Subway Subsurface Chainage System Replacement – award of contract

Date of meeting  19 December 2014  Date of report  27 November 2014

Report by Assistant Chief Executive (Operations)

1. Object of report

To recommend that the Partnership approve the award of contract to replace the chainage system throughout the Subway tunnel system to Malcolm Hughes Land Surveyors Ltd.

2. Background

2.1 Project summary

A fundamental component in the Subway Modernisation project is the quality of the tunnel track system to ensure not only a safe journey but a smooth one. In conjunction with replacing the rolling stock, signalling and control systems as part of Subway Modernisation, a great deal of activity occurs nightly to continue to improve our track system in preparation for the new trains. The Subway has a legacy chainage system which is outdated and unreliable, creating significant difficulty in establishing defined reference points for consistent and accurate measurement and recording of key track features during track improvement activities.

The project consists of a full replacement of the chainage system to provide an accurate metric reference system that is essential for all Subway Operations, Maintenance and Modernisation activities. This will re-baseline the survey datum within the subsurface tunnels, in conjunction with the installation of physical datum plates that record key rail measurements. Radio Frequency Identification (RFID) technology will also be incorporated to allow robust future asset maintenance.

2.2 Technical definition

Chainage is a surveying term and is a linear measurement of distance from a defined reference point. A chainage system normally includes positions being marked at a set distance along the surveying line, known as chainage marks. These marks can consist of the measured distance in conjunction with a set naming convention to ensure unique position markers are created.
2.3 Project aims

The replacement of the chainage system and introduction of RFID technology will:

- Remove all existing non-conformances within the system
- Allow accurate and easily identifiable metric chainage measurement
- Establish a coordinated survey grid for accurate track and tunnel geometry position
- Introduce a more consistent and user friendly naming convention
- Provide an established datum to introduce an asset management system
- Future proof the data capture requirements to develop a virtual 3D model of the track and tunnel system

3. Outline of proposals

3.1 Scope of works

The scope of works will include:

3.1.1 Finalising the new section coding system for location identification within the Subway system. The proposal as developed to date can be viewed in Appendix A.

3.1.2 Producing a full topographical and track geometry data set through detailed survey. The geometry parameters to be captured at each chainage marker location are:

- Top of Rail (TOR)
- Offset to Running Edge (ORE)
- Cant
- Platform Offset and Height

3.1.3 Undertaking a setting out exercise to mark out the new chainage measurements

3.1.4 Designing, fabricating and installing new datum plates (that includes the key survey data) in line with industry standards but modified for SPT data specifics (see Figure 1 for example). The design and installation will also include all fixture and fittings required to install within the different types of tunnel construction sections within the system, i.e. concrete, brickwork and cast iron.
3.1.5 Providing RFID electronic tags attached to the metal backing plate (but remain easy to access). The tags will be suitable for use within the existing SPT tunnel environment.

Note: The development of the asset management system and associated software and hardware tools does not form part of this contract and is being taken forward under a separate specialist contract.

For further information on RFID technology please refer to Appendix B.

3.1.6 Providing a conversion of the existing to new chainage system to allow the transfer and update of record data within the current and proposed asset data management systems.

3.1.7 Removing and disposing of all old/redundant chainage markers and plates.

4. Procurement process

The tender was issued via Public Contracts Scotland (PCS) Utilities portal as an open tender in June 2014.

The invitation to tender was issued on the basis of a fixed price contract. The award being based on the most economically advantageous tender against a 60:40 quality/cost split. Quality was given a higher rating as the accuracy and confidence in surveying skills and installation quality and control is the pivotal requirement, and the tender process sought to identify an organisation that had the correct experience, qualifications and track record in this area of work.

The tender quality submission required tenderers to respond in detail to a set of questions in order to prove their survey, design and installation capability and detail the tenderers’ understanding of the brief and their delivery plans and methodology proposals in order to provide a level of confidence and understanding of the basis of the prices tendered.
Bidders were required to provide evidence, information and commentary against the following quality criteria:

<table>
<thead>
<tr>
<th>Quality Criteria</th>
<th>Score</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevant Experience</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Resources Workload</td>
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<td></td>
</tr>
<tr>
<td>Delivery Team &amp; Structure</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Methodology</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Issues and Risks</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Health &amp; Safety Management</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Nine companies noted interest in the tender, with three tender submissions eventually being received on 22 July 2014.

4.1 Tender assessment

The final tender scores are summarised below:

<table>
<thead>
<tr>
<th>Tender</th>
<th>Tender Price</th>
<th>Weighted Quality Score (out of 60)*</th>
<th>Weighted Cost Score (out of 40)**</th>
<th>Combined Score</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malcolm Hughes</td>
<td>£458,175</td>
<td>60</td>
<td>34</td>
<td>94</td>
<td>1</td>
</tr>
<tr>
<td>CPMS</td>
<td>£391,207</td>
<td>43</td>
<td>40</td>
<td>83</td>
<td>2</td>
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<tr>
<td>Clancy Docwra</td>
<td>£486,485</td>
<td>45</td>
<td>32</td>
<td>77</td>
<td>3</td>
</tr>
</tbody>
</table>

*Highest quality scores 60, **Lowest price scores 40

It should be noted that the trialling of suitable RFID tags for the tunnel environment was undertaken by SPT in parallel to this tender process, therefore, an additional cost of circa £25k will be included within this contract for this element.

When assessed against the tender award criteria, Malcolm Hughes Land Surveyors Ltd received the highest quality scoring as they responded fully to the tender brief. They were able to demonstrate significant relevant and specialist experience in similar survey projects and were able to clearly explain in detail their understanding of the contract scope and their methodology to deliver the required accuracy.

They also had the best appreciation of the risk likely to affect successful contract delivery in terms of cost, quality and programme and had clearly demonstrated how they would propose to mitigate.

The first place quality score in conjunction with their cost score resulted in Malcolm Hughes Land Surveyors Ltd being identified as the preferred tenderer for the contract.
5. Conclusions

The tender submission by Malcolm Hughes Land Surveyors Ltd was assessed as the most economically advantageous tender, taking account of both quality and cost as outlined in the tendering criteria and is recommended as the preferred tenderer.

6. Partnership action

The Partnership is recommended to approve the award of a contract to Malcolm Hughes Land Surveyors Ltd for a sum of up to £483,175 (excl VAT) representing the tendered amount plus an additional £25,000 allowance for the inclusion of RFID tags.

7. Consequences

Policy consequences  None identified.
Legal consequences  None identified.
Financial consequences  These works are contained within the 2014/15 & 2015/16 Subway operations capital budgets under “Tunnels and Infrastructure”.
Personnel consequences  None identified.
Social inclusion consequences  None identified.
Risk consequences  Contractor owned risk included within contract value. SPT risk allowances included in overall agreed budget.

Name  Eric Stewart  Name  Gordon Maclennan
Title  Assistant Chief Executive (Operations)  Title  Chief Executive

For further information, please contact Stuart McMillan, Senior Project Manager on 0141 333 3427.
Appendix A

Existing Issues and Proposals

The Glasgow subway subsurface chainage system comprises of each tunnel section being identified by a 3 letter code that indicates the circle (Inner (I) or Outer (O)) and the station to station track section, starting at ‘A’ between Kelvinbridge and St Georges’ Cross (the reason for ‘A’ being this section is thought to date back to original setting out plans for the system).

The schematic of the Subway network and current location coding system is shown in Figure 2.

![Figure 2 – Current Subway System Coding](image)

To allow location of assets around the system to be defined, chainage positions are marked throughout the system. However, given when this was originally installed, the marking system is not a ‘true’ measured/metric chainage and there are varying chainage intervals. Chainage also has historically been measured and referenced section to section in the direction of travel that includes the station platform length within the section measurement. This is not best practice and has led to difficulty in comparing and aligning survey data sets undertaken at different points in time by different individuals/organisations.
Figure 3 below shows the proposed naming convention for the Subway system including stations, platforms, tunnels, turnout chambers and ramps.

![Figure 3 – Proposed Subway System Coding](image)

The proposed changes will:

- Provide additional clarity and surveying flexibility between tunnel and station sections through making them discrete from each other
- Remove an existing anomaly of some section and chainage records being referenced against the old Merkland St Station which was abandoned as part of the 1970s modernisation programme
- Provide specific and unique references for each area that is more intuitive. For example station codes will be a two letter code based on the station name, platform codes will use the station two letter code prefixed with ‘O’ or ‘I’ denoting inner or outer. Similarly the tunnel section will be referenced using the ‘to and from’ station codes prefixed with ‘O’ or ‘I’.

The existing chainage markers are also a combination of fabricated tags and painted marks that have degraded and/or been re-marked, which has resulted in inconsistent within the marking system developing over time.
Figure 4 – Chainage Measurement Illustration

The inconsistent chainage interval, whilst not ideal, does work in terms of being able to identify discrete locations by quoting the nearest chainage and the requisite number of sleepers from the chainage, with the first sleeper beyond the chainage marker being ‘Chainage +0’.

See Figure 5 below for an illustration of this system.

Figure 5 – Sleeper Chainage Measurement Illustration

This system does require a degree of experience and interpretation of the various markings that have been added since the 1970s to accurately identify a specific location. There is also subjectivity when the sleeper is in very close proximity to the marker. For example, if sleeper +4 as identified in the illustration above was actually positioned as per the dashed box outline, this could be picked up either as Chainage 50+4 or Chainage 51+0, depending on different individuals’ interpretation.
Appendix B

Radio-Frequency Identification (RFID) Technology Overview

During the tender process an opportunity was identified to further enhance the data capture and management of track & tunnel based maintenance activities from the inclusion of RFID electronic tags as part of the chainage replacement.

With the chainage markers providing the basic visual identifiers and physical marking points within the system, the addition of an RFID tag (see Figure 6 below) to each plate will allow the maintenance team, through provision of hand held electronic devices, to gain access to remotely held maintenance records for any particular location and also to complete and update works records at the worksite. There is also the potential that any statutory inspection forms can be undertaken and verified in real time on-site.

Scanning the local RFID tags would launch the necessary applications (stored within the hand held) to do this and any updates would be uploaded to the main server at end of shift, where the data would be updated within SPT’s main asset management system (Infor). The scanning of tags (both pre and post) works would also allow the timing of activities to be recorded allowing better maintenance management and planning.

Figure 6 - RFID Tag Example

Provision of RFID tags is relatively simple and a trial has been undertaken to establish the specification requirements for this. It is therefore proposed to augment the proposed chainage system through the inclusion of RFID electronic tags on the new datum plates.

Specialist technical input is required for the software development required to integrate asset information between our existing Infor system and new hand held devices. Specialist input is also required for data validation exercises post chainage installation and this will be undertaken as a separate project.

However upon completion, the renewed chainage installation will provide a fully robust system and be an industry leading approach to data control and subsurface track based asset management.