inter·noise 96
25th Anniversary Congress – Liverpool

INCE: 52.1

CONSTRUCTION SITE NOISE CONTROL FOR THE AIRPORT RAILWAY IN HONG KONG

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ABSTRACT

The Mass Transit Railway Corporation is currently constructing a new railway to connect Hong Kong Island to the new international airport at Chek Lap Kok.

This creates a unique challenge for construction site noise control as there is substantial construction in highly densely populated areas along the 34 km alignment.

The development of the basic strategy of noise control based on contractor performance and the significance of contractual documents is presented. The management methods employed to ensure compliance to the contractor's noise management plans through event contingency plans will also be presented and critiqued.

Special emphasis is placed on developing a credible interface externally with the control authorities as well as internally with the senior construction management. Training of the construction site staff will also be detailed.

1. INTRODUCTION

The Mass Transit Railway Corporation is designing and constructing the Lantau and Airport Railway (LAR), a 34 km railway that will connect the new international airport with Central Hong Kong. The project cost is approximately US$ 4 billion and will be completed in June 1998. The railway will have a high speed urban and suburban service aimed at reducing the current passenger flow within the over-crowded Nathan Road Corridor (85,000 passengers per hour) and establishing a dedicated airport service.

A particular challenge for this project is the cost-effective management of construction noise impacts effecting the densely populated areas along a portion of the alignment. At one particular site

in Lai King, a new station is under construction some 10 metres from a 12 storey block of flats. Excavation activities requires the removal of 1000m^3 of granite. Though there is currently no daytime legislative requirement construction noise level in Hong Kong, the MTRC has voluntarily required contractor compliance to a 75 dB(A) level at noise sensitive receivers. This paper will address the strategy developed by the MTRC for construction noise mitigation, detail the implementation and indicate the focus on the key elements of the approach.

In particular it will be shown that successful construction noise mitigation depends on defining a clear strategy, implementation of the strategy with full construction staff support and a training programme allowing noise control to be implemented by the site staff themselves.

2. NOISE CONTROL STRATEGY

2.1 Noise control is to operate on a set of trigger, action and target (TAT) levels as follows.

- **Trigger** level is defined as one independently documented complaint in 24 hours or exceedance of the noise target level;
- **Action** level is defined as two independently documented complaints in 24 hours or exceedance of noise target level; and
- **Target** level is defined as more than two independently documented complaints or an exceedance $L_{A,Eq\ 30\ min}$ 75 dB from 0700-1900, or an exceedance of the Noise Control Ordinance at all other times.

The daytime noise target level is a voluntary limit set by the MTRC.

2.2 Noise mitigation is to be based on Contractor performance

- Performance requirements are defined in the General and Particular Specifications of contract;
- Specific actions are included into the conditions of contract in the form of Event Contingency Plans (ECPs) if the Contractor's performance is inadequate ; and
- Supervision by the MTRC site staff ensures that the Contractor complies with the environmental conditions of contract.

2.3 An independent environmental specialist will monitor, audit and report on the Contractor's performance on a monthly basis to the Environmental Protection Department.

3. IMPLEMENTATION

The five major phases of implementation of the noise control strategy were: the Environmental Impact Study, agreement with Government, preparation of contractual documents, training of site staff and the Environmental Monitoring and Audit (EM&A) activities. These are

described in detail below.

3.1 LAR Environmental Impact Study

A consequence of the agreement between the Hong Kong Government and the MTRC for the LAR was a requirement for an Environmental Impact Study (EIS) for the construction and operation of the railway. The EIS was undertaken at the same time that civil engineering tenders were being prepared. This allowed for a most detailed analysis of noise impacts from construction.

Discussions with MTRC Construction Managers concluded the most probable method of construction, and the likely type and number of construction plant for each phase and section of railway. Phases of construction considered were: site preparation and demolition, excavation, foundations and construction.

Along the 34 km alignment there are 18 major construction sites, each with a specific focus: immersed tube tunnel, cut and cover tunnels, viaduct sections on reclamation and through an old landfill, concrete and suspension bridges, drill and blasted rock tunnels and at-grade sections. Distance to the noise sensitive receivers identified within the LAR EIS varied between 7 - 500m.

Estimates were made of the total sound power radiating from each construction site based on the equipment related sound power levels defined in the environmental legislation.

Further discussions with the MTRC Construction Managers concluded draft contractual clauses and identified practical noise mitigation measures: noise hoardings and enclosures, placement of construction equipment and especially quiet construction equipment. It was then required that all senior project management staff including the Project Director approve the EIS Final Report for public issue.

In parallel to these discussions, a Code of Practice for Environmental Site Management was written by the MTRC Environmental Section and approved as a Project Quality Procedure.

3.2 Agreement with Government

It was necessary to gain the approval of the Hong Kong Environmental Protection Department (EPD) to obtain a Crown Lease for the land to construct the LAR. Included as conditions to the lease were the final recommendations of the EIS.

The LAR EIS was managed through a Study Management Group under EPD. This supervision permitted input of specialist control and policy groups on environmental and related areas from all sections of Government. The specific noise questions identified above were dealt with in detail by a separate section of EPD, the Noise Control Group.

In most large scale projects, an enumerated set of specific mitigation measures is required by EPD. This may allow a straightforward assessment of environmental measures, but does not guarantee acceptable environmental performance. It was further argued that the MTRC strategy allowed the Contractor the most latitude in construction methods and programme, would be most cost-effective and was contractually straightforward. EPD endorsed the above strategy after considerable discussion.

The LAR EIS was publicly released and consultations were held with all external parties along the railway alignment. After full discussions with these groups, the LAR EIS was fully endorsed by the Advisory Council on the Environment.

3.3 Contractual Documents

All LAR Civil engineering contracts are based on a General (GS) and Particular Specifications (PS) with the conditions of the PS taking precedence over the GS. The GS has a section dedicated to environmental control and nuisance.

In terms of noise, the GS clauses prescribe the following.

- **Requirements**: use of screens, hoardings, mufflers and other noise mitigation measures, type of sound level meters their use and calibration; and
- **Enforcement**: legislative and reporting requirements, and the powers of the Engineer in regards to noise pollution including a suspension of works clause.

The PS appendix on noise mitigation specified the following.

- The requirement that the Contractor supply a calculation to show the construction method proposed, its noise impacts and the proposed noise mitigation measures to ensure compliance with the TAT levels;
- Where and how often noise monitoring will be undertaken by the independent consultant; and
- ECPs identifying those actions to be undertaken by the environmental consultant, the Engineer and the Contractor upon exceedance of TAT levels.

Mitigation measures specified by the Contractor in the method statements can then be audited regularly to ensure compliance with the Contractor's method statements and the Code of Practice (Section 3.1). Regardless of the measures proposed, the Contractor is still responsible for compliance to the noise target levels.

3.4 Training of Site Staff

As noted above in Section 2.2, the responsibility for environmental compliance rests with the Contractor. The MTRC

site staff is to ensure that the Contractor complies with the conditions of the contract. To ensure that the most cost-effective environmental management would be achieved, the Environmental Section trained the MTRC site staff and the Contractor's site staff as follows.

- A seminar by the Environmental Manager was held for each contract detailing environmental compliance from legal and contractual perspectives. This seminar identified the specific measures required by the GS and PS and gave a general orientation on noise control measures and the implementation of the ECP. In addition, specific noise control measures were identified and information given on their effectiveness;
- Specific information was given to the Contractor illuminating the need for environmental licenses and approvals and explaining the application processes;
- The MTRC site staff was issued a sound level meter, trained by a noise specialist to take noise measurements, and a reporting procedure was implemented;
- Monthly site walk-abouts were held in cooperation with the Contractor and site staff to identify general problem areas, detail actions to be taken and programme when those actions would be concluded through Notices of Non-Compliance.

3.5 Environmental Monitoring and Audit (EM&A) Activities

The purpose of the EM&A activity was to provide a monthly independent compliance report to the site staff and EPD. In addition, the monitoring was used to initiate ECPs as follows.

- Noise monitoring would be undertaken at each noise sensitive receiver at least once per week;
- Upon exceedance of any TAT levels, a Notification of Exceedances would be issued and the environmental consultant would request information from the Senior Construction Engineer. The ECP would then be launched if the exceedance was attributable to MTRC works, ;
- If exceedances were not resolved within the time period specified in the ECPs, an Environmental Engineer would visit site to expedite solutions; and
- On rare occasions, the Environmental Manager would undertake a joint meeting with the Contractor and MTRC site staff to progress particular issues.

The monthly reports included a general description of the construction works, impact monitoring results, baseline reviews, resolution of exceedances, report of any complaints, audits of the Contractor's method statements and comparisons to the earlier

LAR EIS predictions. Additional data was also collected on the number, type and resolution time of exceedances and non-compliancies related to the Code of Practice.

The monthly EM&A reports are used by the Construction Managers to review the Contractor's environmental performance as well as examining the performance of their site staff. EPD would audit the results on a monthly basis to ensure consistency with other construction activities.

4. RESULTS

Construction of the railway was initiated in November 1994. Within 3 months construction activity had begun along the entire alignment.

The results have been positive. The strategy has been successfully implemented with all contractors supplying the calculations and specifying the appropriate noise mitigation measures. Exceedances have been dealt with via the ECPs and most noise exceedances have been eliminated within the defined time frame. Site staff have dealt directly with noise exceedances when they occurred and have resolved problems with the contractors, generally without the need for specialist input.

As expected, excavation at a site in Lai King 7m has been a particularly sensitive issue. Portable noise hoardings, extra hoardings and quiet plant were required to reduce noise impacts from the construction of footings for a noise enclosure. The noise control strategy, tested by the local residents, media and Hong Kong Government, has been shown to be effective in dealing with noise exceedances.

5. CONCLUSION

A noise control strategy and its implementation for the construction of the LAR has been described in detailed. The following is concluded.

- Effective noise mitigation can be based on Contractor's performance without significant impacts on contract costs;
- It is essential that the entire construction management be involved in the development and implementation of the noise control programme;
- An environmental monitoring, audit and reporting programme is required to ensure compliance with contractual conditions and respond to community concerns;
- The TAT approach is laborious and could be effectively reduced to an AT approach without significant sacrifice; and
- Noise control engineering must be communicated and supported to as many members of the construction site staff as possible.

It is suggested that noise control engineering should be included in the civil engineering curriculum and/or continuing professional development programmes.