Kohima Tour Notes-6th -7th January 2014
Bulk Water Supply Project

A visit was made to Kohima to visit the Bulk Water Supply Site and to acquaint us with the choices in terms of tunneling technologies for transmitting the bulk water from the river Dzukou from the valley side of the mountain range to the Kohima town side. Our brief report is as follows:

A. Background:

- Kohima city has an acute shortage of water supply. Current supply is 1.5 MLD expected rise to 5.3 MLD after commissioning of a project underway, against projected requirement of 30 MLD
- Several alternatives have been considered, including a gravity supply scheme which had to be abandoned due to social issues between two tribal villages
- Perennial water supply is available from river Dzukou that lies in a valley on the other side of Kohima city. To bring the water to the city side, a mountain range in-between has to be crossed. This can be done either by tunneling or by pumping. Given the high cost of pumping/ recurring expenses, the State prefers the tunneling option.
- Tunneling through virgin mountain range has its own challenges. The exact geology of the mountains is not known and unanticipated hurdles could delay the project or raise costs much more than provided for.
- SIPMIU, Kohima has been studying the issue and have zeroed in on two technological choices. The technology providers of both options had been invited to visit the site and to advice the SIPMIU on the pros and cons of each option.
- A team of 4 experts from MoUD, 1 from CPHEEO and 3 from PMMC had attended the meeting and also visited the site to understand the nuances and various issues involved.

B. Issues:

- Choice of technologies: There are two suitable technologies. The technology of TBM (Tunnel Boring Machine) or the technology of HDD (Horizontal directional drilling) also known as trenchless technology. Each technology has its own advantages and disadvantages. A judicious choice has to be made. A separate note comparing the two technologies is given below.
- Risks: The risk of time or cost over run has to be factored in. The geology of the mountain is unpredictable and cracks; water leakages, fissures, falling rock, trapped gases etc. may be encountered during boring. These may need treatment, repair, grouting etc. as required. The result may be time over-runs and cost over-runs. Since ADB program cannot be extended beyond 2019, the consequences of time-over-run & cost overrun will have to be considered at the design stage itself.
- Infrastructure required: The boring machines require comprehensive support infrastructure to launch them and infrastructure backup is required. Creating this infrastructure, which requires access roads, sheds, RCC precast facilities, launching

platforms etc. is itself a time consuming and expensive affair. Flat platforms of up to 70 meters long are required for TBM (almost a football field) and 20m for HDD. These need to be assessed.

- Environmental Impact: The impact will be on both the upstream and downstream side of the mountain. There will be long-term impacts such as cutting the mountainside and constructing platforms, stores, roads etc. and short-term impacts such as noise, air pollution, utilization of stream water on existing farming etc. These need to be assessed and mitigation measures outlined. Another impact to be assessed is the diversion of almost 70-80% of the river water for the project and its impact on the downstream ecology. A separate note on the environment impact is attached as **Annexure-I.**
- Riparian rights: River Dzukou is said to be the border between Nagaland and Manipur States, requiring consent of both in addition to the consent of the traditional riparian people.
- Design of Tender Document: Given that there are two competing technologies, a need to carry out additional geological investigations, chances of cost escalation due to unforeseen reasons, factoring of risks, cost of development of supporting infrastructure, the need to complete the project before 2019 etc. the design of the tender document will have to be done carefully and will need identification of expert advice, not readily available in the system. The guide lines of CVC must also be fully incorporated.

C. Comparison of competing technologies:

Tunnel Boring Machine:

- The tunnel diameter will be 3-4 meters even though the water pipe may be about 0.5 meters. The tunnel dia is dictated by the size required for using the TBM.
- Consequently, the earth and rock cuttings will be large; approx. 4-5 lakh cum and its disposal will have to be arranged in an environmentally acceptable method.
- The plus point about this technology is that it is a well-tested and tried technology with several projects in India. Also the developers of this technology have also developed methods to deal with various unforeseen situations that may arise in the course of boring thru the mountain.
- Infrastructure: The TBM requires a launch platform about 70 m long, which will require cutting the mountainside for the launch pad. A road of about 5 km will have to be constructed for disposal of the excavated material. Cement rings/sections are used for stabilizing the tunnel. A facility for production of such pre-cast rings will need to be located close to the TBM.
- Mobilization issues: The machinery and equipment required for the TBM weighs about 530 MT and comes in 25 MT containers. Moving it from Kolkatta port to Kohima and thereafter to the site will be a challenge. During discussions, it was felt that the only answer might be to airlift the equipment to site. The feasibility and availability in India of helicopters for such a lift needs to be explored. The Government may not permit airlifting heavy equipment by helicopter over civilian areas.

- The contractor may need to do some further geological studies before commencing boring in order to improve his prediction of the tunnel geology.

Horizontal Directional Drilling (HDD) technology:

- In this technology, the bore diameter is much lower. For example, a 0.5 m pipe may require a bore dia of 0.75 to 1.0 m. The boring is done in 3 steps. Firstly a pilot hole is drilled. In the second step reaming is done and the bore size is increased to required diameter. In the final step the pipe thru which water is to be transmitted is inserted.
- The volume of earth/rock cuttings in this technology is much lower, about 12% of quantity from TBM as the bore size is much smaller. This is advantageous in lesser handling and disposal and also creates less environmental problems.
- The launch platform required for HDD boring machine is about 20 m, much lower than the requirement of TBM at 70 m.
- Infrastructure: The overall weight of the equipment and machinery is about 170 MT compared to 530 MT of TBM. The platform has to be erected at site, but no major cutting of the mountainside is involved. A bentonite lining plant and cement grouting plant is included in the above mentioned equipment weight.
- Mobilization: The HDD machinery will also need to be airlifted to site from Kolkata port. The issues about the weight lifting capacity of the helicopters and their availability in India are applicable in this case as well. It was explained that further geological studies may not be required before using this technology. Airlifting heavy equipments by helicopter over civilan areas may never be permitted by the Govt.
- There are two major concerns about this technology. Firstly, there does not appear to be any experience for boring in Rocky Mountains in India, although we were informed that such experience is available internationally. The second issue is that this technology requires boring to be started from the upstream side (boring on a downward slope to reduce chances of any mishap with the cutter head). This side of the Dzukou River is a pristine area and its environmental impact will need to be assessed.

D. Cost comparisons:

Cost estimates will need to be obtained for HDD.
The cost estimates for tunneling by TBM have been included in the current cost estimates of Rs 350 cr. However, the cost of road construction and other infrastructure costs have not been included. Hence SIPMIU will have to estimate these costs as well to arrive at a proper cost estimate.

E. Preliminary Time Assessment:

Based on presentations and discussions in Kohima, a preliminary estimate of the total time required for completion of this project may be as given below. While the estimates are subject to fine tuning and boring time is to be confirmed by the experts, the main issue that arises is that

the project may take 8-10 yrs to complete whereas ADB funding will finish in 6 yrs or so. Firstly, the time period assessment below needs confirmation from SIPMIU and DSMC along with estimates from contractors. Thereafter, it needs discussion with ADB and within MoUD.

S. No	Activity	Time- TBM	Time-HDD
1	Preparation & approval of SAR	2 mo	2 mo
2	Preparation & approval of DPR	4 mo	4 mo
3	IEE/EIA approval (including addl ecological and geological investigation)	6 mo	6 mo
4	Statutory clearances	6 mo	6 mo
5	Tender preparation and its approval	2 mo	2 mo
6	Tender floating/evaluation/award	6 mo	6 mo
7	Infrastructure- road, sheds, stores	12 mo	6 mo
8	Mobilization	4 mo	4 mo
9	Tunnel boring	48 mo	48 mo
10	Water intake, pipe laying etc.	6 mo	6 mo
11	Downstream piping, WTP, pipe to city	12 mo	12 mo
12	Unanticipated	12 mo	6 mo
13	Total Time	120 m (10 yr)	108m (9 yr)
	Available time (up to March 2020)	75m (6.25yr)	75m (6.25yr)

F. Next Steps:

1. Formulation of the SAR: At this stage, the two alternatives i.e. pumping water from Dzukou over the mountain range and the tunneling scheme needs to be compared on a whole of life cost basis. A comprehensive assessment should be done to ensure that the least-cost-option technology based on life cycle analysis and the most sustainable option is selected.
2. Given that the experience of using the HDD technology and tunneling for water in NE is limited, it is desirable to identify a tunneling expert as an advisor to SIPMIU, who can guide and assist in the formulation of choice of technology and formulating the DPR. Though based on the presentations, it appears that HDD trenchless technology is more suitable than the TBM technology. However, experts can advice better.
3. The expert can also advice in the formulation of tender document, the pros and cons of pre-selecting a technology vs leaving the technology choice open to allow comparison of cost and time based on tender etc.
4. SIPMIU should carry out an EIA study for the proposed bulk water project. This EIA should address the following critical issues:
    i. Generation and disposal of spoils from the tunnelling
    ii. Ecological survey and impact assessment for the study area (upstream and downstream of the tunnel)
    iii. Impact of logistics and allied activities that are envisaged along with the tunnelling process.
    iv. Social acceptance of the project amongst the stakeholders should be considered at the time of conducting the env

PConsultations should be inclusive of all the local people as the water is common resource controlled by multiple “khel” in the form of SAPO Village Panchayat.

v. Involvement of Potato farmers in the downstream and villagers settled in the upstream of the valley in the public consultation.

5. Selection of the tunnelling technique should be a done based on the findings of the environmental, time and financial studies.

6. MoUD and ADB need to take a position based on the SAR. The SAR should contain a reasonable time estimate as well and outline options in case of unforeseen time and cost over run.
7. In addition the ongoing 3.8 MLD project must be completed and commissioned early by the Govt. of Nagaland. It may also be studied whether more water can be drawn from this project.
8. If approved, the report may also be shared with SIPMIU Kohima so that they may consider the above comments while preparing the SAR.

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Encl:
Annexure-I: Report on environmental considerations
Annexure-II: Proposed tunnel alignment
Annexure-III: Excerpts of presentation of HDD expert

Annexure-I

Environment issues
Proposed tunnel project for Bulk Water Supply to Kohima

Background:

- There is a drinking water scarcity in Kohima City, esp in lean period due to lack of fresh water source in the proximity of the city.
- Alternative perennial resources have been exhausted or are not viable due to economical/ social constraints.
- Dzuko River is perennial source, but the point where it is proposed to tap the river is located across a mountain and requires a tunnel through the mountain (more than 4 km) for conduit to draw water by gravity.
- Three tunnelling options have been considered – Tunnel Boring Machine (TBM), Horizontal Directional Drilling (HDD) and Micro Tunnelling.
- Experts presented the possibility of adopting the above three methods and it was concluded that if at all the tunnelling is to be done it will be either by TBM or HDD method, as they are the most appropriate methods in the present case.

Issues of Concern:

- Dzuko River is located in an ecological sensitive area. The source of water is precipitation and percolation of water from the adjoining mountains into the valley.
- It is proposed that a maximum quantity of 25 MLD will be tapped from the river, which in lean period is more than the total discharge of the river at 14.61 MLD. Hence, this is a matter of great concern considering the impact on the downstream ecology.
- Basic geological survey of the area has been conducted by Dept of Geology, Nagaland University. However, this survey seems to be insufficient and further geotechnical investigations/ consultations needs to be carried out prior to finalizing the tunnel alignment.
- Logistical requirements for allied activities, support infrastructure and disposal of spoils generated from the tunnelling operations are the governing factors selection of the tunnelling point.
- Tunnel boring machines in case of HDD will be 17 – 20 m long containerized machinery, where as TBM machines will be much longer 70 m. Both machines will need to be airlifted by helicopters only to the site and will need a launching platform prior to commencing the drilling.
- Total spoils expected to be generated from TBM tunnel are in the range of 4 - 4.5 lac m^3, whereas spoils expected from HDD would be in the tune of 4000 **m^3** depending on the length and diameter of the tunnel.
- Since, ADB considers projects involving tunnelling as category A project, a complete EIA study needs to be carried out for the proposed project.
- Water source proposed to be tapped is traditionally owned by the indigenous people (IP). Hence, the project will have to be studied in the light of ADB IP policy. Also, since the river forms the boundary between states of Nagaland and Manipur, consent of both for taking up the project seems a must as per constituion of India.

Recommendations:

- SIPMIU should obtain regulatory environmental no objections/clearances from the competent authorities and should reach an understanding in principle to be finalized into an agreement with owners of the water source, vetted by the State Law Department.

- MoU with the traditional owners of the water source should be widely publicized so as to make sure that at the time of entering into a formal agreement, there is no objection from any of the stakeholders.
- SIPMIU should carry out an EIA study for the proposed bulk water project. This EIA should address the following critical issues:
    - Generation and disposal of spoils from the tunnelling
    - Ecological survey and impact assessment for the study area (upstream and downstream of the tunnel)
    - Impact of logistics and allied activities that are envisaged along with the tunnelling process.
    - Social acceptance of the project amongst the stakeholders should be considered at the time of conducting the environmental consultations. Consultations should be inclusive of all the local people as the water is common resource controlled by multiple “khel” in the form of SAPO Village Panchayat.
    - Involvement of Potato farmers in the downstream and villagers settled in the upstream of the valley in the public consultation.
- Considering the occupation health and safety aspect of the tunnelling project, ADB should be requested to procure the services of an international Tunnelling consultant.
- Selection of the tunnelling technique should be a done based on the findings of the environmental, time and financial studies.
- The ongoing 3.8 mld project must be completed and commissioned early by the Govt. of Nagaland. It may also be studied whether more water can be drawn from this project.