

**REVIEW OF STATUS OF
JUBILEE LINE UPGRADE
FOR CHIEF EXECUTIVE OFFICER
TUBELINES LTD**

OCTOBER 2009

Phil Gaffney Consulting Ltd

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1. Scope

This review was requested by Dean Finch, Chief Executive Officer, Tubelines Ltd (TLL).

The review is to provide the CEO with an independent view on the status of the Jubilee Line Upgrade (JLU) and, specifically, the likelihood of completion by end December 2009.

The review focuses on "where are we today?" "where will be by end December 2009?" , " what will it take to get to completion?"

It will not review the history of the Project or try to establish the reasons for any slippage to the programme dates, however, given the nature of the Project, it is inevitable that references will be made to significant events in the Project life cycle.

2. Background

The JLU is the first of the Line Upgrades undertaken by LUL in the PPP with LUL.

The scope of the upgrade includes provision of 7th car on trains; improved turnback facilities at Stanmore; installation of new signalling system on 63 trains; replace and improve track, all of which have been completed. The major remaining element of the upgrade is the completion of the trackside and train control elements of the new Signalling and Train Control system. It is this part of the project which is the subject of this review.

The objective of the upgrade is to reduce the Journey Time Capability (JTC) on the Jubilee Line from 17.76 to 13.91 minutes. The existing Train Control system is to be replaced by a Transmission Based Train Control (TBTC) system specifically the Seltrac S40 system from Thales, formerly Alcatel. This is a significant contract and I understand, the largest contract of its type undertaken by Thales using this technology.

The completion date for the Upgrade and achievement of the improved JTC is 31 December 2009 although various proposals for sectional completion of the project have been proposed through the life of the contract.

I understand that in early 2007 the Commissioning programme indicated the following Commissioning dates:

J1 (Kingsbury – Cannon's Park)	Q4 2007
J2 (Stratford – Canary Wharf)	Q2 2008
J3 (North Greenwich – Green Park)	Q4 2008
J4 (Green Park – Neasden)	Q1 2009
J5 (Neasden – Stanmore)	Q1 2009

To achieve completion of the programme the PPP agreement recognized that there would be disruption to service and this was expressed in a global number for Lost Customer Hours (LCH). TLL expressed this in terms of weekend closures and estimated that approximately 130 – 140 would be required for JLU. These are required to be forecast well in advance of the date and the process is set out in the PPP. Earlier in 2009 a supplementary Closures Agreement was put in place which provided additional closures with the notice period shorter than required in the PPP. These closures were considered to be sufficient to complete the programme. More recently TLL have requested 5 further geographic extensions to closures in the J23 section of the line in the period up to November 2009.

After completion of a Draft of this report, TLL have issued a revised programme to completion dated 05 October 2009.

3. Methodology

The review was conducted over the period 1 – 3, 6 and 15 – 17 September and 3-5 October.

Interviews with key staff were carried out over this period and Appendix 1 lists the people seen during the review.

A site visit was carried out on Sunday 6 September where it was possible to witness testing at Stratford Market Depot; Neasden Control Centre and Systems testing on a train between Canary Wharf and London Bridge.

4. Project Status

1. Design

The design work which remains is mainly focused on the Systems Software releases. For J234 these are required to complete functionality and address Software Change Requirements (SCRs) which have been picked up during Factory Acceptance Tests (FATs) and site testing. For J5 the design task is considerable and will continue for some weeks. The task at Neasden and Wembley Park is particularly challenging given the scope, complexity and age of the existing layout and assets. Software releases are now scheduled for J234 through to the end November and for J5 until 18 December.

These Release dates are subject to satisfactory completion of Factory Acceptance Tests and Safety Assurance processes and are the critical activities for completion of the Project.

2. Installation

Installation work has been completed on J1 and North Greenwich – Waterloo section of J23 with a limited amount of work required on Stratford – North Greenwich section.

The J4 section is substantially (over 90%) completed.

A significant amount of installation work is required on the complex J5 section where currently progress is reported as 60% complete. This work is programmed to continue through to early November and access to this area for installation is critical to the Commissioning programme.

3. Testing and Commissioning

There is a structured approach to Testing and Commissioning, from local testing through to Principles and multi train Systems testing. Only in J1 and J23's North Greenwich – Waterloo section have all tests been reported as complete.

The completion of J234 section testing and commissioning is critically dependant on the availability of the line closures requested by TLL. It is understood that these closures were not agreed by LU for a number of reasons. Irrespective to the timing of when these closures are to take place, the quantum and location requested is necessary for completion of this section. The revised programme issued 05 October has proposed

the same number and location of closures for TLL activities but on dates which are likely to be more acceptable to LU.

It is proposed that the completion of the Change Over Cubicle testing in J4 is carried out during Engineering hours.
Post Installation Checks and Data Comms testing has commenced on J5. The Testing programme for J5 represents a very significant task and an intensive programme, linked to Software Releases and access, will present a major challenge to the Project team.

4. Operational Readiness

LUL

LUL have established support teams for Operational readiness for JLU with Senior Managers reporting to respective Directors.

These teams have been given responsibility to put in place the necessary people and processes which would ensure that the systems when commissioned will be able to be operated to the required level of safety and customer service.

This requires that the Rules and Procedures are reviewed and rewritten to reflect the changed operating characteristics of the TBTC system. The Train Operators on the Jubilee Line require to be trained in the new system as do the Control Room staff at Neasden. Station staff also require familiarization with the system.

These activities had all been put in place for the introduction of TBTC on the Dual Fitted Area (DFA) in 2008 and in particular Drivers were trained for operation of the TBTC and practical experience was gained. The DFA was de-commissioned in June 2009 and since then no driving familiarization has been possible. Certification of Drivers for operation of particular stock has no fixed expiry period but the lack of opportunity to operate the stock will mean that the drivers will require more support when they recommence driving duties on the stock.

Arrangements had been made for driver familiarization to be carried out on the North Greenwich – Waterloo section of J23 over two weekends in August but this was not achieved. Further arrangements were planned for the same activities on the same section on 19/20 or 26/27 September but neither Line Closure extensions could be granted by LU and this activity is now planned for 03/04 October.

TLL

TLL have established a small support team to progress Operational Readiness for JLU.

This team has progressed provision of spares, test equipment and training and certification of Signalling staff. These items are progressed regularly by TLL Ops with Thales and the TLL Project team.

There is provision for 2nd Line Testing equipment for the trainborne system (VOBC) and this will require to be in place for revenue service.

The arrangements in Depots for a health check of TBTC prior to trains entering service appears quite limited and the Support team has developed plans to enhance this provision.

TLL Ops staff have not been involved in Project Installation, Testing and Commissioning activities to any significant level.

The Timetable for revenue service will require 57 trains plus 2 spares. This is an increase of 4 over the current requirement, 4 additional trains were procured by TLL in 2005/2006. TLL Ops and Alstom, the Fleet Maintainer have reviewed how this Timetable requirement can be achieved. This will require the release of the train currently held for TBTC software testing at Highgate ,rearrangement of certain maintenance activities to weekend , adjustment of timing of certain overhaul tasks e.g. wheel replacement and introduction of certain modifications to improve reliability and reduce train withdrawals. These actions have all been identified and await financial approval.

Reliability

TLL have developed a methodology for forecasting reliability levels which will be achieved by the new TBTC system. This is based on the various Reliability , Availability, Maintainability (RAM) studies and models; 16 months experience on DFA ; experience on system tests on J23.

The data available from DFA and systems testing is extremely limited, due to the limited amount of train running achieved to date as a result of the restricted amount of access. As a result, the forecasts made from this data are of limited value.

Much more system testing and operational trials with more trains and with a more stable system, is required to arrive at any sensible figures which can be used to decide on the level of Service Failures which can be expected in revenue service.

5. Findings

General

1. Significant slippage to major Project milestones has led to a severely compressed programme to completion.
2. Currently Design, Installation, Testing and Commissioning activities are taking place along the length of the line.
3. While the objective of this review is not to establish, in any detail, why this has occurred , the main causes would appear to be:
 - significant under estimation by Thales of the scope and complexity of the Project e.g. Book Wiring
 - LUL requirements for features such as Route Secure ;Degraded Mode are non standard Seltrac features and this has led to a significant increase to the Seltrac software development task
 - need to replace concentric cables
 - Thales underestimated the difficulties in working with LUL operational and assurance procedures
 - delayed response by TLL Project Management in the early days of the project to the above problems
 - limited amount of track access particularly for Testing and Commissioning activities,in comparison with projects previously undertaken by Thales which have mainly been “ green field” sites
4. The establishment of a combined Thales /TLL Project team has led to a significant improvement to progress in design and on site.

Programme

1. The changes made by TLL to the Commissioning strategy i.e. combining J2 and J3 then J23 and 4 has meant that a partial geographic commissioning of the line i.e. J2 was not possible and has reduced the capability for a flexible approach to service introduction which would allow much longer time for systems to stabilize and reliability levels to grow.
2. TLL records show that they have requested 118 line closures and although 113 have been granted only 61 of these have been a geographic and / or duration match to the request. In the J23 section of 58 closures requested only 18 have been granted which fully matched the request, with another 35 granted and 5 not agreed. The LUL records provided are on a whole line, all activity bases and are not available for Upgrade activity only. These show

that of 435 requests made 371 were either approved or withdrawn by TLL. The overall agreement rate of 90% from both set of records appears reasonable but the more meaningful figure is that for approvals which match exactly the request and from TLL records this is approximately 50%. Such constraints on access are not unusual for these activities on an operational metro but the level of constraint on JLU has led to a significant level of replanning and adjustment to TLL programme.

3. On the J23 section, the sub section between North Greenwich and Waterloo has been identified as a section where multi train running with LUL Train Operators can now take place. The Seltrac systems have been tested and all of the necessary Safety approvals have been received. However the geographic extensions to Line Closure planned for the weekends of 18/19 and 26/27 September have not been granted for a number of reasons and this activity is now planned for 03/04 October. Closures in this section are essential if the system stability and reliability is to be improved and for LUL to carry out the necessary trial operation and familiarisation.
4. TLL have issued a revised programme, dated 05 October. This shows completion of TLL activities in J234 by end 2009, post Christmas line closure. The Christmas line closure would include 2 days for LUL Trial Operations and a further 2 weekends in January are proposed for LUL Trial Operations. This would allow the system to go into Revenue Service by end January. Section J5 is now shown to be completed by TLL by the end of the line closure proposed for Easter. A similar arrangement would apply for LUL Trial Operations as in J234 i.e. part of Easter line closure and 2 further weekends in April are proposed. At this point ATO would also be available for the whole line.

The programme shows deferral of Software releases on J234 by 1 – 3 and on J5 by 1-8 weeks.

TLL have put a probability of 85% on completion of their activities on J234 by end of 2009 and 90% on J5 by Easter.

Management

1. At this stage of operational railway upgrade projects it has to be recognized that no single party can bring the project to successful completion. To date ,all the various parties i.e. Thales, TLL-Projects, TLL – Operations and LUL have not worked together to a sufficient level to give confidence to all parties that completion could be achieved by the end of 2009.
2. The inability of Thales and TLL to consistently meet promised delivery dates and their request for further closures after the Additional Closures Agreement was reached coupled with LUL being unable to match exactly the requested closures has led to a low level of trust between TLL and LUL.
3. The upward reporting of the Project activities has been too optimistic and this, combined with 2. above, has led to a credibility gap between TLL and LUL as to the status of the Project.
4. The level of Project Management and control of software activities in Toronto has not been sufficient to provide confidence that key dates can be achieved.
5. The immaturity and instability of the software systems together with the logistic difficulties experienced in a project of this nature and in particular the difficulties with granting of Line Closures , has meant that work planning for line closures has had to be very flexible and the TLL Project team has responded well to this challenge.

Software Systems

1. The various software sub systems are not at a high level of maturity and stability and further software releases are planned over the next 2 months.
2. The level of software changes and omissions means that there are significant numbers of Operations Restrictions in place and currently are at a level which would not support revenue service, although it is noted that these are planned to be closed before Revenue Service.
3. LUs requirement for Route Secure , Degraded Mode and Route Secure in Degraded Mode , represents novel features for Seltrac and are not required in other Projects e.g. KCR West Rail Hong Kong. The incorporation of these features are significant in terms of increasing the design, installation, testing and commissioning task. It is estimated by TLL that the provision of these features has

extended the overall programme by approximately 6 months and based on experience of other projects, this seems reasonable.

Operations Readiness

1. LUL have in place an Operations Readiness schedule of activities which cover the key areas of Training, Rules and Procedures and Trial Operations scenarios. Due to the delay to the programme there is likely to be a need for retraining/ familiarization for Train Operators and this will be planned for line closures.
2. The number of train operations in line closures on the new system represents a small fraction of 1 day's normal operation of the line.
3. TLL Ops have a schedule of activities covering the key areas of Training, Spares and Test equipment procurement and development of Maintenance Regime for new assets. The provision of 2nd Line Test equipment is essential before Revenue Service.
4. TLL Ops staff, future Maintainers of the equipment and systems have not been involved sufficiently in the Installation and Testing Phases of the Project.
5. A reliability forecast methodology and growth plan has been developed but there is insufficient empirical data from systems in operation for current forecasts to be meaningful.
6. Completion of J234, together with adjustment to the train traction software, should lead to an improvement to JTC. Dependent on the extent of other mitigation measures e.g simple turnaround booth at Stanmore, possible early introduction of ATO on J5, this could be reduced to around 14.27 minutes, 22 seconds short of the Contract requirement. It is understood that LUL have doubts as to the efficacy of the proposed mitigation measures.

Summary of Findings

1. Based on the programme available at the commencement of this review, there is a 60%-70% probability of J234 being completed to a level able to support revenue service by 29 December 2009 however the level of reliability is likely to be insufficient to operate a robust service. There is not more than 40% probability that J5 will be ready for revenue service by this date. These probabilities depend upon the access that would be needed being available to the project; if this is not possible then the probability would reduce.
2. The geographic extensions to line closures requested for J234, together with the extended Christmas and New Year closures should allow achievement of all system tests, reliability growth and improvement to JTC but not to the Contract level. There should then

follow a short period of Trial Operations by LUL which would require line closures and this would also allow reliability levels to grow. Adoption of this strategy would allow J234 to be available for revenue service by February/ March , subject to reliability being at a level which would support Service Affecting Failures at a level not significantly greater than today but and on a downward trend.

3. The completion of J5 is more problematic, given the complexities of MMA, Neasden and Wembley Park. Also, installation is still taking place on this section and the Software has not undergone Factory Acceptance Testing and has not been delivered to site. This points to a completion date no earlier than 6 months from today and May 2010 would be likely date for the section being available for revenue service.
4. The revised programme issued 05 October reflects the Findings of this review, set out in 2 and 3 above. The probabilities stated by TLL for completion of their activities i.e. 85% for J234 and 90% for J5 are supported, as are the additional weekends proposed for LUL Trial Operations. However, at this stage the reliability level of the system is difficult to forecast and it will be some weeks before this can be done with any degree of confidence. This will determine the dates for Revenue Service.
5. Successful completion will only be achieved if all parties work together in a collaborative manner to an integrated programme, under strong, visible Executive leadership.

6. Recommendations

- 1 .An integrated programme should be developed covering the activities of Thales,TLL Project and Ops and LUL.
2. TLL need to strengthen the Project Management of Software production in Toronto. This is required immediately and should include the involvement of a senior person with proven experience of delivery of Railway Systems software. The initial task should be an assessment of the software to meet the requirements of the revised programme issued 01 October. TLL have been provided with details of a suitable person who could undertake this role.
3. CEO TLL should establish a Weekly Review and Action planning meeting with Senior Management representation from Thales, TLL Project and Ops and LUL.
4. The reporting line in the TLL Project needs to be amended and the JNP Project Manager should report direct to CEO.
5. The quantum of the additional line closures requested by TLL for J23 should be granted and an early decision needs to be taken on the scope of the Christmas and New Year closures
6. Every effort must be made to have sufficient Line Closures to allow multiple trains running on sections of the line at the earliest opportunity
7. The Project should now be phased such that section J234 is made available to early in 2010 for Trial Operations and for ATO to be introduced in line with J5 some time in the 2nd quarter of 2010. This will require at least the Line Closures geographic extensions requested by TLL .This is as set out in the revised programme and this should be finalized and agreed as quickly as possible.
8. TLL Ops staff should be drafted into the Thales/TLL testing teams to gain hands on experience of the systems and equipment.

Appendix1

Phil Gaffney Consulting Ltd

Phil Gaffney Consulting Ltd was formed in 2005 after Phil Gaffney retired from Hong Kong MTR Corporation Ltd. as Managing Director – Operations and Business Development.

After initial training as a Signalling Engineer with British Railways and positions in Scotland and London, Phil Gaffney moved to Hong Kong MTR in 1977. During 28 years with Hong Kong MTR he held various Engineering positions before being appointed as Chief Engineer Operations in 1993. During this period he led MTR in the implementation of major enhancements to the Railway including the replacement of the Automatic Train Control system and the introduction of Platform Edge Doors to the underground platforms of the Operational Railway.

As Operations Director, from 1998 – 2003, he formulated and implemented a major initiative to improve reliability to the railway and reduce operational costs. This was achieved successfully, with MTR becoming one of the most reliable and efficient metro's in the world.

He played a major part in the part privatization of the company and it's listing on the Hong Kong Stock Exchange.

As Managing Director – Operations and Business Development, he developed MTR's International Business strategy, focused on China and Europe.

From 1998 until 2005 he was Chairman of UITP Metropolitan Railways Operations Committee.

From 2005 Phil Gaffney has been a non Executive Director of Irish Railways. He was appointed as Independent Advisor- Asset Performance to Metronet Holdings Board from 2006 – 2008.

Since 2006, assignments have been carried out for Board /Senior Management level in companies such as Tubelines, London Underground Ltd, Taiwan High Speed Rail Corporation, and Cross London Rail Ltd.

Appendix 2

Personnel interviewed

TLL

Dean Finch
Brian Sedar
Adrian Shaw
Malcolm Codling
George Clark
Richard Hoare
Andy Bourne
Lee Jones
Stuart Mills
Dave Smale
Dave Higginson
Louis Fernandes

LUL

David Waboso
Paul Killius Smith
Stuart Harvey
Paul Naylor
Stewart McKay

Thales

Simon Jones