Proposed Nam Theun 2 Hydroelectric Project in Lao PDR
World Bank Responses to IRN-EDF Technical Reviews

March 21, 2005

The World Bank's social and environmental safeguards experts have carefully considered the reviews commissioned by the International Rivers Network (IRN) and Environmental Defense (EDF) to assess the "quality of research and analysis" in the draft safeguards documents for the proposed Nam Theun 2 (NT2) hydroelectric project in Lao PDR. The findings of the IRN-EDF reviews were summarized in a letter to the Bank's Board of Executive Directors on March 3, 2003. The summary of the IRN-EDF review and the Bank's responses are presented below. The Bank's experts understand many of the concerns raised, but differ with the IRN-EDF reviewers on the conclusions they draw. Having engaged the Government of Lao PDR (GOL) and the project developers, the Nam Theun 2 Power Company (NTPC), in an extensive due-diligence process involving a prolonged discussion to review baseline data and mitigation measures, and the assumptions and methodologies underlying these, and having as well undertaken numerous visits to the project area to verify facts and consult local communities during the course of project preparation, **World Bank staff are satisfied that there are ample provisions to mitigate or offset the social and environmental risks entailed by the project.**

The response below is in two sections. An overview section clarifies three generic issues that are common to most IRN-EDF concerns. The remainder of the document is structured in eight parts, in line with the reports commissioned by IRN-EDF and responding to each of the 38 concerns raised therein.

Overview

Three general points are worth noting:

- ***Access to data sets were available to external parties visiting Lao PDR.*** The IRN and EDF claim it was necessary to ask experts based in the US and in Thailand to conduct the desk reviews because *'an independent review of the developers' plans is not possible in Lao PDR'*. This is not accurate: (i) Numerous representatives of donor agencies, civil society organizations and the international media have visited the project areas over the years, and met with the GOL and NTPC to discuss project plans and the data on which they were based. (ii) Where data have not been placed in the public domain for commercial proprietary reasons, researchers have been allowed to consult documents upon request at the NTPC Public Information Centre in Vientiane, as stated in an NTPC communiqué in January 2005. (iii) The reports of the independent International Advisory Group (IAG) advising the President of the World Bank, and of the Panel of Environmental and Social Experts (POE) advising the GOL on the quality of these plans have been posted regularly for public review, together with numerous other background documents. (iv) A series of international stakeholders' workshops were held in Bangkok, Tokyo, Paris and Washington to allow interested parties outside Lao PDR to discuss safeguards and other project issues in detail with the GOL and NTPC, seeking clarifications and raising their concerns.

- ***Sound methodologies were utilized to address data gaps commonly found in lower-income developing countries***. An issue raised in several of the reviews is the lack of adequate baseline data – where 'adequate' is not defined but seems to refer to the expectation that

datasets should meet quality assurance / quality control criteria that more often, though certainly not always, are available in industrialized countries. The IRN-EDF critique fails to recognize the realities of scientific and technical datasets available in Lao PDR and heavily discounts technically acceptable methods for overcoming the analytical difficulties they present. Scientific and technical records in low income countries such as Lao PDR are rarely comprehensive; however, there are sound methods for filling such gaps where they exist. In addition to direct field data collection, techniques used in evaluating and extending the available NT2 baseline information included: mathematical simulation modeling, statistical analysis, sensitivity analysis, and use of experience from analogous situations from Lao PDR, South East Asia, and globally. Furthermore, for NT2, an approach of systematically selecting the most conservative (or worst-case) scenarios has been applied in analyzing the proposed project's social and environmental impacts. The design of the mitigation and compensation measures to address these potential impacts has been based on such scenarios.

- ***Mitigation measures are well-defined and well-funded – based on lessons learned from other large infrastructure projects and specific assessment of the Lao context.*** The IRN-EDF reviews tend to assume that most, if not all of the proposed mitigation measures will fail. The project has negative impacts, and in some cases, these are significant – but this needs to be considered against the proactive development programs that have been proposed to mitigate or compensate for such impacts. Wherever possible the project has sought to use approaches familiar to plateau and downstream communities, and where this is not possible has proposed a menu of alternative livelihoods that would be implemented well in advance of the actual impacts, allowing time for piloting, assessing effectiveness and retrofitting programs as needed. These proposed risk mitigation and compensation measures are clearly described in the safeguards documents. Several will require further detailed design based on participatory and adaptive management approaches during the implementation phase. The developers' responsibility for achieving the proposed outcomes is clearly defined in legally binding documents including the Concession Agreement. Programs are supported by detailed implementation arrangements, including timelines, budgets, and monitoring and evaluation mechanisms. Uncertainties and unforeseen impacts and outcomes have been provided for with contingency funds and recourse arrangements. The risk mitigation and compensation packages have been discussed with affected communities through a consultation process that was unprecedented in Lao PDR for its scope, coverage, balance, and transparency. This consultation process will continue throughout the implementation period. Such comprehensive risk mitigation and compensation measures, and the processes and mechanisms that the project will adopt during implementation are also unprecedented in hydropower development in East Asia – none of which is acknowledged in the IRN-EDF critique.

Part 1: Hydrology

1. *Due to the paucity of hydrological data and questionable statistical analysis techniques, "the project is high risk for meeting its power generation predictions and for estimating project impacts."*

The issues raised by the IRN-EDF reviewers must be understood in light of the realities of (i) scientific and technical data available in Lao PDR, and (ii) the risk-management strategies adopted to address these in the context of NT2.

Very poor developing countries inevitably lack the benefit of long-term scientific and technical databases on key hydrological parameters. Lao PDR is certainly one of them. Nevertheless, the datasets used for the NT2 Project compare quite favorably with those of other projects in developing countries. In addition, hydrologists typically use a variety of mathematical techniques to simulate long-term datasets. Combining the available field measurements with mathematical modeling and statistical techniques such as regression analysis, the hydrology consultants to NTPC, have used technically viable and appropriate approaches, that are common in international practices.

Any large-scale project faces risks. NT2 is no exception—and should be evaluated on the strength of how such risks are managed. To address the gaps in the data records and the uncertainty implied, a number of specific actions to minimize and manage hydrological risks have been taken. Specifically, the project developers and commercial financiers have conducted sensitivity analysis for a range of hydrological risk scenarios to evaluate the project's feasibility, based on which explicit engineering and operational measures have been designed to either prevent or minimize hydrological risks. The measures include construction of the regulating pond to minimize fluctuations in daily discharges into the Xe Bang Fai (XBF), embankment protection at the confluence of the downstream channel and the XBF, commitment to shut down operations before natural over-bank flooding in the upper XBF occurs. Intensive field monitoring to verify assumptions on impacts is foreseen and adaptive management practices will be adopted to make changes to operational and other mitigation measures as needed.

2. *The Nam Theun 2 Environmental Assessment and Management Plan (EAMP) contains no hydrologic analysis, but contains references to unpublished supporting work. For much of the critical hydrologic analysis on which depends the entire assessment of the performance of the project and its environmental consequences, the Nam Theun 2 project sponsors have not provided the underlying data or explained the methodology used, thereby making robust independent analysis impossible.*

All methodological issues, as well as the hydrological data and analysis summarized in the EAMP, including the hydrology reports undertaken for NTPC by the independent consultants Snowy Mountain Engineering Company (SMEC) in 2003, can be examined upon request at NTPC's offices in Vientiane. The Bank's technical specialists have carefully reviewed these reports and have found them satisfactory.

3. *The project plans are based on a maximum of 18-years of stream flow and rainfall records, which is not a statistically valid basis for deriving 100-year and greater flood estimates.*

The hydrological record that has been used by NTPC for assessing inflows to the scheme is a combination of rainfall and streamflow data. Daily rainfall records are available from 13 stations within the Nam Theun and Xe Bang Fai catchment areas, measured over periods ranging from 9-

17 years, and include 52 years of rainfall data from the nearby Nakon Phanom station in Thailand. These data have been translated into streamflow values using 17 years of streamflow records and models that are in line with international good practice.

4. *Hydraulic modeling did not include the upper and middle reaches of Xe Bang Fai River even though significant changes in water elevations will occur and impacts should be assessed.*

Contrary to the claim, the hydrological analysis and modeling covers upper, middle and lower reaches of the Xe Bang Fai. The EAMP indicates that the most noticeable changes will occur in the upper reaches of the river during the dry season, directly downstream of the confluence with the Nam Phit, while lesser impacts are expected further downstream. In the upper Xe Bang Fai, the water level will increase by 4-6 meters over ambient minimum levels during the dry season and will remain at or below maximum ambient levels during the wet season. This change in depth will gradually decline downstream to about 0.5-1 meter above ambient in the lower Xe Bang Fai during the dry season. There will also be weekly fluctuations on Sundays when power generation will be suspended, and the river will drop to about 2 meters above ambient levels during the dry season in the upper Xe Bang Fai. The regulating pond will mute most other fluctuations due to short-term power suspension of up to a few hours, reducing the rate of erosion that would otherwise occur. In addition, a monitoring system has been designed to warn powerhouse operators if the Xe Bang Fai should reach levels where it could overflow its banks at which time power generation and water discharge would be suspended.

A detailed modeling study was also conducted to assess potential, additional flooding (beyond currently observed annual patterns) in the lower Xe Bang Fai in terms of depth, expanse and duration. A mitigation program has been designed and funded to control flooding and to prevent any additional, incremental crop losses beyond that which occurs to varying degrees every year due to natural inundation of the floodplain in that area. The downstream analyses also covered issues such as temperature variation and water quality, and their findings guided the design of the mitigation and compensation measures for the anticipated range of impacts, including erosion and loss of riverbank assets, damage to river bank gardens, degradation of potable river water, dry-season transport across tributaries to the Xe Bang Fai, and fisheries losses. Details of the compensation and mitigation programs are described in the EAMP and SDP, and both should be read and cross-referenced to gain a better understanding of the project's impacts and mitigation and compensation actions.

5. *The project developers have undertaken no analysis of how global climate change might affect flows in the Theun River.*

It is recognized that global and regional weather patterns could potentially affect the project. However, other than through the use of sensitivity analyses, the scientific community has yet to provide specific methodological guidance on how to take into account the effects of climate change on key parameters such as temperature and precipitation, and their relationships to run-off and river flows. While there is concern that extreme events such as prolonged drought, or more intensive rainfall, could be exacerbated as a result of global climate change, it is not possible at this time to make reliable predictions of specific effects on the Nakai Plateau. Under such circumstances, an effective way to mitigate the undisputed impacts of climate change on water resources is to have storage available and to use an adaptive management approach in reservoir operation. NT2 features both.

Part 2: Water Quality Impact Assessment

6. *The data used to characterize the baseline water quality in the project area is wholly inadequate, and as a result, accurate predictions of the water quantity and quality changes that will occur in the reservoir and in downstream rivers are not possible.*

That the baseline data in terms of water quality in Lao is not what one might see in a developed-country context did not prevent good water quality impact assessment from being undertaken. Impacts were simulated using established water quality models and undertaken by highly experienced water quality professionals. The models were primarily based on data obtained from field measurements, local environmental data and the project's engineering design. Where this was not possible, model inputs were based on similar situations, but using conservative numbers. The EAMP also relied on reviews of experiences in reservoirs and their associated downstream areas in Lao (including Nam Leuk and Theun Hinboun) and in the region, which, combined with the model estimates, formed the basis for the impact assessment and design of the mitigation plans.

7. *No effective mitigation strategies are offered in the EAMP to address the potential for prolonged anoxia and resulting releases of nutrients and toxic gases in the Nakai reservoir, which will result in the loss of adult and juvenile fish and fish eggs.*

The EAMP proposes the following practical approaches (going beyond strategies) to prevent, mitigate or compensate for adverse water quality in both the reservoir and downstream areas:

- prevention through reduction of biomass in the reservoir area;
- mitigation by designing outlets in the dam and power station to minimize the release of poor quality bottom water, and by providing aeration devices downstream of the dam and powerhouse that will reduce noxious gases and oxygenate the water ;
- compensation for impacts of water quality that includes a proactive development program to replace anticipated fish losses in downstream areas and provision of drinking water supply systems in areas where water quality would be adversely impacted; and
- monitoring and adaptive management—based on a comprehensive water quality monitoring program, changes will be introduced in management, operation and mitigation programs where appropriate,.

While prolonged periods of anoxia may affect fisheries in the reservoir in the initial years, regional experience shows that water quality improves over subsequent years and productive fisheries can be supported. In the case of NT2, water quality modeling has estimated that during the first years of the project, there will be a large amount of nutrients and degrading organic matter, causing pronounced periods of anoxia in the bottom water of the reservoir especially during the dry season. In the longer term, as the organic matter in the reservoir degrades, anoxia will be of shorter duration (1-3 months) and will be limited to the deepest parts of the reservoir, accounting for a small portion of the total volume of the reservoir. Regional experience indicates that in the first years, fish will avoid the affected areas of the reservoir and will tend to remain in the tributaries. This will be followed by increased fish productivity in the reservoir where the fish will take advantage of the productive conditions provided by the elevated nutrient concentrations while avoiding the more limited areas or depths that have unfavorable water quality.

8. *The EAMP fails to comprehensively examine the possibility for toxic blooms of cyanobacteria and algae in the reservoir, which can produce severe sickness and mortality in humans, wildlife and livestock.*

The EAMP has sufficiently analyzed and assessed the impacts of cyanobacteria, algae and related species. Cyanobacteria (which appears as green scum), commonly found in ponds, rice fields and irrigation ditches in Asia, is of special concern because it can produce toxins, affecting humans and animals.[1] In the case of NT2, the reservoir water quality model estimated the growth of algae, cyanobacteria and diatoms, taking into account the relative nutrient conditions (nitrogen and phosphorous) that promote their growth. This modeling concluded that, during the initial years after reservoir formation, when nutrients are still high, algal and diatom growth would experience a seasonal peak in the summer. In subsequent years, high stocks of cyanobacteria are expected to occur under low nitrogen conditions, at the end of the dry season. A combination of proactive and reactive measures to reduce occurrence and exposure of these organisms, consistent with current international practices, has been proposed for the NT2 Project:

- a salvage logging program will be undertaken to reduce nutrient-rich biomass in the reservoir;
- nutrient pollution due to human activities around the reservoir will be controlled;
- water supply for domestic use in the resettlement area will largely be independent of the reservoir;
- water quality will be monitored to detect if cyanobacteria toxins become established; and
- as necessary, measures will be taken to avoid direct exposure by livestock and humans.

9. *The EAMP provides no data on aquatic macro-invertebrates, which play a vital role in establishing and maintaining good water quality and are an important source of food to many fish and other species.*

The importance of macro-invertebrates to the nutrition of the local populace and as feed for fishes is clearly recognized in the EAMP and SDP. The findings from a detailed study of the Nam Hinboun showed that, in the nearby Theun Hinboun dam, sediment and turbidity from increased erosion had a significant adverse impact on these organisms. This has been factored into the NT2 compensation package, through correlation of losses to fish and other aquatic organisms in the Nam Hinboun to that of the Xe Bang Fai. At the same time, because NT2 would include a regulating pond, it is estimated that erosion will be lower in the Xe Bang Fai than has been the case in the Nam Hinboun, as there would be less frequent fluctuations in river flow and depth.

10. *The reservoir will expand the habitat for vectors of major waterborne diseases known to inhabit the project site. As a result, diseases such as malaria, dengue fever, schistosomiasis, and liver fluke can quickly spread, posing additional health risks for the resettled populations.*

As part of the SDP, a Public Health Impact Assessment and Health Plan was prepared to address water-related and vector-borne diseases. The plan proposes a comprehensive health program targeting resettlers and construction workers, and is complemented by a regional health program for the project area. The aim is not only to mitigate the health impacts of the project but also to improve the health of communities in the area. The assessment discusses the following:

[1] In general the risk is associated with human and animal exposure to toxins released by certain species of these organisms, and can affect wildlife and livestock that ingest these toxins. Incidences of serious human health impacts are occasional, and are normally associated with contamination of drinking water supplies. Less serious effects are due to direct human contact, although these are often avoided as the appearance and odor of the water act as deterrents.

- Malaria: The assessment identifies the major risks with regard to malaria-related impacts as the potential changes in the types of vector strains and resistance of the population due to a combination of reservoir formation, change in water resource use, construction activities, and the increased non-local population. The ongoing malaria prevention program, focusing on the use of bed nets, has had great success and will be expanded to include better facilities, more resources and technical support.
- Liver fluke infection is highly prevalent in the Nam Kathang and Xe Bang Fai where it is picked up through eating infected raw fish (*padek*). Increased availability of water in this area due to the project is unlikely to change this situation. However, the health program includes measures such as improved education targeting food handlers and better treatment and detection of this and other helminthic diseases.
- Schistosomiasis: Although the snail species that spreads the disease is found in the project area, the disease itself is not present. Its transmission to the project area is not expected to occur as it would necessitate transmission from another area and the only known occurrence of the disease in the country is in two districts in southern Lao PDR.
- Dengue: Water changes in the lower Xe Bang Fai may increase the prevalence of dengue which is highly prevalent in the flooding season. Prevention, awareness and treatment programs will be implemented.

Part 3: Downstream Fisheries Impacts on the Xe Bang Fai River

11. *Nam Theun 2 "is likely to have multiple serious, negative impacts on the aquatic resources of the Xe Bang Fai and Nam Phit rivers. As predicted in the Social Development Plan, the Nam Theun 2 project is likely to cause a 'collapse in the aquatic food chain' from the Nam Phit down to the Mekong."*

The Bank and NTPC's environment experts consider that the prediction of a "collapse in the aquatic food chain" would be on a declining scale from the confluence of the Nam Phit with the Xe Bang Fai downstream to the Mekong. This is due to increased water depth and turbidity resulting from increased erosion that will reduce photosynthesis and primary productivity, eliminate rapids, and cover other water beds with sediment. The main incremental effect will be during the dry season when about 55% of the fish are caught from the Xe Bang Fai. Hence, the EAMP and SDP acknowledge that there will be significant impacts on aquatic resources in the Xe Bang Fai and the Nam Phit, especially in the initial (3-5) years after dam construction in the Xe Bang Fai and for the long-term in the Nam Phit. This is expected to reduce not only finfish production but also that of bivalves, shrimps, and aquatic plants by an estimated 24% overall under a "worst case" scenario that has been used for compensation planning purposes. It is based on calculations of production in the Xe Bang Fai and Nam Phit and correlations to the documented experience of losses to fish and other aquatic life in the nearby Nam Hai and Nam Hinboun.

It should be noted that the Nam Hai and Nam Hinboun are affected by turbine water discharged from the Theun Hinboun Hydroelectric Project (THHP) in a similar manner that would take place in the Nam Phit and the Xe Bang Fai with regard to flow. The THHP is also an inter-basin, water transfer project. However, the THHP lacks a downstream regulating pond and aeration weir that are features of the NT2 project. These facilities will mitigate frequent fluctuations in river flow and depth – the main cause of high erosion -- and improve oxygen levels in the discharge to the Nam Phit and Xe Bang Fai as compared to the THHP and should thus reduce NT2's relative impact on fish and other aquatic life.

Despite these mitigation measures, as stated above, impacts on the aquatic food chain are expected. They should be greatest near the confluence of the Nam Phit with the Xe Bang Fai, becoming less pronounced as one moves further along the 160-km stretch toward the Mekong. The compensation plan for affected villages has thus been structured based on the relative impact of the project along the rivers. The fisheries monitoring program will assess whether the estimates are correct with any required adjustments implemented accordingly.

12. *The EAMP lacks scientific and rigorous analysis of impacts. Predictions of impacts on downstream fisheries are based on three dry season surveys only. No study of fish species and migrations during the rainy season has been conducted, despite a recommendation from NTPC's fisheries consultant in 1996.*

The assertion that the EAMP lacks scientific and rigorous analysis of the impacts on aquatic resources is unwarranted. Both the EAMP and the SDP point explicitly to the downstream impacts. These impacts have been taken fully into account in the mitigation and compensation programs proposed for the downstream areas. The baseline surveys reported in the "Xe Bang Fai Socio-Economic, Health and Fisheries Survey, 2001" included both wet and dry season fish catches. That study has been followed by subsequent verification checks and an on-going fisheries survey have confirmed the findings from the 2001 survey. The studies were based on fish catch and not specifically on fish migration. The baseline and follow-up surveys were done in representative villages along the Xe Bang Fai mainstream and some tributaries and showed the presence of species along the impacted stretches of the river as well as upstream of the impacted area in the case of the baseline study.

13. *The EAMP has not been updated to reflect design changes (in particular, greater turbined flows down the Xe Bang Fai river) since the original impact predictions and recommendations were made in 1996. As water levels will be more than twice as high as was assumed in 1996, many of the predictions of potential impacts are now outdated and underestimated.*

The EAMP *has* been updated since 1996, and reflects changes, as a result of several studies undertaken in the nine year period by NTPC. The proposed mitigation and compensation programs are based on operation of the project as currently designed. The EAMP mentions that the annual rate of water discharged to the Xe Bang Fai would average 220 m3/second. Moreover, the SDP has assessed the project's impacts based on the current plan for turbined water entering the Nam Phit and Xe Bang Fai. The change with regard to fish loss in the Xe Bang Fai was revised from no loss in the mid-1990s to an overall current estimate of about 24% loss of fishes and other aquatic organisms—from a total of about 3,000 tons at present to 2,330 tons with the project. The losses will vary depending on the segment of the Xe Bang Fai, with greater impacts occurring in the upper and middle sections. The current estimate is a worst-case scenario, with correlations derived from studies undertaken to assess losses in the nearby Theun Hinboun dam—which lacks a downstream regulating pond and aeration weir, two mitigation measures which were included in the design of the NT2 Project.

14. *The submergence of rapids, which are an important habitat and spawning ground for fish and many other aquatic organisms, will have a major impact on the ability of these organisms to survive.*

The submergence of rapids and its implications for fish and other aquatic organisms has been taken into account in the assessment of impacts. The EAMP describes a range of aquatic habitat types found in the affected river systems and acknowledges that these impacts are likely to be

significant. The implications for fish catch and harvesting of aquatic organisms has been factored into the design of compensation programs for the affected communities. These programs are defined in the SDP.

15. *No assessment of the project's impacts on non-fish aquatic organisms important for human consumption (i.e., mussels, shrimps, and aquatic plants) has been conducted.*

The impacts on both finfish and aquatic organisms fit for human consumption have been assessed. The loss estimate includes both groups. Loss of habitat is a major assumption that was applied to the fisheries loss estimates. The compensation program includes assistance for affected communities to develop alternative livelihoods well in advance of the actual impacts.

Part 4: Compensation for Downstream (Xe Bang Fai) Communities

16. *The Nam Theun 2 Power Company (NTPC) makes the unjustified assumption that loss of wild fisheries can simply be replaced by introducing aquaculture or animal-raising options to impacted villagers. This assumption shows that NTPC does not comprehend the social, economic and practical problems involved in attempting to introduce novel livelihood strategies to numerous geographically widespread rural communities, hitherto inadequately informed or prepared for the changes which they will experience post operations.*

In the context of total livelihood earnings in the Xe Bang Fai, fisheries represent approximately 17% of total household income (cash and imputed), on average, for villages located on the mainstream of the Xe Bang Fai basin. With NT2, that portion of income would be reduced by about 24% -- a net loss of about 4% of total income per household. This will vary depending on the degree to which households are engaged in fishing (those more dependent on fishing being in the upper and middle stretches of the river). Accordingly, 76% of the original catch will still be available to fishers in the Xe Bang Fai,, though it is recognized that there may be some change in species composition. Fishing practices would be similar to those used in the wet season, during which 45% of the annual mainstream catch is landed. The ongoing fisheries monitoring program will be extended through the first 9.5 years of the project, during which time the loss estimates and any changes in species composition will be verified, with adjustments made to the program as needed. The 4% loss of income is compensated through a diversified program consisting of nine livelihood options targeting those dependent on fisheries, on a village-by-village basis. There is experience in the project area and the region for each of the nine models proposed, with most households already engaged in one or more of the activities. Some models are relatively new to the project area despite being well-established elsewhere in the region. Extensive consultation with villagers has occurred, including discussion of project impacts, the proposed livelihoods models, and other mitigation/compensation measures.

17. *NTPC's goal of completing all mitigation and compensation activities within five years of commercial operation is unrealistic, and, if implemented, will leave villagers without adequate long-term livelihood options.*

The mitigation and compensation program, which has been developed with the participation of the affected communities and based on "worst case" scenarios on estimated fisheries loss in the Xe Bang Fai, will be implemented over 9.5 years. It offers a diverse menu of livelihoods options which include aquaculture (e.g., pond fish culture, integrated fish farming), animal husbandry, and integrated rice-fish production in paddies. Implementation of the program will begin in the first year after financial closure with further consultation and detailed design of the livelihood

models, establishment of pilot demonstration activities, training and skills development of affected communities, and instituting continuous water quality and fish monitoring activities. The expansion of aquaculture activities would be implemented based on choices made by the affected households. It is envisioned that these income activities will have long-term sustainability. Contingency funds have been provided to deal with unanticipated impacts.

18. *The Company wrongly assumes that aquaculture can be a direct replacement for lost capture fisheries, which ignores local experience and the fact that cultured fish do not have the same economic, nutritional or cultural value in the diets of Lao villagers. Based on experience in Lao PDR and Thailand, no more than 20% of households are likely to take up aquaculture. Due to the costs of purchasing fish seed and food, the poorest families would most likely miss out on the benefits of this activity.*

The expansion of aquaculture activities as planned under the project would be implemented based on the choice by the affected households. Aquaculture options (integrated rice-fish culture, pond fish culture, and integrated livestock with pond fish culture) would represent only part of the compensation program. There is good experience with aquaculture, particularly in the lower Xe Bang Fai, where it has been expanding from year-to-year. This experience will be applied under the project. Animal husbandry is another option that has been explored. Others will likely be identified and taken up during the 9.5 year implementation period. Moreover, it is estimated that the production from the Xe Bang Fai fisheries will be about 76% of the pre-project situation and would be comprised entirely of species native to the river, though it is recognized that there may be some change in species composition. Therefore, it is envisioned that fishing would continue, using for the most part the practices currently adopted during the wet season when about 45% of the fish are caught (as per the 2001 fisheries survey). The ongoing fisheries monitoring program will be extended through the first 9.5 years of the project, during which the loss estimates and any changes in species composition will be checked, with adjustments made to the program as needed. Also, the costs of fish seed and fish feed, that would need to be purchased by the affected families under the aquaculture model, will be covered through grant funding for the full first year's production as part of the compensation package. The program will also include infrastructure and production facilities, materials, equipment and technical and management training for the affected households that choose to become involved in aquaculture.

19. *It is unlikely that there will be adequate human resources or supporting infrastructure in the area to provide sufficient fish seed or offer training and extension services.*

A robust program of technical assistance is included in the NT2 project to build adequate capacity in terms of technical and extension needs to support implementation of the alternative livelihoods models. With regard to fish seed availability, it is planned that the provincial hatchery's capacity in Thakhek will be expanded under a government program. There is another hatchery planned near the Highway 13 bridge over the Xe Bang Fai. As demand increases, it is also expected that the private sector will become involved in hatchery operations, including households in the Xe Bang Fai basin, as witnessed in Cambodia and elsewhere.

20. *Proposals to introduce alternative livestock production lack form and substance, nor do they build on the experience of the Theun Hinboun Power Company, which has spent three years attempting with mixed results to introduce small livestock in dam-affected villages. The proposition that cattle will be preferred by villagers over small livestock and are feasible for mass extension is unrealistic given local constraints.*

Animal husbandry as documented in the SDP is practiced throughout the Xe Bang Fai basin, in varying degrees, and primarily includes buffalo, cows, horses, pigs, goats, chicken, and ducks. It is therefore a known activity to the downstream communities. Experience from the Theun Hinboun Project has been taken into account in the design of the downstream program. Based on consultations to date, livestock options did not feature prominently among the priorities of villagers; more interest was expressed in aquaculture options and others such as improved wetland fisheries management, flood protection, and irrigation.

Part 5: Agriculture and Livestock Development Plan for Resettled Villagers

21. *Irrigated farmland and intensive livestock raising are two of the livelihood options offered as compensation by the Nam Theun 2 Power Company to resettled households but there is a high risk of failure for both.*

The package of livelihood activities—agriculture, reservoir fishery, livestock raising, community forestry, and other non-farm opportunities—were designed based on technical studies, analyses of existing livelihood patterns, past resettlement experiences, numerous rounds of consultation with the affected communities, and implementation of a pilot resettlement program. The proposed livelihood patterns are not entirely new to the communities to be resettled. They have either been conducting such activities as paddy rice growing, fishing, gardening and logging, or been exposed to them in varying degrees, and have also practiced a substantial level of market activities. A survey in 1997 showed that cash earnings represented about 50% of their household income. We therefore disagree that there will be a 'high risk of failure.'

The people on the Nakai Plateau are extremely poor. The present average annual household income of affected people in Nakai Plateau is US$450, well below Lao's rural poverty line. Only 50% of the households have rice security for six months of the year. The aim of the resettlement program is to improve the quality of the life of the 6,200 affected people by providing them with housing, infrastructure and basic services, and livelihood opportunities which will lift them above the rural poverty line. The Concession Agreement binds GOL and NTPC not only to specific planned measures but also to achieving specific income targets by affected households. This will require changes in livelihood patterns, replacing a subsistence economy in which the majority of the communities have no food security, with a more market-oriented package of livelihood activities.

The SDP contains a detailed analysis of risks and corresponding management strategies. To mitigate the risks, the livelihood development program follows a flexible and adaptive approach for detailed planning and implementation. Measures have been designed to support the resettlers in adapting to the new livelihoods, including transitional assistance, extension services, and various community development initiatives. The project also includes an elaborate system to monitor socio-economic trends and SDP implementation closely and continuously on the Nakai Plateau so that issues are identified and addressed in a timely fashion.

22. *The resettlement site has extremely infertile soils that will require high inputs of both organic and inorganic fertilizers and lime. Villagers will be provided with support for these inputs for a period of 3-8 years. Because villagers have never had to make such high inputs before, the Social Development Plan notes the "very real likelihood" that villagers will not be willing - or able - to do so once the project ceases support. Cropping systems and fertilizer schemes proposed are untested and therefore experimental?*

Despite the fact that soil quality on the Plateau is poor and would be infertile without fertilizer and lime inputs, the villagers chose, through the consultation process, to remain close to the future reservoir in order to take advantage of fisheries opportunities and to stay within their spiritual boundaries. To address soil quality issues, alternative farming strategies and methodologies have been proposed and planned in consultation with the villagers. The experience at the demonstration farms and the pilot village has shown positive results with respect to the willingness and ability of the resettlers to use fertilizer. These fertilizers and lime, needed to farm the land successfully, will be provided by the project for the first five years as transitional assistance. These provisions will continue thereafter with partial payments until the end of the resettlement implementation period, when the resettler households are expected to be able to purchase these with their established livelihoods. There would be a gradual phase-out taking into account the status of livelihood development of the resettlers. The SDP clearly recognizes the need for strong and continuous extension support to be available to the resettled villagers.

23. *Though irrigated land for dry season rice cropping has been promised, the Social Development Plan acknowledges that this may only be feasible "in the longer term."*

The allocation of 0.66 ha of irrigated land (including a minimum of 0.16 ha developed as paddy land) is a standard policy entitlement for all resettler families under the project, regardless of which site they are moving to. The agriculture potential of each site will be further assessed when detailed implementation begins, and possibly more land will be allocated for agriculture, depending on the village resource utilization plan that the villagers will develop. For example, in the pilot village, use of the upper drawdown zone for establishing forage crops is being examined. In the degraded forest area, the potential for domesticated NTFPs mixed with reforestation of native species is being tested. At this stage, one hectare has been allocated to each family for this purpose.

24. *The villagers will need to rely on markets for their livelihoods, yet the Nakai Plateau is an extremely remote area. In the early years of resettlement the construction camps will likely provide a market for the produce. However, if permanent markets do not develop, villagers will lose their market base after construction is complete, which will coincide with the cessation of agricultural support.*

The resettler households are expected to grow a diverse range of crops supported by the project. Some of the produce, such as rice, will be for self-consumption. Some would need to be sold in markets. During the construction period, for around four years, it is expected that there would be a large market for the farmers' produce, particularly vegetables and fruit. It is expected that this market would have to be replaced when the construction phase is over. To prepare for the expected impact, measures are planned in the SDP, including establishing a marketing unit on the plateau, provision of vehicles for transport, and training programs for resettlers. At the same time, since this impact would only happen three or four years after actual relocation further planning efforts will continue in consultation with the resettlers and draw on experiences from the initial years of implementation.

25. *The reservoir will flood 45,000 hectares of prime buffalo raising pasture and the resettlement area does not have enough replacement land to support the resettlers' existing buffalo herds. Proposals for alternative forage production are inadequate, risky and untested.*

There is a long history of animal raising in the plateau, where the animals are mostly left on their own to graze freely, with limited management efforts. Animals, particularly large animals, are a

desired asset. While households currently with larger flocks would most likely need to reduce their size, this will be further explored as village boundaries are demarcated, resources mapped and resource utilization planned. Each individual village development plan will include a detailed livestock component, including use of drawdown areas and degraded forest areas, as well as possible forage growing.

Part 6: Nam Theun 2 Reservoir Fisheries

26. *The Social Development Plan presents the Nam Theun 2 reservoir fishery as one of four livelihood options for the 6,200 people displaced by the project but this presumption "is a precarious gamble at best."*

The fisheries management plan is based on three production scenarios for the Nakai Reservoir, drawing on the range of experience in the region, including the findings from five reservoirs in Laos and the Thailand—Nam Ngum in Laos, and Ubolratana, Nam Phung, Sirinthon, and Chulaphon in Thailand. All have successful and sustained annual production from fisheries, as described in Chapter 12 of Volume 2 of the Social Development Plan. Ubolratana has many of the same characteristics as the Nakai Reservoir in terms of overall area and drawdown, with fisheries production characteristics similar to those of the planned Nakai Reservoir.

27. *Rather than introducing fish species into the reservoir, the reservoir fisheries plan recommends closing the dam gates after the migratory season and allowing native species to adapt to the changed conditions. However, the reservoir is likely to be anoxic (lacking in oxygen) during the first few years after impoundment as a result of decomposing biomass left in the inundation area. As fish cannot survive without oxygen, most of the fish trapped during the initial filling of the reservoir are likely to die during the initial years after dam construction.*

IRN-EDF's recommendations that species should be introduced into the reservoir from outside the project area runs counter to sound conservation practice as it potentially could have serious implications for native fish stocks. The preferred approach of the project is to rely on the viability the natural fish stocks rather than on artificial introduction of species which could pose high risks such as disease, impacts on habitat, and other disturbance to indigenous species that can occur with introduction of exotic species. With the proposed fisheries management program, that includes setting aside fish sanctuaries, optimal production should result. It should be noted that, at present, the fisheries in the project area have been degraded due to increasing over-fishing, blast fishing, and the impact of the Theun Hinboun Dam that blocks fish migration from and to the Mekong through much of the year. It is expected that, with the project, fish yields will thus increase significantly on the plateau. While the anoxic conditions in the first years will limit overall production in the reservoir, fish will not be eliminated but rather will tend to congregate in the tributaries, tributary mouths and oxygenated areas of the reservoir. As water quality conditions improve in the reservoir they will be able to populate the reservoir. A monitoring program will be instituted to observe changes in reservoir species composition and population.

28. *Dam operations will shrink the reservoir to less than a fifth of its size during the dry season, which eliminates most of the underwater habitat. As the reservoir level decreases there will be less and less water capable of sustaining fish life. The deeper and relatively stagnant parts extending back from the dam are likely to be uninhabitable due to anoxic conditions.*

Perennial water will be retained in the reservoir throughout the year and over most of its length, particularly along the area where the Nam Theun riverbed presently exists, in addition to the impoundment in the area immediately behind the Nakai Dam. Based on experience in the region, it is expected that after about three years the epilimnion (the upper layer of the lake) which typically presents good water quality, will stabilize with a depth of about 10 m across the reservoir in the dry season. Below that level, the quality of the hypolimnion (the lower strata) will be poor, but makes up a relatively small portion of the volume of water. It is expected that the area where the Nam Theun riverbed presently exists plus the impoundment immediately behind the Nakai Dam, as is the case with freshwater natural lakes, would be most susceptible to supporting anoxic bottom water during drawdown, and thus would be largely devoid of fish. In the context of the entire reservoir, this anoxic bottom water will not significantly limit fish habit after the first several years of poor water quality. Based on modeling and regional experience the majority of the reservoir will be shallow enough to prevent formation of stagnant bottom water.

The reduction in water available for fish during the dry season is not expected to affect the viability of the reservoir fisheries. Under similar situations of extreme drawdown (e.g., Tonle Sap and Ubolratana), productive fisheries have been supported. Moreover, a substantial portion of the 80-km2 perennial water area will be established as fish sanctuaries to assure sustained fish populations and could improve diversity through helping to conserve a breeder population of the higher valued species that otherwise would likely be fished out.

29. *Assuming there are fish to catch, the shallow depth and seasonal muddy drawdown of the reservoir would likely make subsistence fishing too costly and time consuming. Villagers would have to transport boats, outboard motors, and fishing equipment over long distances through deep mud to the lakeshore and back again*.

The nature of the seasonally changing area of the reservoir has been considered in the planning of the fisheries management program. A few options are under consideration and will be decided upon through consultation with the resettled households. One is to establish fisheries management where interested households are able to fish following specific fishing rules (e.g., types of permitted gear, closed seasons, intensity of fishing) through a licensing system under the guidance of the planned Reservoir Office of the Watershed Management Protection Authority. Another option under discussion would be to establish a shareholding company that would be owned by the resettled households and operated by a board of their representatives. The board would hire a management team as well as the fishers/guards who would be selected from among interested resettled households who would also be paid a wage. After operating and maintenance costs are deducted each year, the remaining balance would be divided equally among shareholding households. Other options are also being discussed,. The management plan will be prepared in consultation with the resettled households, and will be finalized three years after financial close in advance of inundation. A fishery monitoring program is included in the management plan, the data from which will be used to make adjustments to management.

The conjecture that villagers will need to transport their boats or other heavy fishing equipment over long distances and through deep mud is unwarranted as fishing is largely a seasonal activity. The Reservoir Management Authority will develop an overall reservoir fishery management plan to regulate the fishery throughout the year. It is assumed that fishing activities will be less intensive during the dry season when the reservoir is at its lowest levels. Some of the areas may be closed to fishing altogether to protect the reservoir fish stocks while others may be open to fishing year-round.

30. *At best, a small number of fish species could survive in the reservoir; at worst, the reservoir "will become largely devoid of life, except for invasive aquatic weeds and small islands of survivor fish species near the tributary mouths."*

It is not expected that the reservoir would become devoid of fish life. It is expected that fish yields could be low in the first three years, starting at about 225 tons per year (5 kg/ha/year), and stabilizing between 675 tons to about 2,000 tons per year (15-45 mean /kg/ha/year) in subsequent years. Experience in the region and recorded data show similar yields -- Nam Phung at 68 kg/ha/year, Sirinthon at 18 kg/ha/year (averaged from data from 1987-1995); Ubolratana 38 kg/ha/year (similar size and fluctuation as the Nakai Dam).

The reservoir drawdown area will fluctuate from about 450 km2 at the height of the wet season to about 80 km2 at the low point of the dry season. These fluctuations have been factored into the design of the plateau livelihood program. Water quality is expected to be poor for the first 2-3 years after the creation of the reservoir, after which the epilimnion will likely stabilize at a 10-m depth, which is also the experience in the region. The drawdown could actually improve water quality. During the dry season, it is also expected that vegetation will grow in the drawdown area providing nutrition for the next season's fishery. It is possible that, in some areas, agriculture will also be feasible, though pesticide use would need to be curtailed.

Part 7: Forestry Development Program for Resettled Villagers

31. *The SDP admits that the profitability of the community forestry – a livelihood option proposed by NTPC for resettled villagers – is unlikely. Past illegal logging activities have dramatically reduced the availability of quality timber in the resettlement area. In order to ensure profitability, tax concessions must be secured and post-harvest chemical treatment of timber must take place, but both of these are uncertain. If either one fails to materialize the viability of the entire plan will be jeopardized.*

Many if not most of the activities of the Nakai Plateau Village Forest Association (NPVFA) are not "totally foreign" but rather quite familiar to the villagers, with the exception of sawmill operation, furniture making and business management. The SDP considers that villagers have the right, and (interested villagers) should be given the opportunity, to become experienced and capable in these areas of activity. For the first few years, until such capacity is gained, a number of key technical and managerial posts will be filled by engaged and skilled technical assistance staff.. To encourage the profitability of forestry activities, the Government has granted tax-exempt status to the Nakai Plateau Village Forestry Association (NPVFA) on local tax and will issue logging and sawmilling licenses after the completion of the NPVFA forest management plan in May 2005.

32. *Villagers will lose a major part of their income from the collection and sale of non timber forest products (NTFPs), many of which will disappear once the reservoir is flooded. The community forestry area can be used to harvest some NTFPs, but a 1997 survey reveals that due to the poor soils, this area will produce "very few NTFPs". There are few plans for a substitute NTFP base. In addition, the SDP does not address the fact that NTFP collection currently occurs in the proposed community forestry area by villagers who do not live on the Nakai Plateau. Their access to these NTFP collection sites will presumably be lost when the forestry development program is initiated.*

Plateau villagers do not produce sufficient rice and need to earn additional income to ensure food security. Villagers derive 10-25% of their income from NTFPs. The NT2 resettlement livelihoods development program aims to lift the project-affected communities out of a situation of food insecurity and provide an additional source of income while reducing their dependency on NTFPs. The community forestry program aims to diversify income sources for affected communities. If villagers still have to collect NTFPs, it would be for a correspondingly lower (and quite small) portion of increased incomes. While a few NTFPs lost through inundation may re-establish in the modified environment of the drawdown zone wetlands, compensation for loss of NTFPs in the inundation zone will be provided by allocating all NTFP and timber resources in the resettlement areas to the affected communities. While some of these are collected in the foothills of National Biodiversity Conservation Area (NBCA) and in the resettlement areas, some are also collected in the inundation zone. Where feasible, NTFP domestication would be undertaken.

It is generally understood that, over time, the NTFP resource base has been declining gradually on the plateau, including in the allocated resettlement area. The resettler villages themselves have increasingly turned to the NBCA in the north for NTFP collection. The social surveys and consultation process did not reveal active NTFP collection activities on the plateau by non-plateau communities. However, it is difficult at this stage to rule out the possibility of individual non-plateau farmers collecting NTFP on the plateau and thus being impacted due to restrictions to the areas. GOL and NTPC will be monitoring activities on the plateau and should be able to detect such occurrences. The project grievance redress mechanism would also allow identification of any such instance and the need to address them.

33. *The SDP recommends the establishment of the Nakai Plateau Village Forestry Association (NPVFA) to manage the forest area and harvest, process and sell the timber on a sustainable basis. Profits will be distributed equally between all the resettled households. From a managerial perspective, the operation of this association seems particularly optimistic given the present capacity of villagers and government staff.*

Both GOL and NTPC have recognized the challenge for the Nakai communities to adapt, manage and operate the NPVFA on a sustainable basis. It has been well understood that the villagers do not have the capacity to carry out the NPVFA activities and external support will be needed to develop appropriate sustainable forestry management systems, and to train and guide the villagers until they are able to carry out the work themselves. The Nakai District Agriculture and Forest Office, aided by NTPC, will provide technical assistance to NPVFA in all phases of the forestry development program.

To meet the challenge, the Nakai Plateau Village Forestry Program also includes an institutional development component. It covers organization of the NPVFA, provision of technical assistance and capacity development of the villagers and staff. Technical assistance, mainly national, but also regional and international, will be provided through: (i) short-term support during the starting months to establish management and administration systems, and to design and procure plants and equipment; and (ii) training over a three-year period for the gradual development of villager and staff capacity to operate the NPVFA. The technical assistance and training programs are described in detailed in the SDP.

34. *NTPC plans to fund the forestry program mainly in the first year. After this time the forestry association will be on its own. Given the complexity and uncertain economic viability of the operation, NTPC should offer financial support for the first 5 years at least, until the forestry association establishes its viability.*

The assumption is that most of the financial support is needed upfront (soon after financial closure) because NPFVA should be able to make a profit after the first year's logging, sawmilling, processing and marketing. NTPC will provide technical assistance support for the entire resettlement implementation period. It should also be noted that the community forestry program is part of a livelihood restoration package linked to income restoration and enhancement targets to which NTPC is legally bound through the Concession Agreement.

Part 8: Review of the Watershed Management Plan (SEMFOP-1)

35. *The management of the Nakai Nam Theun 2 National Protected Area (NNT NPA) will be funded primarily by contributions from NTPC of US$1 million per year. The provision of substantial funding alone is unlikely to result in the sound management of NNT. The main constraint to improved management of the area is institutional commitment, not funding. If funds are used inappropriately, greater environmental degradation and negative impacts on the livelihoods of NNT's residents are possible and perhaps even likely.*

The importance of institutional commitment is recognized in the SEMFOP, and is reflected in the "Shared Vision" statement that the Government has prepared. The earlier Decree 25, creating the Watershed Management and Protection Authority (WMPA), was recently amended and issued as Decree 39 to be in alignment with the Shared Vision. We fully agree that funding alone will not solve conservation challenges in Lao PDR, and that the SEMFOP needs to be backed by strong political commitment and sound institutions. The SEMFOP calls for both and has put in place the required risk mitigation arrangements. Recognizing that Lao PDR has a poor track record in conservation, that the WMPA is a new agency, and that capacity building is a medium-term endeavor, the SEMFOP proposes a strong program of high-quality technical assistance and capacity building, based on (i) in-house, full-time experts; and (ii) the contracting of operational NGOs to prepare inventories, carry out land use planning, conduct monitoring, and train WMPA staff in patrolling and enforcement.

36. *Protected area management has a poor track record in Lao PDR.. Independent monitoring of the SEMFOP, with linkages between funding and performance, is essential. The monitoring arrangement proposed in the SEMFOP fails the test of independence.*

In addition to the above-mentioned institutional strengthening program, independent national and international monitors will be appointed for the conservation, ethnic minority, and financial aspects of SEMFOP execution. The Panel of Experts that has advised the Government on the social and environmental aspects of the project throughout project preparation will continue to operate. Of course, the international financial institutions' own supervision will provide additional oversight. The Bank is satisfied that the planning and monitoring approach proposed in the SEMFOP is adequate for the first eight-year implementation period. The approach will be carefully assessed as an input to preparation of the management plan for the second stage of the conservation effort.

Note: We would appreciate clarification of which aspect of the proposed monitoring arrangements described above fails the test of independence.

37. *The SEMFOP proposes to use part of its funding to improve access into NNT. However, some of the most significant threats to the protected area, such as unsustainable wildlife trade, unsustainable commercial sale of some NTFPs, illegal encroachment logging, and excessive*

population growth, are likely to be made worse, not better, by increased access. This is especially true in light of the additional pressure on NNT that will result from the influx of around 20,000 construction workers and their families into the area.

The clear lesson from around the world is that improved access to forest areas increases the pressures on wildlife, NTFPs, and illegal encroachment. This needs to be balanced against the legitimate desire of the people who have lived for generations within the NT2 Watershed to have better access to, for example, medical services and markets at which to sell their own products and to purchase consumer goods. The GOL and the Bank have recognized this and sought to strike the right balance in a thoughtful and novel 'access strategy', described in Section 2.1.6 of the SEMFOP, which goes into considerable detail on how access would be directed through a limited number of controlled points. This seems to have been interpreted by the IRN-EDF reviewers simply as "funding to improve access into NNT".

The potential impacts of the arrival of construction workers and others into certain areas near the NT2 Watershed has long been a concern for the GOL and the Bank, and both the SEMFOP and the EAMP detail how this threat will be handled. The SEMFOP foresees patrolling of the NPA by the WMPA with the support of operational NGOs. The Head Construction Contractor's Environmental Management and Monitoring Plan specifies codes of conduct for construction workers and includes sanctions against collection of firewood, hunting and other activities. NTPC's and the GOL's environmental management units would be responsible for monitoring compliance with these provisions. Additional oversight will be provided by the POE and the Lenders' Technical Adviser.

38. *The SEMFOP is overly ambitious given the capacity of its implementing institutions. The NNT NPA has several inherent management advantages, such as partial insulation from the insatiable market for natural resources, low population density, remarkably diverse agricultural systems, and the relatively stable, secure livelihoods of many of its residents. SEMFOP should narrow its scope, at least initially, to conserving rather than interfering with these intrinsic advantages.*

It is incorrect to suggest that the NT2 Watershed is partially insulated from the insatiable market for natural resources. Were that true, there would be less concern over the impacts of the harvesting, often illegal, of wildlife and NTFPs, which has caused the abundance of some species to have fallen to critical levels. To describe the SEMFOP as "interfering" with the intrinsic advantages of the area is a misreading or misunderstanding of the document, which seeks to manage the pressures on the resources of the watershed. The philosophy and core of the SEMFOP is the participatory integrated conservation and development and the three planning processes that will be conducted within each village. The processes will be conducted over months and years and there is no fixed menu of activities that will interfere with the status quo in the villages—except when they are clearly damaging to the environment—and will indeed seek to maintain those attributes which favor conservation. The SEMFOP is certainly ambitious but, as explained above, the Bank is satisfied that well-defined technical assistance and capacity building are an integral part to the plan.