Cambridge Science Park Interchange Station

OLE Design – Approval in Principle

Document Ref 5110967/51.4/OLE/001

Issue: 03 For Approval

Date: 27/02/13

ATKINS

Cambridgeshire County Council

Network Rail

Plan Design Enable

Notice

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Document History

JOB NUMBER: 5110967			**DOCUMENT REF:** 5110967/51.4/OLE/001			
Revision	**Purpose Description**	**Originated**	**Checked**	**Reviewed**	**Authorised**	**Date**
DRAFT	For internal comments	KCS	KCS	SF	RDM	16/11/12
01	For Approval	KCS	KCS	SF	RDM	16/01/13
02	Minor updates added. For Approval	KCS	SF	KCS	RDM	04/02/13
03	Minor updates added. For Approval	KCS	SF	KCS	RDM	27/02/13

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1. Executive summary

This report has been produced in accordance with Network Rail Standard NR/L2/ELP/27311 (Engineering Assurance Requirements for Design and Implementation of Electrical Power Engineering Infrastructure Projects) to provide an Approval in Principal (AIP) Overhead Line Equipment (OLE) Design for the Cambridge Science Park Interchange Station project. Also considered was Network Rail Standard NR/L3/ELP/27406 (Engineering Deliverables for Electrical Power Asset Design) which provides the requirements for the Engineering Deliverables required to support the stages of assurance defined in NR/L2/ELP/27311, in particular Modules A (Generic Requirements) and Module B (Contact Systems-OLE)

The current proposal is to build a 3 platform face (2 main line and 1 bay) station linked with a footbridge and walkway at the site of the former Central Materials Depot, Chesterton Junction. The proposed station platforms shall be located approximately between OLE chainage 93.173 to 93.473. The Down Line/bay platform shall be 9m wide and will start on the Cambridge side of existing structures C/93/07 and end on the Kings Lynn side of existing structures C/93/15. The Up Line platform shall be 7m wide and will start on the Cambridge side of existing structures C/93/08 and end on the Kings Lynn side of existing structures C/93/16. The proposed footbridge shall be installed between existing structures C/93/07-08 and C/93/09-10 with a proposed soffit height of 7m. This will to allow the existing OLE profile to be maintained without the need to reduce the wire height.

2. Abbreviations

This is a list of typical abbreviations used in OLE reports and drawings. Not all abbreviations are used in this report.

AC	Alternating Current
ACG	Anti-climbing guard
AT	Auto Tensioned (Equipment)
ATX	Auto Transformer
AWAC	Alumo-weld Aluminium Conductor
BWA	Balance Weight Anchor
CAD	Computer Aided Design
DC	Double Channel (Mast)
ECR	Electrical Control Room
FS	Feeder Station
HSSI	High Speed Section Insulator
IRC	Insulated Return Conductor
MFD	Major Feeding Diagram
MPA	Mid Point Anchor
MIR	Mechanical Independent Registration
MPTSC	Mid Point Track Sectioning Cabin
NR	Not Registered
NSR	Not Supported or Registered
OLE	Overhead Line Equipment
OOR	Out of running
OLEMI	Overhead Line Equipment Master Index
RC	Return Conductor
RE	Running Edge
REFOS	Running Edge to Face of Steel
SCADA	Supervisory Control and Data Acquisition
SI	Section Insulator
S&C	Switch and Crossings
SPS	Small Parts Steelwork
SSA	Self Supporting Anchor
STC	Single Track Cantilever
TOP	Toes of Points
TSC	Track Sectioning Cabin
TTC	Two Track Cantilever
UC	Universal Column
UK1	An OLE design range within OLEMI used on the WCML upgrade works
VDU	Visual Display unit

3. Design Commentary

This Approval In Principle (AIP) Overhead Line Equipment (OLE) design is being submitted as a design deliverable as part of the Cambridge Science Park Interchange Station project under the direction of the Network Rail Sponsor Mr Rob Fairhead. The proposed date of implementation is presently 2015.

This submission meets all Group Standards, Network Rail Standards, UK legislation, PRS and IDC comments. Any non-compliance to standards shall be identified in Section 7.3 of this document.

This submission shall only utilise Network Rail product approved assets. If product approval is required for any of the assets then this shall be identified in Section 5.8 of this document.

Prior to the issue of this AIP, an Inter Disciplinary Check (IDC) meeting shall be arranged and chaired by the Contractors Engineering Manager (CEM). This shall ensure that all engineering design deliverables offer an integrated design solution and highlight any conflict areas that were not previously identified during the individual discipline design process. The completed IDC certificate shall be attached to this submission as Appendix D.

Under the present Approval In Principle design proposal it is not required to re-locate the existing booster overlap. However due to the new alignment of the connection line, one of the overlap anchor masts requires to be removed and the anchor tail extended to a new mast. A new half tension length of OLEMI Mark 3D auto tensioned equipment (approx 630m) shall be installed to wire the new bay platform line. New structures shall be required to wire the connection to the new bay platform and allowance has been made to install 5 new portal structures in the vicinity of the new station. The main line cross over located South of the girder bridge U/B1550 requires to be lengthened due to an increase in speed, therefore an new double channel mast is required at the South end.

Insulated return conductor shall be installed throughout the length of the station platforms.

Structure bonding arrangements in the platform areas shall allow for the inspection of the entire length of the structure to rail bond without excavation works being required. Therefore the portal masts shall be bonded on the bay platform line.

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4. Scope of works

Atkins has been commissioned to undertake the Approval In Principal Design for the necessary OLE modifications required to accommodate the proposed new station as part of the Cambridge Science Park Interchange Station project.

4.1. Area of Impact on Electrification Infrastructure

The area of impact on existing OLE infrastructure is between structures C/92/17-18 to C/93/21-22 on the Down and Up Main Lines.

4.2. Site Survey

A visual day shift site survey was carried out on 30/05/12.

A night shift survey to specifically look at the main line crossover and Up Line masts was carried out on 20/09/12.

A height and stagger OLE survey has been undertaken on 20/11/11.

TAP videos of the area have also been reviewed.

4.3. Condition of Existing Equipment

As far as can be ascertained from the visual inspection the condition of the OLE appears to be in reasonable condition.

4.4. Existing Non Compliances

All OLE campaign changes shall be completed by the project for all wire runs, existing and new, affected by the station works. All jumpers require to have the 10.5mm deformed type bi metal connections to AWAC catenary replaced with the 20mm diameter bi metal spill rod.

The upgrade of the RC connection span at the booster transformers to 19.422mm RC has been carried out.

Cross contact wire bridges require to be upgraded from rod to pre-straightened contact wire.

5. Proposed Works

5.1. Electrification Equipment

The existing electrification system in the area of the works is Mk3B Simple AT 25kV AC overhead line. Registration items shall only be allocated from the OLEMI range. UK1 registrations shall only be used with prior authorisation of the Network Rail project team. It is proposed to utilise Mk3D equipment with some design/equipment enhancements namely:

- Independent tensioning of the catenary and contact wires
- All insulators shall be polymeric type
- All OOR insulation shall be cut in over the edge of the sleeper

5.2. Staging

Staged installation of the OLE portal masts will be required to facilitate the transfer of OLE and removal of existing structures that foul the location of the new platform. The detailed staging is subject to agreement with Network Rail and the OLE Installation Contractor. This will be confirmed at the Form B detailed design stage.

5.3. Interfaces with Other Disciplines

The following interfaces with other disciplines have been identified.

Permanent Way

A track alignment design has been produced to show the new bay platform line, realignment of sidings within the sidings area, proposed relocation of the Dickerson siding and proposed speed increase of the sidings turnout and the main line cross over. This design has been used as the base drawing for the OLE design.

Signalling

A new signalling scheme plan has been produced to accommodate the proposed track alignment design as described above. The location of the new signals shall be considered within the OLE design.

Telecoms

A telecoms design has been produced to accommodate the proposed signalling alterations and new station requirements. The location of new telecoms equipment within the new station area shall be considered within the OLE design.

Civil Engineering

The design of the new station building, footbridge, platforms and canopy's shall be considered within the OLE design.

5.4. Interfaces with Other Projects

These works are not required to interface with any other known works in the Cambridge area at this time.

5.5. Design Inputs from Other Disciplines

The following inputs have been used as part of the OLE Outline Design.

Permanent Way

- 5110967-RLS-CSP-CPW-001
- 5110967-RLS-CSP-CPW-002

Signalling

- 5110967/SG/SK/01/2 Ver:P02 09/10/12

Telecoms

- GRIP 3 report Section 7

Civil

- GRIP 3 report Section 4

5.6. OLE Inputs

The following inputs have been used as part of the OLE Outline Design.

- Topographical survey
- The height and stagger survey
- Site visit carried out on 20/11/11.
- TAP video
- Existing OLE layout plans
- Existing Isolation Diagram

5.7. Romford ECR - SCADA

The introduction of a new electrical sub-section 426P for the bay platform line shall require to be incorporated in the SCADA system within the control room at Romford. This will involve the updating of the ECR VDU screen and master station database. Updates will be required to the isolation diagrams and associated isolation instructions, which must be accepted no less than 4 weeks prior to any works taking place.

5.8. Product Approval

There are no items of equipment associated with this submission that require product approval

6. System Design Principles

6.1. Type of Equipment

The existing wire runs in the area of the works are of Mk3B simple AT equipment. It is proposed that the new OLE will be Mk3D simple AT equipment.
Contact Wire – 19/2.1 Cad Cu (or approved alternative), tensioned to 11kN
Catenary – 107mm2 Cad Cu (or approved alternative), tensioned to 11kN

The new catenary shall cross below the existing AWAC at the junction interface, to avoid copper washing.

6.2. OLE Sectioning

The section insulator shall be of the Arthur Flurry Overlapping skid type. The isolator shall be of the Morris Line Engineering 1250A type with an earth position provided in order to earth the platform line if required. It is not envisaged that the new electrical section shall require alterations to the existing 25kV distribution circuit breaker protection settings.

A proposed Section Diagram drawn in Microstation has been produced as part of the Form A submission, see:

5110967/ESD/CSP/001 – Proposed Section Diagram

6.3. OLE Layout Plan Design

A OLE Layout Plan drawn in Microstation format using standard OLE symbologies has been produced as part of the Form A submission. see:

5110967/ELP/CSP/001

The following standard colour conventions have been used:

BLACK – Existing Equipment.

GREEN – Equipment to be removed.

RED – New Equipment.

BLUE – Existing Equipment in new position/modified.

6.4. Tension Length Details

The following new half tension length has been used:

Wire Run Number	Track Name	Start		End		Wire Run Length (km)
		Structure Number	Location (km)	Structure Number	Location (km)	
7A	Bay Platform Line	C/92/39A	92.838	C/93/15A	93.467	0.629

6.5. OLE Traction Bonding Alterations

Amendments to the existing bonding plan will be necessary due to the revised P-Way layout, alterations to signalling and the revised OLE layout. Staged bonding plans will be produced by the Signal Engineer as part of the Form B design and will go through the IDC process at that stage. The OLE designer at the detailed design stage is required to input into the combined bonding plan.

6.6. EMC Requirements

A separate EMC, Earthing and Bonding Strategy document has been produced as part of this commission. See document 5110967/EMC/CSP/001

6.7. Impact on Signalling Sighting

New OLE structures are required and have been positioned to minimise any signal sighting obscurations in the area. There will also be amendments to support and registration arrangements at existing structures. The impact on signal sighting will be assessed by desk top study and will be detailed in the Signalling Outline Project Specification (OPS).

6.8. Existing Structures

The existing structures in the area are a mixture of single and twin cantilevers. As far as can be ascertained from inspection of photographs, TAP videos and record cross sections, the structures are of standard Mk3B design and appear to be in reasonable condition. The new bay platform wire is being supported from various new structures with one exception where a cantilever is being installed off the back of an existing double channel mast. This arrangement can be accommodated with the existing design and will be confirmed at detailed design.

6.9. Registration and Supports

The existing support and registration assemblies will be retained wherever possible. However, any new registration items shall only be allocated from the OLEMI Mark3 range. UK1 registrations shall only be used with prior authorisation of the Network Rail project team.

The new portal structures shall utilise mechanically independent registration assemblies in order to minimise service disruption during a de-wirement incident.

The new footbridge has been designed to be installed over the existing OLE with no alterations being required. The proposed soffit height of the footbridge is 7000mm. The existing adjacent catenary heights are 6245mm/6190mm and with the footbridge located at approximately mid-span an electrical clearance of greater than 600mm shall be achieved.

The OLE design shall allow for normal track maintenance/OLE tolerances.

6.10. Redundant Structures

Redundant foundations shall be broken out to 500mm below existing ground level.

The following structures will require to be removed as part of these works:

Structure Number	Structure Type	Comments
C/92/26 (92.709)	Twin cantilever	Existing structure to be removed
C/92/41 (92.856)	Single cantilever	Existing structure to be removed
C/92/43 (92.898)	Single cantilever	Existing structure to be removed
C/92/45 (92.957)	Single cantilever with BWA	Existing structure to be removed and BWA relocated
C/93/07 & 08 (93.189)	Single cantilever	Existing single cantilever masts to be removed
C/93/09 & 10 (93.256)	Single cantilever	Existing single cantilever masts to be removed
C/93/11 & 12 (93.323)	Single cantilever	Existing single cantilever masts to be removed
C/93/13 & 14 (93.390)	Single cantilever	Existing single cantilever masts to be removed

6.11. New Structures

A following new structures are required:

Structure Number	Structure Type	Comments
C/92/24A (92.706)	Twin cantilever	New twin cantilever mast
C/92/39A	SSA	New SSA UC structure (AT end of new wire)

(92.838)		
C/92/41A (92.864)	TTC	New TTC mast
C/92/43A (92.904)	Twin cantilever	New DC mast with BWA
C/92/45A (92.956)	TTC	New TTC mast with switch
C/93/01 (93.007)	Existing DC mast	New cantilever added to existing DC mast
C/93/01A (93.045)	Single cantilever	New UC mast
C/93/03A (93.083)	Single cantilever	New DC mast (allowing for future wire)
C/93/05A (93.135)	Single Cantilever	New UC mast
C/93/05B (93.188)	Portal	New portal mast
C/93/07A (93.236)	Portal	New portal mast
C/93/09A (93.291)	Portal	New portal mast
C/93/11A (93.346)	Portal	New portal mast
C/93/13A (93.407)	Portal	New portal mast
C/93/15A (93.467)	SSA	New SSA UC mast

The portal legs of structures C/93/05B, 07A, 09A, 11A and 13A at the rear of Platform 1 shall have anti-climbing guards fitted. Also due to the close proximity of the proposed platform fence and the existing boundary palisade fence, these items may require to be bonded to one of these structures to avoid differential earth voltages.

6.12. Basic Design

No new basic design is envisaged.

6.13. Structure Foundations

Based on available ground investigation results the OLE foundations are assumed to be standard 610mm diameter pile foundations or standard concrete side bearing foundations taken from current OLEMI design range. Foundation types will be specified in Form B GRIP 5 detailed design cross sections.

Due consideration to be taken of the proposed platform drainage soak-a-way channel at the rear of platform 1, when installing the portal leg foundations for masts C/93/05B, 07A, 09A, 11A and 13A.

6.14. Anchor Terminations

In order to eliminate live out-of running conductors extending into the cess area, insulation shall be inserted at the sleeper end throughout the OLE design.

The tensioning device for the new half tension length shall be located at the end of the bay platform with the AT end located on a new SSA structure. Separate tensioning devices shall be utilised for the contact and catenary wires. Only product approved anti-fall balance weights or Tensorex devices shall be used and one complete assembly shall be offered to the local maintainer as a spares provision.

6.15. Return Conductor

Return Conductor to be installed in accordance with Network Rail standard NR/SP/ELP/21078 which requires a minimum vertical clearance of 600mm to 25kV conductors through all temperature ranges. It shall also be insulated in the station area and where it crosses live OLE.

7. Application of Design

7.1. Approved Designs

The new support and registration assemblies will be taken from the OLEMI Basic Design range. Registration items shall only be allocated from the OLEMI Mark3 range. UK1 registrations shall only be used with prior authorisation of the Network Rail project team

7.2. Network Rail Design Standards

Document Reference	Document Title	Applicable to Contract
NR/L2/ELP/27311	Engineering Assurance Requirements for Design and Implementation of Electrical Power Engineering Infrastructure Projects	Yes
NR/L3/ELP/27406	Engineering Deliverables for Electrical Power Asset Design	Yes
NR/SP/ELP/21036	Specification for 25kV Booster Transformers for AC Electrified Lines	No
NR/SP/ELP/21074	Overhead Line Equipment Allocation Design for Railway Electrification	No
NR/SP/ELP/21078	Specification for Design of Return Conductor for AC Electrified Lines	Yes
NR/SP/ELP/21085	Design of Earthing and Bonding Systems for 25kV AC Electrified Lines	Yes
NR/GN/ELP/0004	A.C. electrified lines earthing and bonding	Yes
NR/SP/ELP/21130	Technical Competency Requirements for Design of Overhead Line Equipment	Yes
NR/SP/ELP/27042	The Location and Design of Designated Earth Points for Overhead Line Equipment	Yes
NR/SP/ELP/27215	Design of Overhead Line Structures	Yes
NR/SP/ELP/27300	Specification for Computer Aided Design Formats for Electrification and Plant Documentation	Yes
NR/GN/ELP/27039	Wind Loading on Overhead Line Equipment and Structures	Yes
NR/GN/ELP/27088	Layout of Overhead Equipment	Yes

7.3. Deviations from Design Standards

There are no deviations from design standards as part of this submission.

8. Construction Methodology

There are no foreseen access issues associated with these works. Good vehicle access is available into the former Chesterton Sidings yard area giving access to the existing relay and generator rooms and the location of the proposed station. Road/Rail vehicle access is also good with the level crossing nearby and a RRAP being proposed as part of the track design submission.

Outline Construction Methodology could be as follows:

- Install all new pile/concrete foundations for new structures. TTC mast C/92/45A and DC mast C/92/43A with tie rod will take priority in order to allow existing mast C/92/45 to be removed to allow the new track alignment to be installed.
- Install remainder of new single UC structures, double channel structures, TTC structures and portal structures. Apply bonds to traction return rail.
- Install small part steelwork to new masts
- Install cantilevers and registration assemblies to new structures
- Carry out alterations to cross over wire and move section insulator in association with the planned permanent way stage works
- Install new catenary wire to bay platform line.
- Install new contact wire to bay platform line. Install droppers and register contact wire to correct height and stagger.
- Transfer main line support assemblies and remove redundant masts when transferred
- Install/re-route insulated return conductor
- Install section insulator and switch at mast C/92/45A
- Carryout campaign change alterations/upgrades and any other height/stagger alterations required by changes to the track alignment
- Test and Commission.

Further more detailed construction methodology will be determined at detailed design stage in liaison with Network Rail and the Construction Contractor.

9. Source Documents

The following source documents have been used:

- OLE layout Plans L/A/C 91.2-92.9 Rev 5
- OLE layout Plans L/A/C 92.9-94.5 Rev 4
- OLE layout Plans L/A/C 94.5-95.7 Rev 3
- Isolation Diagram NSE/WA/R/36 Rev B

10. Commissioning Strategy

It is anticipated that there will be a number of staged installation phases, with the relevant parts of the OLE being Tested and Commissioned after each Stage. At GRIP 5 stage the construction methodology shall identify all assets to be included in the commissioning stages and the required isolation diagram amendments/issues.

Following receipt of the marked up copies of the “For Construction” design documentation the As Fitted documentation will be produced. These drawings will form part of the handback documentation.

11. Appendix A – Layout Plan

The following OLE Layout Plan has been produced:

- 5110967/ELP/CSP/001

Rev	Date	Description of Revisions	Drawn	Chkd	Appr
A02	19/02/13	FOR FORM A APPROVAL	CML	SMF	BJH

Status: FOR FORM A APPROVAL

NetworkRail

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Project: CAMBRIDGE SCIENCE PARK STATION INTERCHANGE

Drawing Title: OLE OUTLINE DESIGN LAYOUT PLAN

Designed	Carl Lawley	Signed	Date 19/02/13
Drawn	Carl Lawley	Signed	Date 19/02/13
Checked	Steve Fox	Signed	Date 19/02/13
Approved	Brian Hoyle	Signed	Date 19/02/13

Scale(s): 1:500 | ELR & Mileage:

Alternative Reference: | Sheet 1 of 1

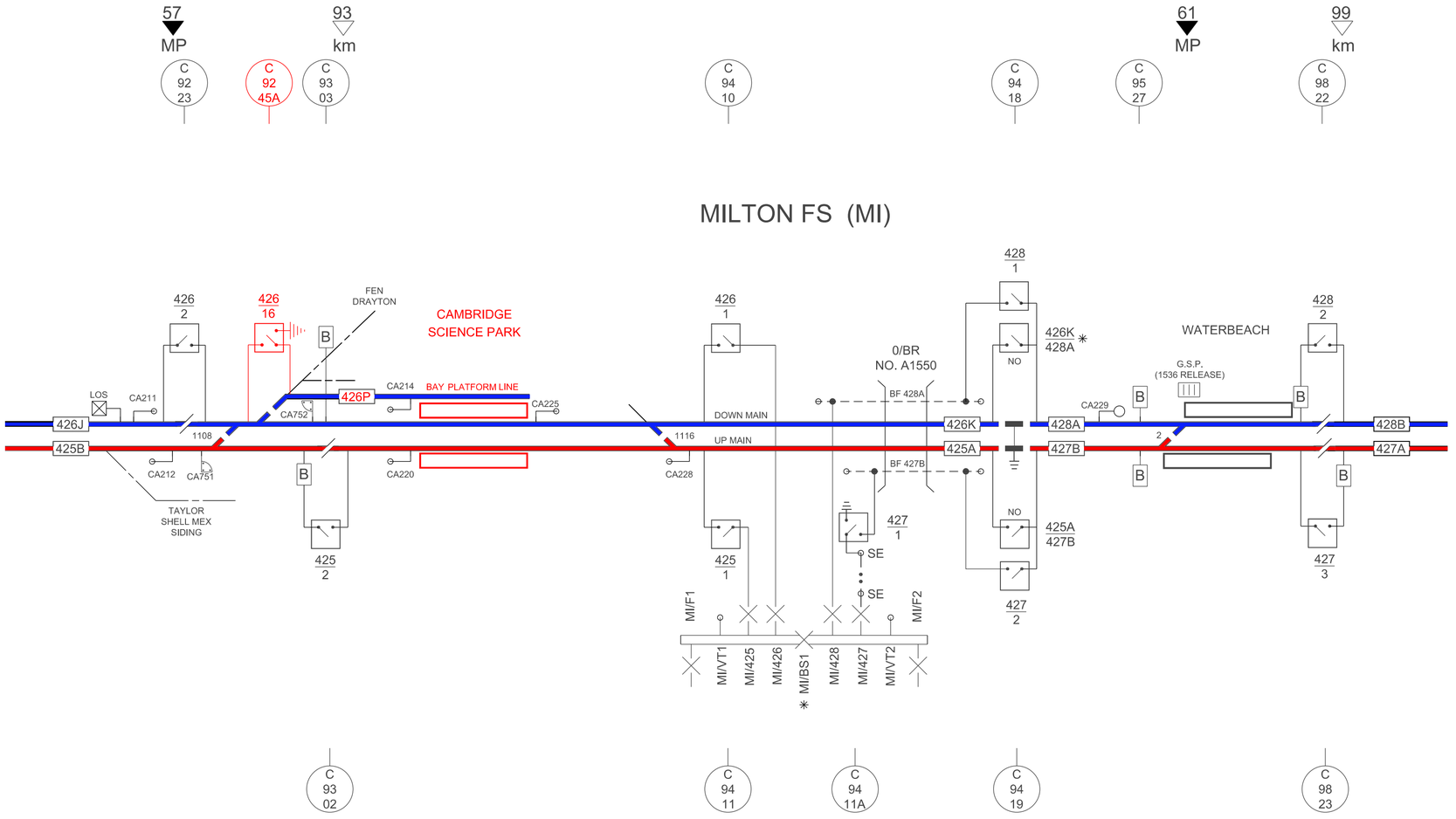
Drawing Number: 5110967-ELP-CSP-001 | Revision: A02

Sheet Size A2+10 420 x 2694

12. Appendix B - Isolation Diagram

The following preliminary Isolation Diagram has been produced:

- 5110967/ESD/CSP/001



Legend/Notes

Rev	Date	Description of Revisions	Drawn	Chkd	Appr
A01	18/01/13	Issued for Client Acceptance and Approval	R.P.L.	S.M.F.	B.J.H.

Status

FOR APPROVAL

Network Rail

Cambridgeshire County Council

Contractor(s)

ATKINS

Project

CAMBRIDGE SCIENCE PARK
STATION INTERCHANGE

Drawing Title

OLE OUTLINE DESIGN
SECTION DIAGRAM

Designed	R. P. Ludwell	Signed	Date 18/01/13
Drawn	R. P. Ludwell	Signed	Date 18/01/13
Checked	S.M. Fox	Signed	Date 18/01/13
Approved	B.J. Hoyle	Signed	Date 18/01/13

Scale(s) N.T.S.

ELR & Mileage BGK 57m65ch

Alternative Reference

Sheet 1 of 1

Drawing Number 5110967-ESD-CSP-001

Revision A01

Sheet Size A3+1 297 x 630

13. Appendix C - Existing Height & Staggers

Survey inputs completed by — Name signitures: P Hilton

Chesterton

AREA: Chesterton — Taken By: G WATSON — TEMP: 10 deg — DATE: 21/10/2012

START MILEAGE: -242.6 — FINISH MILEAGE: 950 — DIRECTION: ~~FACING LONDON~~ / BACK TO LONDON

STAGGER READING FACING LONDON : — STAGGER READING WITH BACK TO LONDON:

STRUCTURE NUMBER			Chainage	TRACK NAME	Registration Details	REG ARM TYPE	DC / SC	L/R	I.R./ OOR	Stagger mm	CONT m	CAT m	SOFFIT / BOOM	CANT ~~mm~~ / Deg	REFOS m	Bonds N/F	Mast Size	NOTES Positions of SI/JUMPERS, MPC, X-Contact bar, DEP. Anchors / BWA / ATetc
G	92	18	-242.6	UP MAIN	Pull	UK1 900 Shallow Curve	SC	L	IR	-76	5.089	5.815		0.8	2.863	B	165x165	
Mid- Span								L	IR	-21	5.107	5.73		0.9				
G	92	20	-200	UP MAIN	Pull	UK1 900 Shallow Curve	SC	R	IR	102	5.173	6.033	6.15	0.8	2.675	B	155x160	DEP
Mid- Span								R	IR	43	5.224	5.85		0.8				
G	92	22	-148.2	UP MAIN	Pull	UK1 900 Shallow Curve	SC	R	IR	123	5.340	6.205	6.339	1.1	2.835	B	200x210	B W A.
Mid- Span								R	IR	24	5.354	6.032		1.2				
G	92	24	-98.2	UP MAIN	Tube	Tube	SC	R	OOR	522	5.655	6.802		1.2	2.873	B	605x230	
G	93	24	-98.2	UP MAIN	Pull	UK1 900 Shallow Curve	SC	R	IR	161	5.449	6.415		1.3	2.873	B	605x230	
Mid- Span								R	IR	213	5.547	6.349		1.4				
Mid- Span								R	OOR	32	5.491	6.06		1.3				
G	92	26	-47.5	UP MAIN	Pull	UK1 900 Shallow Curve	SC	R	IR	34	5.407	6.306		1.2	2.596	B	600x230	
G	92	26	-47.5	UP MAIN	Direct	Tube	SC	R	OOR	77	5.455	6.643		1.3	2.596	B	600x230	
Mid- Span								R	IR	35	5.380	5.797		1.4				
G	92	28	0	UP MAIN	Pull	UK1 900 Shallow Curve	SC	R	IR	96	5.516	5.948	6.273	1.4	2.693	B	160x155	
BA1				UP MAIN	Pull	UK1 900 Shallow Curve	SC	L	IR	-40	5.568			1.2				Bridge Arm 1
BA2				UP MAIN	Pull	UK1 900 Shallow Curve	SC	L	IR	-73	5.576	5.574		1.2				Bridge Arm 2
BA3				UP MAIN	Pull	UK1 900 Shallow Curve	SC	L	IR	-55	5.602			1.2				Bridge Arm 3
BA4				UP MAIN	Pull	UK1 900 Shallow Curve	SC	L	IR	-50	5.597	5.598		1.0				Bridge Arm 4
BA5				UP MAIN	Pull	UK1 900 Shallow Curve	SC	L	IR	-15	5.592		6.259	1.1				Bridge Arm 5
G	92	40	76.9	UP MAIN	Pull	UK1 900 Shallow Curve	SC	L	IR	-108	5.553	5.672		1.1	2.870	B	160x155	
Mid- Span								R	IR	43	5.683	6.077		0.2				
G	92	42	99	UP MAIN	Pull	UK1 900 Shallow Curve	SC	L	IR	-220	5.713	6.587		0.3	3.065	B	160x150	
Mid- Span								R	IR	24	5.623	6.136		0.2				
G	92	44	142.1	UP MAIN	Pull	UK1 900 Shallow Curve	DC	L	IR	-234	5.710			0.2		B	155x160	
Mid- Span								L	IR	-50	5.627	6.135		0.1				
G	92	46	200.6	UP MAIN	Pull	UK1 900 Deep Curve	DC	R	IR	224	5.659	6.492		0.1	2.405	B	210x205	BWA
Mid- Span								R	IR	95	5.645	6.533		1.1				
G	93	2	250.7	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-35	5.682	7.058		0.5	1.843	B	305x600	BOOSTER
G	93	2	250.7	UP MAIN	Direct	Tube	DC	L	OOR	-445	5.920	7.058		0.5	1.843	B	305x600	BOOSTER
Mid- Span								R	OOR	290	5.670	6.392		1.6				
Mid- Span								L	IR	-150	5.642	6.392		1.6				
G	93	4	300.4	UP MAIN	Direct	Tube	DC	R	OOR	25	5.863	6.594		1.5	2.338	B	600x230	
G	93	4	300.4	UP MAIN	Push	UK1 900 Deep Curve	DC	R	IR	518	5.622	6.594		1.5	2.338	B	600x230	
Mid- Span								R	IR	130	5.538	6.005		1.3				
G	93	6	365.2	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-140	5.505	6.339		1.6	2.822	B	200x205	BWA
Mid- Span								L	IR	-12	5.406	5.839		1.4				
G	93	8	431.8	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-178	5.413	6.246		1.3	2.854	B	155x160	
Mid- Span								L	IR	-3	5.338	5.731		1.2				
G	93	10	498.7	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-43	5.346	6.192		1.2	2.751	B	155x160	
Mid- Span								R	IR	3	5.277	5.738		1.2				
G	93	12	565.4	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-105	5.267	6.123		1.1	2.500	B	155x160	
Mid- Span								R	IR	22	5.145			1.2				
G	93	14	632.4	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-44	5.116	5.938		1.1	2.515	B	155x160	
Mid- Span								L	IR	-5	5.038	5.426		1.3				
G	93	16	699.3	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-214	5.057	5.899		1.5	2.522	B	150x160	
Mid- Span								L	IR	30	4.976	5.36		0.6				
G	93	18	766	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-165	4.964	5.804		1.2	2.405	B	150x160	
Mid- Span								L	IR	-27	4.880	5.3		1.1				
G	93	20	832.7	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-142	4.905	5.763		1.1	2.443	B	150x160	
Mid- Span								R	IR	18	4.880	5.273		1.1				
G	93	22	899.2	UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-135	4.908	5.759		1.3	2.535	B	150x160	
Mid- Span								R	IR	20	4.858	5.254		1.4				
G	93	24		UP MAIN	Push	UK1 900 Deep Curve	DC	L	IR	-178	4.900	5.75		1.4	2.570	B	150X160	

Survey inputs completed by | Name signitures | P Hilton

Chesterton

AREA: Chesterton | Taken By: G WATSON | TEMP: 10 deg | DATE: 21/10/2012

START MILEAGE: -242.3 | FINISH MILEAGE: 950 | DIRECTION: ~~FACING LONDON~~ / BACK TO LONDON

STAGGER READING FACING LONDON : | STAGGER READING WITH BACK TO LONDON:

STRUCTURE NUMBER			Chainage	TRACK NAME	Registration Details	REG ARM TYPE	DC / SC	L/R	I.R./ OOR	Stagger mm	CONT m	CAT m	SOFFIT / BOOM	CANT ~~mm~~ / Deg	REFOS m	Bonds N/F	Mast Size	NOTES Positions of SI/JUMPERS, MPC, X-Contact bar, DEP. Anchors / BWA / ATetc
C	92	17	-242.3	Down Main	Pull	UK1 900 Shallow Curve	SC	L	IR	-66	5.067	N/A		0.8	2.824	B	155x160	
Mid- Span									IR					0.9				
C	92	19	-201.6	Down Main	Push	UK1 900 Shallow Curve	SC	R	IR	101	5.177	6.042		0.9	3.025	B	155x160	DEP, ANCHOR,BWA
Mid- Span								L	IR	-34	5.195	6.027		1.0				
C	92	21	-151.3	Down Main	Push	UK1 900 Shallow Curve	SC	R	IR	-13	5.273	6.952	6.515	1.1	3.138	B	600x235	
C	92	21	-151.3	Down Main	Direct	Tube	SC	L	OOR	468	5.516	6.262	6.515	1.2	3.138	B	600x235	
Mid- Span								L	IR	-384	5.361	6.486		1.0				
Mid- Span								R	OOR	109	5.362	6.064		1.1				
C	92	23	-98.5	Down Main	Direct	Tube	SC	R	OOR	9	5.363	6.289		1.0	3.350	B	600x230	HANDLE
C	92	23	-98.5	Down Main	Push	UK1 900 Shallow Curve	SC	R	IR	2	5.368	6.305		1.0	3.350	B	600x230	HANDLE
Mid- Span								L	IR	-111	5.361	6.024		1.1				
C	92	25	-52.6	Down Main	Push	UK1 900 Shallow Curve	SC	L	IR	-30	5.435	6.33		1.2	3.003	B	205x210	DEP, BWA
Mid- Span								L	IR	-134	5.446	5.887		1.1				
C	92	27	-0.4	Down Main	Direct	Tube	SC	R	IR	41	5.579	6.252	6.78	1.2	2.891	B	600x230	
BA1				Down Main	Pull	UK1 900 Shallow Curve	SC	L	IR	-76	5.583			0.9				BRIDGE ARM 1
BA2				Down Main	Pull	UK1 900 Shallow Curve	SC	L	IR	-76	5.588			0.8				BRIDGE ARM 2
BA3				Down Main	Pull	UK1 900 Shallow Curve	SC	L	IR	-98	5.577			0.9				BRIDGE ARM 3
BA4				Down Main	Pull	UK1 900 Shallow Curve	SC	L	IR	-95	5.589			0.9				BRIDGE ARM 4
BA5				Down Main	Pull	UK1 900 Shallow Curve	SC	L	IR	-118	5.601		6.28	0.9				BRIDGE ARM 5
C	92	39	77.3	Down Main	Push	UK1 900 Shallow Curve	SC	R	IR	103	5.628	5.836		1.3	3.061	B	155x155	
Mid- Span								R	IR	110	5.661	5.671		1.3				
C	92	41	99	Down Main	Push	UK1 900 Shallow Curve	SC	R	IR	90	5.686	6.316		0.7	3.112	B	155x155	
Mid- Span								L	IR	-93	5.714			0.3				
C	92	43	140.6	Down Main	Pull	UK1 900 Shallow Curve	SC	L	IR	-213	5.716	6.561		0.0	2.962	B	155x155	
Mid- Span								R	IR	15	5.622	6.128		0.1				
C	92	45	200.6	Down Main	Push	UK1 900 Deep Curve	DC	R	IR	57	5.716	6.601		0.1	1.758	B	200x205	BWA
Mid- Span								R	IR	95	5.713			0.1				
C	93	1	250.4	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-80	5.675	7.058		0.7	2.756	B	600x230	DOWN SIDE MAST
C	93	1	250.4	Down Main	Direct	Tube	DC	R	OOR	349	5.910	7.058		0.7	2.756	B	600x230	DOWN SIDE MAST
Mid- Span								L	IR	-138	5.639			0.8				
Mid- Span								R	OOR	358	5.691			0.8				
C	93	3	300.3	Down Main	Push	UK1 900 Deep Curve	DC	R	IR	65	5.635	6.614		0.4	2.975	B	600x305	BOOSTER
C	93	3	300.3	Down Main	Direct	Tube	DC	L	OOR	-424	5.872	6.614		0.4	2.975	B	600x305	BOOSTER
Mid- Span								R	IR	102	5.536	5.994		0.5				
C	93	5	365.1	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-188	5.477	6.337		0.5	2.472	B	200x210	DEP, BWA
Mid- Span								L	IR	-20	5.327	5.722		0.4				
C	93	7	431.9	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-200	5.340	6.211		1.3	2.506	B	150x160	
Mid- Span								L	IR	-20	5.271	5.731		1.4				
C	93	9	498.5	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-135	5.282	6.139		1.3	2.607	B	150x160	
Mid- Span								R	IR	20	5.211	5.608		1.2				
C	93	11	565.5	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-176	5.219	6.068		1.4	2.688	B	150x160	
Mid- Span								R	IR	15	5.122	5.517		1.3				
C	93	13	632.3	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-22	5.110	5.983		1.2	2.616	B	150x160	
Mid- Span								R	IR	43	5.013	5.412		1.1				
C	93	15	699.8	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-135	4.996	5.867		1.2	2.541	B	150x160	
Mid- Span								R	IR	5	4.876	5.271		1.0				
C	93	17	765.7	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-168	4.853	5.718		1.3	2.521	B	150x160	
Mid- Span								L	IR	-15	4.785	5.18		1.1				
C	93	19	832.5	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-156	4.837	5.722		1.0	2.365	B	150x160	
Mid- Span								L	IR	-25	4.773	5.163		1.1				
C	93	21	899	Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-170	4.801	5.666		1.2	1.996	B	150x160	
Mid- Span								R	IR	18	4.734	5.127		1.3				
C	93	23		Down Main	Pull	UK1 900 Deep Curve	DC	L	IR	-140	4.794	5.679		1.4	1.713	B	155x155	

14. Appendix D - IDC Certificate

The IDC was carried out on 16/01/13 in the Atkins Glasgow office.

ATKINS

Project Title	Cambridge Science Park
Atkins Project Number	5110967
Location of Meeting	Glasgow
Date	4/2/13
Chairperson	Rob McGowan

Present

CEM: Robert McGowan (RMcG)

E&P: Engineering Angus Malloch (AM), Stewart Douglas (SD)

OLE: Kenneth C Stewart (KCS)

Civils: Ross Rankin (RR), Craig MacFarlane (CM)

Signalling: Steven Stark (SS), Peter Bell (PBe)

PWay: John Bell (JB), Kevin Caldwell (KC)

Architecture: Quintin Doyle (QD)

Telecomms: Kashmir Lota (KL)

Interdisciplinary Design Checking Meeting

Design Reviewed by this IDC	Version
5110967/51.4/OLE/001 OLE Design – Approval in Principle	A02

Date of follow up IDC/IDR: Not required

Items Requiring Rectification:

None

ATKINS

I certify that reasonable professional skill and care has been used in the Interdisciplinary Check described above.	
Atkins Contractor's Engineering Manager	
Name	Robert D McGowan
Title	Team Leader, Electrification
Signature	
Date	4/2/13

ATKINS

CERTIFICATE OF IDC COMPLIANCE

All outline design is complete and suitable for submission for Acceptance

Atkins OLE Design CRE

Name Kenneth C Stewart
Title Principal Engineer
Signature K C Stewart
Date 4/02/13

Atkins Civils Engineer

Name Craig MacFarlane
Title Civils Design Engineer
Signature
Date 4/02/13

Atkins Permanent Way Engineer

Name John Bell
Title Permanent Way Design Manager
Signature
Date 4/2/13.

Atkins E&P Engineer

Name Angus Malloch
Title Senior Design Engineer
Signature A Malloch
Date 04/02/13

Atkins Telecommunications Engineer

Name Kashmir Lota
Title Principal Telecommunications Engineer
Signature
Date 04/2/13

Atkins Signalling Engineer

Name Steven Stark
Title Principal Signalling Engineer
Signature
Date 04/02/13

15. Appendix E – Designers Risk Assessment

DESIGNERS RISK ASSESSMENT

The risk matrix (Table 1.1) has been utilised in attributing risk to identified hazards. The product of the severity rating (S) and likelihood factor (L) determines the risk rating (R) for a given hazard.

1.1 Table: Risk Matrix

			Severity (S)				
			1	2	3	4	5
			Trivial Injury Minor Disruption	Minor Injury Minor Disruption	Major Injury Significant Disruption	Major Injury Disruption up to 1 week	Fatality Disruption 1 week +
Likelihood (L)	1	Very Unlikely	Low	Low	Minor	Minor	Minor
	2	Possible	Low	Minor	Minor	Significant	Significant
	3	Infrequent	Minor	Minor	Significant	Significant	Critical
	4	Regular	Minor	Significant	Significant	Critical	Critical
	5	Common	Minor	Significant	Critical	Critical	Critical

Table: Risk Matrix Key

Rating	Category	Description
1 – 2	Low	Control measures to be monitored to ensure no increase in risk category.
3 – 6	Minor	Control measures to be reviewed and monitored to ensure no increase in risk category.
8 – 12	Significant	Further control measures to added to reduce the risk category.
15 – 25	Critical	Risk category unacceptable.

Table: Likelihood Factor Ratings (L)

Rating	Likelihood Factor	Description
1	Very Unlikely	Very unlikely occurrence in this project.
2	Possible	Possible, but unlikely, occurrence in this project.
3	Infrequent	Possible, and likely, occurrence in this project.
4	Regular	Regular occurrence in this project.
5	Common	Common occurrence in this project.

Table: Risk Severity Ratings (S)

Rating	Severity	Description
1	Trivial Injury Minor Disruption	Trivial injury (non RIDDOR) with minor disruption / damage.
2	Minor Injury Minor Disruption	Minor injury (non RIDDOR) with minor disruption / damage.
3	Major Injury Significant Disruption	Major injury (RIDDOR) with significant disruption / damage.
4	Major Injury Disruption up to 1 week	Major injury (RIDDOR) with significant disruption (up to 1 week).
5	Fatality Disruption 1 week +	Fatality, with significant disruption (greater than 1 week).

1.2 Table: Designers Risk Assessment

Item No.	Activity	Hazard	Consequence(s)	Liklihood	Severity	Risk Factor	Risk Category	Control Measure(s)	Liklihood	Severity	Risk Factor	Risk Category	Person Responsible for Control Measures
1	Foundation/ Steelwork Installation	Structure Clearance Gauge	Potential for collision with OLE structure and rolling stock	1	4	4	Minor	Design in accordance with HMRI and Network Rail Group/Line Standards	1	1	1	Low	Designer
2	Foundation Installation	Design	Foundation cannot be installed as per design	2	2	4	Minor	Design Approval process to layout /cross section drawings Site Queries answered in time to enable new designs to be approved and issued prior to installation	2	1	2	Low	Installation Contractor Designer
3	Foundation Installation	Striking buried or existing services	Risk of Injury Major disruption to railway operations	5	4	20	Critical	Network Rail to provide buried services records to construction contractor Site verification prior to work commencing. Use of CATSCAN or similar	2	3	6	Minor	Construction Contractor
4	Foundation Installation	Contaminated Land	COSHH Issues Disposal of soil	3	4	12	Significant	Appropriate investigations carried out and recommendations actioned	1	4	4	Minor	Construction Contractor
5	Foundation Installation	Foundations not installed in accordance with design	Redesign required Programme delays Additional costs	2	3	6	Minor	Adequate site control measures applied to work As Built surveys to be undertaken Network Rail Group/Line standards to be applied	2	1	2	Low	Construction Contractor

Item No.	Activity	Hazard	Consequence(s)	Liklihood	Severity	Risk Factor	Risk Category	Control Measure(s)	Liklihood	Severity	Risk Factor	Risk Category	Person Responsible for Control Measures
6	Steelwork Installation	Signal sighting impaired	SPAD	3	4	12	Significant	Signal sighting to be considered during OLE design	1	4	4	Minor	Designer
7	Foundation Installation	Position clashes with existing or new infrastructure	Redesign required Programme delays Additional costs	2	3	6	Minor	IDC Meeting to be co-ordinated Designer to undertake survey of proposed foundation positions	1	4	4	Minor	Designer
8	Foundation Installation	Poor ground conditions requiring gravity or non OLEMI designs	Redesign required Programme delays Additional costs	3	2	6	Minor	Undertake Geo-technical SI, design special foundations where required	1	2	2	Low	Foundation Designer
9	Masts – General	Collision, rail vehicles	Derailment	1	5	5	Minor	Site structures away from vulnerable points, careful structure siting	1	5	5	Minor	Designer
10	Masts – General	Overloading	Deflection and yield leading to failure, dewirement etc.	4	5	20	Critical	Evaluate each structure. Avoid overloading or strengthen, add other structures. Design process	1	5	5	Minor	Designer
11	Conductors, Contact Wire.	Wear out	Wire failure, possible injury to installer and maintainer and public.	3	5	15	Critical	Review conditions of existing contact wire, replace as required. Improved performance for newly installed contact wires.	1	5	5	Minor	Designer

Item No.	Activity	Hazard	Consequence(s)	Liklihood	Severity	Risk Factor	Risk Category	Control Measure(s)	Liklihood	Severity	Risk Factor	Risk Category	Person Responsible for Control Measures
12	Conductors, Catenary Wire. Fatigue, Wear and Arc damage.	Installation Hazard.	Broken strands, ultimately catenary wire failure. Dewirement, electrocution, injury to installer and maintainer also public.	3	5	15	Critical	Inspection, review and replace catenary as required. Design out causes of problems for upgraded equipment.	1	5	5	Minor	Designer Construction Contractor
13	Bonding	Temporary Installations	Step and touch potential – Electrocution Wrong side failure - Train incident.	2	5	10	Significant	Bonding Plan overlay. Use correct temporary screw type clamps. Remove paint as required to ensure good electrical contact. Ensure electrical continuity of all steelwork items being bonded	1	5	5	Minor	Designer Construction Contractor.
14	Bonding	New Installations	Damage to signalling equipment under fault conditions. Wrong side failure - Train incident	2	5	10	Significant	New bonding only to be installed to a signed–off and approved bonding plan	1	5	5	Minor	Interface with Signalling Designer.
15	Wiring	High Radial Loads	Failure of components. Causing injury or possible death due to staff being knocked from wiring platform	2	5	10	Significant	Ensure components are not overloaded during installation. Identify actual loads.	1	5	5	Minor	Designer Construction Contractor
16	In-span equipment	Droppers and jumpers Poor electrical connection.	Excess conductor heating, damage to catenary wire. Failure of tension length.	2	5	10	Significant	Allocation of correct jumpers and droppers.	1	5	5	Minor	Designer

16. Appendix F – AIP Form A

FORM A (Electrical Power)

APPROVAL IN PRINCIPLE OF SINGLE OPTION SELECTION

Part 1 Submission details

Project	Cambridge Science Park Interchange Station	Project No.	5110967
Submission Title	OLE AIP Design	Submission Reference	5110967/51.4/OLE/001
Name of organisation (*where external to NR)*	Atkins	Location	200 Broomielaw, Glasgow

Part 2 Submission Details

Submission Details (to be attached to this form):
a) List of documentation
b) List of drawings
c) List other Engineering Deliverables relevant to this submission
d) Other Supporting Documents
I certify that the design submission meets the requirements outlined in Network Rail Standard NR/L2/ELP/27311 and complies with the PRS.

Signed KC Stewart	Title CRE
Name (print) Kenneth C Stewart	Date 27/02/13
To be signed by the CRE	

Part 3 Design Acceptance

I have considered this submission for Approval in Principle as required by Network Rail Standard NR/L2/ELP/27311, and I hereby give Acceptance for the submission.

Signed	Title
Name (print)	Date
To be signed by the Network Rail Project Engineer	

Part 4 Approval in Principle

I have considered this submission for Approval in Principle as required by Network Rail Standard NR/L2/ELP/27311, and I hereby give Approval In Principle for this submission.

Signed	Title
Name (print)	Date
Comments:	
To be signed by the Network Rail Route Asset Manager (or their representative)	

16. Appendix F – AIP Form A

FORM A (Electrical Power)

APPROVAL IN PRINCIPLE OF SINGLE OPTION SELECTION

Part 1 Submission details

Project	Cambridge Science Park Interchange Station	Project No.	5110967
Submission Title	OLE AIP Design	Submission Reference	5110967/51.4/OLE/001
Name of organisation *(where external to NR)*	Atkins	Location	200 Broomielaw, Glasgow

Part 2 Submission Details

Submission Details (to be attached to this form):
a) List of documentation
b) List of drawings
c) List other Engineering Deliverables relevant to this submission
d) Other Supporting Documents
I certify that the design submission meets the requirements outlined in Network Rail Standard NR/L2/ELP/27311 and complies with the PRS.

Signed KC Stewart	Title CRE
Name (print) Kenneth C Stewart	Date 27/02/13
To be signed by the CRE	

Part 3 Design Acceptance

I have considered this submission for Approval in Principle as required by Network Rail Standard NR/L2/ELP/27311, and I hereby give Acceptance for the submission.

Signed HTaylor	Title PROJECT ENGINEER (C+P)
Name (print) HELEN TAYLOR	Date 01/03/2013
To be signed by the Network Rail Project Engineer	

Part 4 Approval in Principle

I have considered this submission for Approval in Principle as required by Network Rail Standard NR/L2/ELP/27311, and I hereby give Approval In Principle for this submission.

Signed K Marshall.	Title SENIOR ASSET ENGINEER.
Name (print) KEVIN MARSHALL	Date 08/03/2013
Comments: NONE.	
To be signed by the Network Rail Route Asset Manager (or their representative)	

Mr Rob McGowan
Atkins Rail
200 Broomielaw
Glasgow G1 4RU

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Telephone: 0141 220 2000
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