the two critical areas within the landscape. The project as it is being proposed currently will only compound the existing stress on this zone.

   Compliance measure: Noted.

   Adequate precautions will be put in place in consultation with the EMC to minimise the impact.

4. It is recommended, both in the interest of the Project and wildlife, that the entire infrastructure (underground and aboveground) be restricted to Singara. This recommendation has been made, as the 4ha land earmarked within the TNEB campus at Masinagudi is a part of the Moyar-Avarahalla segment of the Corridor where there is immense movement of wildlife (including elephants). The only water-hole that exists here is very close to the Project site and there is a lot of wildlife movement in this habitat during summer (see vulnerability map) (Immediate action)

   Compliance measure: Noted and agreed.

   The matter is being pursued with the TNEB to get permissions to locate all the infrastructure facilities in Singara itself, or in a different location in Masinagudi TNEB Campus.

5. Irrespective of the land use in the project site, compensatory mechanisms for re-vegetation need to be evolved and implemented. The project team needs to recognise that trees alone do not make a forest. Appropriate location for re-vegetation will have to be identified in consultation with the Forest Department, TNEB, NGOs and residents; a potential site is the 4ha adjoining the PUSHEP guest-house at Masinagudi earmarked for the INO Project (Mid and Long-term actions).

Compliance measure: Noted.

See details in item 9b of EIA compliance report. Afforestation using indigenous species will be carried out within the available area to the extent possible, in consultation with the EMC.

6. Compensating the loss of vegetation should not however be done by planting trees along the Singara-Masinagudi road. In fact, planting trees along the roads will only aggravate human-wildlife conflicts as avenues of trees tend to attract animals closer to roads. When these animals attempt to cross roads attracted by trees on the other side (example primates; macaques and langur that are abundant in the landscape), they are run over by passing vehicles.

Compliance measure: Noted and agreed.

7. There are suggestions of creating gardens within the Project site and this should not be done. The project, even in its expansion phase, should strongly deter from any of the routine 'beautification' processes such as laying of lawns or creating ornamental shrubbery. This needs to be incorporated into the DPR (Immediate action).

Compliance measure: Noted and agreed.

Gardening or beautification activities alien to the natural surrounding or without concurrence of EMC expert will not be taken up in the INO campus.

8. The EIA report has categorically stated that there should be no parallel fencing made anywhere along the road between Singara and Masinagudi. Fencing in any form anywhere will prove detrimental to wildlife in the landscape. Temporary walls (if absolutely needed) would be the most ideal option after specifying the area that will be thus cordoned during the 5 years of construction and installation of equipment (Immediate and Short- term actions).

Compliance measure: Noted and agreed.

No fencing beyond the existing borders of TNEB camp at Singara will be erected for the INO project. Temporary walls, if constructed for protection of construction materials, will be dismantled at the end of the construction period.

9. A volume of 67,500 m^3 of muck that may be left unused will create a mound that is much larger than what is presently there at Singara. Leaving this huge volume unused and covering it with earth for growing plants (trees) does not seem a viable proposal. There is need for better management plan when it concerns the disposal of muck. In fact, disposal of muck is certainly the greatest environmental impact the INO Project is likely to cause in the landscape (Immediate action).

Compliance measure: Noted and agreed.

See detailed discussion in item 3a of EIA compliance report.

10. There should be a complete cessation of activities during the months November to February. There should also be no movement of vehicles of Project INO/ implementing agency/contractor during the elephant movement hours (3 AM until 6 AM and

between 4 PM until 8 PM). The night hours are critical for the other wildlife. Hence the vehicular movement of Project INO should be only between 6 AM and 4 PM (Immediate and Short-term actions).

Compliance measure: Noted.

See detailed discussion in item 5a of EIA compliance report.

11. Based on the existing vehicular movement on the Masinagudi- Singara Road it is being proposed that only 4 trips of heavy vehicles (which entails that the vehicle moves 8 times to and fro) be allowed per day (Short-term actions).

Compliance measure: Noted.

See detailed discussion in item 5a of EIA compliance report.

12. In accordance with the existing norms of the GOI, the heavy vehicles can be of only 8 tonnes capacity. Adherence to this norm will ensure that the habitat integrity is preserved, and that there is no demand for laying new/additional roads (Immediate action).

Compliance measure: Noted and agreed.

Special permissions from the relevant authority may be obtained for specialised transportation exceeding 8 tons, which may be routed via the causeway at Theppakadu with appropriate precautions.

13. It should be ensured through the EMC and the trackers that the vehicles do not engage in washing, cleaning operations on the Masinagudi-Singara Road. Parking space should be found within Singara (Short-term action).

Compliance measure: Noted and agreed.

14. Project INO should not in any manner allow the establishment of any additional service provider in Singara (Short-term and Mid- term actions).

Compliance measure: Noted and agreed.

Services of existing Service providers at Masinagudi will be utilised.

15. The Project plan must to the extent possible engage, local labourers, who are in a manner are the residual effect of the Pykara project. Strict monitoring of their condition and activities must be ensured by the EMC (Immediate and Short-term actions).

Compliance measure: Noted and agreed.

More details are to be found in item 6 of the EIA compliance report.

16. The indigenous population at the Singara and Masinagudi is small, but comprises of extremely capable trackers/wildlife guides. It is absolutely important that a viable number of indigenous people are employed right from the beginning as trackers. They in turn can be engaged to monitor vehicular movement, movement of wildlife, forest fire mitigation, etc. This once again should be an integral component of the conservation initiative of Project INO (Long-term action)

Compliance measure: Noted and agreed.

More details are to be found in item 6 of the EIA compliance report.

17. Nature's services that the INO Project personnel will enjoy include 'relaxation' (recreation) thanks to the proximity of Mudumalai WLS and the Maravakandy Reservoir. Willingness to pay amongst the small fraction of INO Project staff and visiting scientists/students can be translated into kind appropriately so that the aesthetic and recreation service benefits that they enjoy will also provide economic incentives to a larger spectrum of local residents. A contributory 'nature conservation fund' can be considered (Long- term action).

Compliance measure: Noted and agreed.

The INO team members will be sensitised to their environment.

18. The National Wildlife Action Plan for 2002-2016 has reiterated the need to identify and preserve wildlife corridors. It has been proposed that all wildlife corridors be given the status of 'ecologically sensitive areas' under the provisions of the Environmental (Protection) Act, 1986. The INO Project should honour the commitment.

Compliance measure: Noted and agreed.

As stated, the INO project is committed to nature conservation and environmental protection.

19. Herds of elephants may continue to roam in the adjoining habitats despite the construction activities. Variations between individuals of elephants in their sensitivities to noise, vibrations and the smell of explosives have not been understood. INO Project should post a competent team of wildlife biologists (and trackers) to monitor the elephants both during construction and operational phases. The Project should be sensitive to precautionary recommendations that the experts (Environmental Monitoring Committee) provide from time to time.

Compliance measure: Noted and agreed.

Guidelines from EMC and the Environmental Management Panel will be followed.

20. A watchtower located at a strategic point within the Project site will greatly aid the monitoring of wildlife movement both in the short and long terms (Immediate action).

Compliance measure: Noted and agreed.

Watch tower/s will be provided as recommended by the EMC.

21. The tie-up with the TIFR/NCBS MSc Wildlife Biology Programme is an achievable target. Creating a permanent wildlife research and monitoring facility within the available space is also an achievable target. Dedicating infrastructure like a vehicle for wildlife studies in the landscape is certainly possible. Many such recommendations that find a place in the EMP with indications of whom the Project agency should partner with while attempting to implement them must be given the due consideration.

Compliance measure: Noted and agreed.

Possible tie-up is being actively explored.

22. The proposed INO Project can easily take head-on the challenge of contributing to the Goals II and III of the 1995 Seville Strategy of the Man and Biosphere Program. Specific ways of achieving the targets set by the Goal III are the following:

    - Integrate wildlife research with the INO Project by making provisions for a state-of-the-art field research facility within the residential complex and ear-marking staying facilities for students and researchers who are involved in wildlife studies in the landscape.
    - Provide a vehicle (four-wheel drive) exclusively for wildlife studies in the landscape.
    - Make a formal tie-up (immediately) with the TIFR/NCBS MSc Programme in Wildlife Biology such that the students enrolled for the course can use the INO Project facility for their annual field trip. These field trips that last for as much as twenty days at a stretch can be effectively used for collecting high quality baseline data on wildlife in the landscape and for effective monitoring of the short and long- term impacts of the Project. The proximity to Bangalore will make this initiative a fabulous success and least expensive strategy if carefully fabricated

Compliance measure: Noted and agreed.

See details in item 10 of EIA compliance report.

23. While the above pointers have to be given due consideration, there are certain recommendations that might come in as an advantage to the INO Project. These are:

24. Eco-development in multiple use areas of tiger reserves and other protected areas permit the use of rope ways in difficult and remote high altitude areas so as to ensure better economic returns to the local people from the transport of goods; the possibility of reviving the TNEB winch in Singara may be explored if it serves the purpose.

Compliance measure: Noted.

The TNEB has been requested permission for use of the winch, but it appears unlikely. In any case, considering the capacity limitations and safety implications, use of the winch will not majorly ease the material movement pressure on the Singara-Masinagudi road.

25. Eco-development programs should also provide building material to the people who are relocated from the core areas (example the proposed relocation from the Mudumalai WLS); the possibility of diverting a part of the muck for this purpose has to be carefully explored.

Compliance measure: Noted.

Possibility of diverting part of the tunnel muck as building material for relocation of bona fide people from core areas will be considered in consultation with appropriate government authorities.

26. The project agency should evolve flexible procedures to ensure that the landscape and its inhabitants are insulated and protected from the problems that have been enumerated. Existing and routine norms, guidelines, protocols and procedures that typify audit processes should not be used to justify actions that are contrary to the ecological sensitivity of the landscape.

Compliance measure: Noted and agreed.

4 Compliance with Expert Appraisal Committee recommendations, MoEF, GoI

Part A. Specific Conditions :

I. Construction Phase:

1. Consent for establishment shall be obtained from Tamil Nadu Pollution Control Board under Air and Water Act and a copy shall be submitted to the ministry before start of any construction work at the site.

   Compliance measure: Noted agreed.

   Application to TNPCB is being made for consent.

2. All required sanitary and hygienic measures should be in place before starting construction activities and to be maintained throughout the construction phase.

   Compliance measure: Noted and Agreed.

3. A first aid room will be provided in the project both during construction and operation of the project.

   Compliance measure: Noted and Agreed.

4. Adequate drinking water and sanitary facilities should be provided for construction workers at the site. Provision should be made for mobile toilets. The safe disposal of waste water and solid wastes generated during the construction phase should be ensured.

   Compliance measure: Noted and Agreed.

5. All the top soil excavated during construction activities should be stored for use in horticulture/landscape development within the project site.

   Compliance measure: Noted.

6. Disposal of Muck during construction phaser should not create any adverse effect on the neighbouring communities and be disposed taking the necessary precautions for general safety and health aspects of people, only in approved sites with the approval of competent authority.

   Compliance measure: Noted and Agreed.

7. Soil and ground water samples will be tested to ascertain that there is no threat to ground water quality by leaching of heavy metals and other toxic contaminants.

Compliance measure: Noted and Agreed.

8. Construction spoils including bituminous material and other hazardous materials must not be allowed to contaminate water courses and the dump sites for such material must be secured so that they should not leach into the ground water.

Compliance measure: Noted and Agreed.

9. Any hazardous waste generated during construction phase, should be disposed off as per applicable rules and norms with necessary approvals of the Tamil Nadu Pollution Control Board.

Compliance measure: Noted and Agreed.

10. The diesel generator sets to be used during construction phase should be low sulfur diesel type and should conform to Environment (Protection) Rules prescribed for Air and Noise emission standards.

Compliance measure: Noted and Agreed.

11. The diesel required for operating DG sets shall be stored in underground tanks and if required, clearance from Chief Controller of Explosives shall be taken.

Compliance measure: Noted and Agreed.

12. Vehicles hired for bringing construction material to the site should be in good condition and should have a pollution check certificate and should conform to applicable Air and Noise Emission Standards and should be operated only during non-peak hours.

Compliance measure: Noted and Agreed.

13. Ambient noise levels should conform to residential standards both during Day and Night. Incremental pollution loads on the ambient air and noise quality should be closely monitored during construction phase. Adequate measures should be made to reduce ambient air and noise levels during construction phase, so as to conform to the stipulated standards by CPCB/TNPCB.

Compliance measure: Noted.

14. Fly ash should be used as building material in the construction as per provisions of Fly Ash Notification of September, 1999 and amended as on 27th August, 2003. (The above condition is applicable only if the project site is located within 100 km of thermal power stations).

Compliance measure: Not applicable.

No thermal power plant within 100km radius.

15. Ready mix concrete must be used in building construction.

Compliance measure: Noted.

It is proposed to reuse the excavated rubble as aggregates and as substitute for sand after processing at site.

16. Storm water control and its reuse as per CGWB and BIS standards for various applications.

Compliance measure: Noted and Agreed.

17. Water demand during construction should be reduced by use of premixed concrete, curing agents, and other best practices referred.

Compliance measure: Noted.

See item 15. Water usage will be minimised to the extent possible.

18. Permission to draw ground water shall be obtained from the competent Authority prior to construction/operation of the project.

Compliance measure: Noted.

Ground water is not proposed to be tapped for the project.

19. Separation of grey and black water should be done by the use of dual plumbing line for separation of grey and black water.

Compliance measure: Noted and Agreed.

20. Fixtures for showers, toilet flushing and drinking should be of low flow either by use of aerators or pressure reducing devices or sensor based control.

Compliance measure: Noted and Agreed.

21. Use of glass may be reduced by up to 40% to reduce the electricity consumption and load on air conditioning. If necessary, use high quality double glass with special reflective coating in windows.

Compliance measure: Noted and Agreed.

The main laboratory is underground. The surface facilities will have reduced glass area.

22. Roof should meet prescriptive requirement as per Energy Conservation Building Code by using appropriate thermal insulation material to fulfil requirement.

Compliance measure: Noted and Agreed.

23. Opaque wall should meet prescriptive requirement as per Energy Conservation Building Code which is proposed to be mandatory for all air-conditioned spaces while it is aspirational for non-air-conditioned spaces by use of appropriate thermal insulation material to fulfil requirement.

Compliance measure: Noted and Agreed.

24. The approval of the competent authority shall be obtained for structural safety of the buildings due to earthquake, adequacy of fire-fighting equipments, etc., as per National Building Code including protection measures from lightning, etc.

Compliance measure: Noted and Agreed.

25. Regular supervision of the above and other measures for monitoring should be in place all through the construction phase, so as to avoid disturbance to the surroundings.

Compliance measure: Noted and Agreed.

26. Under the provisions of Environment (Protection) Act, 1986, legal action shall be initiated against the project proponent if it was found that construction of the project has been started without obtaining environmental clearance.

Compliance measure: Noted.

II. Operation Phase

1. The installation of the Sewage Treatment Plant (STP) should be certified by an independent expert and a report in this regard should be submitted to the Ministry before the project is commissioned for operation. Treated affluent emanating from STP shall be recycled/reused to the maximum extent possible. Treatment of 100% grey water by decentralised treatment should be done. Discharge of unused treated affluent shall conform to the norms and standards of the Tamil Nadu Pollution Control Board. Necessary measures should be made to mitigate the odour problem from STP.

Compliance measure: Noted and Agreed.

2. The solid waste generated should be properly collected and segregated. Wet garbage should be composted and dry/inert solid waste should be disposed off to the approved sites for land-filling after recovering recyclable material.

Compliance measure: Noted and Agreed.

3. Diesel power generating sets proposed as source of back-up power for elevators and common area illumination during operation phase should be of enclosed type and conform to rules made under the Environment (Protection) Act, 1986. The height of stack of DG sets should be equal to the height needed for the combined capacity of all proposed DG sets. The location of the DG sets may be decided with in consultation with Tamil Nadu Pollution Control Board.

Compliance measure: Noted and Agreed.

4. Noise should be controlled to ensure that it does not exceed the prescribed standards. During night time, the noise levels measured at the boundary of the building shall be restricted to the permissible levels to comply with the prevalent regulations.

Compliance measure: Noted and Agreed.

5. The green belt of the adequate width and density preferably with local species along the periphery of the plot shall be raised so as to provide protection against particulates and noise.

Compliance measure: Noted and Agreed.

Local plant species will be planted, in suitable location, in consultation with the Tamil Nadu Forest Department and environmental experts.

6. Weep-holes in the compound walls shall be provided to ensure natural drainage of rain water in the catchment area during the monsoon period.

Compliance measure: Noted and Agreed.

7. Rainwater harvesting for roof run-off and surface run-off, as plan submitted should be implemented. Before recharging the surface run-off, pre-treatment must be done to remove suspended matter, oil and grease. The bore-well for rainwater recharging should be kept at least 5 m above the highest ground water table.

Compliance measure: Noted and Agreed.

8. The ground water level and its quality should be monitored regularly, in consultation with Central Ground Water Authority.

Compliance measure: Noted and Agreed.

9. Traffic congestion near the entry and exit points from the roads adjoining the proposed project site must be avoided. Parking should be carefully internalised and no public space should be utilised.

Compliance measure: Noted and Agreed.

10. A report on the energy conservation measures conforming to energy conservation norms, finalised by Bureau of Energy Efficiency, should be prepared incorporating details about building materials and technology, R and U factors, etc., and submit to the Ministry in three month's time.

Compliance measure: Noted and Agreed.

The report will be submitted within three months of the financial approval for the project is obtained.

11. Energy conservation measures like installation of CFLs/TFLs for the lighting the areas outside the building should be integral part of the project design and should be in place before project commissioning. Use of CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/rules of the regulatory authority to avoid mercury contamination. Use of solar cells may be done to the extent possible.

Compliance measure: Noted and Agreed.

12. Adequate measures should be taken to prevent odour problem from solid waste processing plant and STP.

Compliance measure: Noted and Agreed.

13. The building should have adequate distance between them to allow movement of fresh air and passage of natural light, air and ventilation.

Compliance measure: Noted and Agreed.

Part B. General Conditions

1. The environmental safeguards contained in the EIA report should be implemented in letter and spirit.

Compliance measure: Noted and Agreed.

2. Provision should be made for supply of kerosene or cooking gas and pressure cooker to the labourers during construction phase.

Compliance measure: Noted and Agreed.

Cooking gas and pressure cooker will be supplied to the labourers.

3. Six-monthly monitoring reports should be submitted to the Ministry and its regional office, Bangalore.

Compliance measure: Noted and Agreed.

4. Officials from the regional office of MoEF, Bangalore, who would be monitoring the implementation of environmental safeguards, should be given full cooperation, facilities, and documents/data by the project proponents during their inspection. A complete set of all documents submitted to MoEF should be forwarded to the CCF, Regional Office of MoEF, Bangalore.

Compliance measure: Noted and Agreed.

5. In the case of any change(s) in the scope of the project, the project would require fresh appraisal by this Ministry.

Compliance measure: Noted and Agreed.

6. The Ministry reserves the right to add additional safeguard measures subsequently, if found necessary, and to take action including revoking of environmental clearance under the provisions of the Environmental (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

Compliance measure: Noted and Agreed.

7. All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980, and Wildlife (Protection) Act, 1972, etc., shall be obtained as applicable by project proponents from the respective competent authorities, before the start of construction.

Compliance measure: Noted and Agreed.

8. These stipulations would be enforced among others, under the provisions of Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991, and EIA Notification, 2006.

Compliance measure: Noted.

9. Environmental clearance is subject to final order of the Hon'ble Supreme Court of India in the matter of Goa Foundation vs. Union of India in Writ Petition (Civil) No. 460 of 2004 as may be applicable to this project.

Compliance measure: Noted.

10. Any appeal against this environmental clearance shall lie with the National Environment Appellate Authority, if preferred, within a period of 30 days as prescribed under Section 11 of the National Environment Appellate Act, 1997.

Compliance measure: Noted.