Edinburgh Tram Network

ETN Infraco Contract
Audit on Design Assurance, System Integration

Draft Report

February 2010

CEC00443393_0001

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System Integration

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Executive Summary

Introduction

During January 2010, Nichols in conjunction with **tie** Ltd undertook an audit of the ETN Infraco Contract in relation to Design Assurance, System Integration and Best Value.

The critical success factors / objectives of the audit were to:

- Obtain confidence from the Consortium that the design programme is being developed, monitored and effectively managed with respect to integration of the system components.
- Obtain confidence from the Consortium that the design programme is being developed, monitored and effectively managed with respect to Best Value.
- Obtain confidence that the Consortium has achieved and assured integrated design against the relevant acceptance criteria required to commence construction of Leith Walk section of works and the Gogar landfill surcharge Area.
- The audit was undertaken in accordance with the provisions of clause 104 'Information and Audit Access' of the Infraco Contract

Audit Findings

The findings of the audit are:

Item 1 - Programme

- An integrated design programme is not being maintained and utilised by the consortium to manage the works. The consortium did provide details of the controls presently in place.
- There is a process in place to manage design integration issues and evidence was provided to confirm the ongoing management
- The control programmes utilised to manage SDS, CAF and Siemens design elements do not appear to link to the monthly look ahead programme or the contract programme.

Item 2 – Best Value

- The Audit determined that the consortium does not follow a formal Value Management or Value Engineering processes.

- There is no evidence of an integrated approach to risk or presence of an integrated risk register between BSC and tie.

Item 3 – Integrated Design & Acceptance Criteria

- Whilst a formal systems integration plan has not yet been concluded the consortium did articulate their intentions in respect to management of integration to date, and how it will be controlled during the remainder of the contract,
- The consortium has implemented an organisational structure which seeks to match competence with roles and accounts for succession planning of key resources,
- Design interfaces are being managed,
- Design Assurance Statements (DAS) are envisaged by the consortium to be issued at the end of the design, construction, testing and commissioning phase. It was noted by **tie** Ltd representatives during the audit that they are anticipating progressive submission of DAS,
- The process utilised by the consortium to determine a section of works is ready for construction is not well defined:

Audit Recommendations

The recommendations of the audit are:

Item 1 - Programme

1. As an integrated design programme is not being maintained by the consortium at present, as a minimum the consortium should agree priority milestones and include them using the same coding within the logic of the design programmes for SDS, CAF, and Siemens, and in addition reflect the same milestones within the look ahead and contract programmes.
2. Consideration to be given to amending the monthly progress reports to draw out design status of the project by inclusion of for example:

Approvals Tracker	Filtered to reflect approvals in period / remaining
IFC Tracker	Filtered to reflect IFCs with respect to agreed prioritised milestones. Activity in period / remaining
IDR / IDC Tracker	Filtered to reflect IDR / IDC activity in relation to agreed prioritised milestones Activity in period / remaining
Design Milestones	Variance Tracker

Item 2 – Best Value

3. The contract does not appear to encourage a proactive approach to value engineering. No evidence of an integrated approach to risk and opportunity management by the project was identified during the Audit. However, it is evident in some instances that value engineering is carried out intuitively as part of the design process. Whilst the contract may not encourage a collaborative approach to value engineering or risk management, there are clear benefits to the project, BSC and **tie** Ltd of having a more joined up approach in these areas.

Item 3 – Integrated Design & Acceptance Criteria

4. To provide ongoing transparency in the design process the consortium should develop an ICF tracker and provide ongoing evidence of active ICFs for each area as part of the monthly progress reports.

5. Discussion and agreement of process, content, acceptance and timing of partial and full DAS submissions is required between **tie** Ltd and the consortium to ensure that opportunity is maximised as part of compiling body of evidence and verification of no objection by the independent competent person (ICP).

6. It is suggested that consideration be given to the provision of a design construction pack to **tie** Ltd in advance of commencement of the works, as this will ensure that all necessary design components are in place prior to construction thus aiding a reduction in possible conflict during the works.

Contents

1. Scope of Audit

During January 2010, Nichols in conjunction with **tie** Ltd undertook an audit of the ETN Infraco Contract in relation to Design Assurance, System Integration and Best Value.

The critical success factors / objectives of the audit were to:

Item 1 - Programme

- Obtain confidence from the Consortium that the design programme is being developed, monitored and effectively managed with respect to integration of the system components.

Item 2 – Best Value

- Obtain confidence from the Consortium that the design programme is being developed, monitored and effectively managed with respect to Best Value.

Item 3 – Integrated Design & Acceptance Criteria

- Obtain confidence that the Consortium has achieved and assured integrated design against the relevant acceptance criteria required to commence construction of Leith Walk section of works and the Gogar landfill surcharge Area.

- The audit was undertaken in accordance with the provisions of clause 104 'Information and Audit Access' of the Infraco Contract.

The main findings and recommendations of the audit are set out in this report.

2. Audit Findings

2.1 Item 1 – Programme

The audit sought to obtain confidence from the consortium that the design programme is developed, monitored and effectively managed with respect to integration of the system components.

The audit team requested that the consortium provide details and evidence of the procedures utilised to collate, control and update the design programme with respect to integration of the system components.

It was anticipated that the consortium would outline and demonstrate through evidence the existence and adherence to robust project controls procedures in relation to design schedule development and management.

Findings

An integrated design programme is not being maintained and utilised by the consortium to manage the works.

The consortium noted that the contract programme was issued in May 2008, revision 1 being issued in November 2008 and revision 2 issued in March 2009 as part of change process. Revision 2 has to date not been agreed with the client. The background of change requests has in the opinion of the consortium made it impractical to maintain an integrated design programme.

In the absence of the acceptance of revision 2 of the contract programme, the consortium has implemented a Focus and Prioritisation process which is outlined in their process flow chart within Appendix 3 entitled “Focus and Prioritisation”.

The process as described includes setting of anticipated commencement of construction dates for works elements. It was indicated that these priorities are reviewed on a weekly basis and that a steering committee resolves conflicts and reviews priorities.

The control programmes and variance statements are given on a monthly basis in the project report with the design progress being subjected to weekly monitoring meetings (minutes of meetings were provided as evidence of this).

The process as detailed is not considered to be best practice and the provision of a fully integrated design programme is considered to be the most suitable approach to managing and monitoring interfaces between the various design teams. The lack of an agreed construction

programme is noted, however we recommend driving logic between the programmes should be established in a format acceptable to all parties.

There is a process in place to manage design integration issues and evidence was provided to confirm the ongoing management

Design interfaces are identified via the Interface Management Process at the start of the project and are subjected to an ongoing review process to resolve them and close them out.

Interface Control Forms (ICF) are generated at the commencement of the design elements and resolution of issues noted are checked during the development of the design. (ICF forms were provided as evidence items 14 to 18 for cable ducts). The evidence confirms that the consortium is following an iterative process of review and close out prior to entering formal Interdisciplinary Design Reviews (IDR) review meetings which is aimed at minimising residual design conflict whilst the design is under development. As a final step in the process, the consortium undertakes an IDR of the Issued For Construction (IFC) drawings to ensure that all residual interface issues have been resolved prior to commencement of construction. IDR minutes and checklist were provided as evidence (items 27/28 and 9). The evidence provided is further referenced within Item 3 below. The Interdisciplinary Design Certificate (IDC) certificate is the final assurance that a fully integrated and compliant design has been achieved.

The consortium is operating a schedule to get drawings to IDC outwith the design programmes. The schedule however does not reference any milestone coding from programmes to allow its impact to be taken in context of the wider programme.

IDR for Leith Walk is ongoing. that the consortium priority was that the design should be finished by start of January 10 and it is approaching completion. The current plan is for all IDCs to be completed by early March.

The control programmes utilised to manage SDS, CAF and Siemens design elements do not appear to link to the monthly look ahead programme or the contract programme.

Sample review of the SDS programme, monthly look ahead programme and contract programme could not identify commonality of milestones which could be effectively used to monitor progress and impact upon the design and construction programmes respectively.

2.2 Item 2 – Best Value

The Audit requires confidence from the consortium that the design is developed, monitored and effectively managed with respect to best value in relation to the Leith Walk and Gogar Landfill areas. The aim is to determine that a process for value management exists and whole life costs have been assessed. Key evidence anticipated is examples of where potential

decreases in whole life cost, by amending the design and scope of works, has been considered and assessed against future impacts on maintenance, and performance.

The Audit is also seeking evidence of the process being used to identify opportunities and alternative design solutions to achieve the optimum and best value design solution, particularly regarding the integration of the SDS and BSC designs. Key evidence anticipated is the process for value engineering and opportunity management supported by examples.

Findings

The audit determined that BSC does not have any documented Value Management or Value Engineering processes.

BSC consider that any significant value management and whole life cost assessment should have been taken in the previous project phases prior to contract award. £11 million of value engineering opportunities were identified by tie at the BAFO stage in January 08. This sum was deducted from the final contract value as an incentive for BSC to deliver these initiatives. The mechanism for delivering these initiatives is via the Change Process. BSC stated that they are currently struggling to deliver these initiatives and therefore have not put any significant effort into identifying any more. Should any further value engineering opportunities be identified by the consortium, under the contract, BSC will receive 50% of the saving and 50% is awarded to tie. Due to this, BSC further commented that the nature of the contract does not encourage a proactive approach to value engineering. Therefore there has been no significant focus on this issue by the consortium.

However, despite a lack of obvious value engineering process or proactive approach by the consortium, reference was made by BSC to some recent value engineering carried out for the Gogar Landfill site. This proposal comprises an alternative type of track form to the SDS design of rigid track form. BSC proposes a ballasted track option as it provides a cheaper solution in terms of capital cost and will help maintain the current budget. Maintenance costs have not yet been assessed but are thought to have minimum impact. Evidence presented by BSC comprised aerial photos of the Gogar Landfill plus elevations and sections dated February 08 (See Appendix 2). Evidence of the proposed new design was not provided.

BSC also stated that evidence is available regarding restraint of the ballast for safety purposes. However, this evidence was not provided. BSC stated that they are holding a workshop on Gogar Landfill in the week commencing 01/02/10. Some historical examples of value engineering were also provided for Gogar Landfill (see Appendix 2). As this information was prior to contract award it has not been considered as part of the Audit.

BSC stated that for Leith Walk there are areas where the design has been optimised e.g. noise and vibration mitigation measurements taken to assist track design. BSC stated that they are always looking for opportunities to simplify construction which in turn may help the design.

BSC commented that there were a few value engineering workshops held in the early days of the contract. These were chaired by Frank McFadden of **tie** Ltd and none have been held since.

The principles of BSC's design were discussed thus:

- The default OLE design is a single pole with a double header.
- The most workable drainage design has been chosen rather than the cheapest option.
- There have been limited opportunities to integrate track form and OLE but it has been carried out on bridge deck on Edinburgh Park Bridge. The track form on Edinburgh Park Bridge is being reassessed at tie's request.
- There have been very limited opportunities for value engineering in systems as items are generally off the shelf.

Our observation is that whilst BSC is not proactively carrying out value engineering, examples are given of where it has been done intuitively as part of the design process.

During discussions, BSC stated that no collaborative approach on risk and opportunity management.

BSC stated that their project risk register is largely based on the impact of change. Extracts were provided from the 'PB Health and Safety Residual Risk Register' and 'BSC's Period 8 Risk Register'. Both documents are fairly typical for a project of this nature. However, it was evident from discussions that the risk of encountering unmarked services or shallow structures has not been identified as a risk by BSC due to the fact that the consortium were promised a 'clear box' (i.e. no services) as part of the contract.

The audit identified that tie and BSC have not found an integrated approach to managing the risks associated with ground conditions. No evidence of an integrated risk register or integrated approach to risk management was identified between BSC and tie during the Audit.

The contract does not appear to encourage a proactive approach to value engineering. However, it is evident in some instances that value engineering is carried out intuitively as part of the design process. No evidence of an integrated approach to risk and opportunity management by the project was identified during the Audit. Whilst the contract may not encourage a collaborative approach to value engineering or risk management, there are clear benefits to the project, BSC and tie Ltd of having a more joined up approach in these areas.

2.3 Item 3 – Integrated Design & Acceptance Criteria

The audit sought to obtain confidence that the Consortium has achieved and assured integrated design against the relevant acceptance criteria required to commence construction of Leith Walk section of works and the Gogar landfill surcharge Area.

Findings

Whilst a formal systems integration plan has not yet been concluded the consortium did articulate their intentions in respect to management of integration to date, and how it will be controlled during the remainder of the contract:

The consortium noted they have aligned their processes with Schedule 30 of the Employers Requirements. The audit and subsequent overview of the consortium's processes observed that intention is for systems integration to be achieved by adherence to:

- Requirements Management
- Requirements Management Plan [ETN(BSC$MC&ADB#050401 Revision A]
- Interface Management
- Interface Management Plan [ETN(SPM$Q&ADB#05o151 Revision B]
- Design Assurance Statement & Interdisciplinary Design Check [BSC/25.1.201/PSP/003]
- Verification & Validation
- Design Assurance Statement & Interdisciplinary Design Check [BSC/25.1.201/PSP/003]
- Inspection & Test Plan [to be drafted and concluded]
- Testing & Commissioning Plan [to be drafted and concluded](Verification & Validation)
- Configuration Management
- Configuration Management Plan [not viewed by audit team]
- Reliability, Availability, Maintainability, and Safety [EN50126]

The consortium provided copies of the following evidence in support of adherence to processes noted above (listed within Appendix 3):

- 10 Response to Technical Approval Section 1B (CEC) SS/1/RG
- 11 Response to Roads Technical Approval Section 1B SS/1/HIB

- 14-18 Interface Control Form – Cable Ducts / duct works IF-5-SYS-CIV Rev – to E
- 27, 28 IDR/IDC Meeting 017/018 Minutes of 19 and 26.01.09 respectively

The consortium has implemented an organisational structure which seeks to match competence with roles and accounts for succession planning of key resources.

Role matching and appointment to key posts within the consortium has been subject to competence assessment internally within the consortium and opportunity to note objection given to **tie** Ltd.

ETN Design is lead by Stefan Rothaus of Bilfinger Berger (Civils) and Michael Wilkens of Siemens (Systems). Systems Integration Lead is taken by Michael Wilkens. However, Michael and Stefan are each responsible for integration being achieved. In the event of consensus not being reached any issues are in the first instance escalated to Colin Brady. Input to integration from CAF is via David Steel.

Formal confirmation of the roles and responsibilities will be clarified by submission of the Systems Integration Plan which is due for submission w/e 5/2/10.

The consortium noted that Simon Nisbett has full authorisation to represent Stefan Rothaus and would be his successor in the event that this is necessary. In the event that Michael Wilkens requires a successor Miguel Berrozpe would fulfil the role on an interim basis.

Job descriptions are available for key skills and competences.

Design interfaces are being managed by complying with:

- Interface Management Plan [ETN(SPM$Q&ADB#050151 Revision B]
- Design Assurance Statement & Interdisciplinary Design Check [BSC/25.1.201/PSP/003]
- The consortium demonstrated compliance with the process through provision of
- 14-18 Interface Control Form – Cable Ducts / duct works IF-5-SYS-CIV Rev – to E
- 27, 28 IDR/IDC Meeting 017/018 Minutes of 19 and 26.01.09 respectively
- IDC/IDR Schedule Cover of Letter Ref ETN(BSC)TIE&ABC # 053877

The interface management plan provides for the identification and recording of perceived interfaces via the Interface Control Form (ICF). The ICF forms provided by the consortium reflect cable ducting development from Oct 08 to June 09. Whilst the forms demonstrate compliance with the process, they are not specific to Leith Walk and Gogar sections. The consortium should provide ongoing evidence of active ICFs for each area as part of the monthly progress reports.

In addition the consortium provided 9 IDR Checklists which set out actions following IDR meetings. The IDR checklist notes that interface elements have been identified for action in relation to OLE pole locations within Leith walk section. Interfaces identified within the Gogar Landfill area include ambiguities / omissions identified between discipline drawings, OLE and foundation interfaces etc.

IDR minutes presented as evidence provide further details of the interfaces noted above.

Design Assurance Statements (DAS) are envisaged by the consortium to be issued at the end of the design, construction, testing and commissioning phase. It was noted by tie Ltd representatives during the audit that they are anticipating a more progressive submission of DAS. Discussion and agreement is required between tie Ltd and the consortium to ensure that opportunity of progressive submission of DAS is maximised.

The DAS was noted to contain IDC of the section, completed ICFs, confirmation that the design complies with the requirements, verification, validation and testing requirements.

The consortium noted that DAS's submitted in draft to date will not be submitted as final until all activities in a particular section are complete. There is an opportunity for provision of partial DAS submissions to be capitalised upon by the ETN project as a whole.

Process utilised by the consortium to determine a section of works is ready for construction is not well defined:

The consortium noted that they determine design is ready for construction when:

- Approved For Construction (AFC) drawings are complete with residual CDM risks noted on the drawings
- Safety deliverables are covered by the traffic management plan
- IDC is in place
- **tie** Ltd grants permission to take access of the site.

We suggest that the consortium considers the provision of a construction pack to **tie** Ltd in advance of commencement of the works which references the following:

- Area of Works
- Details of the Works Proposed
- Approvals & Consents Attained
- Drawings and specifications associated with the works

- Confirmation of compliance with Requirements
- IDC forms
- Status of Hazard close out
- CDM residual risks
- Compliance and closure of any necessary third party agreements
- Signatories of relevant designers and checkers within the package confirm that they are satisfied that the works are suitable for construction.

It is understood that some of the above may be covered within the Work Package Plans and the adoption of any such refinement of process is subject to review of this.

3. Recommendations

3.1 Recommendations

1. As an integrated design programme is not being maintained by the consortium at present as a minimum the consortium should agree priority milestones and include them using the same coding within the logic of the design programmes for SDS, CAF, and Siemens, and in addition reflect the same milestones within the look ahead and contract programmes.

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4. To provide ongoing transparency in the design process the consortium should develop an ICF tracker and provide ongoing evidence of active ICFs for each area as part of the monthly progress reports.

5. Discussion and agreement of process, content, acceptance and timing of partial and full DAS submissions is required between **tie** Ltd and the consortium to ensure that opportunity is maximised as part of compiling body of evidence and verification of no objection by the independent competent person (ICP).

6. It is suggested that consideration be given to the provision of a construction pack to **tie** Ltd in advance of commencement of the works, as this will ensure that all necessary design components are in place prior to construction thus aiding a reduction in possible conflict during the works.

4. Acknowledgements

We wish to thank the staff of **BSC** for their co-operation, openness and support during this audit.

5. Definitions & Abbreviations

tie Ltd	Transport Initiatives Edinburgh
ETN	Edinburgh Tram Network
CEC	City of Edinburgh Council
BSC	Bilfinger Berger, Siemens and CAF
ROGs	Rail and Other Transport Guided Systems
Design programme	Time schedule (Gant Chart) which sets out the timings and interdependencies of design activities across the various engineering disciplines and is used to develop and monitor design production.
DAS	Design Assurance Statement
ICF	Interface Control Form
IDR	Interdisciplinary Review
IDC	Interdisciplinary Check

6. Appendices

Appendix 1 Scope of Audit

Appendix 2 Audit Attendance

Appendix 3 Evidence Provided by BSC Consortium

Appendix 1

Scope of Audit

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Appendix 2

Audit Attendance

Marc Hamilton, the Nichols Group

Kate Gray, the Nichols Group

Colin Matlock, **tie** Ltd

Bob Cummins, **tie** Ltd

Sheena Smith, **tie** Ltd

Colin Kerr, **tie** Ltd

Colin Brady, BSC Consortium

Michael Wilken, BSC (Siemens)

Stefan Rothaus, BSC (Bilfinger Berger)

Alan Dolan, BSC (SDS)

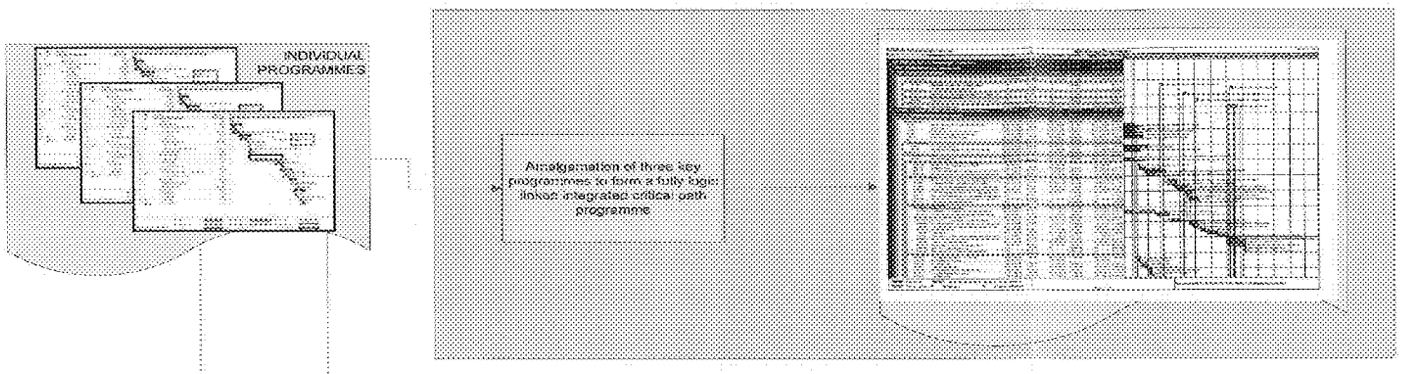
Appendix 3

Evidence Provided by BSC Consortium

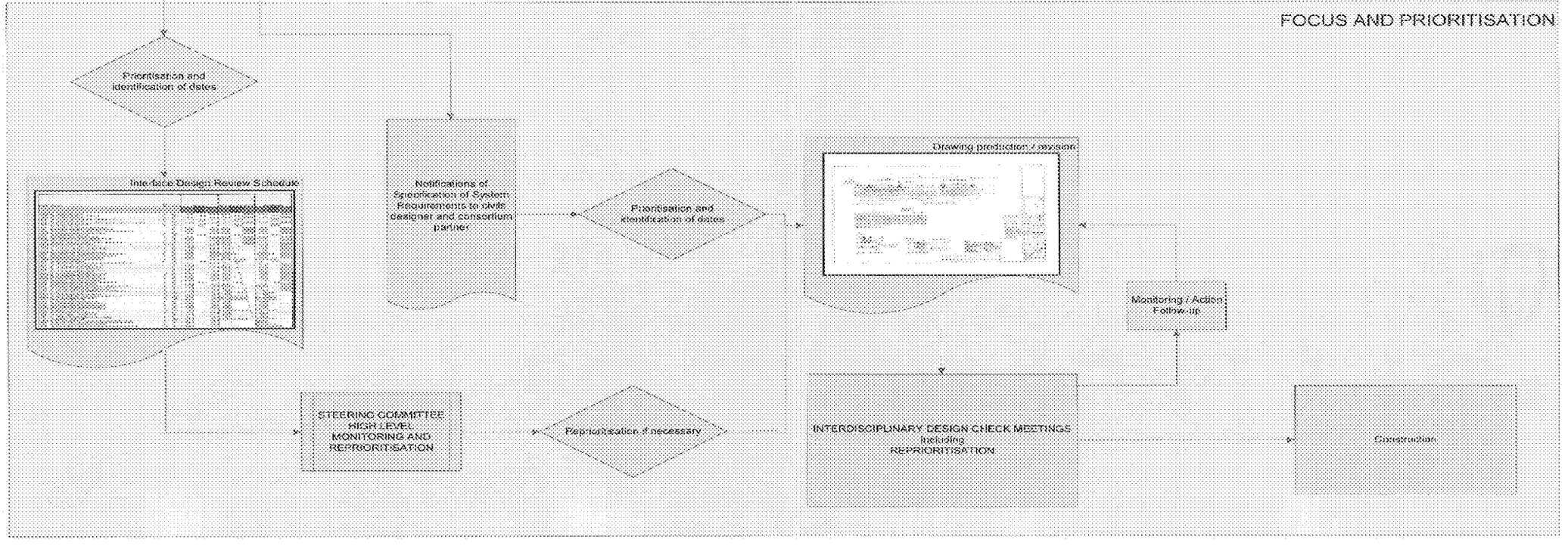
Serial	Document	Reference
1	Health & Safety Risk Register	ULE90130-01-RRR-00023 R1
2	Nehaven Road to Haymarket Road Scheme Layout Plan Section 1B Sheet 13 of 24	ULE90130-01-HRL-00013 R7
3	Newhaven to Haymarket Drainage Plan Section 1B Sheet 11 of 24	ULE90130-01-DNG-00011 R5
4	Gogar Landfill Surcharge Details Sub Section 7A	ULE90130-07-GEO-00010 R5
5	Gogar Landfill Cross Sections (Sheet 1 of 2) Subsection 7A	ULE90130-07-GEO-00011 R4
6	Gogar Landfill Cross Sections (Sheet 2 of 2) Subsection 7A	ULE90130-07-GEO-00012 R4
7	Gogar Lanadfill Reinforcement & Soil Nail Elevations Sub Section 7A	ULE90130-07-GEO-00014 R4
8	BSC Risk Register	Period 8
9	IDR Checklist	
10	Response to Technical Approval Section 1B (CEC)	SS/1/RG
11	Response to Roads Technical Approval Section 1B Road	SS/1/HIB
12	Current Drawing List for Leith Walk	Pgs 1to 8
13	Technical Approval Section 1b Road Safety Audit (ULE90130-01-REP-00094,R4), Roads Technical Design Statement (ULE90130-01-REP-00058,Rev 4) and Lighting Departures (ULE90130-01-REP)	SS/1/AR
14	Interface Control Form – Cable Ducts / duct works	IF-5-SYS-CIV Rev E
15	Interface Control Form – Cable Ducts / duct works	IF-5-SYS-CIV Rev D
16	Interface Control Form – Cable Ducts / duct works	IF-5-SYS-CIV Rev C
17	Interface Control Form – Cable Ducts / duct works	IF-5-SYS-CIV Rev B
18	Interface Control Form – Cable Ducts / duct works	IF-5-SYS-CIV Rev -
19	Request for Information 114	-
20	ETN Cable Duct Requirements Generic Arrangements	Email 21.09.08

21	Request for cable duct design support schedule BB/SDS from Siemens	Email 09.12.08
22	Proposal for Duct Design Section 1A	Email 05.05.09
23	Siemens markup on Proposal for Duct Design Section 1A	Email 30.07.09
24	Updated SDS cable duct/route drawings for section 1B – to be reviewed	Email 15.01.09
25	ETN SDS Design Programme	ULE90130-SW-PRO-0010 02.12.09 V51
26	Prioritisation Order – Drainage Approval and Roads Close out Report	Email 27.01.2010
27	IDR/IDC Meeting 017	Minutes 19.01.09
28	IDR/IDC Meeting 018	Minutes 26.01.09
29	Gogar Landfill Civil & Trackwork Design	Minutes 29.09.09
30	Gogar Landfill Civil & Trackwork Design	Minutes 13.01.10
31	Appendix C – Indentified Value Engineering	-
32	Document Transmittal Form	ULE90130-SW-DTF-03848
33	Contaminated Landfill, Gogar – Option Appraisal	ULE90130-07-LET-00302
34	Gogar Landfill Treatment	Letter DES-ADM791
35	Value Engineering Report ULE90130-SW-REP-00260 V1	Letter ULE90130-SW-LET-00297
36	Programme & Schedule Prioritisation Process Diagram	-
37	Section 7A Estimate	INTC 28.11.08
38	BB Organisation Chart	-
39	Siemens Organisation Chart	-
40	Consortium Organisation Chart	-
41	Approvals Tracker	-

7.



Prioritisation and Focus in changing project environment



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