THIS IS SCHEDULE PART 30 REFERRED TO IN THE FOREGOING AGREEMENT BETWEEN TIE AND THE INFRACO

SCHEDULE 30

INFRACO PROPOSALS

	Bilfinger Berger – Siemens Consortium					
	Edinburgh Tram Network **Infraco Proposals – Civil**					
1	**Introduction**					
1.1	BBS proposals for Civil Works are the SDS Design, to be developed and finalised to Issued For Construction (IFC) status under the Design Management Plan in Schedule Part 14					
1.2	The Design is, at present, incomplete or not issued to BBS for some Sections of the Works					
1.3	We refer to the Design Due Diligence Summary Report Rev 2B 18 02 2008, Appendix C					
1.4	The Design will, where possible, be developed and finalised in accordance with Section 3 4, Pricing Assumptions included in Part 4 of the Schedule to the Infraco Contract					
1.5	Part 4 of the Schedule deals with Notified Departures from the Pricing Assumptions					
Appendix A	Document List					
Appendix B	Due Diligence Summary Report Rev 2B 18 02 2008					
Appendix C	Construction Support by SDS					
2	**Requirements for Development and Finalisation of SDS Design**					
2.1	System Wide	**Information from BBS to SDS**	Description of Design completion activities			
2.1.1	**Surveys**					
2.1.1.1	Surveys need to be completed to ensure a safe and economic design.		see Sections			
2.1.1.2	Confirm adequacy of existing structures and that as built records and/or valid historical surveys are acceptable		see Sections			
2.1.1.3	Monitoring requirements need to be defined		see Sections			
2.2	**Land Made Available**					
2.2.1	Available land is to be identified in drawing and setting out data format.		**Available land is to be identified in drawing and setting out data format**			
2.3	**Risks**					
2.3.2	Construction risks related to design are to be identified.		**Residual Risk from Design/Designer Hazard Log to be completed for all Design packages**			
2.4	**Construction Support**					
	Construction Support by SDS Site Staff		See Appendix C			

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	Infraco Proposals and Requirements for Development and Finalisation of SDS Desig				
	Section 1A				
			Information from BBS to SDS	**Description of Design completion activities**	
1A.1	**Trackform**				
1A.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				
1A.1.2	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.		SDS believe that loadings are required to enable them to complete this Design activity	Incorporate BBS selected Trackform on drawings and confirm minimum track construction depth and corresponding formation condition requirement as Pricing Assumption or at some other depth condition measure to be agreed/approved by SDS, BBS, tie and CEC	
1A.2	**Sytems and Power Cable Ducts**				
1A.2.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Information on cabling requirements to be supplied to SDS by BBS	Design duct group and spacing to accommodate cabling requirements and incorporate information on drawings	
	Geometry				
1A.3	**Horizontal Alignment**				
1A.3.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Complete Design	
1A.3.2	Confirmation required that alignment is compatible with CAF Tram DKE and LOD.			Incorporate CAF Tram DKE in Design	
1A.4	**Vertical Alignment**				

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		Information from BBS to SDS	Description of Design completion activities	
1A.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1A.4.2	Revise alignment, where possible and where Programme permits for on-street section to minimise Roads work-scope.		Revise, generally raise, vertical alignment of Track	
1A.4.3	Revised alignment required to facilitate direct fixing of rails to structures and guideway.		Revise, lower, vertical alignment of Track	
1A.5	**Tramstops**			
1A.5.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1A.6	**Sub-station Buildings**			
1A.6.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information on Sub-station equipment to be supplied to SDS by BBS	Complete Design	
1A.7	**OLE Foundations**			
1A.7.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information from BBS to be issued on OLE poles, including loadings.	Design OLE Foundations	
1A.8	**Site Clearance**			
1A.8.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1A.9	**Earthworks**			
1A.9.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Earthworks Design	

				Information from BBS to SDS	Description of Design completion activities	
1A.9.2	Requirements for excavation and filling below Earthworks Outline to be designed and specified and assessment of anticipated formation conditions				Standard Details for treatment of low CBR or Stiffness or Soft Material; excavate and replace with class 6, Lime Modification, Geotextiles	
1A.9.3					Extent; length, width and depth of areas requiring earthworks below Earthworks Outline	
1A.9.4	Formation requirements to be confirmed.				CBR or Stiffness Requirements at Formation for Highways and Track	
1A.9.5	Requirements for excavation and disposal of contaminated material, and refilling of void, to be designed and specified.				Extent; length, width and depth of areas requiring earthworks below Earthworks Outline and materials to be used for refilling where required	
1A.9.6	Special Geotechnical measures, e.g. embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.				embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.	
1A.10	**Roads**					
1A.10.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	

		Information from BBS to SDS	Description of Design completion activities	
1A.10.2	Subject to survey, pavement design to be developed and finalised to minimise work scope		Pavement design is to be revised to a plane and re-surface (new regulating and surface course only) when survey information is available and where it confirms the feasability of this design solution Note This activity is an alternative to the Vertical Alignment activity above)	
1A.10.3	Further pavement surveys and assessments are required.		GPR and/or Pavement Condition surveys as required by 1A.10.2 (above)	
1A.11	**Drainage**			
1A.11.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1A.11.2	Requirements for maximising use of and connection to existing drainage network to be confirmed.		Review and complete design	
1A.12	**Landscaping**			
1A.12.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1A.13	**Accommodation Works**			
1A.13.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
	Structures (Bridges and Walls)			
1A.14	**W1 Lindsay Road**			

				Information from BBS to SDS	Description of Design completion activities	
1A.14.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
1A.15	**S16 Victoria Dock Entrance**					
1A.15.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
1A.16	**S17 Tower Place**					
1A.16.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	

	Infraco Proposals and Requirements for Development and Finalisation of SDS Design			
	Section 1B			
		Information from BBS to SDS	**Description of Design completion activities**	
1B.1	**Trackform**			
1B.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			
1B.1.2	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.		Incorporate BBS selected Trackform on drawings and confirm minimum track construction depth and corresponding formation condition requirement as Pricing Assumption or at some other depth condition measure to be agreed/approved by SDS, BBS, tie and CEC	
1B.2	**Sytems and Power Cable Ducts**			
1B.2.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information on cabling requirements to be supplied to SDS by BBS	Design duct group and spacing to accommodate cabling requirements and incorporate information on drawings	
	Geometry			
1B.3	**Horizontal Alignment**			
1B.3.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1B.3.2	Confirmation required that alignment is compatible with CAF Tram DKE and LOD.		Incorporate CAF Tram DKE in Design	
1B.4	**Vertical Alignment**			

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		Information from BBS to SDS	Description of Design completion activities	
1B.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1B.4.2	Revise alignment, where possible and where Programme permits to minimise Roads work-scope.		Revise, generally raise, vertical alignment of Track	
1B.5	**Tramstops**			
1B.5.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1B.6	**Sub-station Buildings**			
1B.6.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information on Sub-station equipment to be supplied to SDS by BBS	Complete Design	
1B.7	**OLE Foundations**			
1B.7.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information from BBS to be issued on OLE poles, including loadings.	Design OLE Foundations	
1B.8	**Site Clearance**			
1B.8.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1B.9	**Earthworks**			
1B.9.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Earthworks Design	

				Information from BBS to SDS	Description of Design completion activities	
1B.9.2	Requirements for excavation and filling below Earthworks Outline to be designed and specified and assessment of anticipated formation conditions				Standard Details for treatment of low CBR or Stiffness or Soft Material; excavate and replace with class 6, Lime Modification, Geotextiles	
1B.9.3					Extent; length, width and depth of areas requiring earthworks below Earthworks Outline	
1B.9.4	Formation requirements to be confirmed.				CBR or Stiffness Requirements at Formation for Highways and Track	
1B.9.5	Requirements for excavation and disposal of contaminated material, and refilling of void, to be designed and specified.				Extent; length, width and depth of areas requiring earthworks below Earthworks Outline and materials to be used for refilling where required	
1B.10	**Roads**					
1B.10.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design					
1B.10.2	Subject to survey, pavement design to be developed and finalised to minimise work scope				Pavement design is to be revised to a plane and re-surface (new regulating and surface course only) when survey information is available and where it confirms the feasability of this design solution Note This activity is an alternative to the Vertical Alignment activity above)	
1B.10.3	Further pavement surveys and assessments are required.				GPR and/or Pavement Condition surveys as required by 1B.10.2 (above)	

				Information from BBS to SDS	Description of Design completion activities	
1B.11	**Drainage**					
1B.11.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
1B.11.2	Requirements for maximising use of and connection to existing drainage network to be confirmed.				Review and complete design	
1B.12	**Landscaping**					
1B.12.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design					
1B.13	**Accommodation Works**					
1B.13.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
	Structures (Bridges and Walls)					
1B.14	**S18 Leith Walk Railway**					
1B.14.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	

	Infraco Proposals and Requirements for Development and Finalisation of SDS Desig			
	Section 1C			
		Information from BBS to SDS	**Description of Design completion activities**	
1C.1	**Trackform**			
1C.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1C.1.2	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.		Incorporate BBS selected Trackform on drawings and confirm minimum track construction depth and corresponding formation condition requirement as Pricing Assumption or at some other depth condition measure to be agreed/approved by SDS, BBS, tie and CEC	
1C.2	**Sytems and Power Cable Ducts**			
1C.2.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information on cabling requirements to be supplied to SDS by BBS	Design duct group and spacing to accommodate cabling requirements and incorporate information on drawings	
	Geometry			
1C.3	**Horizontal Alignment**			
1C.3.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1C.3.2	Confirmation required that alignment is compatible with CAF Tram DKE and LOD.		Incorporate CAF Tram DKE in Design	
1C.4	**Vertical Alignment**			

	Section 1C			
		Information from BBS to SDS	**Description of Design completion activities**	
1C.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1C.4.2	Revise alignment, where possible and where Programme permits to minimise Roads work-scope.		Revise, generally raise, vertical alignment of Track	
1C.5	**Tramstops**			
1C.5.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1C.6	**Sub-station Buildings**			
1C.6.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information on Sub-station equipment to be supplied to SDS by BBS	Complete Design	
1C.7	**OLE Foundations**			
1C.7.1	Design to be completed to IFC status and all design consents and approvals obtained.	Information from BBS to be issued on OLE poles, including loadings.	Design OLE Foundations	
1C.8	**Site Clearance**			
1C.8.1	Design to be completed to IFC status and all design consents and approvals obtained.		Complete Design	
1C.9	**Earthworks**			
1C.9.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Earthworks Design	

	Section 1C					
				Information from BBS to SDS	**Description of Design completion activities**	
1C.9.2	Requirements for excavation and filling below Earthworks Outline to be designed and specified and assessment of anticipated formation conditions				Standard Details for treatment of low CBR or Stiffness or Soft Material; excavate and replace with class 6, Lime Modification, Geotextiles	
1C.9.3					Extent; length, width and depth of areas requiring earthworks below Earthworks Outline	
1C.9.4	Formation requirements to be confirmed.				CBR or Stiffness Requirements at Formation for Highways and Track	
1C.9.5	Requirements for excavation and disposal of contaminated material, and refilling of void, to be designed and specified.				Extent; length, width and depth of areas requiring earthworks below Earthworks Outline and materials to be used for refilling where required	
1C.10	**Roads**					
1C.10.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design					
1C.10.2	Subject to survey, pavement design to be developed and finalised to minimise work scope				Pavement design is to be revised to a plane and re-surface (new regulating and surface course only) when survey information is available and where it confirms the feasability of this design solution Note This activity is an alternative to the Vertical Alignment activity above)	

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	Section 1C	Information from BBS to SDS	Description of Design completion activities	
1C.10.3	Further pavement surveys and assessments are required.		GPR and/or Pavement Condition surveys as required by 1C.10.2 (above)	
1C.11	**Drainage**			
1C.11.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1C.11.2	Requirements for maximising use of and connection to existing drainage network to be confirmed.		Review and complete design	
1C.12	**Landscaping**			
1C.12.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
1C.13	**Accommodation Works**			
1C.13.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	

	Infraco Proposals and Requirements for Development and Finalisation of SDS Desigr						
	Section 1D						
				Information from BBS to SDS	**Description of Design completion activities**		
1D.1	**Trackform**						
1D.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design						
1D.1.2	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.				Incorporate BBS selected Trackform on drawings and confirm minimum track construction depth and corresponding formation condition requirement as Pricing Assumption or at some other depth condition measure to be agreed/approved by SDS, BBS, tie and CEC		
1D.2	**Sytems and Power Cable Ducts**						
1D.2.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Information on cabling requirements to be supplied to SDS by BBS	Design duct group and spacing to accommodate cabling requirements and incorporate information on drawings		
	Geometry						
1D.3	**Horizontal Alignment**						
1D.3.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design		
1D.3.2	Confirmation required that alignment is compatible with CAF Tram DKE and LOD.				Incorporate CAF Tram DKE in Design		
1D.4	**Vertical Alignment**						

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				Information from BBS to SDS	Description of Design completion activities	
1D.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
1D.4.2	Revise alignment, where possible and where Programme permits to minimise Roads work-scope.				Revise, generally raise, vertical alignment of Track	
1D.5	**Tramstops**					
1D.5.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
1D.6	**Sub-station Buildings**					
1D.6.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Information on Sub-station equipment to be supplied to SDS by BBS	Complete Design	
1D.7	**OLE Foundations**					
1D.7.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Information from BBS to be issued on OLE poles, including loadings.	Design OLE Foundations	
1D.8	**Site Clearance**					
1D.8.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
1D.9	**Earthworks**					
1D.9.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Earthworks Design	

				Information from BBS to SDS	Description of Design completion activities	
1D.9.2	Requirements for excavation and filling below Earthworks Outline to be designed and specified and assessment of anticipated formation conditions				Standard Details for treatment of low CBR or Stiffness or Soft Material; excavate and replace with class 6, Lime Modification, Geotextiles	
1D.9.3					Extent; length, width and depth of areas requiring earthworks below Earthworks Outline	
1D.9.4	Formation requirements to be confirmed.				CBR or Stiffness Requirements at Formation for Highways and Track	
1D.9.5	Requirements for excavation and disposal of contaminated material, and refilling of void, to be designed and specified.				Extent; length, width and depth of areas requiring earthworks below Earthworks Outline and materials to be used for refilling where required	
1D.9.6	Special Geotechnical measures, e.g. embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.				embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.	
1D.10	**Roads**					
1D.10.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design					

				Information from BBS to SDS	Description of Design completion activities	
1D.10.2	Subject to survey, pavement design to be developed and finalised to minimise work scope				Pavement design is to be revised to a plane and re-surface (new regulating and surface course only) when survey information is available and where it confirms the feasability of this design solution Note This activity is an alternative to the Vertical Alignment activity above)	
1D.10.3	Further pavement surveys and assessments are required.				GPR and/or Pavement Condition surveys as required by 1D.10.2 (above)	
1D.11	**Drainage**					
1D.11.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
1D.11.2	Requirements for maximising use of and connection to existing drainage network to be confirmed.				Review and complete design	
1D.12	**Landscaping**					
1D.12.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
1D.13	**Accommodation Works**					
1D.13.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	

	Infraco Proposals and Requirements for Development and Finalisation of SDS Desigr			
	Section 2A			
		Information from BBS to SDS	**Description of Design completion activities**	
2A.1	**Trackform**			
2A.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			
2A.1.2	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.		Incorporate BBS selected Trackform on drawings and confirm minimum track construction depth and corresponding formation condition requirement as Pricing Assumption or at some other depth condition measure to be agreed/approved by SDS, BBS, tie and CEC	
2A.2	**Sytems and Power Cable Ducts**			
2A.2.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information on cabling requirements to be supplied to SDS by BBS	Design duct group and spacing to accommodate cabling requirements and incorporate information on drawings	
	Geometry			
2A.3	**Horizontal Alignment**			
2A.3.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
2A.3.2	Confirmation required that alignment is compatible with CAF Tram DKE and LOD.		Incorporate CAF Tram DKE in Design	
2A.4	**Vertical Alignment**			

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				Information from BBS to SDS	Description of Design completion activities	
2A.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
2A.4.2	Revise alignment, where possible and where Programme permits to minimise Roads work-scope.				Revise, generally raise, vertical alignment of Track	
2A.4.3	Revised alignment required to facilitate direct fixing of rails to structures				Revise, lower, vertical alignment of Track	
2A.5	**Tramstops**					
2A.5.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
2A.6	**Sub-station Buildings**					
2A.6.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Information on Sub-station equipment to be supplied to SDS by BBS	Complete Design	
2A.7	**OLE Foundations**					
2A.7.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Information from BBS to be issued on OLE poles, including loadings.	Design OLE Foundations	
2A.8	**Site Clearance**					
2A.8.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
2A.9	**Earthworks**					
2A.9.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Earthworks Design	

				Information from BBS to SDS	Description of Design completion activities	
2A.9.2	Requirements for excavation and filling below Earthworks Outline to be designed and specified and assessment of anticipated formation conditions				Standard Details for treatment of low CBR or Stiffness or Soft Material; excavate and replace with class 6, Lime Modification, Geotextiles	
2A.9.3					Extent; length, width and depth of areas requiring earthworks below Earthworks Outline	
2A.9.4	Formation requirements to be confirmed.				CBR or Stiffness Requirements at Formation for Highways and Track	
2A.9.5	Requirements for excavation and disposal of contaminated material, and refilling of void, to be designed and specified.				Extent; length, width and depth of areas requiring earthworks below Earthworks Outline and materials to be used for refilling where required	
2A.9.6	Special Geotechnical measures, e.g. embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.				embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.	
2A.10	**Roads**					
2A.10.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design					

				Information from BBS to SDS	Description of Design completion activities	
2A.10.2	Subject to survey, pavement design to be developed and finalised to minimise work scope				Pavement design is to be revised to a plane and re-surface (new regulating and surface course only) when survey information is available and where it confirms the feasability of this design solution Note This activity is an alternative to the Vertical Alignment activity above)	
2A.10.3	Further pavement surveys and assessments are required.				GPR and/or Pavement Condition surveys as required	
2A.11	**Drainage**					
2A.11.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
2A.11.2	Requirements for maximising use of and connection to existing drainage network to be confirmed.				Review and complete design	
2A.12	**Landscaping**					
2A.12.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design					
2A.13	**Accommodation Works**					
2A.13.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
	Structures (Bridges and Walls)					
2A.14	**S19 Haymarket Viaduct**					

USB00000088_0024

		Information from BBS to SDS	Description of Design completion activities	
2A.14.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
2A.14.2	Requirements for a design condition survey of the existing wall.		Carry out or complete Condition Survey	
2A.14.3	Requirements for special foundations at Pier 4 and Abutment E to be confirmed.		Review Design	
2A.15	**S20 Russell Road**			
2A.15.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
2A.15.2	Possible re-design (subject to programme allowance) of sub-structure to improve buildability	refer to Appendix B	refer to Appendix B	

	Infraco Proposals and Requirements for Development and Finalisation of SDS Design				
	Section 5A				
			Information from BBS to SDS	**Description of Design completion activities**	
5A.1	**Trackform**				
5A.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				
5A.1.2	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.			Incorporate BBS selected Trackform on drawings and confirm minimum track construction depth and corresponding formation condition requirement as Pricing Assumption or at some other depth condition measure to be agreed/approved by SDS, BBS, tie and CEC	
5A.2	**Sytems and Power Cable Ducts**				
5A.2.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Information on cabling requirements to be supplied to SDS by BBS	Design duct group and spacing to accommodate cabling requirements and incorporate information on drawings	
	Geometry				
5A.3	**Horizontal Alignment**				
5A.3.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Complete Design	
5A.3.2	Confirmation required that alignment is compatible with CAF Tram DKE and LOD.			Incorporate CAF Tram DKE in Design	
5A.4	**Vertical Alignment**				

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		Information from BBS to SDS	Description of Design completion activities	
5A.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5A.4.2	Revised alignment required to facilitate direct fixing of rails to structures		Revise, lower, vertical alignment of Track	
5A.5	**Tramstops**			
5A.5.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5A.6	**Sub-station Buildings**			
5A.6.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information on Sub-station equipment to be supplied to SDS by BBS	Complete Design	
5A.7	**OLE Foundations**			
5A.7.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information from BBS to be issued on OLE poles, including loadings.	Design OLE Foundations	
5A.8	**Site Clearance**			
5A.8.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5A.9	**Earthworks**			
5A.9.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Earthworks Design	

				Information from BBS to SDS	Description of Design completion activities	
5A.9.2	Requirements for excavation and filling below Earthworks Outline to be designed and specified and assessment of anticipated formation conditions				Standard Details for treatment of low CBR or Stiffness or Soft Material; excavate and replace with class 6, Lime Modification, Geotextiles	
5A.9.3					Extent; length, width and depth of areas requiring earthworks below Earthworks Outline	
5A.9.4	Formation requirements to be confirmed.				CBR or Stiffness Requirements at Formation for Highways and Track	
5A.9.5	Requirements for excavation and disposal of contaminated material, and refilling of void, to be designed and specified.				Extent; length, width and depth of areas requiring earthworks below Earthworks Outline and materials to be used for refilling where required	
5A.9.6	Special Geotechnical measures, e.g. embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.				embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.	
5A.10	**Roads**					
5A.10.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design					

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		Information from BBS to SDS	Description of Design completion activities	
5A.10.2	Subject to survey, pavement design to be developed and finalised to minimise work scope		Pavement design is to be revised to a plane and re-surface (new regulating and surface course only) when survey information is available and where it confirms the feasability of this design solution Note This activity is an alternative to the Vertical Alignment activity above)	
5A.10.3	Further pavement surveys and assessments are required.		GPR and/or Pavement Condition surveys as required by xxxx (above)	
5A.11	**Drainage**			
5A.11.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5A.11.2	Requirements for maximising use of and connection to existing drainage network to be confirmed.		Review and complete design	
5A.12	**Landscaping**			
5A.12.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			
5A.13	**Accommodation Works**			
5A.13.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
	Structures (Bridges and Walls)			
5A.14	**W3 Russell Road (Wall) No 1**			

				Information from BBS to SDS	Description of Design completion activities	
5A.14.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5A.15	**W4 Russell Road (Wall) No 2**					
5A.15.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5A.16	**W18 Murrayfield Tramstop (Wall)**					
5A.16.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Further GI required to inform Design	
5A.17	**S21A Roseburn Street Viaduct**					
5A.17.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5A.17.2	Possible re-design to reduce scope and cost.				Re-Design to 2 separate single span structures with re-inforced earth walled embankments replacing removed spans	
5A.17.3	Further GI required to confirm foundation design.				Further GI, in conjunction with GI for W18 (see above) to ascertain extent of soft layer	
5A.17.4	Re-design required to allow cost efficient fabrication of structural steel.			Appoint steelwork sub-contractor	Liaise with BBS and steelwork sub-contractor and re-design/re-detail accordingly	
5A.18	**S21B Murrayfield Stadium (Wall)**					

		Information from BBS to SDS	Description of Design completion activities	
5A.18.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5A.19	**S21C Murrayfield Stadium Underpass**			
5A.19.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5A.20	**S21D Murrayfield Training Pitches**			
5A.20.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5A.21	**S21E Water of Leith**			
5A.21.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5A.21.2	Subject to Programme allowance, redesign pier foundations to improve buildability.		Re-design with 2 No larger dia bored piles (mono-piles), one per column. Design a direct connection to the columns, to be made within the pile casing. Pile casings will be cut off at river bed level	
5A.21.3	Re-design required to allow cost efficient fabrication of structural steel.	Appoint steelwork sub-contractor	Liaise with BBS and steelwork sub-contractor and re-design/re-detail accordingly	
5A.22	**W8 Baird Drive**			
5A.22.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			
5A.23	**S22 Balgreen Road (A and B)**			

		Information from BBS to SDS	Description of Design completion activities
5A.23.1	Design to be completed to IFC status. all design consents and approvals obtained and BBS will construct IFC Design		

	Infraco Proposals and Requirements for Development and Finalisation of SDS Design				
	Section 5B				
			Information from BBS to SDS	**Description of Design completion activities**	
5B.1	**Trackform**				
5B.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Complete Design	
5B.1.2	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.			Incorporate BBS selected Trackform on drawings and confirm minimum track construction depth and corresponding formation condition requirement as Pricing Assumption or at some other depth condition measure to be agreed/approved by SDS, BBS, tie and CEC	
5B.2	**Sytems and Power Cable Ducts**				
5B.2.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Information on cabling requirements to be supplied to SDS by BBS	Design duct group and spacing to accommodate cabling requirements and incorporate information on drawings	
	Geometry				
5B.3	**Horizontal Alignment**				
5B.3.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Complete Design	
5B.3.2	Confirmation required that alignment is compatible with CAF Tram DKE and LOD.			Incorporate CAF Tram DKE in Design	
5B.4	**Vertical Alignment**				

		Information from BBS to SDS	Description of Design completion activities	
5B.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5B.4.2	Revised alignment required to facilitate direct fixing of rails to structures and guideway.		Revise, lower, vertical alignment of Track	
5B.5	**Tramstops**			
5B.5.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5B.6	**Sub-station Buildings**			
5B.6.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information on Sub-station equipment to be supplied to SDS by BBS	Complete Design	
5B.7	**OLE Foundations**			
5B.7.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information from BBS to be issued on OLE poles, including loadings.	Design OLE Foundations	
5B.8	**Site Clearance**			
5B.8.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5B.9	**Earthworks**			
5B.9.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Earthworks Design	

				Information from BBS to SDS	**Description of Design completion activities**	
5B.9.2	Requirements for excavation and filling below Earthworks Outline to be designed and specified and assessment of anticipated formation conditions				Standard Details for treatment of low CBR or Stiffness or Soft Material; excavate and replace with class 6, Lime Modification, Geotextiles	
5B.9.3					Extent; length, width and depth of areas requiring earthworks below Earthworks Outline	
5B.9.4	Formation requirements to be confirmed.				CBR or Stiffness Requirements at Formation for Highways and Track	
5B.9.5	Requirements for excavation and disposal of contaminated material, and refilling of void, to be designed and specified.				Extent; length, width and depth of areas requiring earthworks below Earthworks Outline and materials to be used for refilling where required	
5B.9.6	Special Geotechnical measures, e.g. embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.				embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.	
5B.10	**Roads**					
5B.10.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	

				Information from BBS to SDS	Description of Design completion activities	
5B.10.2	Subject to survey, pavement design to be developed and finalised to minimise work scope				Pavement design is to be revised to a plane and re-surface (new regulating and surface course only) when survey information is available and where it confirms the feasability of this design solution Note This activity is an alternative to the Vertical Alignment activity above)	
5B.10.3	Further pavement surveys and assessments are required.				GPR and/or Pavement Condition surveys as required by 5B.10.2 (above)	
5B.11	**Drainage**					
5B.11.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5B.11.2	Requirements for maximising use of and connection to existing drainage network to be confirmed.				Review and complete design	
5B.12	**Landscaping**					
5B.12.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5B.13	**Accommodation Works**					
5B.13.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
	Structures (Bridges and Walls)					
5B.14	**W9 Balgreen Road (Wall)**					

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		Information from BBS to SDS	Description of Design completion activities	
5B.14.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5B.15	**S23 Carrick Knowe**			
5B.15.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5B.15.2	Completed design to have foundations outwith Track Support Zone ?		Review and Revise Design	
5B.16	**S26 South Gyle Access Road**			
5B.16.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5B.17	**W11 Bankhead Drive Tramstop (Wall)**			
5B.17.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5B.18	**S27 Edinburgh Park Station Viaduct**			
5B.18.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5B.18.2	Possible re-design to reduce scope and cost		Redesign piers with flared tops and/or crossheads so that pre-cast deck beams can be placed without the need for Temporary Works (temporary beam supports)	
5B.18.3	Completed design to have foundations outwith Track Support Zone		Review and Revise Design	

	Infraco Proposals and Requirements for Development and Finalisation of SDS Design					
	Section 5C					
				Information from BBS to SDS	**Description of Design completion activities**	
5C.1	**Trackform**					
5C.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5C.1.2	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.				Incorporate BBS selected Trackform on drawings and confirm minimum track construction depth and corresponding formation condition requirement as Pricing Assumption or at some other depth condition measure to be agreed/approved by SDS, BBS, tie and CEC	
5C.2	**Sytems and Power Cable Ducts**					
5C.2.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Information on cabling requirements to be supplied to SDS by BBS	Design duct group and spacing to accommodate cabling requirements and incorporate information on drawings	
	Geometry					
5C.3	**Horizontal Alignment**					
5C.3.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5C.3.2	Confirmation required that alignment is compatible with CAF Tram DKE and LOD.				Incorporate CAF Tram DKE in Design	
5C.4	**Vertical Alignment**					

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				Information from BBS to SDS	Description of Design completion activities	
5C.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5C.4.2	Revised alignment required to facilitate direct fixing of rails to structures				Revise, lower, vertical alignment of Track	
5C.5	**Tramstops**					
5C.5.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5C.6	**Sub-station Buildings**					
5C.6.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Information on Sub-station equipment to be supplied to SDS by BBS	Complete Design	
5C.7	**OLE Foundations**					
5C.7.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Information from BBS to be issued on OLE poles, including loadings.	Design OLE Foundations	
5C.8	**Site Clearance**					
5C.8.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
5C.9	**Earthworks**					
5C.9.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Earthworks Design	

				Information from BBS to SDS	**Description of Design completion activities**	
5C.9.2	Requirements for excavation and filling below Earthworks Outline to be designed and specified and assessment of anticipated formation conditions				Standard Details for treatment of low CBR or Stiffness or Soft Material; excavate and replace with class 6, Lime Modification, Geotextiles	
5C.9.3					Extent; length, width and depth of areas requiring earthworks below Earthworks Outline	
5C.9.4	Formation requirements to be confirmed.				CBR or Stiffness Requirements at Formation for Highways and Track	
5C.9.5	Requirements for excavation and disposal of contaminated material, and refilling of void, to be designed and specified.				Extent; length, width and depth of areas requiring earthworks below Earthworks Outline and materials to be used for refilling where required	
5C.9.6	Special Geotechnical measures, e.g. embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.				embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.	
5C.10	**Roads**					
5C.10.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design					

		Information from BBS to SDS	Description of Design completion activities	
5C.10.2	Subject to survey, pavement design to be developed and finalised to minimise work scope		Pavement design is to be revised to a plane and re-surface (new regulating and surface course only) when survey information is available and where it confirms the feasability of this design solution Note This activity is an alternative to the Vertical Alignment activity above)	
5C.10.3	Further pavement surveys and assessments are required.		GPR and/or Pavement Condition	
5C.11	**Drainage**			
5C.11.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5C.11.2	Requirements for maximising use of and connection to existing drainage network to be confirmed.		Review and complete design	
5C.12	**Landscaping**			
5C.12.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5C.13	**Accommodation Works**			
5C.13.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
	Structures (Bridges and Walls)			
5C.14	**W19 Gyle Tramstop (Wall)**			

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		Information from BBS to SDS	Description of Design completion activities	
5C.14.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
5C.15	**S28 A8 Underpass**			
5C.15.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			
5C.15.2	Subject to Programme allowance, re-design to incorporate a more economical piling solution along with further GI to confirm ground water regime.		subject to programme allowance, re-design secant piles as contiguous piles	
5C.15.3	Re-design for BT duct crossing (over structure)		re-design section of underpass to facilitate construction under BT duct	

	Infraco Proposals and Requirements for Development and Finalisation of SDS Design			
	Depot (Section 6)	**Information from BBS to SDS**	**Description of Design completion activities**	
6.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
6.2	Building			
6.2.1	Liaison on steelwork design for Depot Building may be required to allow BBS to comply with BAA requirements for notice period to lower crane jibs if BAA require use of the auxiliary runway. Any re-design is unlikely or minimal		Liaise with structural steel subcontractor on design of steelwork, where required, to allow BBS to comply with BAA requirements for notice period to lower crane jibs if BAA require use of the auxiliary runway	
6.3	Trackform			
6.3.1	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.			
	Structures (Bridges and Walls)			
6.4	**S32 Depot Access Bridge (or Depot Access Bridges)**			
6.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Design to be completed from basic information, discussed at meeting on xxxx between BBS and SDS. The DABs are to be 2 separate structures. BBS will work with SDS to develop a cost effective Design	

	Infraco Proposals and Requirements for Development and Finalisation of SDS Desigr					
	Section 7A					
				Information from BBS to SDS	**Description of Design completion activities**	
7A.1	**Trackform**					
7A.1.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design					
7A.1.2	Cross sections required to reflect BBS's selected Track System, including minimum track construction depths (top of rail to formation) with corresponding formation condition requirements.				Incorporate BBS selected Trackform on drawings and confirm minimum track construction depth and corresponding formation condition requirement as Pricing Assumption or at some other depth condition measure to be agreed/approved by SDS, BBS, tie and CEC	
7A.2	**Sytems and Power Cable Ducts**					
7A.2.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design			Information on cabling requirements to be supplied to SDS by BBS	Design duct group and spacing to accommodate cabling requirements and incorporate information on drawings	
	Geometry					
7A.3	**Horizontal Alignment**					
7A.3.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design				Complete Design	
7A.3.2	Confirmation required that alignment is compatible with CAF Tram DKE and LOD.				Incorporate CAF Tram DKE in Design	
7A.4	**Vertical Alignment**					

		Information from BBS to SDS	Description of Design completion activities	
7A.4.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
7A.4.2	Revised alignment required to facilitate direct fixing of rails to structures		Revise, lower, vertical alignment of Track	
7A.5	**Tramstops**			
7A.5.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
7A.6	**Sub-station Buildings**			
7A.6.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information on Sub-station equipment to be supplied to SDS by BBS	Complete Design	
7A.7	**OLE Foundations**			
7A.7.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design	Information from BBS to be issued on OLE poles, including loadings.	Design OLE Foundations	
7A.8	**Site Clearance**			
7A.8.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design	
7A.9	**Earthworks**			
7A.9.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Earthworks Design	

				Information from BBS to SDS	Description of Design completion activities	
7A.9.2	Requirements for excavation and filling below Earthworks Outline to be designed and specified and assessment of anticipated formation conditions				Standard Details for treatment of low CBR or Stiffness or Soft Material; excavate and replace with class 6, Lime Modification, Geotextiles	
7A.9.3					Extent; length, width and depth of areas requiring earthworks below Earthworks Outline	
7A.9.4	Formation requirements to be confirmed.				CBR or Stiffness Requirements at Formation for Highways and Track	
7A.9.5	Requirements for excavation and disposal of contaminated material, and refilling of void, to be designed and specified.				Extent; length, width and depth of areas requiring earthworks below Earthworks Outline and materials to be used for refilling where required	
7A.9.6	Special Geotechnical measures, e.g. embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.				embankment slope steepening (by selection of fill type, re-inforced earth) cut slope steepening (by slope drains, buttresses, soil nails) soft ground treatment (by surcharging/consolidation, load transfer platforms) to be designed and specified.	
7A.9.7	Design special Geotechnical measures for Gogar Landfill Site. Solution to be dev				Design solution to be developed with BBS Engineers for surcharge embankment with appropriate consolidation period and excavation and replacement in the vicinity of Gogarburn Bridge East Abutment	

		Information from BBS to SDS	Description of Design completion activities
7A.10	**Roads**		
7A.10.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		
7A.11	**Drainage**		
7A.11.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design
7A.11.2	Requirements for maximising use of and connection to existing drainage network to be confirmed.		Review and complete design
7A.12	**Landscaping**		
7A.12.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design
7A.13	**Accommodation Works**		
7A.13.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design
	Structures (Bridges and Walls)		
7A.14	**S29 Gogar Burn**		
7A.14.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design
7A.15	**S30, 31 and 34 Gogarburn Culverts 1,2 and 3**		
7A.15.1	Design to be completed to IFC status, all design consents and approvals obtained and BBS will construct IFC Design		Complete Design
7A.16	**W14 and 15 Gogarburn Walls 1 and 2**		

		Information from BBS to SDS	Description of Design completion activities
7A.16.1	Design to be completed to IFC status. all design consents and approvals obtained and BBS will construct IFC Design		Complete Design

31st March 2008

Updated Proposal Submission

Edinburgh Tram Network

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Combined Proposal

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Combined Technical E&M Proposal

	Doc-Name
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1.	System Engineering
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Section 1: Overall PM Concept

Part 1 – Programme and Project Execution

Table of Content

1 Project Management Plan

1.1 Introduction

This document summarises the fundamentals of the BBS Consortium project management system, its approach, key tools and procedures. It explains the general approach for all the organizational units and its implementation through appropriate planning and setting appropriate targets.

When Consortium, BBS (Bilfinger+Berger, Siemens) or BBS Consortium is used in this document or its annexes, it stands only for the E&M part of the Edinburgh Tram Network.

1.2 Customer Requirements

As requested by the Employer's Requirements, the Consortium presents herewith the General Project Management Plan.
The following graphic illustrates how the Employer's requirements will be implemented as part of the project implementation philosophy. The project management system provides the proven approach to achieve the desired results to the complete satisfaction of the Employer.

Figure 1: Management System Cycle

1.3 Project Management Approach

The cornerstone for the Consortium Project Management Approach will be the implementation of the Edinburgh Tram Network Project. The Management System

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is Risk-Based, Process-Driven and will integrate the various Management Systems of the Partners and Sub-systems. Thru implementation of an integrated management system, Infraco can integrate the various project management operations within each and every sub-system of the project to better assure implementation of the project requirements and also provide the objective evidence needed to demonstrate compliance.

The process, with a strong Systems Engineering and Systems Integration lead, proves crucial in support of maintaining the integrated operation method for overall mechanical and electrical system engineering and civil engineering. The Management System branches to include processes for design management, interface management, configuration & document control management, construction/installation management, RAMS and RAMS assurance management, requirements management, and information management. The entire process falls under the project Quality Management System (QMS) to ensure effective monitoring, improvement, and compliance.

The structure of the Consortium Project Management has been applied successfully in projects throughout the world. It has proven to be effective and successful in more than 20 projects worldwide. These Projects have been completed on time and within budget and are equally complex projects to the Edinburgh Tram Network Project

The Consortium Management System has proven its capabilities in some of the executed projects to successfully manage the integration and parallel execution of Civil Works and Electrical and Mechanical works to the benefit of the customer. Consequentially, the Consortium will incorporate its experienced project managers, engineers and supervisors into their management team, ensuring a smooth and professional implementation of the project.

Therefore, BBS propose to implement this well-proven Project Management structure also for this Edinburgh Tram Network Project

Table 1 Management Processes lists the management processes which are considered as the basis for the Consortium Management System and which will be described in detail with the Project Procedure Manual, which will be submitted within the first 90 days of the Project Implementation.

- Management Process

• Project Organization
• Project Controls
• Project Quality Management
• Environmental Management
• Project Documentation Management
• Project Design & Engineering Management
• Interface Management
• Reliability, Availability, Maintainability
• Project Safety Management
• Testing & Commissioning
• Risk Management
• Project Acceptance Management
• Contract Management
• General Office Management

Table 1 Management Processes

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2 Design Management

2.1 Design Management

Please refer to Section 2: Overall Technical Concept; Chapter 1 - System Engineering

3 Risk Management

The objective of the Risk Management is to apply proven management techniques to risk identification and to remove issues of uncertainty from the project. The specific method to achieve this objective is to follow plans and procedures for the purpose of:

- Risk identification
- Risk classification
- Recording of identified risks in the Risk Register and Risk Forms
- A risk prioritisation process
- A risk mitigation process
- A process for reviewing the status of risks and mitigation
- A risk reporting process

The Risk Management applies to all project risks, irrespective of which party suffers the consequences of the risk occurrence.

3.1 Risk Deliverables

The BBS Consortium will establish, manage, develop, maintain, update and distribute the below listed documentation:

- BBS Consortium Risk Management Plan (IRMP)
- BBS Consortium Assumption Register (IAR)
- Risk Register (IRR)
- Risk Progress Report
- Construction Risk Control Report (CRCR)
- Commissioning Risk Control Report

4 Communication Strategy

4.1 Communications Plan

The BBS Consortium will develop a "Communications Plan" and this will be submitted in accordance with the Review Procedure.

The Communications Plan will illustrate how all the communication processes, activities and issues are to be managed, progressed and satisfactorily resolved. The Communications Plan will detail how the BBS Consortium will communicate with Sub-Contractors (including Tramco), the Operator, tie, the MUDFA Contractor, key stakeholders and third parties.

The BBS Consortium will implement all the requirements of the Communications Plan.

The BBS Consortium will liaise with the relevant parties to ensure that the BBS Consortium is copied into all relevant communications that are generated by others, in order to ensure that any relevant construction related issues, such as Temporary Works and practical constraints, are identified and addressed.

4.2 Meetings

The BBS Consortium will work with tie to develop the meetings schedules and requirements for progress reporting throughout the duration of the BBS Consortium Works. The following table provides a minimum of the meetings to be held:

Meetings	Frequency	Chaired by / Minutes taken
Safety Meeting	Weekly	BBS Consortium
Management Review Meetings	Two monthly	tie/BBS Consortium alternately
Project Progress Meetings	Four weekly (Fortnightly prior to site start)	tie
Design and Planning Meetings	Fortnightly	BBS Consortium

Stakeholder & Third Party Meetings	As required	**tie**
Site Meetings	Weekly	BBS Consortium
Cost Review Meetings	Four weekly	**tie**

The primary purpose of these meetings will be to enable the BBS Consortium to advise on:

- Any safety issues;
- The current state of the programmed BBS Consortium Works;
- Progress made in the various activities;
- Communication issues;
- Third party issues; and
- Commercial issues (including Change Control).

The BBS Consortium will propose a comprehensive meetings schedule indicating those meetings which the BBS Consortium will chair and those meetings which the BBS Consortium will attend.

Prior to commencement on site, progress meetings will be held every two weeks. The purpose of these meetings will be to review progress made by all parties, and identify and agree actions required.

The BBS Consortium will provide an agenda, for all meetings to which they are designated as Chair. The BBS Consortium will also provide appropriate documentation in advance of each of the meetings.

5 Consents and Approvals

An Overall Approvals Management Plan for the System will be developed by BBS Consortium liaising with the Operator and **tie** which will cover at least the following:

- all statutory Necessary Consents to be obtained, identifying in each case the applicable Relevant Authority, the person or body responsible for obtaining the statutory Necessary Consent and the intended date by which such statutory Necessary Consent is to be obtained;
- all third party Necessary Consents to be obtained, identifying in each case the applicable third party, the person or body responsible for obtaining the third party Necessary Consent and the intended date by which the third party Necessary Consent is to be obtained;
- procedures to be used in obtaining statutory Necessary Consents and third party Necessary Consents; and
- procedures for maintaining the Overall Approvals Management Plan.

The BBS Consortium will comply with all aspects of the Overall Approvals Management Plan as may be necessary to implement and maintain the Overall Approvals Management Plan.

The BBS Consortium will develop an Approvals Management Plan capable of incorporation within the Overall Approvals Management Plan and covering at least the following:

- all statutory Necessary Consents to be obtained by the BBS Consortium and the intended date by which such statutory Necessary Consents are to be obtained;
- all third party Necessary Consents to be obtained by the BBS Consortium and the intended date by which such third party Necessary Consents are to be obtained;
- procedures to be used by the BBS Consortium in obtaining statutory Necessary Consents and third party Necessary Consents required in terms of paragraphs (a) and (b)above; and
- procedures for maintaining the Overall Approvals Management Plan.

The BBS Consortium will comply with all aspects of the Approvals Management Plan as may be necessary to implement and maintain the Approvals Management Plan.

The implementation of the SDS contractor into the above mentioned Approval and Consent procedures will be based on the SDS Agreement.

6 Quality Management

6.1 General

Quality management is the state of fulfilment of specified requirements for all products and services. It consists of coordination activities to direct and control an organization with regard to quality standard DIN EN ISO 9001:2000.

6.2 ISO 9001 Quality Management System Certification

Siemens has implemented and maintains a quality management system according to the DIN EN ISO 9000:2000 standards. Please find the Certificate in Annex 2.

All Partners of the Consortium operate under a certified DIN EN ISO 9001:2000 Quality Management System. Design & Implementation, Manufacturing, Construction – Installation, and Testing & Commissioning for the Project will all be done in accordance with the quality requirements of the Project Quality Management System - by certified suppliers.

6.3 Quality Policy

The Consortium Quality Policy states the commitment to become our customer's most valued supplier by providing products and services that meet our customer's requirements.

6.4 Quality Management Approach

The BBS Consortium will undertake the Works fully in compliance with Quality Management processes and procedures referenced in DIN EN ISO 9001:2000 and I DIN EN ISO 14001:2000.

The BBS Consortium will develop a Quality Plan to meet the requirements of DIN EN ISO 9001:2000, and which fully defines all quality aspects of the Works. The Quality Plan will be submitted in accordance with the Review Procedure. The Quality Plan will demonstrate an integrated quality management system relating to the design, construction, testing and commissioning of the system and will show how BBS Consortium and its sub-contractors will comply with the requirements of the Quality Plan.

The BBS Consortium will have all associated documentation readily available for internal review and review by tie. Regular internal audits will be undertaken by the BBS Consortium to ensure full compliance with DIN EN ISO 9001:2000. The BBS

Consortium will prepare and submit in accordance with the Review Procedure a "Schedule of Internal Audits" for agreement with tie. This will define the planned nature and timing of the internal audits.

Quality control including materials and works on site will also be undertaken.

7 Safety Management on Site

7.1 Policy Statement

The policy statement on safety and loss control is as follows:

The regard for the safety of all employees is an essential prerequisite for the achievement of our objective to provide a quality project and satisfy the needs of our client and the public.

To achieve this objective the management will:

- Actively participate in safety and loss control programs to ensure the involvement of all employees and to stimulate interest to maintain the lowest achievable frequency of injuries and damage that may result from incidents;
- Apply all realistic efforts to prevent injuries, fire, explosions, pollution and conditions that may jeopardize the health of employees or public or damage equipment;
- Ensure that all statutory regulations are complied with.

It is expected of each employee to:

- Have a thorough knowledge of all safety rules and procedures and to adhere to them at all times;
- Actively participate in the promotion of safety, for example, by submitting safety suggestions;

Put safety first at all times.

7.2 Safety Management Plan

The BBS Consortium will submit a Safety Management Plan that is over-arching with regard to safety and defines the management procedures that will be put in place to ensure Health & Safety for the design, construction, testing and commissioning, of the system. The Safety Management Plan will address issues relating to the safety of the Works, staff and third parties, as listed below:

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- The plan will detail the approach and all management procedures relating to health and safety for the Edinburgh Tram Network.

- The plan will show how the BBS Consortium will ensure that its sub-contractors apply all relevant health and safety policies and procedures.

- Details of all interfaces associated with safety and the procedures of how these will be managed. Interfaces will include Roads Authorities, Health and Safety Executive; HMRI; Network Rail; Police; Fire and Rescue Services; Ambulance Service; and all applicable Law.

- Proposed Safety Initiatives.

- How the BBS Consortium ensures that a safety culture will be cascaded and enforced throughout the team including its sub-contractors.

- The Emergency procedures which the BBS Consortium will implement.

- Details of how the BBS Consortium will implement Accident & Incident reporting and promotion of an open culture.

- The BBS Consortium Safety Inspection & Safety Tour regime.

- An outline of the BBS Consortium's procedures relating to safety for dealing with tie's Drugs & Alcohol Policy and procedures and details of the BBS Consortium's own similar policy and procedures.

- Details of any particular safety issues the BBS Consortium considers would be significant and initial mitigation measures.

8 Project Documentation Management

8.1 General

For Control and coordination purposes (e.g. status of submissions, change requests, correspondence tracing, etc.) the role of Documentation Management to support the project has become more and more important during the past. The processes of unique identification, adequate reviewing and documented approval of all documentation as well as a safe management of all correspondence and all changes are key aspects of the documentation management approach.

8.2 Documentation Management Tool

During the execution of the Edinburgh Tram Network Project, an Electronic Document Management Tool (EDM - Tool) will be used for legally binding documents that may contain all kind of documents including correspondence between all parties.

Electronic Document Management Tool fulfils the requirements of the quality management system based on the International standard DIN EN ISO 9001. The processes of unique identification, adequate reviewing and documented approval of all documents as well as a safe management of all correspondence and all changes are supported by the Electronic Document Management Tool.

8.3 Requirements to the Electronic Documentation Management Tool

The Electronic Documentation Management Tool will meet the following requirements:

- Unique Identification of all Project Documents

- Easy Access to the Documents for all Project Partners involved

- Traceability of Document Status

8.4 Submittals Schedule

Within 4 weeks of the Commencement Date the BBS Consortium will provide a schedule identifying all deliverables anticipated under the project, the anticipated date for submission and a summary of the intended scope.

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9 Interface Management

9.1 General

The objective of the Interface Management is to identify, describe, clarify, settle and control all interfaces between the project partners and their products or systems as well as with any other party involved in the project. This happens in order to ensure the functionality of the integrated system, to save costs and time caused by uncoordinated work or unnecessary rework.

The purpose of all interface management activity is that:

- The detailed design of each of the co-functioning items contains the necessary information to assure that items, when individually designed and produced or installed will work together, and

- If either item needs to be changed for any reason, its performance, functional or physical attributes, that are involved in the interface, act as constraints on the design change.

The main tasks of the interface management are thus the

- Identification
- Description
- Settlement
- Modification
- Cancellation

of all interfaces.

9.2 Interface Definition

Generally, interfaces are the physical, functional, performance or test boundaries between two (or more) different co-functioning organizations or products, within or outside of the project.

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Interfaces within the responsibility of a subsystem (e.g. the construction of the propulsion system) are not managed by the project's interface management but are dealt with separately by the partner responsible for the subsystem.

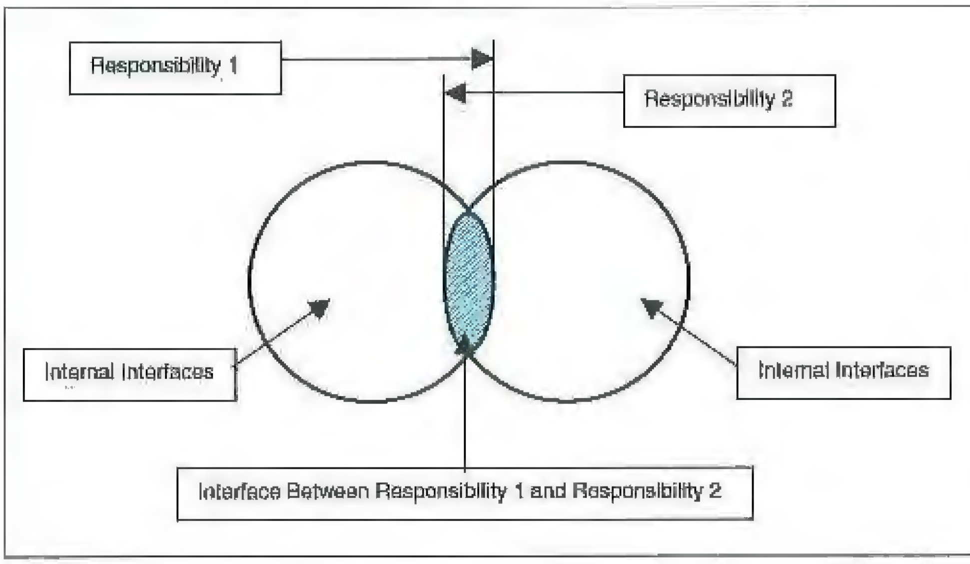

Figure 2: Interface between two Sub-Systems

Interfaces of sub-systems within the consortium are called internal interfaces, interfaces between a sub-system and sub-systems of the client or other entities are called external interfaces.

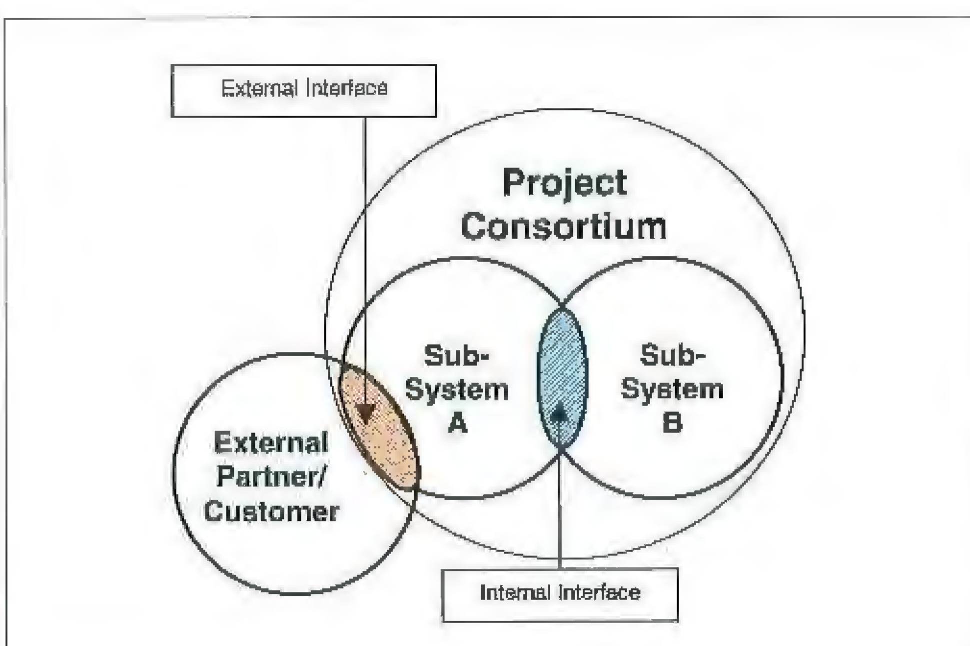

Figure 3: Internal and External Interfaces

9.3 Interface Management Approach

Based on the List of Responsibilities, and with the use of an Interface Identification Log and an Interface Status Form, all interfaces will be identified, documented and tracked. Clear allocations of responsibilities within the identified interface partners and regular interface meetings will form the basis of a proper implementation of the interfaces.

9.4 List of Responsibilities (LoR)

The "List of Responsibilities" (LoR) is one of the fundamental documents for interface management. It clearly regulates the responsibilities for the products to be supplied or services to be rendered, broken down according to the relevant project phases Testing & Commissioning.

9.5 Schematic Interface Overview

For Schematic Interface Overviews, please refer to Annex 3 of this document.

10 Table of Annexes

Annex No	Title
1	Management Manual – Quality, Health & Safety
2	ISO Certificate
3	Interface Schematics

Table 2: Table of Annexes

BILFINGER BERGER Civil

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31st March 2008

Updated Proposal Submission

Edinburgh Tram Network

Section 1: Overall PM Concept

Part 1 – Programme and Project Execution

Annex 1 – Management Manual

Management Manual

Siemens Transportation Systems

Quality

Environment, Health & Safety (EH&S)

SIEMENS

efficient rail solutions

Content

Siemens Transportation Systems is one of the largest suppliers of railway technology in the world. As a global player, we give railways the competitive edge they need to perform on a world stage by offering products, systems and services that are innovative, economical, reliable and safe. We provide our services over the entire value-added chain from customer to customer: in marketing and sales, development, procurement, project administration, production, assembly, commissioning and after-sales service. We believe that excellent quality and environmental friendly design are an obligation. Through consistent customer alignment, we are expanding our position further and securing our future – in each of the business segments within the railway industry. Thanks to our fields of competence: Automation & Power, Rolling Stock, Turnkey Systems and Integrated Services, we are perfectly positioned to achieve this goal. This is how we can offer efficient, pioneering solutions thus ensuring sustained improvement in our business results – to the complete satisfaction of our customers.

Preface

Thanks to their exceptionally high quality, the products, systems and solutions of the Transportation Systems Group enjoy an excellent reputation. The reliability of our environmentally friendly systems, their safety, long service life and commercial viability are known and acclaimed around the globe. We believe that this brings with it a far-reaching responsibility — to our customers, to our employees and to society as a whole.

The expectations placed on our services are high. We are therefore obliged to ensure and further improve the high quality standard of our products, environment, health & safety (EH&S) procedures through comprehensive management. We consider this to be a key requirement for our common success.

To this end, we have established a comprehensive plan of action encompassing the following:

Quality, environment, health & safety are personal

Everyone has a contribution to make. In this way we will fulfill the expectations of our customers, employees and society.

Quality, environment, health & safety are obligatory

Everyone must adhere to and continually improve the processes.

Quality, environment, health & safety are comprehensive

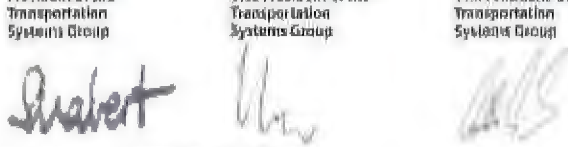
Everyone contributes to the success of our company through their creativity and commitment.

The management system described in this manual is binding for all managers and employees of Siemens Transportation Systems.

Hans M. Schabert
President of the Transportation Systems Group

Hans-Dieter Bott
Vice President of the Transportation Systems Group

Friedrich Smaxwil
Vice President of the Transportation Systems Group



Erlangen, November 2003


Continual improvement of the management system
Management responsibility
Customer requirements
Resource management
Measurement, analysis, improvement
Customer satisfaction
Product realization
Input
Product

Management System

This manual describes the fundamentals of the Siemens Transportation Systems' management system. It explains the general requirements for all of the organizational units. Group Executive Management promotes the development and implementation of the management system through appropriate planning and setting the appropriate targets. It also includes a controlling process and initiates further development.

The management system is binding for every employee. Its documentation structure is described in the section "Documentation". If permitted exclusions from the requirements of ISO 9001 are required, these must be named, substantiated and documented by the organizational units. Associated companies included in the Transportation Systems organizational chart can have their own independent management systems. The same applies to organizational units whose particular business mandate requires an independent management system.

Regulations

The individual processes, including all operations and procedures, are stipulated in the organizational units as regulations. These exist in a structured form, preferably in the Intranet but also through other media. They contain important company know-how and are thus intended for internal use only.

Implementation and review

The aim of the management system is to fulfill customer requirements. Furthermore, it complies with the following Standards and Guidelines:

- Quality management system according to ISO 9001
- Environmental management system according to ISO 14001
- Occupational health and safety management according to the ICSCA Industry Guidance on Health and Safety at Work
  (ICSCA – Industry Cooperation on Standards and Conformity Assessment)

The management is responsible for monitoring and reviewing the implementation and efficiency of this system.

Processes

Management Processes

- Management and Inter-Company Cooperation
- Change Management
- Strategic Planning

Core Process: Project Management

Quality in the Project

Account Management

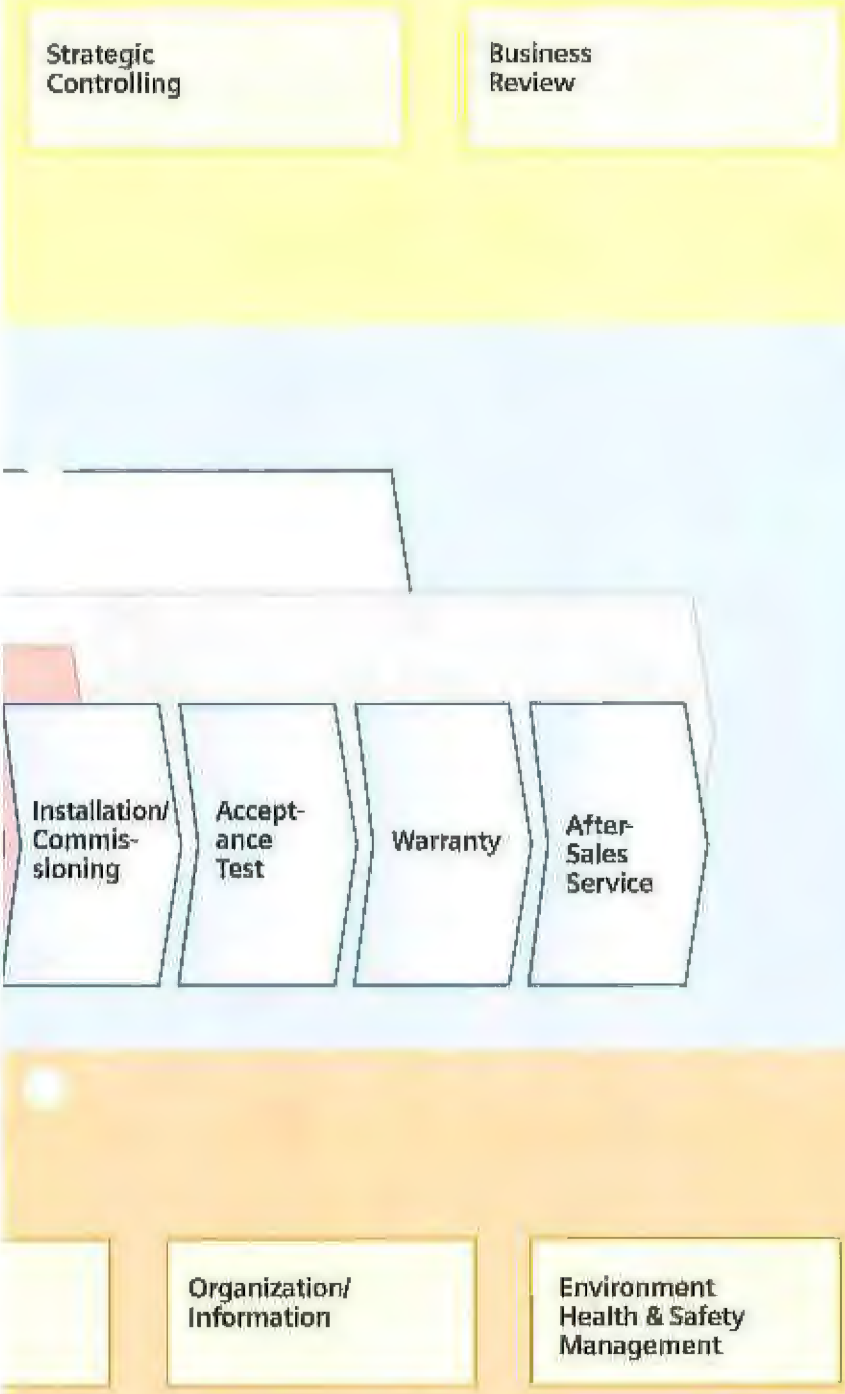
Project Management

Purchasing

- Creating Standard Products
- Acquisition
- Bid
- Nego-tiations/ Contract
- Project Planning
- Engineer-ing Planning
- Procure-ment
- Production

Support Processes

- Business Administration
- Human Resources
- Quality Management
- Strategic Purchasing



Management Processes

Core Process

Support Processes

Our claim:
Reliable process quality ...

Our management system involves multiple processes. The aim of these processes is to ensure that our products, solutions and services completely fulfill the requirements of all those involved, particularly our customers.

These processes unfold on three, closely interrelated process levels that are closely intermeshed with one another:

- In the **management processes**, the general specifications for the core process are formulated and controlled.
- In the **core process**, all business activities – from product creation and acquisition to hand-over to the customer and after-sales service – are executed in precisely coordinated subprocesses.
- The **support processes** comprise all ancillary activities, such as resource management and documentation. Process analysis and optimization with targeted measurements, intensive analyses and effective measures are a key factor here. This process also includes such tasks as information security, knowledge management, risk management and much, much more.

Process coordinators support the various sub-areas at all three process levels. Every individual process is planned, supervised and documented by these coordinators according to customer- and product-specific criteria.

The operation and effectiveness of the core processes are secured by consequentially applying project management and supported by the use of quality gates. Further, additional elements of quality assurance are integrated in the process as well as environment, health & safety management. Thus the fulfillment of customer requirements and the legal compliance, standards and further regulations is guaranteed. Specifically, this support takes the form of integrated quality assurance, environment, health & safety activities.

Suitable methods have been initiated in the organizational units to control and monitor the core processes, for example, process indicators.

The aim is to make all of the processes stable and transparent and to include customers, partners and suppliers in the best manner possible.

... with integrated activities for environmental protection and safety at work.

Organization

The responsibility and specialist support for quality, environment, health & safety is stipulated in a three level regulation that is applicable for all of Siemens AG.

	Responsibility	Specialist Support
	Corporate Executive Committee Siemens AG	Corporate offices: ■ Quality management ■ Environmental protection ■ Occupational Health & Safety
Within the framework of the Siemens AG corporate structure, the Transportation Systems Group is managed independently by Group Executive Management. The organizational chart depicts the relevant division of work. The responsible member of Group Executive Management must specify, and ensure compliance with, the group targets for quality, the environment, health & safety. This person ensures that the management system is further developed and implemented and also works to constantly improve its efficiency. This includes: ■ Giving managers and staff a clear direction and motivating them to work consistently in a customer-oriented manner. The fulfillment of customer requirements and the statutory and official requirements are a priority. ■ Stipulating the management policy with the objective of improving economic value added and increasing customer benefits. ■ Performing regular management reviews to boost the efficiency of the management system and thus to also improve product quality. ■ Securing the availability of suitable resources.	Group Executive Management	Group coordinators: ■ Quality management ■ EH&S
The management teams of the divisions and those of the operational organizational units stipulate the quality, environment, health & safety goals and the relevant areas of responsibility and authorities. The managers of the organizational units are responsible for the quality of their processes and products and for adherence to environmental, health & safety laws and regulations. They stipulate which measures can improve the quality of the product and the environment and ensure the health and safety of employees in the workplace. In addition, they determine who is responsible for which sub-processes. Every manager is in charge of encouraging employees to work in a health-conscious manner to promote quality and respect for the environment. Furthermore, they must ensure that the knowledge and skills required to this end are imparted to the employees and that the necessary tools and resources are made available to them. The managers of the organizational units are responsible for all activities that impact on quality management and EH&S.	Division presidents, process coordinators, operations managers	Quality managers, environmental protection specialists, safety specialists, company doctors

Organizational structure
The schematic organizational chart depicts the organizational structure of the Transportation Systems Group. It is described in detail in the latest versions of the organization and work plans. The group's coordinator for Quality Management and EH&S report directly to the Group Executive Management.

Level 1

The group's coordinators for Quality Management and EH&S set out the framework conditions. Their role in this context is to provide information, coordination, advice and supervision. The same applies for all other quality offices, management representatives, environmental protection specialists, safety specialists, safety assistants and company doctors.

All of the named offices support the process and product managers; however this in no way relieves the latter of their relevant responsibility.

Level 2

The quality managers of the divisions and group functions are appointed by the responsible member of Group Executive Management. Their tasks are stipulated in detail. The quality manager reports directly to the manager of the relevant organizational unit and is independent of the other organizational structures.

Quality management representatives for subdivisions and sub project quality managers are appointed according to defined regulations.

The EH&S-specialists are appointed by the site manager and report directly to him/her. Their tasks are set down in the appointment.

Level 3

Business Policy

The corporate principles of Siemens AG shape the attitudes and actions of the entire company and are binding for everyone. They are described in detail in the company guidelines: "Principles of Siemens Quality Management", "Siemens AG's OH&S Management System", "Principles of Environmental Protection and Technical Safety" and "Regulations for Information Security", among others. It is from these guidelines that the Transportation Systems Group has derived the principles for its management system.

Principles
The principles of our business policy in our endeavors to achieve Business Excellence are as follows:
- Achieving the highest level of customer satisfaction and an ongoing trust in our products and services is, in our opinion, one of our core tasks.
- We strive for constructive, long-term and trust-based relationships with all our partners around the globe.
- We want to generate ongoing earnings to secure our future and our activities.
- We encourage the competence, creativity and performance of all our employees.
- We are very conscious of our sustainable development and our social, ecological and economical responsibility.

Targets
Our essential targets are:
- To develop, manufacture and sell high quality, reliable, environmentally friendly and safe products.
- To meet the agreed, but also the expected, requirements of our customers to their complete satisfaction.
- To constantly monitor and optimize the processes on the basis of application-specific experiences, in order to achieve the highest customer benefits with simultaneous commercial viability.
- To secure our innovative power through constantly high earnings.
- To ensure the efficient implementation of statutory provisions, guidelines and standards as well as to establish legal compliance to EH&S.
- To effectively incorporate our project partners and suppliers into our processes.
- To reduce costs by avoiding errors.
- For the management executives to act in an exemplary manner: to inform and support their employees and to train them in line with the requirements.
- To protect the life and health of our employees and of third parties.
- To be considerate in our use of natural resources.
- To promote team and group work.

Individual targets have been derived from these principles and have been made binding by a multi-level target agreement process. Measurable and tangible targets are stipulated and pursued particularly in the organizational units.

Strategy
Through the realization of the above-mentioned targets, the Transportation Systems Group is endeavoring to attain a world-class position. To this end, we have developed a corporate strategy that is based on a comprehensive management system.

Product Quality

Product creation
Product planning and development are customer-oriented and in line with the market. Studies and surveys were performed in advance to ensure this.
In order to fulfill these requirements and to exclude errors from an early stage, preventive quality measures and other techniques are planned and implemented in a targeted fashion. These include: review techniques, failure mode and effects analyses (FMEA), safety and reliability studies, trials/tests (in the laboratory and on the test track), type tests, evaluation of environmental aspects etc.
We leave nothing to chance. Qualified, experienced employees ensure systematic error prevention.
This This procedure is also applied to the engineering/project planning phase.

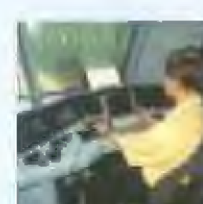
Production and assembly
Production and assembly are planned intensively, documented in detail in work and test plans and specified for the various processes and operations.
Back-up tests, such as screening and system tests, are integrated into reproducible process steps.
Targeted quality assurance measures run through the entire production and assembly process. The functions of all safety- and reliability-relevant components are tested before they are installed.
Agreed customer acceptances are factored in and conducted. EH&S are actively promoted during production and assembly.

Creating Standard Products | Acquisition | Bid | Nego-tiations/ Contract | Project Planning | Engineer-ing Planning | Procure-ment | Production

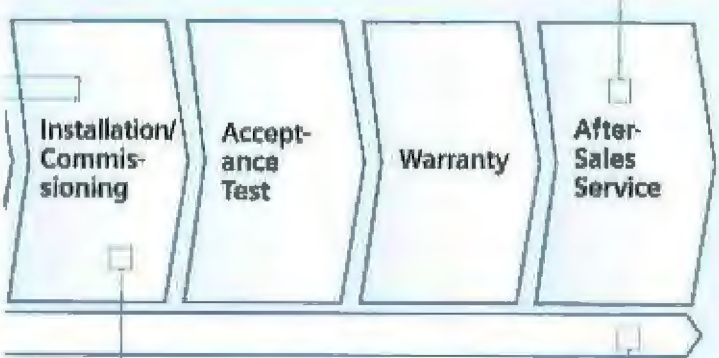
Test Center

Supplier management
We maintain long-term relationships with trusted suppliers, who we think of as partners. They are assessed, evaluated and promoted in a thorough selection and qualification procedure.
The suppliers are generally involved in the development process from an early stage, in order to produce innovative and high-quality products that incorporate the principles of environmental protection.
Joint quality standards are coordinated and stipulated in quality assurance agreements (QAA) and technical documents. The release and acceptance processes are defined on a product-for-product basis.

Commissioning
Vehicles, infrastructure products and turnkey systems, including the integrated or related modules and components, are inspected and tested on the basis of a test plan.
The scope of testing for commissioning encompasses the contractual customer specifications including the requirements defined by official bodies and recognized standards.
The proof of the performance and reliability of a turnkey system is recorded in the documents that are relevant for acceptance.



After Sales/Services
Our range of services covers scheduled maintenance, spare parts procurement, training and documentation. These services are also subject to a detailed planning process in order to ensure the individual customer requirements are fulfilled. To this end, quality tools are also deployed for preventive measures as well as when creating products.The results of scheduled maintenance activities are checked using state-of-the-art techniques to ensure the agreed level of availability and safety.
Documentation and training for our customers' drivers and maintenance personnel are significant issues. Highly qualified specialist personnel pass on our know-how and thus ensure a systematic transfer of knowledge to the customer.



The Wildenrath Test Center monitors product quality. Before being handed over to the customer, our products are tested comprehensively.
This internal, certified test center validates the national and international customer and official requirements – from development through to the hand-over to customers. The integrated test center holds all the required national and international licenses, including those from the Federal Railways Office.
An accredited safety assessment center has been established in Braunschweig for rail safety technology.

This is how we ensure product quality ...

Product Quality
Product requirements are determined, evaluated and contractually stipulated in close contact with the customer. All of the development, engineering and project processing activities are planned on this basis.

From the project specifications (that is, the planning documents or procurement specifications) functional and technical solutions are derived in defined processes and stipulated for realization in specifications (for instance, in the performance specifications). The results are reviewed, verified and validated.

When procuring products, released specifications and other technical documents are issued to qualified suppliers. Defined tests and other suitable measures are used to ensure that the products supplied comply with the procurement specifications.

We plan and implement manufacturing, assembly, commissioning and service under controlled conditions, including targeted monitoring and measuring procedures. State-of-the-art test centers, run by specialists, guarantee these measures. The use of all required supervision and measuring equipment is ensured – as is the use of appropriate calibration and tracking systems.

The procedure described above serves to systematically secure product quality. Preventive measures along with supervisory and testing activities are factored in over the entire value added process and are implemented and documented accordingly. In complex projects especially qualified sub-project managers for quality – as co-pilot of the project manager – combine the quality-related aspects of the project.

Environment, health & safety
Already in the planning phase, we assess and consider the possible impact our products and services will have on people and the environment. In this process, we take the entire life cycle of the products into consideration. We devote particular attention to the promotion of the health of our employees, the prevention of accidents on our construction sites and in our factories as well as to the process- and product-related resource efficiency.

... while adhering to all EH&S standards.

Management Processes

Core Process

Support Processes

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Controlling the Management System

6-step improvement program

Improvement
top⁺ is the company-wide improvement program.
top⁺: represents clear goals, concrete measures, unambiguous consequences. This instrument is an improvement system that requires a correspondingly high level of commitment from all managers. It is supported by a 6-step process, a process we will utilize to improve our quality and our standard of EH&S – thus benefiting the customer and strengthening our cost position in the process.
We rely on the commitment of our managers and employees. We therefore encourage and actively use their ideas, suggestions and initiatives. To this end, we have established an employee initiatives management system. This system is used to evaluate all employee suggestions and, if put into practice, a bonus is paid in accordance with internal regulations.

Finance

Best Practice
Our aim is to be world class – this is why we have benchmarking. In addition, we also practice Best Practice Sharing. Once the results are evaluated, relevant improvement measures are decided upon and implemented. We assess our success using a targeted realization controlling system.

Guide Manage teams

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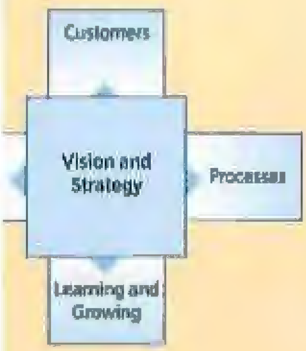

Balanced Scorecard
Company management will only achieve excellent results if they make the highest demands: on the devel opment of business policy and strat egies, on the choice, deployment and qualifications of employees, on the shaping of partnerships and processes and on the use of resources.
For the purposes of pursuing strategic goals, therefore, targeted key values and measurement points are defined at all levels and represented in the Balanced Scorecards. The change in these variables is regularly monitored by management and, if necessary, corrected through targeted actions.

Siemens Leadership Framework
The Siemens Leadership Framework demonstrates our mutual under standing of excellent management and is binding for all executives. It provides a clear basis for measuring and evaluating management per formance, the results of which can be used to formulate concrete meas ures for promotion and personnel development.
Excellent executives achieve excel lent results by mean of their excel lent capabilities: namely, to drive, focus, impact and guide.

During controlling, partial targets and measures are permanently aligned towards achieving the overall targets of the company.
The targets are concrete, measurable and agreed and updated periodically in the organizational units.
Management executives pursue, evaluate, improve and report on the degree of fulfillment of these targets.

Target discussions
The fundamental issues of quality, environment, health & safety are, among other issues, stipulated in target agreements (integrated strategy and budget meeting) between the Corporate Executive Committee of Siemens AG and Transportation Systems Group Executive Management. The agreements are implemented in the organizational units.

Self-assessment
The strengths and weaknesses of the processes are worked out and improvement measures are thus derived. The promotion of "best practice" and bench-marking plays a key role in this process.

Management review / audits
The management system for quality, and EH&S are reviewed regularly by management within the organ-izational units.
Management evaluate their implementation, for ex-ample, on the basis of audits, assessments, bench-marks, inspections, self-assessment and reviews.
The necessary improvement measures are then derived from the results and realized; and their efficiency monitored.

Customer satisfaction
We gather customer-related information both actively and passively. This is evaluated and used to determine ways of boosting customer satisfaction.

Thanks to the interaction of all these management instruments and to targeted controlling, we have established a continuous improvement process, which encompasses all levels of our company and is wholly aimed at achieving BUSINESS EXCELLENCE.

Documentation

Document management
Document management ensures that documents and data are checked, released and/or enforced according to a specific procedure. The same applies to their distribution, archiving, modification or deletion as well as their listing in directories, according to their relevant status.

Principles
Corporate
Guidelines

Level 1
Siemens AG

Siemens AG
The principles of Siemens AG shape our corporate culture.
The company guidelines "Principles of Siemens Quality Management", "Siemens AG's OH&S Management System" and "Principles of Environmental Protection and Technical Safety" set out fundamental statements on targets, organization and the responsibilities of our company.
They serve to further develop and continuously improve the management systems.

TS Management
Manual

Level 2
Group
Siemens
Transportation
Systems

Siemens Transportation Systems Group (TS)
This manual contains general statements on the management system of the Siemens Transportation Systems Group. It is supplemented by process regulations that apply group-wide and detail generally applicable stipulations and the processes of the management system.

Process Regulations

Level 3
Divisions
Group Functions
Sales Regions

Divisions, group functions, sales regions
The management system is documented in a concrete fashion in these units. These regulations describe the individual procedures and processes – if required, down to the employee level.

Siemens Transportation Systems – The Divisions

TS RA – Rail Automation

- Signaling and control systems
- Interlockings
- Automatic train control systems
- Signaling components
- Telecommunications systems
- Operations control system for maglev trains

TS EL – Electrification

- Contact lines for mass transit and main-line services
- Traction power supplies for mass transit and main-line services

TS MT– Mass Transit

- Metro and underground trains
- Suburban rapid transit
- Tramcars
- Light rail transit

TR Trains

- High-speed and InterCity trains
- Commuter and regional trains
- Passenger coaches

TS LM – Locomotives

- Electric locomotives
- Diesel-electric locomotives
- Special-purpose vehicles
- Refurbishment
- Drive and power supply for maglev trains

TS IS – Integrated Services

- Maintenance
- Spare parts
- Documentation and training
- Consultancy
- Diagnostic services

TS TK – Turnkey Systems

- Turnkey systems for mass transit services
- Turnkey systems for main-line services

Siemens AG
Transportation Systems
Group Coordinator DUAS
P.O. Box 3327
38023 Braunschweig
Germany

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Fax: (+49) (5 31) 2 26-4233

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P.O. Box 3240
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www.siemens.com/transportation

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BILFINGER BERGER Civil

SIEMENS

31st March 2008

Updated Proposal Submission

Edinburgh Tram Network

Section 1: Overall PM Concept

Part 1 – Programme and Project Execution

Annex 2 – ISO Certificate

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DET NORSKE VERITAS
CERTIFICATE

DNV ZERTIFIZIERUNG UND UMWELTGUTACHTER GMBH

certifies that the company

Siemens AG
Transportation Systems (TS)

has established
an integrated quality, safety, health and environmental management system
in the units listed on page 2 and 3

in conformity with the standards

ISO 9001 : 2000
ISO 14001 : 2004
OHSAS 18001 : 1999

This Certificate is valid for:

Project Planning, Acquisition, Engineering, Procurement, Production, Assembly, Commissioning and Service of Products, Systems and Services of the fields of Rail Automation, Electrification, Locomotives, Trains, Mass Transit, Bogies,Turnkey Systems and Integrated Services

This Certificate is valid until:
31.12.2009

Certificate-Registration-No.:
CERT-30777-2006-AE-ESN-TGA

Issued in Essen on
12.12.2006
[redacted]
N. Kim
General Manager

Certified by DNV since
19.05.2006
[redacted]
T. Beck
Technical Support

DNV Zertifizierung und Umweltgutachter GmbH, Schnieringshof 14, 45329 Essen, Germany
Tel.: +49 (0)201 7296 300, Fax: +49 (0)201 7296 333, www.dnv.de/zertifizierung

DNV 14019/1.2

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DET NORSKE VERITAS

CERTIFICATE

This certificate is valid for the following units:

Standards: ISO 9001:2000, ISO 14001:2004, OHSAS 18001:1999

TS Executive Board
Head Office EH&S Management System - TS QM and TS SE

D – 38126 Braunschweig, Ackerstraße 22
D – 91052 Erlangen, Werner-von Siemens-Straße 61 / 67

TS Group Functions
Siemens AG Transportation Systems, GT - Group Technology

D – 91052 Erlangen, Werner-von-Siemens-Straße 67

Siemens AG Transportation Systems, OI - Organization, Information Processing

D – 91052 Erlangen, Sieboldstraße 16

Siemens AG Transportation Systems, CS – Central Services

D – 12435 Berlin, Elsenstraße 87-96
D – 38126 Braunschweig, Ackerstraße 22
D – 91052 Erlangen, Werner-von-Siemens-Straße 50

Business Units TS RA - Rail Automation

D – 12435 Berlin, Elsenstraße 87-96
D – 38126 Braunschweig, Ackerstraße 22

Business Units TS EL – Electrification

D – 91052 Erlangen, Mozartstraße 33 b

Business Units TS MT - Mass Transit

D – 91052 Erlangen, Werner-von-Siemens-Straße 61
Siemens Transportation Systems GmbH & CO. KG
A – 1110 Wien, Leberstraße 34
D – 90461 Nürnberg, Katzwanger Straße 150

Business Units TS LM - Locomotives

D – 91052 Erlangen, Werner-von-Siemens-Straße 67
D – 80997 München, Krauss-Maffei-Straße 2

Business Units TS TR –Trains

D – 91052 Erlangen, Werner-von-Siemens-Straße 69
D – 47829 Krefeld-Uerdingen, Duisburger Straße 145

Siemens Transportation Systems GmbH & Co KG
Passenger Coaches
A – 8021 Graz, Eggenberger Straße 31

Siemens Transportation Systems GmbH & Co KG
Passenger Coaches
A – 1110 Wien, Leberstraße 34

Siemens Kolejová vozidla s.r.o. (SKV)
CZ – 155 21 Praha 5, Ringhofferova 115/1

Business Units TS TK - Turnkey Systems

D – 12435 Berlin, Elsenstraße 87-96

Business Units TS IS - Integrated Services

D – 91052 Erlangen, Sieboldstraße 16
D – 38126 Braunschweig, Ackerstraße 22
D – 12435 Berlin, Elsenstraße 87-96
D – 40231 Düsseldorf, Königsberger Straße 100

DET NORSKE VERITAS

CERTIFICATE

This certificate is valid for the following units:

Standards: ISO 14001:2004, OHSAS 18001:1999

TS Group Functions

Siemens AG Transportation Systems, CS – Central Services

D – 41844 Wegberg-Wildenrath, Friedrich-List-Allee

D – 47289 Krefeld-Uerdingen, Duisburger Straße 145

A – 8020 Graz, Eggenberger Straße 3

A – 1110 Wien, Leberstraße 34

Business Units TS RA - Rail Automation

Siemens Transportation Systems S.A.S.
F – 92542 Châtillon, Le Diagonal - Avenue de la République

Siemens Transportation Systems S.A.S.
F – 59015 Lille, Immeuble Le Plaza, 91 Rue Nationale

messMa GmbH
D – 39167 Irxleben, Am Stadtfeld 8

Siemens Signalling Company Ltd.
CN – 710016 Xi'an, No. 30 Feng Cheng Erlu

Subdivision TS BG - Bogies

Siemens Transportation Systems GmbH & CO. KG
A – 8020 Graz, Eggenberger Straße 31

Business Units TS IS - Integrated Services

D – 41844 Wegberg-Wildenrath, Friedrich-List-Allee

Siemens Transportation Systems, Inc.
Rolling Stock

USA – 95828 CA – Sacramento, 7464 French Road

Siemens Transportation Systems - a division of Siemens plc.
Automation & Power

UK – SW1H 9BP London , 2 Queen Annes Gate Buildings, Dartmouth Street

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31st March 2008

Updated Proposal Submission

Edinburgh Tram Network

Section 1: Overall PM Concept

Part 1 – Programme and Project Execution

Annex 3 – Interface Schematics

Edinburgh Tram Network Infraco , Schematic Interface Overview

Glossary, Colour codes and Interface log acronyms

Contractor/Owner/Interface partner	Edinburgh Tram Network Infraco System	Neighbouring/connecting Systems to be integrated	3rd parties' systems	Other system/s
	Bidding Consortium • Bilfinger & Berger • Siemens	**Other contracts** • Tramco • Tramco maintenance	**Public services:** • Power and utilities supply authorities • Fire brigade, Police • Lothian buses • Banks	**(If applicable/relevant)**
Rolling Stock	RST	RST-E	RST-T	RST-O
Overhead Catenary System	OCL	OCL-E	OCL-T	OCL-O
Traction Power Supply (TPSS)	TPS	TPS-E	TPS-T	TPS-O
SCADA / Power SCADA	SCA	SCA-E	SCA-T	SCA-O
Signalling	SIG	SIG-E	SIG-T	SIG-O
Telecommunication	COM	COM-E	COM-T	COM-O
Automatic Fare Collection	AFC	AFC-E	AFC-T	AFC-O
Depot and Workshop Equipment	DWE	DWE-E	DWE-T	DWE-O
LV Power Supply and Distribution	LVS	LVS-E	LVS-T	LVS-O
Trackwork	TRW	TRW-E	TRW-T	TRW-O
Civil Works	CIV	CIV-E	CIV-T	CIV-O
Building Services	BUS	BUS-E	BUS-T	BUS-O

The Acronyms given behind the different colour codes will be the basis for the structure for later interface matrix/interface logs. e.g. interface between vehicle and OCL on neighbouring existing section would be denominated as RST_OCL-E ... (with additional identifiers etc.)

Note: Number and/or shape of Equipment shown on the schematic interface drawings do not represent the quantity and/or the technical characteristics or layout of equipment to be installed. For detailed information refer to drawings, detailed descriptions, BoQ etc. of the lots

Edinburgh Tram Network Infraco

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NOT TO SCALE

SCHEMATIC INTERFACE OVERVIEW

Glossary

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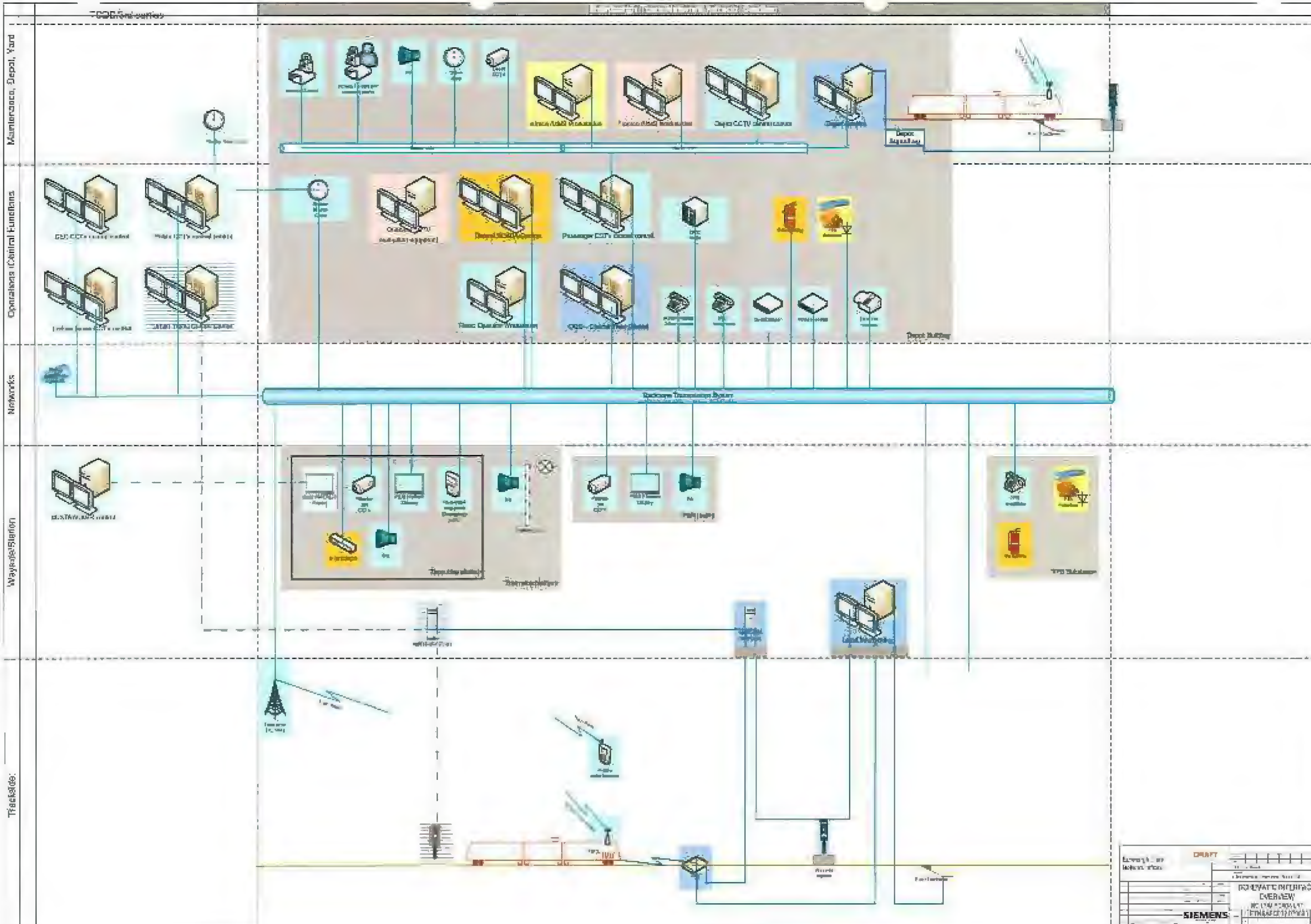
Maintenance, Depot, Yard
Operations (Central Functions)
Networks
Wayside/Station
Trackside
Depot CCTV Surveillance
Passenger CCTV Surveillance
Backbone Transmission System
Depot Building
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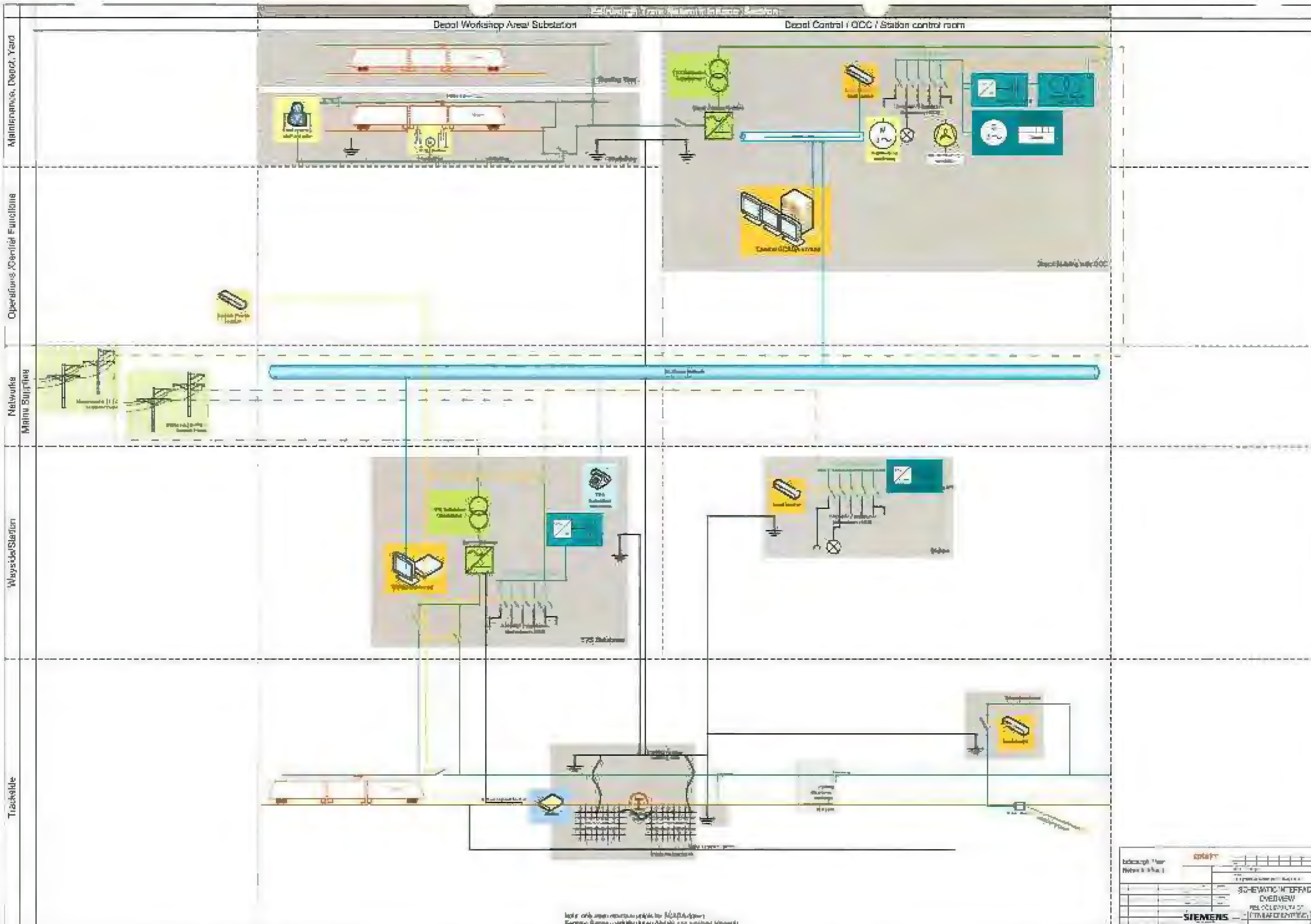
SIEMENS



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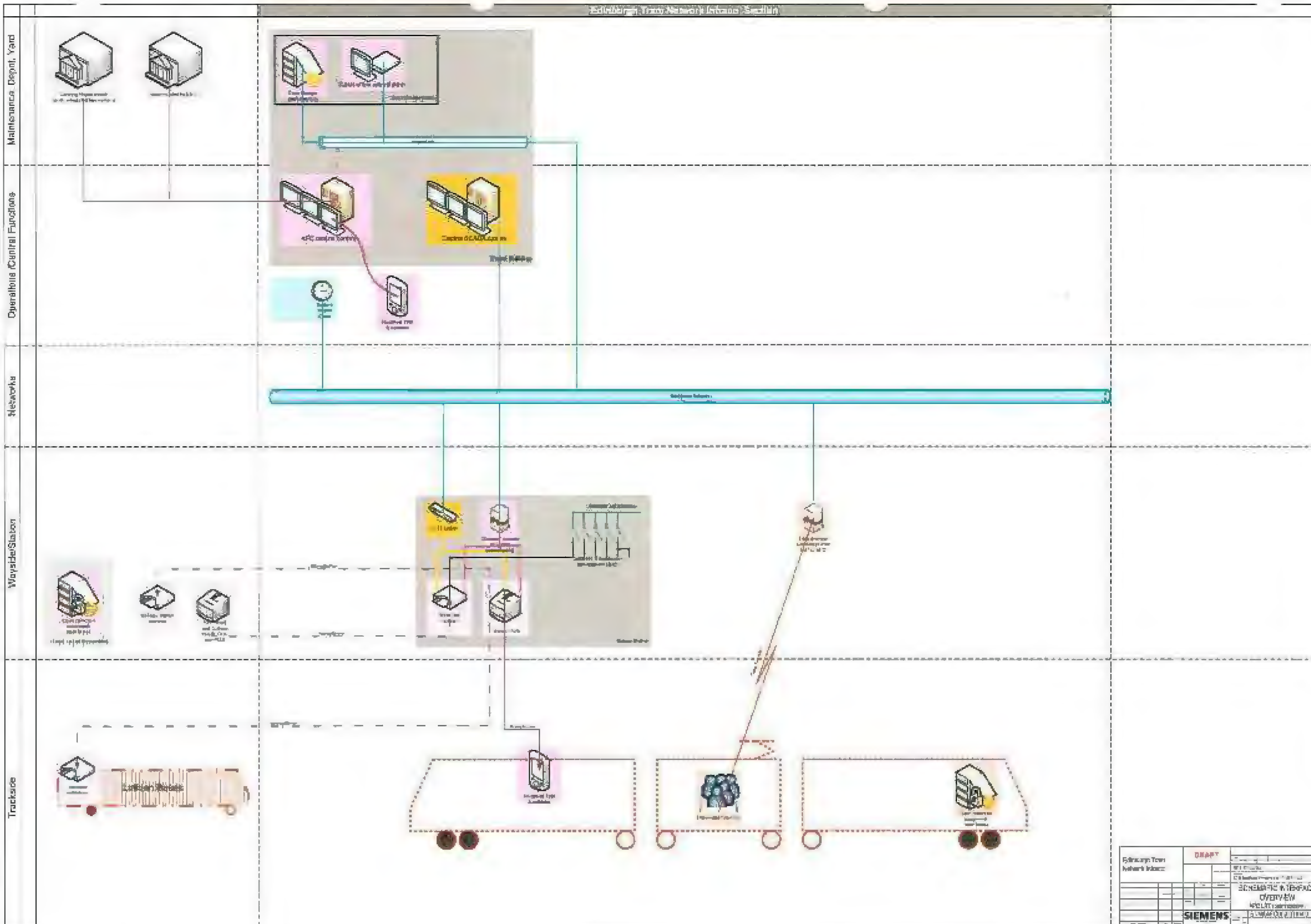
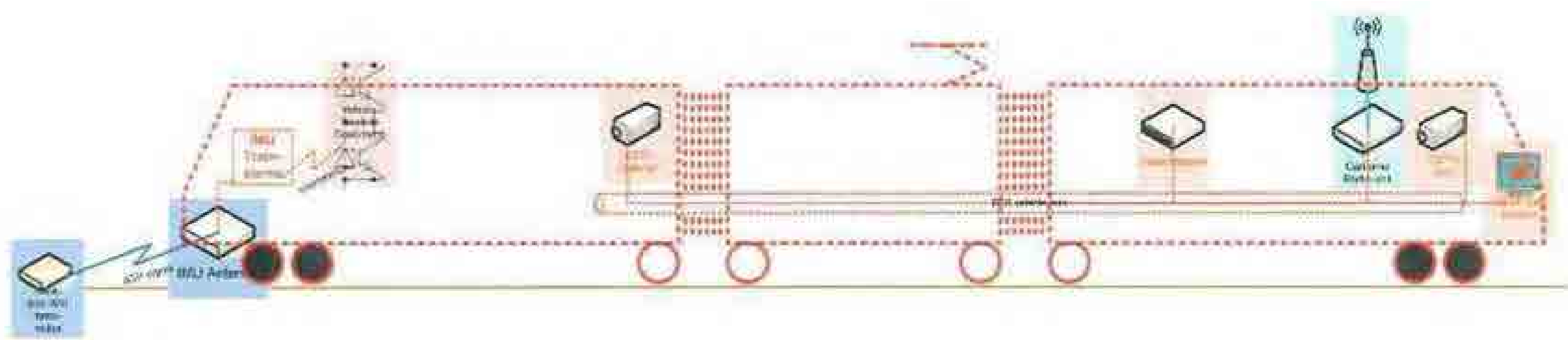


Maintenance, Depot, Yard
Operations /Central Functions
Networks
Wayside/Station
Trackside
DRAFT
SCHEMATIC INTERFACE
OVERVIEW
SIEMENS



Edinburgh Tram
Network Infraco

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NOT TO SCALE

ETN Interface Schematics ETC-SI-IFSD

SCHEMATIC INTERFACE
OVERVIEW
RST and trainborne systems

SIEMENS

ETN&AFC002 070503

SIEMENS

31st March 2008

Updated Proposal Submission

Edinburgh Tram Network

Section 2: Overall Technical Concept

Part 1 – System Engineering

Table of Content

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1 Overall Subject

This document describes the general approach of the System Engineering and the scope of activities for the Edinburgh Tram Network during the Design and the Implementation Phases.

The Infraco will approach the design and submit the necessary deliverables forming the Infraco Deliverables, using the similar processes as defined within the "SDS Provider's Agreement with **tie** (which BBS understands will be novated to BBS under the Infraco Contract and which is included in Volume 7 of the ITN).

One advantage of having a tram system being implemented as a Turnkey Tram System is to have all project phases and activities in one hand - comprising the system configuration and detailed design, the construction of the system, the system commissioning and the integration tests up to the trial run and the training of Operation and Maintenance (O&M) staff of the future Operator.

In this context, the novation of the SDS contract to the Bilfinger&Berger-Siemens Consortium, referred to hereinafter as BBS, and the interface between the two becomes an essential issue for the fulfillment of the BBS contract.

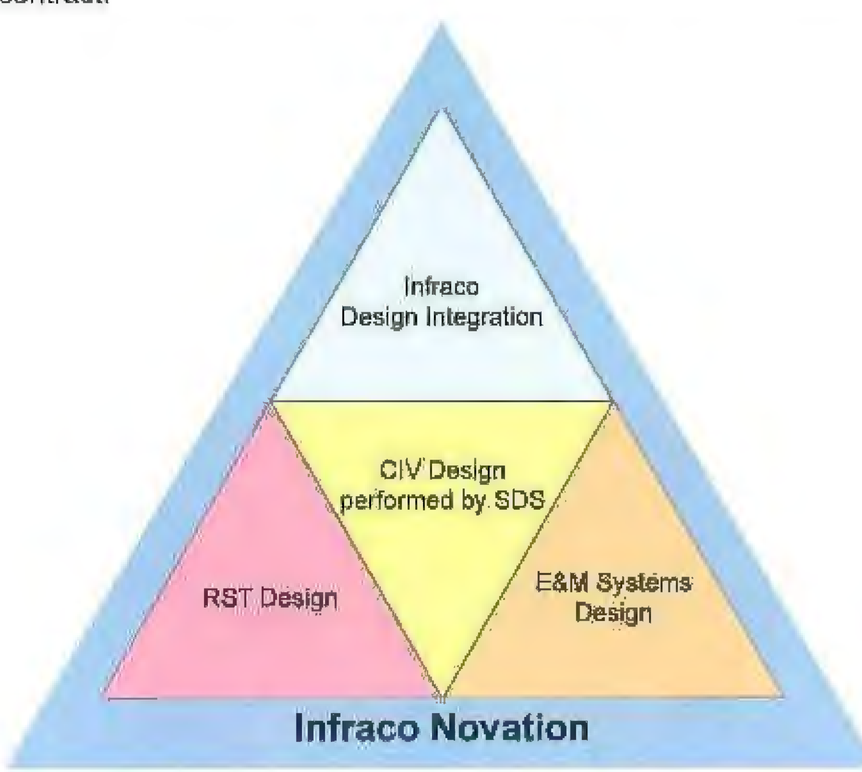

Figure 1 Engineering Model for ETN

It is understood, that the System Design Services has been contracted separately by **tie** to the SDS Provider, and will be novated to BBS after contract award of the ETN Infraco contract to BBS. It is further understood that the scope of the works for which the SDS Provider is responsible includes but is not limited to their provision of the Infrastructure Detail Design.

The technical project co-ordination and the system configuration to be provided by BBS and the System Engineering does not only comprise the Electrical and Mechanical (E&M) sub-systems but also covers the interfaces with the SDS Detail Infrastructure designs.

2 Proposal for Handling SDS Design Process

The construction, installation and implementation of a totally new transportation system as a Turnkey System is based on a top-down engineering process, which deduces design requirements for the elements of the next lower subsystems from the constraints and requirements to be fulfilled by the appropriate superior level of integration.

It is understood, that for the Edinburgh Tram Network, the Overall System Engineering will form part of the BBS Works.

As a general approach, BBS intends to take the so-called "V-Process" (which is for example described for RAMS in the EN 50126) as guideline to define the interfaces and the procedures to manage their interface with the SDS Provider and all project stakeholders including the Tram Supplier.

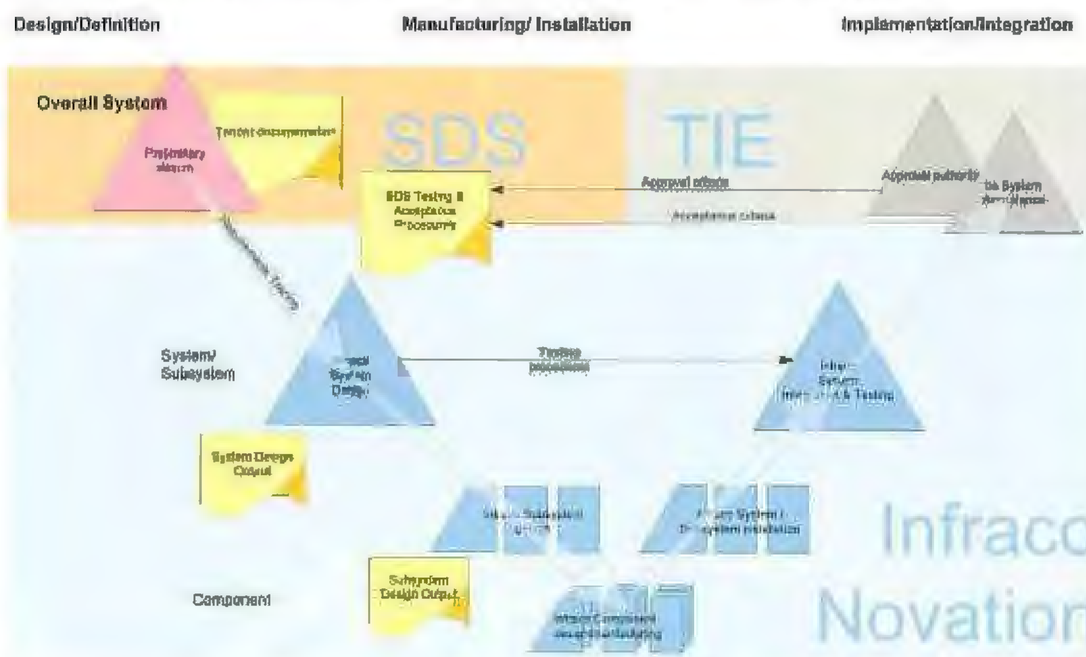

Figure 2 System Engineering Process in relation between tie, SDS and BBS

Arising from this model, BBS identifies a number of interfaces to the SDS design output.

Accordingly BBS will develop their system and subsystem proposals and provide SDS with the timely provision of the necessary information of the BBS proposals to enable SDS to incorporate specific features of the BBS proposals within their SDS Infrastructure detail designs in order to revisit and update them to make the most effective use of the equipments being offered to tie for incorporation within the ETN Network.

As part of their works BBS will produce such test and acceptance plans and procedures and criteria on system level that shall enable BBS to demonstrate to **tie** the compliance of the ETN System to Employer's Requirements. Furthermore, these plans and procedures shall be worked out and agreed to an extent, that enables BBS to perform tests according to these and to apply for acceptance and approval respectively and that these tests cover all appropriate ETN requirements and functionality as defined in the Employer Requirements.

In the progress of design review of these Test and Acceptance procedures, BBS will also justify the extent of these in relation to the Employer's Requirements and the requirements set out by the relevant authorities.

3 Liaison to Tramco contract

Rolling stock for the ETN will be contracted separately under the Tramco contract. Tramco's vehicles will have to be integrated into the ETN system, by BBS.

As the System Design, where he main features of Tramco's rolling stock will have to be defined, shall be managed and carried out by BBS, this definition and integration has to be handled between BBS, SDS and Tramco.

BBS will contribute to this process with the system design reviews mentioned above. Beyond this, BBS expects vehicles to be manufactured, commissioned, tested and approved according to the design agreed defined by **tie**.

Layout and dimensioning of the BBS deliverables depend to a great extent from the characteristics and the parameters of the rolling stock employed for ETN. The current layout included in this bid is based on the parameters and technical issues of Tramco's vehicles as they are currently defined in the Infraco tender documentation. It is understood, that tie will nominate the vehicle supplier after the submission of the BBS bid. Therefore, parameters of the BBS deliverables have to be reviewed after definition of the tram supplier and the release of confirmed technical data of the vehicles.

Details of technical data required for the overall engineering of the system were communicated with tie within the "Tramco / Infraco Matrix" in relation to RT 089. Comments to this matrix were given by BBS as far as required and applicable.

Following the Due Diligence Process BBS will employ a Tram Inspector to be agreed by tie, who shall follow the Tramco design process and be responsible for the trams approval based on the tie specification and the parameters agreed on in the "Tramco / Infraco Matrix".

4 System Concepts

System Engineering activities comprises a set of basic System Concepts which are key documents for the whole engineering process. These concepts shall be elaborated by BBS. BBS suggests to use technical solutions and outline concepts included in this bid as basis thereto (see annexes).

These System Concepts comprise, but are not limited to, the following:

- Operations Concept and Plans,
- RAM Concept (Reliability, Availability, Maintainability),
- System Safety Concept and Plans, Safety Case,
- Concepts for Earthing & Bonding and for EMC (Electromagnetic Compatibility),
- Maintenance Concept and Plans,
- Concept for Interface Management,
- Concept for Commissioning, Testing and Trail Run,
- Training Concept.

5 Approval of SDS Design by BBS

After inclusion of the required details in BBS system and/or subsystem design, this will be forwarded separately or incorporated in the SDS design, as far as applicable, for approval to tie and other approving bodies.

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6 Installation

6.1 Installation

Delivery and installation plans and proposals will be developed by BBS to identify and assign direct responsibility for all elements of the BBS delivery and installation process. These plans will ensure that all elements of the ETN are correctly manufactured, delivered, installed, inspected, and tested to the level necessary to ensure that equipment, subsystems, and the overall system perform in accordance with the design criteria.

Installation method statements will be developed for all installation work. These method statements typically identify the activities to be performed to ensure equipment is correctly installed and include inspection and testing requirements to verify conformance. Modularised, self-contained equipment assemblies with standardised panel layout, power and signal interfaces, and mounting configurations, will be used to the maximum extent practical to minimise 'custom' site installations. This approach permits the use of many standard drawings and procedures, thereby, significantly reducing the amount of time required for the production and approval of the installation method statements.

Installation method statements will also clearly identify protection requirements, resource and material requirements, and equipment preservation instructions.

7 Commissioning and Testing

The strategy for testing and commissioning is to transfer all subsystems into operational conditions

- step by step based on the logistic sequence,
- in parallel if logistically possible (e.g. installation of telecommunication equipment, commissioning of power supply)
- section by section to have the possibility to test integrated parts of the system as early as possible.

Commissioning phase will start with site testing of different units and/or subsystems within one line section. After successful testing the integration of further subsystems will follow until completion of the whole line section. The specified technical function will be demonstrated for one line section until subsequently performed for the entire system to complete system ready for Trial Run.

Some of these tests may be performed during Trial Run, when the whole System is more reliable.

During the different phases the verification takes place by each lot. The verification of the whole system is to be co-ordinated by the System Integration Manager. Parallel to the commissioning process the set up of the Operations and Maintenance Organisation, and the on-site training of the staff has to be finalised. The complexity of the commissioning process with relation to staff training and operation and maintenance of the system will require a clear and strict organisation including the co-operation of all parties involved. Training of operations and maintenance staff partly may be executed during the phases of System Demonstration and/or Trial Run.

Commissioning and testing will comprise the following stages:

- Factory tests
- Installation Tests (Site tests items a and b)
- System integration tests (Site tests items c and d; SIT, SCT)
- Trial Run initial stage, completed with T1 tests
- Trial Run performance ramp up, completed with T2 tests
- Shadow running, completed with T3 tests
- Provisional System Acceptance, Handover and start of revenue service
- First year of revenue service, completed with T4 and T5 tests
- Final System Acceptance

7.1 Testing & Commissioning Process

Validation of the technical contractual requirements / specifications will generally be implemented by testing, whereby other means of validation (e. g. simulations, calculation notes) may also be applied where appropriate to provide confidence about the correctness of the design.

The Testing and Commissioning Process shall be performed by a working group consisting of customer and operator representatives and subsystem suppliers, whereby the following tasks / objectives shall be considered:

Customer Representatives

- Review and comment of Test Program Plan, Test Procedures and other relevant test documents;
- Monitoring of testing methods and procedures;
- Witnessing of tests.

Project Management and Subsystem Representatives

- Elaboration of basic documentation for Testing and Commissioning for the respective subsystem tests and integration tests;
- Planning and performance of progress control of commissioning on basis of the project installation schedule;
- Coordination of on site the testing of subsystem suppliers and other contractors interfacing equipment and installations;
- Performance of maintenance during commissioning phase;
- Supervision of Safety and Security;
- Realisation of Quality Control and Documentation for subsystem and system level;
- Follow up of correction of variances/deviations on subsystem and system level;
- Performance and coordination of System Integration and Demonstration Tests (with support by the subsystem suppliers);
- Submission of relevant testing documentation to the Customers review team.

Operations and Maintenance

- Take over the System as specified in the contract for Revenue Service;
- Performance of operation and maintenance of the system during and after Trail Run Operation;
- Participation in testing, commissioning and start up activities;
- Witnessing of tests and participation on facility inspections;
- Support and assistance the integration and overall system testing with trained and experienced staff.

7.2 Test Planning

The Test Plan is expected to be developed for all test phases on system level, i.e. from the site tests SIT/SCT to T5, by BBS, tie and the relevant authorities. This test plan shall clearly identify all items to be tested to satisfy tie's requirements to provide acceptance to the system and all items required from HMRI or other relevant authorities to grant approval for operation, energization and the like. Test planning shall be completed by the end of the final design.

In addition the Commissioning and Testing Plans shall include but not be limited to the following information:

- Systems/components to be commissioned with its dedicated functional requirements (e.g. definition of parameters),
- Roles and responsibilities, incl. commissioning team organization and schedule for the required support by the operators personnel
- Commissioning process to be followed, incl. commissioning pre-requisites and schedule
- Commissioning report requirements, incl. Progress Reporting and logs.

Subsequent documentation will detail:

- test procedures,
- the approval procedures,
- safety management and related measures,
- the process for managing non – conformances.

7.3 Testing of construction phases 1a and 1b

Factory tests in terms of type and investigation tests will be performed in phase 1a. Routine tests will be performed as stipulated by the applicable standards. Where equipment for phase 1b differs from any reason to phase 1a, type and investigation tests may be repeated if necessary.

Installation tests and System Integration tests as well as trial running will be performed for every phase (1a and 1b) separately and independently. For joining phases 1a and 1b, the testing for the anticipated 56-h-period has to be agreed separately and independently from the following descriptions.

7.4 Factory Tests

Factory tests will be performed by each lot and sub supplier on their own responsibility, but under coordination of BBS's System Engineering. Factory tests may comprise type tests, routine tests or bench tests or a combination of these, as deemed necessary from the supplier and stipulated by the applicable standards.

7.5 Installation Tests

Installation tests, including Subsystem Integration (Site tests items a and b) will be performed mainly by each lot and sub supplier on their own responsibility, yet under coordination of the system engineering. To promote the progress of works, BBS's System Engineering will coordinate system installations and tests such, that subsystems can be completed on certain sections simultaneously. Therewith, these sections can be handed over to System Integration tests section wise as indicated in the BBS Contract (Sections A to F). Furthermore, the coordination will normally aim to give priority to the completion to section close to the depot to have them operative for the first test runs with the vehicles at an early stage.
In case that interfacing components of sub systems are missing in the above process, this has to be covered by operational procedures / instructions. Those instructions and procedures will be adjusted according to the status of the system.

7.6 System Integration Tests

E&M System Integration Test activities will be handled by the BBS's System engineering with support by the lots and sub suppliers

The System Integration Test shall verify the correct interaction and interfacing of the appropriate subsystem with other interfacing systems and its correct functioning in its environment according to the contractor's offer and to the specification requirements.

The E&M System Integration Tests will start at the SIT level, normally with that interfacing subsystem regarded as the most decisive for the overall functioning of the appropriate subsystem (e.g. SCADA with communication) followed by the other interfacing subsystems until achieving full functionality of the appropriate system.

Completing all System Integration Tests will lead to the SCT level (Site tests item d).

As said before, this System Integration testing can also be split up into dedicated sections of the systems which may then, after passing the SCT level, may be used e.g. for test runs with vehicles with Tramco.

7.7 Trial Run

The Trial Run is the ultimate project phase prior to Shadow running. In the particular case, the Trial run will considered in two stages, the initial stage to achieve full functionality and completed with the T1 test (runtime confirmation). The second stage will include full driver familiarization and ramp up of the system performance until reaching the system performance as stipulated in the chosen operational variant (one of the variants set out in the Information release 2007-03 28). The second stage of te Trial run will be concluded with the T2 test (System Performance).

The staff of the Operator, the "O&M Organisation" will execute the Trial Run as part of the "On-the-Job Training".
During this phase the main activity is also with System Engineering supported by the suppliers including Tramco that are co-ordinated by the Site Management.

The following technical and organizational preconditions shall be fulfilled prior to the start of the Trial Run:

The system has to be commissioned completely. Punch list Items are allowed, but all safety relevant requirements and functions need to be fulfilled and the relevant certificates have been issued, respective the Operations Manager took over the system, (exceptions such as completion of AFC or prioritization of traffic lights may be agreed with the Customer)

- The organization of the Operation and Maintenance Company is established.
- Training of Operation staff necessary for the Trial Run operation has been completed the examination is documented accordingly.
- Training on Maintenance staff necessary is completed as far as required for achieve the overall requirements for Trial Run operation.
- Rules & Regulations and procedures required for Trial Run Operation are available
- Coordination of Operation and Maintenance Management with Site Management defined
- The Evaluation Committee (and if required the appropriate sub committees) is founded.

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7.8 Shadow Running

The Shadow Running is a final stage, where nearly no tests are performed any more, but where various operational patterns and emergencies can be trained. T3 test will be part of the final stage of shadow running. Within T3 tests, Tramco has to prove that their rolling stock is able to provide a riding comfort level as set out in Tables 8-1 and 8-2 of the Employer's Requirements on track as specified in the BBS contract.

7.9 Revenue Service and Network Performance/Reliability Test

After Provisional Acceptance granted after T3 tests respectively after successful termination of Shadow running, the system will enter into revenue operation. During the first 12 month of revenue service the Network Reliability Test (T5) and the Network Performance Test (T4) will be performed.
The Network Reliability Test (T5) will be performed in a period of 90 consecutive days, whereby the reliability targets for the subsystem as set out in Section 1b /10.3 of the Employer's Requirements will be demonstrated.

The Network Performance Test (T4) will be performed in parallel in a period of 28 consecutive days, whereby special demonstrations - Substation and UPS Demonstration, Tram Change Over as defined in part 1d/ 9.4 ff. of the Employer's Requirements will be performed.

For both tests effects of vandalism, damage or other impacts caused by third parties (e.g. collision of motor vehicles), shall be eliminated from the performance demonstration and neither effect nor deem as interruption of the ongoing demonstration period.

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8 Acceptance and Approval

Acceptance and approval are distinguished here as follows:

- Acceptance: certification that the system is conform to the requirements of the customer, discharge of BBS from their contractual obligations
- Approval: certification that the system is conform to legal requirements, standards and the like and that the system is allowed to enter into passenger service

Approval and acceptance shall be given according to clear pass-fail criteria as set out in the test plans worked out by the BBS (see 2).

31st March 2008

Updated Proposal Submission

Edinburgh Tram Network

Section 2: Overall Technical Concept

Part 1 – System Engineering

Annex 1 – RAMS Concept

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Table of Content

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1 General

1.1 Purpose

The purpose of the present RAMS Concept is to provide an overview of the RAMS process intended to be performed for BBS scope of supply to provide a safe and reliable transit system.

1.2 Scope

The RAMS Concept describes the tasks and activities of system safety, RAM management and engineering required to identify, evaluate and control hazards, or reduce potential risk to a level acceptable to the Authority.

BBS will approach the RAMS activities as part of the design and submit the necessary deliverables to form the BBS Proposals, using the same processes as defined within the "SDS Provider's Agreement with tie (which is being novated under the Infraco Contract and which is included in Volume 7 of the ITN). Details of the design output from SDS to BBS terms of RAMS activities have to be defined.

This RAMS Concept applies to activities related to the technical safety, and RAM during design, construction/installation, testing and safety certification process until the start of revenue operation.

The following sections provide outline details for

- The general RAMS activities (System Assurance activities) in Section 2.1
- Safety activities in Section 2.2
- Reliability, Availability, Maintainability (RAM) activities in Section 2.3

BBS will perform these RAMS activities in order to provide a safe, reliable, available and maintainable railway system according to the European standard EN 50126.
Site Safety, and Occupational Health and Safety are not part of the RAMS activities outlined in this document.

1.3 RAMS Policy

It is the goal the BBS consortium to provide systems, products and services of appropriate quality that offer maximum benefit to our customers worldwide. RAMS is an integral part of quality, therefore RAMS policy is based on our quality policy.
Reliability, availability, maintainability and safety play an important role in ensuring the specified performance, which justifies the special attention paid to RAMS aspects throughout the project.

1.4 Applicable Documents

The following standard will be used as reference:
EN 50126, Specification & Demonstration of Reliability, Availability, Maintainability & Safety (RAMS) for Railway Applications, September 1999

1.5 Definitions and Abbreviations

Availability: The ability of a product / system to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval assuming that the required external resources are provided.
Hazard: A physical situation with a potential for human injury. (EN 50126)
Maintainability: The probability that a given maintenance action, for an item under given conditions of use can be carried out within a stated time interval when the maintenance is performed under stated conditions and using stated procedures and resources.

RAMS: An acronym meaning Reliability, Availability, Maintainability and Safety.
RAM-Program: A documented set of time scheduled activities, resources and events serving to implement the organizational structure, responsibilities, procedures, activities, capabilities and resources that together ensure that an item will satisfy given RAM-Requirements relevant to a given project or contract.
Reliability is defined as the capacity of a system / component to fulfill it's assigned function under defined conditions for a certain time (IEC 271). That means, reliability is the probability that an item can perform a required function under given conditions for a given time interval expressed in hours (MTBF: Mean Time Between Failure) or kilometers (MKBF: Mean Kilometers Between Failure).
Risk: The probable rate of occurrence of a hazard (expressed in a time interval) causing harm and the degree of severity (expressed in hazard severity levels) of the harm.

Safety: Freedom from unacceptable risk of harm (EN 50126).
Safety-Program: A documented set of time scheduled activities, resources and events serving to implement the organizational structure, responsibilities, procedures, activities, capabilities and resources that together ensure that an item will satisfy given Safety-Requirements relevant to a given project or contract.
The following abbreviations are used:

EN	European Norm
GF	Business domain (GeschäftsFeld)
RAM	Reliability, Availability, and Maintainability
RAMS	Reliability, Availability, Maintainability, and Safety
SAP	System Assurance Plan

1.6 RAMS Aspects of Railway System

This RAMS Concept covers the RAMS aspects of railway systems. The term RAMS represents the core aspects of System Assurance and means:
- Reliability,
- Availability,
- Maintainability, and
- Safety.

System Safety includes the technical safety, the safe system operation, especially the safety of persons, and the safe functioning of the equipment installed.
The attainment of acceptable in-service RAM parameters can only be achieved by meeting ongoing reliability, and availability requirements, by controlling the maintenance activities, and the operational environment.

1.7 Integration of System Suppliers

Specific internal rules and regulations to improve co-ordination, and quality of work of internal system suppliers for mass transit systems will be established. Internal suppliers are obliged to provide their input according to requirements established by the contract, by applicable standards, and the internal regulations fixed in the "GF" process. This "GF" process is developed to provide, beside others a RAMS process according to EN 50126.

Sub-contractors will be integrated in the RAMS process by using sub-system specifications considering the Contract, EN 50126, and project procedures, e.g. for organization, quality management, or documentation.

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2 RAMS Process

2.1 General RAMS Activities

2.1.1 RAMS Program (System Assurance Program)

The RAMS program scheduled by BBS comprises activities relating to RAMS aspects of transit systems. RAMS, also known as System Assurance will be ensured by duly performing the RAMS activities outlined below.
The RAMS activities described below represent the RAMS Program including the preparation of a System Assurance Plan (SAP). This System Assurance Plan for the BBS scope of supply details the general RAMS activities work to be carried out by BBS. The plan defines the scope of the RAMS tasks that will be undertaken to achieve a safe and reliable system operation. Details about the documentation of the RAMS activities are provided in section 2.1.4.
The following RAMS aspects will be considered in the SAP:

- RAMS Management Structure
- Scheduled RAMS Activities
- RAMS Documentation
- Reporting
- Reviews
- Quality Management
- Limitation of Scope

2.1.2 RAMS Management Structure

BBS will establish a comprehensive, and effective RAMS management. This includes the controlling of the RAMS activities on overall system, system, and on sub-system level. A hierarchical management structure as shown below will be established. This structure has proven to deliver good results in mass transit turnkey projects.

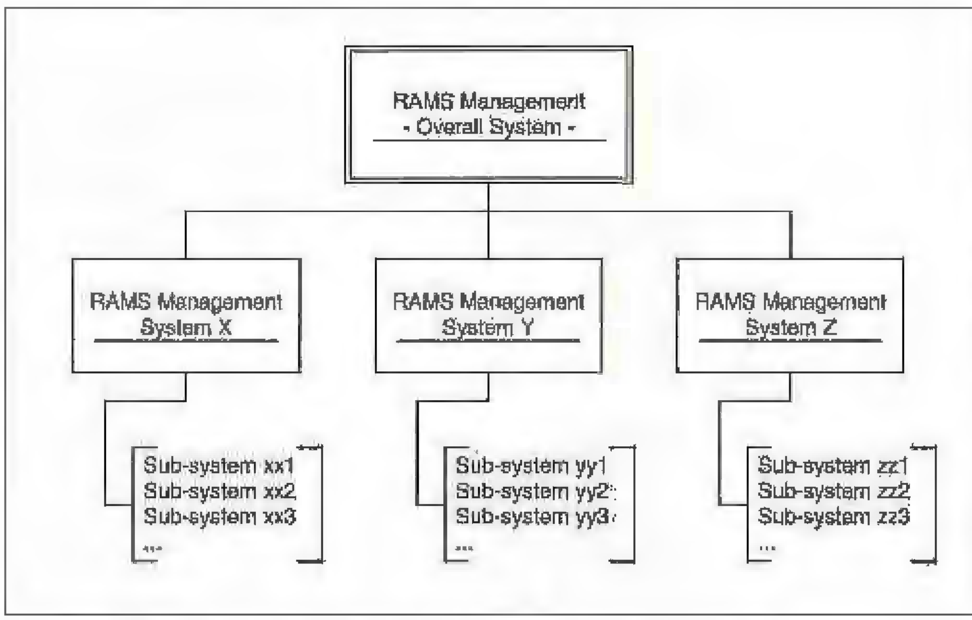

Figure 1.: Example for hierarchical RAMS management structure

2.1.3 Scheduled RAMS Activities

A global flowchart of the RAMS activities scheduled in relation to general project phases is given below.

The activities outlined in figure 2 will be detailed in the RAMS documentation according to the specific project phases, and the RAMS requirements established. The activities are scheduled in accordance with EN 50126, and will be tailored to the specific project requirements.

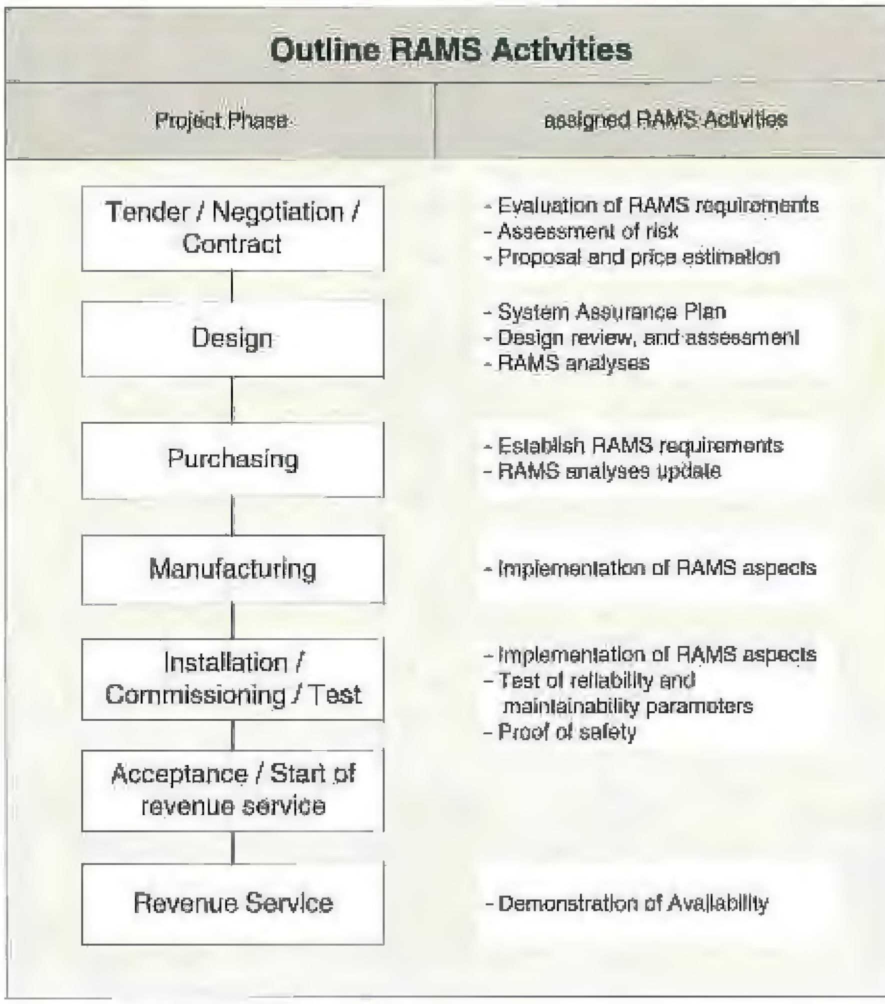

Figure 2.: RAMS activity flowchart

2.1.4 RAMS Documentation

The RAMS Program contains several activities for the RAMS aspects of the project. BBS will document the RAMS activities. Figure 3 shows the documentation structure proposed for system assurance activities on the overall system level.

The System Assurance Plan covers the RAMS related procedures and activities from design phase up to the start of revenue operation of the system. The objective of the System Assurance Plan is to ensure that the approach adopted by BBS for the reliability, availability, maintainability and safety activities will satisfy the requirements established for modern mass transit systems. The System Assurance Plan can contain System RAM Plan, and a System Safety Plan. In this case these documents will provide the details of the RAMS activities.

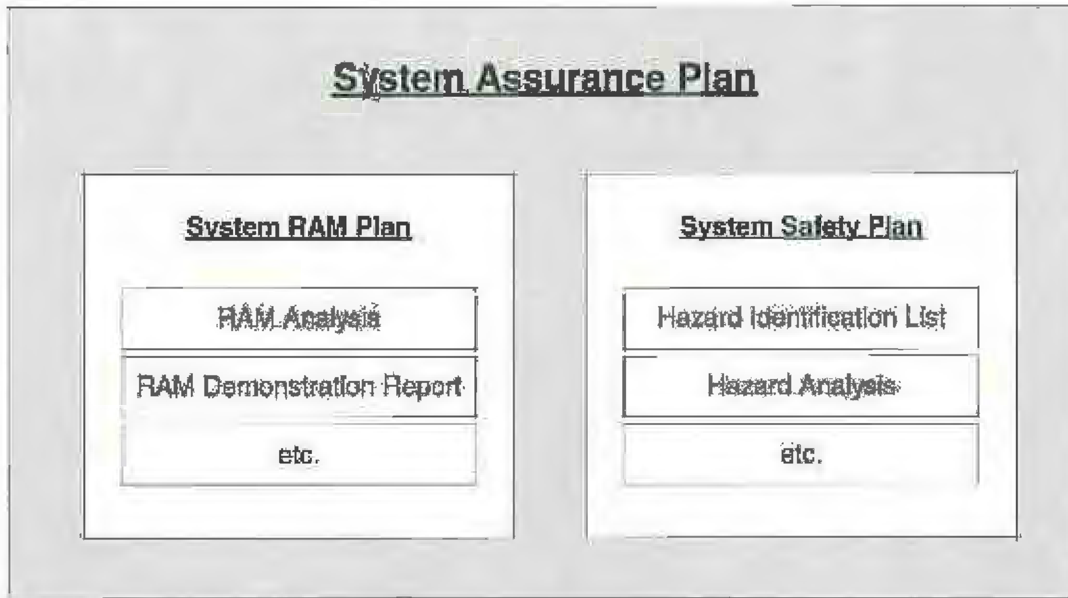

Figure 3.: Example for RAMS documentation on overall system level

A hierarchical documentation structure will be established for the systems RAMS activities. Figure 4 below shows a rough example for the structure of the RAMS documentation. This structure will be extended according to the specific requirements established.

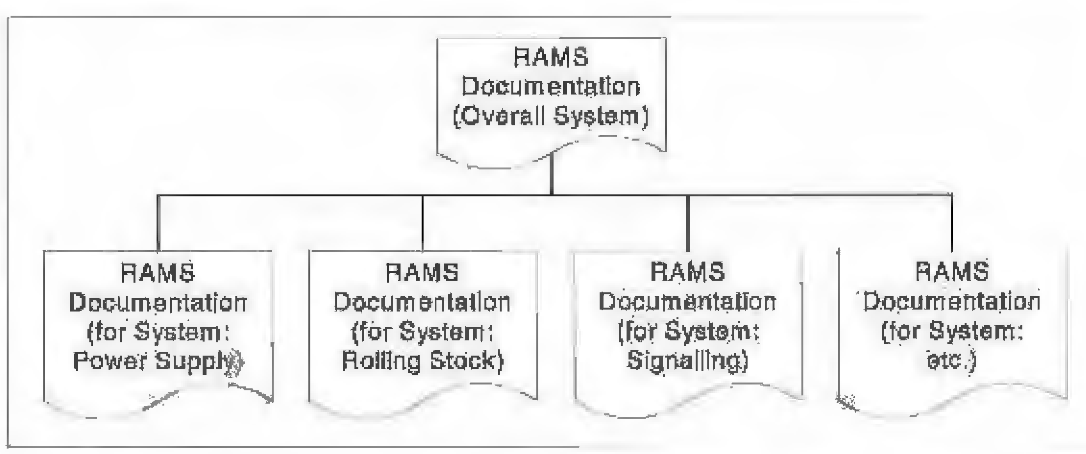

Figure 4.: Example for hierarchical structure of RAMS documentation

2.1.5 Reporting

Reports will be prepared and submitted to the Authority providing information about RAM and Safety analyses, and demonstration tests performed by system suppliers. RAMS activities can be reported for the overall system level as well as for the system level depending on the RAMS requirements established, and the system complexity. Details will be provided in the RAM and Safety plans.
Status reports will be prepared periodically containing information about work progress.
BBS will present the status, and results of RAMS activities at least at the end of design period, and commissioning period, if required.

2.1.6 Reviews

Internal reviews of system assurance work will be performed at the end of major design phases.

2.1.7 Quality Management

High product quality is a precondition for successful achievement of the RAMS requirements.
BBS will establish a project Quality Management during the project phases to supervise and control the BBS works as well as the works of the sub system suppliers. The Quality Plan will provide further details.

2.1.8 Limitation of Scope

The following events will not be covered by safety or RAM studies:

Consideration of any malevolent or voluntary action, vandalism or force majeure.
Site Safety, and Occupational Health and Safety.

2.2 System Safety Activities

BBS intend to perform the following safety activities:

- Hazard identification and analysis
- Detailed safety analysis for items identified as safety critical
- Demonstration of safety related functions
- Documentation of safety activities

Generally the safety activities will be performed to provide:

- Evidence of adequate Quality Management,
- Evidence of adequate Safety Management,
- Details of the implementation and results of technical safety analysis and activities,
- Recommendations and restrictions for use of system and / or installation operational and maintenance requirements constraints.

2.2.1 System Safety Objective

The system safety activities will ensure that the policy of BBS is:

- To meet the contract requirements on safety,
- To design, procure and commission the system capable of being operated and maintained at the required safety level which has been identified as result of hazard analysis for this project.

Application of this policy means:

- Safety risks (i.e. likelihood and consequences of hazards) will be reduced, e.g for signalling by designed fail-safety of the employed technology or other protective product features down to a rate considered as being tolerable in accordance with EN 50129

Priority is to provide proven safety so that:

- The requirements on proven safety are met,
- The safety process focuses on adaptations and modifications from generic systems.
- The consistency of the overall safety concept of the project is not undermined by new developments of safety critical items.

BBS will ensure that the safety policy statement from their partners and sub-contractors have equivalent complementary statements that support and comply with this policy.

2.2.2 System Safety Organisation

The safety organization is an integrated part of the system assurance organization outlined in section 2.1.2. BBS will designate a System Safety Manager for the overall system.
System suppliers are responsible for implementation of the Safety policy within their scope of work. They will designate their Safety manager(s)/officer(s) for the application of it.
These managers, and officers will form the Safety Team and they will meet on a regular basis. The System Safety Plan will provide a description of the Safety organization.

2.2.3 System Safety Plan

BBS will prepare a System Safety Plan as part of the SAP or as a separate document (see section 2.1.4).
As a basic guideline of the Safety Program, the System Safety Plan will provide the program elements.
The objective of the Safety Plan is to provide the Authority and BBS with a complete statement of the planned System Safety Program. This program is an element of the transportation project to ensure compliance with the relevant safety requirements established by the authorities and will include the milestones for obtaining approvals from the authorities. BBS will identify, analyze and control all relevant hazards under normal, restricted and emergency conditions following the plan so that the hazards can be eliminated or controlled at levels, considered as being tolerable in accordance with EN 50126.

The System Safety Plan will require that:

- BBS, their partners and main subcontractors will provide their own plans, which will be compatible with their own in-house design safety management practices and consistent with the System Safety Plan.
- BBS, their partners and main subcontractors will provide a detailed management structure document describing and emphasizing the

responsibilities relating to safety management together with the definition of the organization, the roles and responsibilities of the individuals involved.

- BBS, their partners and main subcontractors will have a demonstrably competent and well-trained workforce.

The Safety standard to be complied with is European standard EN 50126. The content of the safety analyses will fulfill the applicable requirements and will be conform to the relevant safety standards.

The Safety Plan is part of the RAMS program, see also section 2.1.4., and covers the following items:

- General system safety requirements, recommendations and criteria
- Overview about the system configuration
- Safety organization and management
- Scheduling of safety activities
- Safety Program activities
- Documentation of safety activities

2.2.4 System Safety Program

The objective of the Safety Program is to demonstrate that the system design and/or its application are likely to achieve the specified safety requirements. The Safety Program will provide the authorities as well as BBS with a complete statement of our proposed methodology for ensuring compliance of the system design with the required safety regulations. The Safety Program will be subject to approval by the Authority.

The Safety Program will include the required documentation of safety related analyses, tests and reports and will be performed on the overall system and sub-system level. Each document that is part of the Safety Program will be submitted to the Authority for approval.

A Time Schedule will be provided to the Authority, which will include the milestones for submission of the safety related documents, and for safety verification and validation procedures.

2.3 System RAM Activities

The RAM activities will be performed as part of the system assurance activities. BBS intend to perform the following RAM activities:

- RAM analysis and prediction

- Detailed analysis for items identified as reliability critical

- Demonstration of reliability, availability, and maintainability if required

- Documentation of RAM activities

2.3.1 System RAM Objective

The RAM activities will ensure that the policy of Contractor is:

- To meet the contract requirements relating to RAM,
- To design, procure and commission a highly available, reliable, and maintainable system.

Application of this policy means:

- Provision of high quality products, and system engineering combined with professional project management.

2.3.2 System RAM Organisation

The RAM organization is an integrated part of the system assurance organization outlined in section 2.1.2. BBS will designate a System RAM Manager for the overall system. One person can take over responsibility of the System RAM Manager and the System Safety Manager.
System suppliers are responsible for implementation of the RAM requirements within their scope of work. They will designate their RAM manager(s)/officer(s) for the application of it. These managers and officers will meet on a regular basis. The System RAM Plan will provide a description of the RAM organization.

2.3.3 System RAM Plan

BBS will prepare a System RAM Plan as part of the SAP or as a separate document (see section 2.1.4).
This plan contains all relevant information about the RAM organization, RAM schedule and RAM activities applicable to the overall system.
The RAM Plan covers the following items:

- General system RAM requirements, recommendations and criteria
- Overview about the system configuration
- RAM organization and management
- Scheduling of RAM activities
- RAM Program activities
- Documentation of RAM activities

2.3.4 System RAM Program

The objective of the RAM Program described in the System RAM Plan is to demonstrate that the system design and/or its application are likely to achieve the specified RAM requirements. The RAM Program will provide the Authorities, as well as BBS with a statement of the methodology proposed for ensuring compliance of the system design with the required RAM targets.
The RAM Program will include the required documentation of analyses, tests and reports. It will be performed on overall system level, and on system level.
A Time Schedule will be provided to the Authority, which will include the milestones for submission of the RAM related documents, and for RAM demonstration if required.

3 RAMS Requirements

The Edinburgh Tram Network shall be made as reliable as practicable by making the subsystems as reliable as practicable, subject to the constraints of cost. Where necessary, the system should be made resilient to single point equipment and cable failure by employing suitable levels of equipment/cable redundancy and duplication.

On equipment or cable failure, systems shall be designed in a safe manner with modes of degradation leaving possibilities to work around. Limited back-up facilities shall be provided to maintain services under specified partial failure conditions.

Defined within chapter 3.5 are the requirements for availability of individual subsystems (each of which is given a definition), and the reliability of individual components of the subsystems (see chapter 3.2).

3.1 Definition of Reliability

The capacity of a system / component to fulfill its assigned function under defined conditions for a certain time (IEC 271).

For the percentage values in clause 3.2 and 3.3 the following calculation should apply:

$$R_{Subs} = 100\% * [Nh_{oa} - (Nh_{oa} / MTBF) * MTTR] / Nh_{oa}$$
$$= 100\% [1 - MTTR / MTBF]$$

R_{Subs} – Subsystem-Reliability [%]
Nh_{oa} – Operation-hours per year (7300hours = 20hours/day * 365 days)
MTBF – 'Mean Time between Failures'
MTTR – 'Mean Time To Repair (without administration and logistic time)

For all components and subsystems, assume a Mean Time to Repair (MTTR) of 4 hours for the definition of the Reliability-targets. For the demonstration of the Reliability-targets the real MTTR will be taken into account for the estimation of R_{Subs} under consideration of the stipulation made in 3.9 herein.

3.2 Reliability targets for Subsystems

3.2.1 Overhead Line Equipment and Power supply

Component or Subsystem Minimum Reliability

OLE System, where its availability is defined as the probability that in any linear km of the OLE system, trams are not able to operate at the normal operational speed due to defects in the OLE. (this is based on 20hr/day operation and 20 route-km plus depot, about 50 track-km) maintenance by skilled personnel according maintenance manual, operation within specified limits, transient-effect failures and third-party impact will not be taken into account.

99.995% for each km

Component or Subsystem Minimum Reliability

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AC circuit breaker, where its reliability is defined as the probability that it either fails to conduct electricity when commended to be closed. **99.99%**
Transformer / rectifier where its reliability is defined as the probability that it either fails to provide the nominal 750VDC when energized. (coil short circuit neglected) **99.99%**
DC circuit breakers and busbars, where its reliability is defined as the probability that traction power is not available from the DCCB when commanded to be closed, provided that 750 VDC is available at from the rectifier **99.99%**
Transformer / rectifier where its reliability is defined as the probability that it fails to provide the nominal 750VDC when energized by the HV input. (coil short circuit neglected) **99.99%**
Substation battery and charger, where its reliability is defined as the probability that control voltage is not available from the battery at any time during its normal operation, regardless of the state of the incoming LV supply **99.99%**
Substation, where its reliability is defined as the probability that 750VDC voltage is not available for the OLE when the substation is commanded to provide 750VD **99.75%**

3.2.2 Supervisory and Communications Systems

<u>Operational Data Network</u>
Component or Subsystem Minimum Reliability
ODN node **99.99%**
Fibre Optic Cabling **99.99%**
Patch Panels and Connectors **99.99%**
ODN network, where its Reliability is defined as the probability that any message from a given input to a node reaches its intended destination node correctly and could be transmitted onwards by that node. **99.75%**

<u>Tram Position and Detection System</u>
Component or Subsystem Minimum Reliability
Transponder (if used) **99.9%**
Loop Detector **99.75%**
TPDS Trackside Controller **99.9%**
TPDS subsystem, where its Reliability is defined as the probability that any given tram has its position detected and passed to the signal controller and to Control Centre operators correctly, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional **99.75%**

<u>Passenger Information Display</u>
Component or Subsystem Minimum Reliability
Passenger Information Display **99.9%**
Local Controller (if required) **99.9%**
PID subsystem, where its Reliability is defined as the probability that the appropriate message is displayed correctly at a given PID, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional **99.75%**

<u>Telephone Network</u>
Component or Subsystem Minimum Reliability
Telephone Handset **99.9%**
PABX **99.99%**

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Telephone network, where its Reliability is defined as the probability that any 30 second conversation between a given telephone and another given telephone is heard clearly and completely by the caller and the intended recipient, assuming that the ODN is fully functional. **99.75%**

<u>Public Address System</u>

Component or Subsystem Minimum Reliability

PA speaker **99.9%**
PA controller **99.9%**
Microphone and speaker **99.9%**
PA subsystem, where its Reliability is defined as the probability that an operator can make an intended announcement clearly at a given platform, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional. **99.75%**

<u>Operational Radio System</u>

Component or Subsystem Minimum Reliability

Base Station **99.95%**
Mobile Handset (Tram, Vehicle, or Hand Held) **99.7%**
Central Switch **99.99%**
Operational Radio subsystem, where its Reliability is defined as the probability that a 10 second call (voice) or short data message can be received clearly by the intended recipient, assuming that the ODN is fully functional and that the hardware component of the Control Centre workstations is fully functional **99.5%**

<u>Passenger Help / Passenger Emergency Help System</u>

Component or Subsystem Minimum Reliability

Help / Emergency Help Point **99.9%**
Help Point subsystem, where its Reliability is defined as the probability that a member of the public can contact the control room operator and can carry out a Help Point conversation lasting 20 seconds, clearly and without interruption, assuming that the ODN is fully functional and that the PABX is fully functional **99.75%**

<u>CCTV System</u>

Component or Subsystem Minimum Reliability

CCTV camera **99.95%**
Digital Video Recorder **99.95%**
CCTV Matrix **99.95%**
CCTV subsystem, where its Reliability is defined as the probability that an image is displayed correctly and in the specified sequence at the Control Centre, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional **99.75%**
Recording and replay subsystem, where its Reliability is defined as the probability that an image is displayed from any given time in the past (within the recorded period) can be retrieved and displayed correctly, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional
99.9%

<u>SCADA System</u>

Component or Subsystem Minimum Reliability

SCADA RTU (including I/O cards and interface cards) **99.95%**
SCADA subsystem, where its Reliability is defined as the probability is the lesser of

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(a) that an indicator is read correctly at the RTU, transmitted to the SCADA Master Station in the Control Centre, and displayed correctly on any SCADA display that is in use within four seconds; and
(b) that a control is effectively transmitted to an outstation within three [two] seconds assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional **99.75%**

Central Control Equipment

Component or Subsystem Minimum Reliability	
Servers (if necessary, by use of hardware and software redundancy)	**99.99%**
Workstations	**99.9%**
Printers	**99.5%**
CCTV Matrix Controller	**99.9%**
LAN Switches, Routers and Hubs	**99.99%**

Further reliability targets are stipulated in 3.3 herein.

3.3 Network Reliability tests for Subsystems

The Network Reliability Test (T5) will be performed in a period of 90 consecutive days, whereby the reliability targets for the subsystem as set out in this chapter will be demonstrated.

For this test effects of vandalism, damage or other impacts caused by third parties (e.g. collision of motor vehicles), shall be eliminated from the performance demonstration and neither effect nor deem as interruption of the ongoing demonstration period.

Each specified sub-system has its own specified target detailed in this chapter. The tests will start on the same date (on or after Service Commencement Date) and as each subsystem is individually demonstrated to meet its contractual target that subsystem reliability test is then considered completed. Network Reliability Test is only passed when all the sub-systems meet their targets.

The undertaking of the test will essentially be a maintenance function carried out by the Contractor. However, it requires contractor management of the preparation for the Tests with technical support and monitoring by Contractor, (along with representatives from **tie** during the Test).

The contractor will undertake and pass Network Reliability Test within twelve months after the Service Commencement Date of the whole Edinburgh Tram Network to pass Network Reliability Test.

If any part of the works or part of the ETN fails to pass Network Reliability Test then rectification, repair, modification or reinstatement of that system will be undertaken. The defect correction period on that part of the system or any sub-system which fails the test will be extended a further twelve months beyond the time of rectification, repair or modification. The contractor will propose and undertake the necessary remedial action to achieve acceptance.

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tie will be given thirty working days advance notice of the Network Reliability Test plan and fourteen working days written notice of the test commencement date.

TEST	TARGET VALUE
Tram Reliability	see Tramco Supply Agreement.
Hand Held Ticket Vending Machine	dedicated to supplier for Automatic Fare Collection System
Ticket Control System	dedicated to supplier for Automatic Fare Collection System
Passenger Information Display System	as set out in chapter 3.2.2 herein
Passenger Help/Emergency Help Point System	as set out in chapter 3.2.2 herein
On Street Track & Formation	Achieves **99.995%** reliability over six consecutive Periods.
Off Street Track & Formation	Achieves **99.995%** reliability over six consecutive Periods.
Point Machine	Achieves **99.995%** reliability over two consecutive Periods.
Traction Switchgear	Achieves **99.995%** reliability over two consecutive Periods.
OLE Equipment Achieves	reliability as set out in chapter 3.2.1 herein over two consecutive Periods.
Bonding & Earthing	No stray current, or 'touch voltage' recording that is within 15% of tolerable target for four consecutive Periods
Operational Radio	Achieves reliability as set out in chapter 3.2.2 over two consecutive Periods.
Operational Data Network	Achieves reliability as set out in chapter 3.2.2over two consecutive Periods.
UTC Interface Achieves	**99.75%** reliability over four consecutive Periods.
Wheel/Rail Interface	No proven instances of Noise and Vibration exceedences have occurred in a six month period
CCTV System	Achieves **99.75%** reliability over two consecutive Periods.
Tram Position Detection System	Achieves **99.75%** reliability over two consecutive Periods.
Traction SCADA System	Achieves **99.75%** reliability over two consecutive Periods.
Tramstop Lighting	Achieves **98.5%** reliability over two consecutive Periods.

General Exclusions and Assumptions
Should the Contractor be able to prove to the reasonable satisfaction of **tie** that any of the reliability tests would have been exceeded by means of one or more of the following exclusions then, in consultation with **tie,** the test results will be amended to discount the effects of such proven Network Reliability Test exclusions.

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The Network Reliability Test exclusions and Network Reliability Test assumptions set out in this section relate only to the Network Reliability Test and will not be used or relied upon in any circumstances in any connection with any other test. For the avoidance of doubt, third party vandalism and damage will be included in these tests.

Operator Influences
Defects caused by the Operator's failure to:
- Provide properly trained staff as defined in the DPOFA, exercising an absolute duty of care.

Exclusions
The burden of proof will be on the Contractor to show that such failures of the Operator were caused by reasons for which the Contractor was not responsible and for which the Operator should be properly accountable for by reason of the Operator's default, omission, negligence or breach of statutory duty. The Contractor will develop and agree audit procedures with **tie** and the Operator in respect of the Network Reliability Test exclusions set out in this paragraph.

However, in no event will any allowances or relief or Reliability Network Reliability Test exclusion be granted to the Contractor where any delays or failure to pass Network Reliability Test has been caused or contributed to by:
- Any default, breach or omission of the Contractor;
- Contractor defects; and
- Equipment undergoing modification or rectification by the Contractor.

Realistic long term response times to repair defects will be provided by Contractor during the period of the test. It is assumed that **tie** will procure all electrical power and that a supply is available for the tests. Any failures resulting from inappropriate actions or omissions by the Operator or his contracted staff will be discounted as set out in the DPOFA. For the avoidance of doubt, the impact of third party vandalism and damage will be excluded.

3.4 Monitoring and Reporting of Test Performance

The scoring of faults should be achieved by first reviewing the fault logs and performance reports using them as a filter to establish which faults need to go forward into the review. The review meeting will then be used to discuss and allocate the responsibility of faults under the performance regime.

The review meeting will take place daily where the performance of each system will be reviewed for the previous period. Representatives of Contractor, Tramco, **tie** and the Operator will attend this meeting. Each sub-system will be reviewed and agreement reached on all failures. The meeting will be recorded and the resulting daily report distributed to each party.

3.5 Definition of Availability and its Demonstration

The 'Availability' is defined in general as fallow:
<u>The ability</u> of a product to be in a state <u>to perform a required function</u> under <u>given conditions</u> at a <u>given instant of time</u> or over a <u>given time interval</u> assuming that the required external resources are provided. (EN 50126)

The Non-Availability is defined as follow:

Non-Availability = 1 – Availability

Vise versus applies:

Availability = 1 – Non-Availability

The offer of the contractor regarding the Availability/ Non-availability based on the following stipulations:
In general the Availability is depending from the status of the overall system. In the beginning of operation ("burn-in" phase) the availability may be influenced by spurious "early" failures. During this period the availability will grow up to the targeted availability of 99% (long term averaged value) due to replacement of such failed equipment under defects liability. According to common experience this period ends approximately after one year when the system is in the phase of 'normal use' characterized by a stable availability (averaged over the '*given instant of time* or *given time interval*').

'*The ability ... to perform a required function*' is defined over part 1e, 2.6 'Maintenance Strategy'; 'Reactive and Fault Corrective Maintenance' (Table 2-1) of the tender documents.
The ability to perform a required function is no more given when a 'failure halting the operation of the tram network in whole or part thereof' longer than 2h and/or a 'failure impact the punctuality of the tram network' longer than 8h.

'*..a given instant of time or over a given time interval*' is depending from the status of the overall system as mentioned above. In the beginning ("burn-in" phase) a fluctuation of the availability is possible. Due to that the '*given instant of time* or *given time interval*' should not be shorter than half a year in this period. In the follow-up period (phase of "normal use") the '*given instant of time* or *given time interval*' could be 3 months.

The specific definition of the (overall) Availability is defined as follow:

(overall) Availability = 1- Sum(t_{BDI})/ t_{Cal}

Sum(t_{BDI})	- Sum of time-periods for failure halting the operation of the tram network in whole or part thereof longer than 2h per failure-event over a given time interval (3month) (e.g. a failure-event were a failure halting the operation of the tram network in whole or part thereof for 2,5hours the time-period which has to be taken into account for the availability calculation would be t_{BDI} = 0,5h)
t_{Cal}	- Calendar-time of the given time interval

3.6 RAM Apportionment of the overall Availability

The following table gives an overview of the apportionment of 'Non-Availability/ Availability' based on common experiences for modern mass transport systems. This table serves as orientation only. The portion of the subsystems could diverge due to its stochastical character, but this deviations will compensate each other so that the averaged availability of 99,00%* will be reached during the phase of 'normal use'.

general ETN Subsystems	ETN non-availability allocation	ETN Availability * (99,0%-related)	ETN non-Availability * (99,0%-related)
Rolling Stock	50,00%	99,500%	0,500%
Signalling	22,50%	99,775%	0,225%
Power Supply	24,00%	99,760%	0,240%
Telecommunication	2,00%	99,980%	0,020%
Trackwork	1,50%	99,985%	0,015%
	100,00%	99,00%	

* long-term averaged value

3.7 Definition and targets for Maintainability

The probability that a given maintenance action for an item under given conditions of use can be carried out within a stated time interval when the maintenance is performed under stated conditions and using stated procedures and resources.

The system and its components will be designed with maintainability in mind. To this end, the following will be observed:

- Particular equipment will be in a redundant configuration, so that a component may be replaced while stand-by equipment takes over its duty
- Equipment will be replaceable if possible as field replaceable units, so that defective components can be replaced without the need to power down the overall piece of equipment
- Equipment, particularly at trackside and stopping points, will be positioned so that where possible it is accessible for maintenance or replacement without the necessity to halt tramway traffic or to close down the stopping point and without the need to use access equipment such as steps.

For all components and subsystems assume a Mean Time to Repair (MTTR) of 4 hours.
Any downtime required for planned maintenance can be discounted from the determination of availability, provided that such maintenance can be reasonably undertaken at a time when the maintenance has no impact on the operation of the system. This will often be during overnight system shut-downs.

3.8 Targets for Maintenance

Response times for reactive and fault correcting maintenance will be based on the potential impact of the incident or failure.

Fault category	Correction Time Limit	Description
1	1 hour to attend and make safe. 2 hours to Breakdown Intervention	Critical issue such as Health & Safety risk, or failure halting the operation of the tram network in whole or part thereof, failure of major system
2	8 hours	Failure impacting the punctuality of the tram network, or having potential

		to impact.
3	24 hours	Failure or incident not having immediate impact on network operation, but impacting the service quality
4	1 week	Failure or incident not impacting network operation, nor service quality

A response to other minor event is to be initiated within the time limits detailed as follow:

Fault category	Correction Time Limit
cleaning Fault - Spillages	2 hours
Tramstop cleaning Fault – Offensive Graffiti and fly posting	2 hours
Tramstop cleaning Fault – Graffiti	5 hours
Tramstop cleaning Fault – Other	24 hours
Tramstop lighting Fault	2 days
Tramstop telephone Fault	3 days
Fault causing the lift at Murrayfield Tramstop to be out of operation	6 hours
Tramstop electronic passenger information display Fault	2 days
Tramstop PA system Fault	24 hours
Tramstop CCTV Fault	2 days
Defect, fault or other disrepair that restricts access to all or part of a Tramstop or otherwise interferes with its use	3 days
Defect, fault or disrepair causing a trip hazard at an Tramstop (including unintended changes of floor levels or protrusions from the floor of more than 25mm)	24 hours
Broken glass at an Tramstop	2 hours
Overflowing / damaged gutter at an Tramstop	24 hours
Structural defect, fault or other disrepair at an Tramstop	28 days
Any other defect, fault or other disrepair at a Tramstop (including in relation to shelters, seats, canopies, signage, cycle parking, litter bins and poster cases) but excluding blocked drains, overgrown vegetation and fencing faults.	5 days
Blocked drain other than on a street running section of the Edinburgh Tram Network System	24 hours
Blocked drain on a street running section of the Edinburgh Tram Network System	2 hours
Overgrown vegetation	3 days
Defect, fault or disrepair fencing such that access to the track or buildings and equipment is not prevented	6 hours
Defect, fault or disrepair in respect of a Monitoring Point or any other Electronic monitoring equipment	24 hours
Structural defect, fault or disrepair other than at a Tramstop	28 days
Any other defect, fault or disrepair other than at a Tramstop	2 days

Elements of infrastructure will refurbish and replace before its performance deteriorates below the design, stated tolerances or equipment has become obsolete and/or is incurring disproportionately high maintenance costs. The initial lifecycle replacement plan will be based upon the manufacturer's stated design life, our previous experience, and assumptions on the impact of designed use. Subsequent annual updates will take into account condition and reliability data gathered during the inspection, maintenance and operational use.

In addition to preventive, life cycle and reactive maintenance undertake the:

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- Removal of graffiti;
- Repair vandalism and accident damage; and
- Undertake cleaning as detailed in tender documentation

3.9 Limitation of Scope for Availability, Reliability and Maintainability

The following events will not be covered in the estimation of the Availability/Non-availability' or Reliability or Maintainability:

Consideration of any

- malevolent or voluntary action,
- vandalism or force majeure
- third party impact

The consideration of administrative and logistic time for the estimation of the time for 'Breakdown Intervention' used for the availability-calculation and 'Mean Time To Repair' used for the reliability-calculation is excluded.

The maintenance has to be done in general by skilled personnel according maintenance manual, operation within specified limits.

31st March 2008

Updated Proposal Submission

Edinburgh Tram Network

Section 2: Overall Technical Concept

Part 1 – System Engineering

Annex 2 – Training Support

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1 Training Support

The Bilfinger Berger–Siemens Consortium (BBS) offers in addition to the Suppliers Training on ETN subsystems special Training Support for operations and maintenance staff of the future Operator in an extent of twelve (12) man-months.

This Training Support may cover

- assistance in preparation of the Training Plan, and
- support in operational training on System operations under Regular and Degraded Operations Modes, handling of Emergencies and regarding Recovery Strategies.

Details of this additional support with respect to training scope and scheduling should be discussed and jointly agreed with **tie** and the future Operator.

The Suppliers Training will be performed by each Supplier for the Operator's operations and maintenance staff to be trained at their specific subsystems including

- operating of equipment, and
- execution of preventive and corrective maintenance of the equipment.

It is understood that the Suppliers Training will also cover the training of drivers in operating the tram vehicles. This Drivers Training will be subject to separate contract with the tram supplier (Tramco).

Key aspects of the Suppliers Training will be:

- Handling of equipment and/or trains;
- Fault finding;
- Repair and maintaining of equipment;
- Response to irregularities;
- Safety rules for the respective field of work;
- Handling of protective devices and emergency equipment.

Suppliers Training will mainly be performed as an "on-the-job" training with the required theoretical background. Therefore the most benefit might be derived from a progressive involvement of the trainees in the installation, testing and commissioning of the relevant subsystem, where applicable.

The relevant training documents will be produced by the Suppliers step by step as needed for the different tasks. The Supplier's necessary documentation like the operating and the maintenance manuals of the specific subsystems will be part of the training documents.

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Section 2: Overall Technical Concept

Part 1 – System Engineering

Annex 3 – Earthing and Bonding

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1 Scope

The construction of railway installations generally requires a concept for earthing and bonding including provisions for lightning protection as a basic document for the involved parties in the project. This is important particularly for modern systems with high traction currents and the extensive use of electrical energy for many purposes.

The objectives for earthing and bonding are:

- The safety of persons:
The safety of persons is characterised by the value of the touch voltage.

- The protection of installations:
Damage of installations may arise from overheating of conductors, by arcing and by electrical corrosion.

- The intended operation of the system:
For the intended operation of the system the aspect of electromagnetic compatibility (EMC) has to be considered too.

The safety of persons is considered to have the highest priority!

The present Concept deals with all aspects of earthing and bonding of the Edinburgh Tram Network project.

The earthing system described in this concept is a combined system for all purposes:

- Traction Power Supply and Traction Return Circuit
- Service Power Supply of all voltage levels
- Lightning Protection
- EMC appropriate earthing design

Earthing and Bonding form the basis of EMC!

Figure 1-1 shows the relation among EMC, earthing, bonding, and lightning protection.

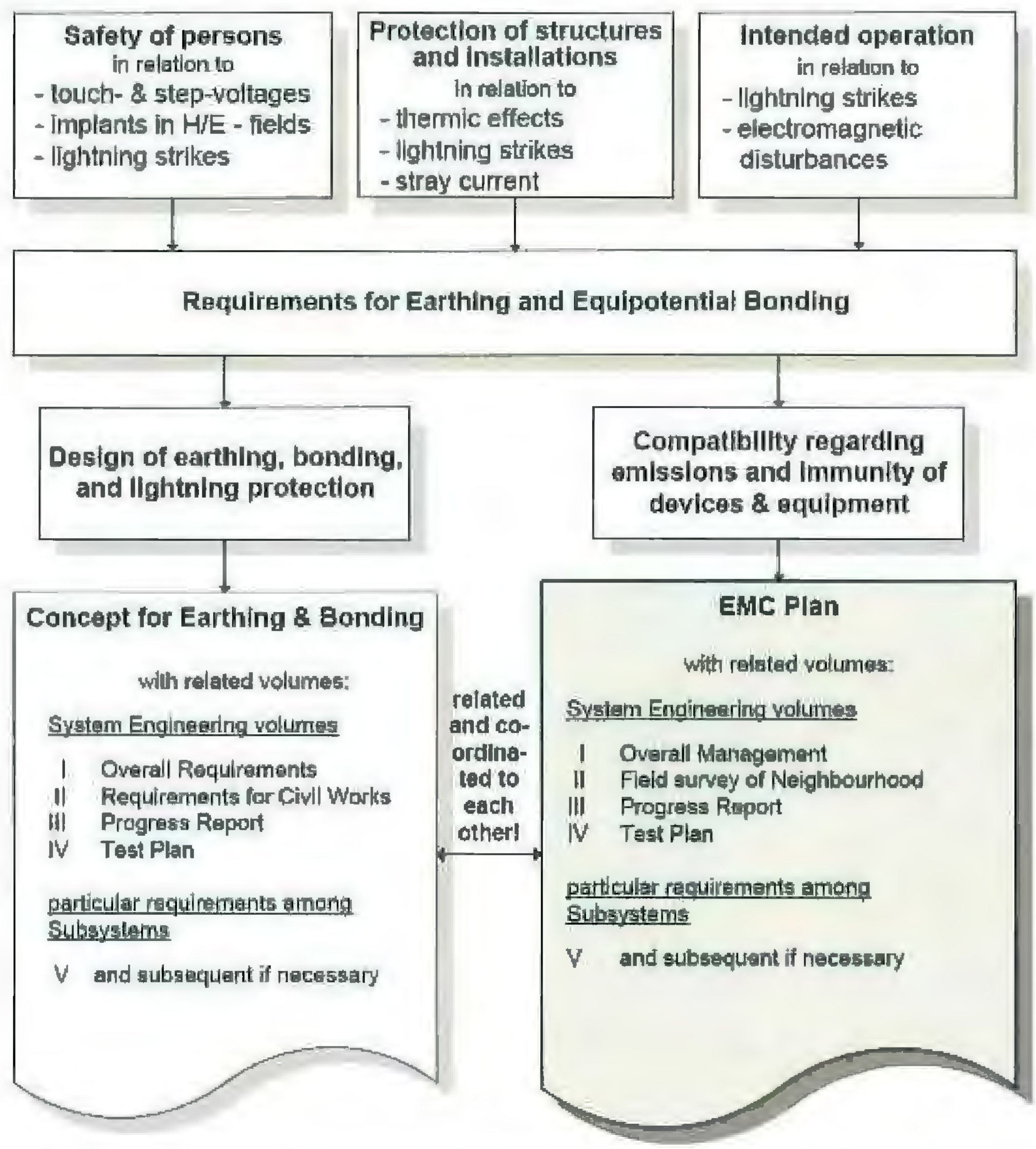
Earthing and Lightning protection are two essential aspects of EMC dealt with in this document, for all other EMC related aspects see the document "EMC plan". (will be subject of the detail planning phase)

To ensure consistent earthing design for the whole project, there is only one Concept for Earthing, Bonding and Lightning Protection of the Edinburgh Tram Network. It describes the structure of the earthing and bonding network, the rules, methods, calculations and materials to be adopted by all subsystems (lots) concerned to fulfil these objectives.

The measures described base on the relevant international and European standards and recommendations.

The return circuit of a DC-railway is not allowed to be connected to earthing systems like pole foundations and building earthing systems. This is to force the main part of the traction return current to flow back to the traction supply substation via the running rails. Nevertheless, the resistance between the running rails and the soil generates a stray current which can cause stray current corrosion in adjacent metallic systems.

Stray current protection measures are therefore a definite necessity in a DC system. They are described in chapter 6.2.5 and in more detail in EN 50122-2.



Notes The volumes III and IV are collections of required detailed documents according to progress of project
The numbering of volumes is not in line with their ranking or date of issue, but with systematic considerations

Figure 1-1 Relation between EMC and E&B

The construction of external LPS and the parts of the earthing systems embedded to concrete are made by Civil Works. This concept provides sketches and descriptions of typical solutions of the earthing measures for the civil structures of the Edinburgh Tram Network (ETN).

This document fulfils the requirements of the Concept for Earthing & Bonding of Volume I, II including the particular requirements of traction power. This document will remain unchanged during the whole project life time. Further reports as mentioned above, Progress Report and Test Plan will be elaborated during project life time.

2 Project Overview

The essential project parameter like line & track configuration, traction & service power supply, headway and so on are named in the invitation of bid.

A summary of key data will be created after start of project.

The use of the term "railway" in this concept considers also the application of the relevant requirements and standards on "railways".

3 Abbreviations and Definitions

3.1 Table of Abbreviations

General Abbreviation	Explanation
AC or a.c.	Alternating Current
CISPR	Comity International Special of perturbations radioelectriques (This is a comity of the IEC.)
DC or d.c.	Direct Current
DIN	Deutsche Industrie-Norm (German Industrial Standards)
E&B	Earthing and Bonding
E&M	Electrical and Mechanical Equipment
EMC	Electromagnetic compatibility
EN	European Standard
H/E	Magnetic / Electrical Field
HV	High Voltage (> 45 kV DC; > 45 kV AC)
IEC	International Electrotechnic Commission of ISO
ITU	International Telecommunication Union (This union is the former CCITT.)
LPS	Lightning Protection System
LV	Low Voltage (<= 1 kV AC; <= 1.5 kV DC)
MEBB	Main Equipotential Bus Bar, sometimes named MET (Main Earthing Terminal)
MV	Medium Voltage (< 1 kV and <= 45 kV AC; < 1.5 kV and <= 45 kV DC)
OCL	Overhead Contact line
PE(N)	Protection Conductor (or combination with Neutral Conductor)
TSS	Traction Supply Substation
VDE	Verband Deutscher Electrotechniker (Germans electrotechnic standardisation organisation)
WHO	World Healthy Organisation

This table will be amended according to the progress of the project if necessary!

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3.2 Definitions

For a common understanding of the technical requirements some definitions are essential. Further definitions can be found in the mentioned standards.
List of definitions:

3.2.1. earth [IEC 60050(826)-04-01]

The conductive mass of the earth, whose electric potential at any point is conventionally taken as equal to zero.

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3.2.2. structure earth [EN 50122-2]

The electrical interconnection of the reinforcing rods of structures, and in the case of other modes of construction, the conductive interconnection of the metallic parts. Examples are reinforced railway structures such as bridges, viaducts and reinforced trackbed.

3.2.3. earth electrode [IEC 60050(826)-04-02]

A conductive part or a group of conductive parts in intimate contact with and providing an electrical connection with earth.

3.2.4. foundation earth electrode [IEC 62305-3]

Reinforcing steel of foundation or additional conductor embedded in the concrete foundation of a structure and used as an earthing electrode

3.2.5. equipotential bonding [IEC 60050(826)-04-09]

Electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential.

3.2.6. global earthing system [HD 637 S1]

An earthing system established by the connection of local earthing systems, which ensures that no dangerous touch voltages arise from the near vicinity of these local earthing systems. Global earthing systems reduce the potential increase of the local earthing system by distributing the fault currents. Such a systems performs as a quasi equipotential area.

3.2.7. main earthing terminal [IEC 60050(826)-04-08]

A terminal or bar provided for the connection of protective conductors, including equipotential bonding conductors for functional earthing if any, to the means of earthing.

3.2.8. exposed conductive part [IEC 60050(826)-03-02]

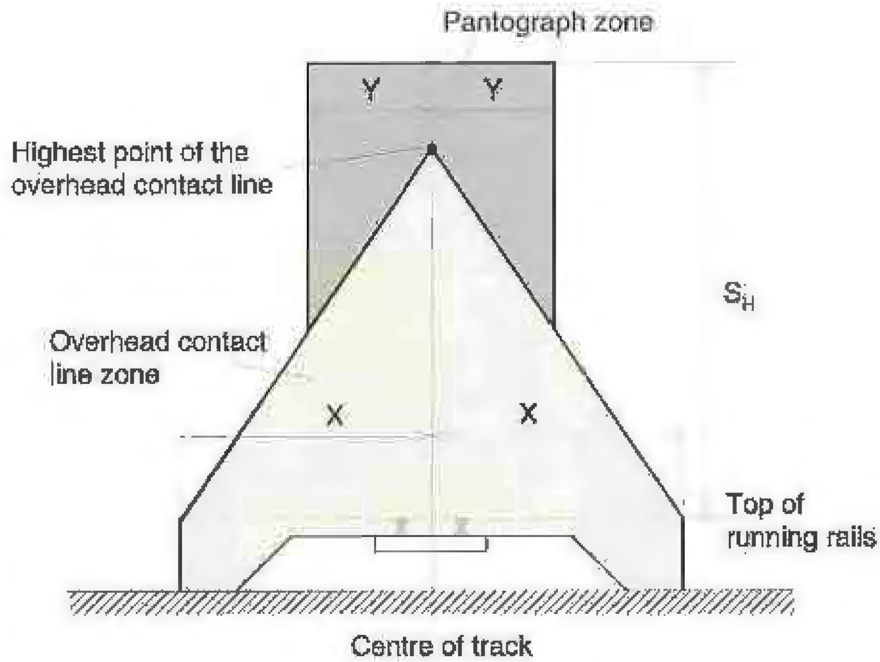
A conductive part of electrical equipment, which can be touched and which is not normally live, but which may become live under fault conditions.
NOTE: A conductive part of electrical equipment which can only become live under fault conditions through an exposed conductive part is not considered to be an exposed conductive part.

3.2.9. extraneous conductive part [IEC 60050(826)-03-03]

A conductive part not forming part of the electrical installation and liable to introduce a potential, generally the earth potential.

3.2.10. overhead contact line zone and pantograph zone [EN 50122-1]

Zone whose limits are not exceeded in general, by a broken overhead contact line or a pantograph which is energized, in the event of dewirement or by broken fragments.



3.2.11. return circuit [EN 50122-1]

All conductors which form the intended path for the traction return current and the current under fault conditions.
Note: The conductors may be for example:
- running rails,
- return conductor rails,
- return conductors,
- return cables.

3.2.12. track return system [EN 50122-1]

A system in which the running rails form a part of the return circuit.

3.2.13. rail potential [EN 50122-1]

The voltage occurring under operating conditions when the running rails are utilised for carrying the traction return current or under fault conditions between running rails and earth.

3.2.14. (effective) touch voltage [EN 50122-1]

Voltage under fault conditions between parts when touched simultaneously.
NOTE: The value of the effective touch voltage may be appreciably influenced by the impedance of the person in contact with these parts.
Additional remark: This term is used in this document for operating conditions in the same manner. Depending on conditions on site, touch voltage may be a part of or the total value of the voltage of a touchable part versus earth.

3.2.15. voltage limiting device [EN 50122-1]

A protective device against permanent existence of an inadmissible high touch/accessible voltage.

7 Basic design rules for earthing and bonding of structures

7.1 Basic Principle for Civil Works

Civil works shall bear in mind during design and construction of all civil structures the following main principle:

The reinforced civil structures generally form the basis for earthing and bonding of an electrified railway system.

Therefore, the earthing conductors embedded in concrete are an essential part of the earthing system of the railway and need careful design and installation.

7.2 Structure earth

All buildings made from reinforced concrete shall have a structure earth including foundation earth electrode. For this purpose, the foundation slab and the walls of the building will get a mesh of earth wires of about 10 by 10 m mesh size.

This mesh may by part of the reinforcement, or made from additional mild steel rods and wire-tied to the reinforcement at least each 40 cm..

The foundation earth electrode shall be located from 5 to 8 cm from the lower concrete surface (see chapter 7.3). For the welding of structure earth see chapter 7.5.

7.3 Embedded Earthing conductors

Earthing conductors for all purposes, including lightning protection, have to be designed according to named standards to withstand mechanical and thermal stress. This also applies to earthing conductors embedded in concrete, which may be part of the reinforcement or additional mild steel rods.

If not otherwise stated, the following cross-sections shall be applied to embedded earthing conductors according to the standards referred above and basing on experience from conventional electrified railway systems.

Material	Minimum cross-section
Steel	200 mm²
Copper	50 mm²

Table 7-1: Minimum cross-sections for concrete-embedded earth conductors

Remark to table:
The minimum cross-section of vertical earthing rods of piles must be 314 mm^2 or an equivalent round steel with minimum diameter of 20 mm.

Stainless steel of vertical earthing rod must be applied in soil. It must fulfil the following requirements:

Chromium	≥ 16 %
Nickel	≥ 5 %
Molybdenum	≥ 2 %
Carbon	≤ 0.03 %

The cross-section of earthing wires is subject of detail design.
All embedded earthing conductors must be covered by at least 5 cm of concrete for corrosion protection.

Conductors, which are part of an earth electrode or are located within the OCL or pantograph zone, shall not be covered by more than 8 cm of concrete. That is necessary to ensure sufficient contact to the soil or to a broken overhead contact line respectively. The exact locations of these embedded conductors will be subject of detail design.
The down conductors inside of walls have to be connected to the reinforcement at intervals of 400 mm by means of wire wrapping.

7.4 Lightning protection down conductors

According to IEC 62305-3 down conductors must be erected from the roof to the foundation earth in the outer walls of buildings. Large buildings like Main Workshop buildings additionally require down conductors inside the building. Steel columns and reinforced columns should be utilised for this, otherwise additional conductors will be required. That will be subject of detailed design. An earthing terminal should enable the connection of down conductors to the air termination system on the roof surface.

7.5 Welding

Figure 7-1 shows examples for welded connections. The minimum length of two opposite welded seams is 50 mm. To ensure a fully electrical conductive length of 50 mm, a welding length of at least 55 mm is recommended. In case of single side welding a minimum length of the seam of 100 mm is required.

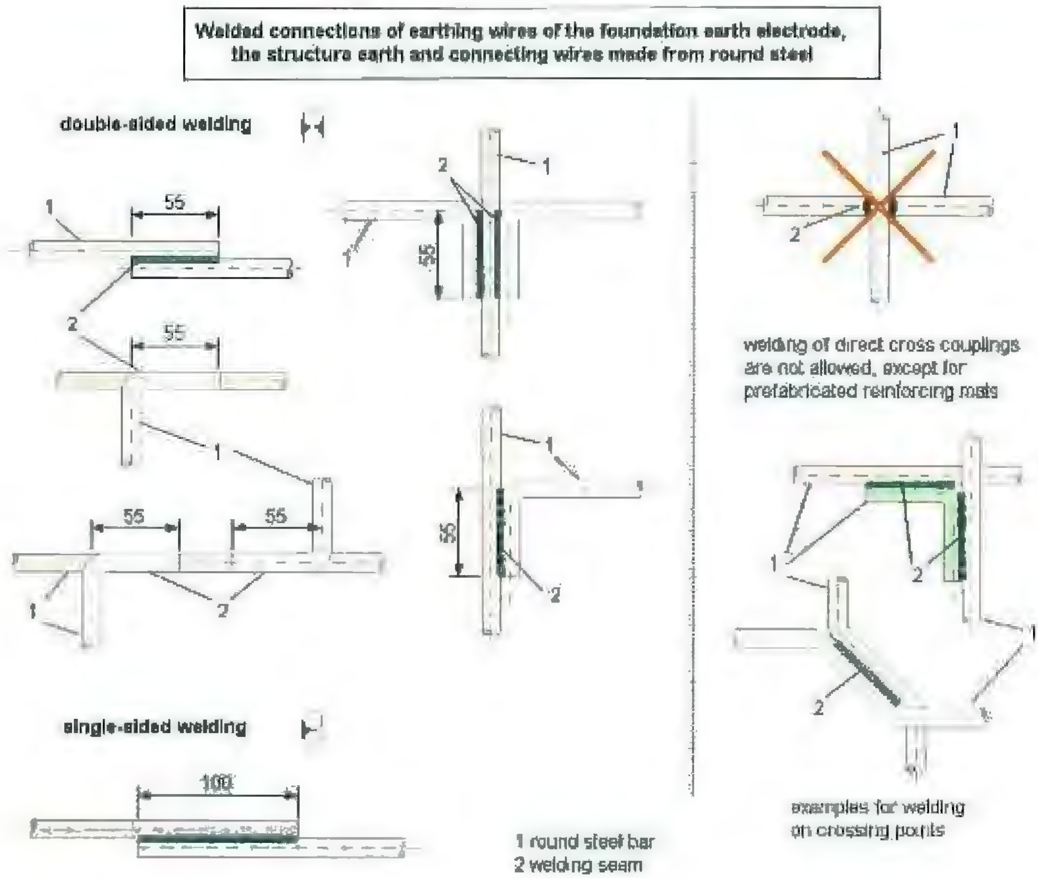


Figure 7-1: Welded earthing connections

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7.6 Terminals

Terminals for the connection of embedded parts to other parts of the earthing systems will be required.

Inside of buildings and other closed structures contact tongues made from hot galvanized flat steel or embedded terminals for bolted connections shall be used.

For connections outside of buildings and for open structures embedded terminals for bolted connections made from stainless steel shall be used only. These terminals are furnished with a thread inside for one bolt M16.

Figure 7-2 shows an example of an embedded terminal.

Earthing terminals must be non-corrosive welded to the earthing bars according to the welding requirements above.

The earthing terminals shall be accessible in a height from 30 to 50 cm above concrete floor or final ground level.

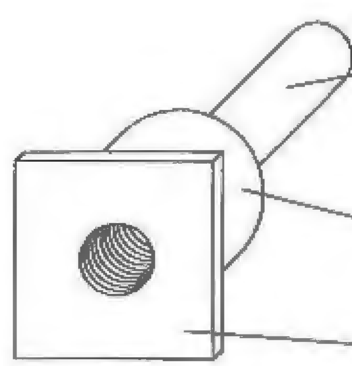

Figure 7-2: Example of embedded terminals

The supplier of terminals must provide a certificate for terminal applying according to threats parameter by short circuits, direct lightning strikes and corrosion by climate.

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7.7 Services/ Utilities

Conductive Services and Utilities entering or leaving the railway environment from/to the outside are not allowed to transmit currents or dangerous voltages.

Therefore all such pipes need an insulating joint where they enter a building, which is accessible for tests and maintenance.

According to the requirements of equipotential bonding all metallic utilities and devices must be earthed. Potential equalisation is achieved by

- Direct bonding of all extended metallic installations at their foot points like e.g. escalators, elevators, banisters, air condition pipes
- Direct bonding of all outgoing and incoming metallic installations at the inside of building boundary like e.g. cable armour and pipes of water, gas etc.

For this purpose earthing terminals must be provided for these connections.

The locations of earthing terminals will be defined in the related drawings during detailed design.

Service utilities in parallel to or crossing the tracks, which have applied active corrosion protection, the requirements for separation or additional insulation have to be elaborated in coordination with the owner of the utility.

8 Typical measures for different types of civil structures and its parts

8.1 General note

All the following descriptions and drawings show and explain typical solutions for earthing and bonding measures of structures.

In chapter 10 "Overall Single Line Diagram" is shown an overview of the structure of the earthing system for the whole railway, the main earthing and bonding measures and the responsibilities of the subsystems.

The solutions to be applied for Edinburgh Tram Network are subject of detailed design and may vary in details.

8.2 Trackside structures and installations

8.2.1 Overhead contact line zone and pantograph zone

Figure 8-1 shows the overhead contact line zone and pantograph zone.

Any exposed conductive part within the overhead contact line zone and pantograph zone shall be connected to the structure earth. Conductive structures smaller than 2 m and not supporting or containing electrical equipment, do not need any protective measures. The tendons of pre-stressed reinforcement are excluded from this measure because of usually existing trackbed layers above which are connected the structure earth. These protective provisions avoid non-permissible touch voltages in case of insulator flashovers, short-circuits and other faults which do not occur directly to the running rails.

Care shall be taken at constructional overlaps of the contact line. The overhead contact line zone shall be extended, where the contact and messenger wire are tensed at anchor supports. This has to be considered mainly for wayside running fences and noise walls.

Following measures shall be defined according to related standard and experience in relation to Centre of Track (CoT) and Top of Rail (ToR) to
X = 4 m; Y = 2 m; Z = 2 m.

S_H will be defined in relation to highest point of overhead contact line. When this point cannot be determined, S_H shall be defined to 8 m.

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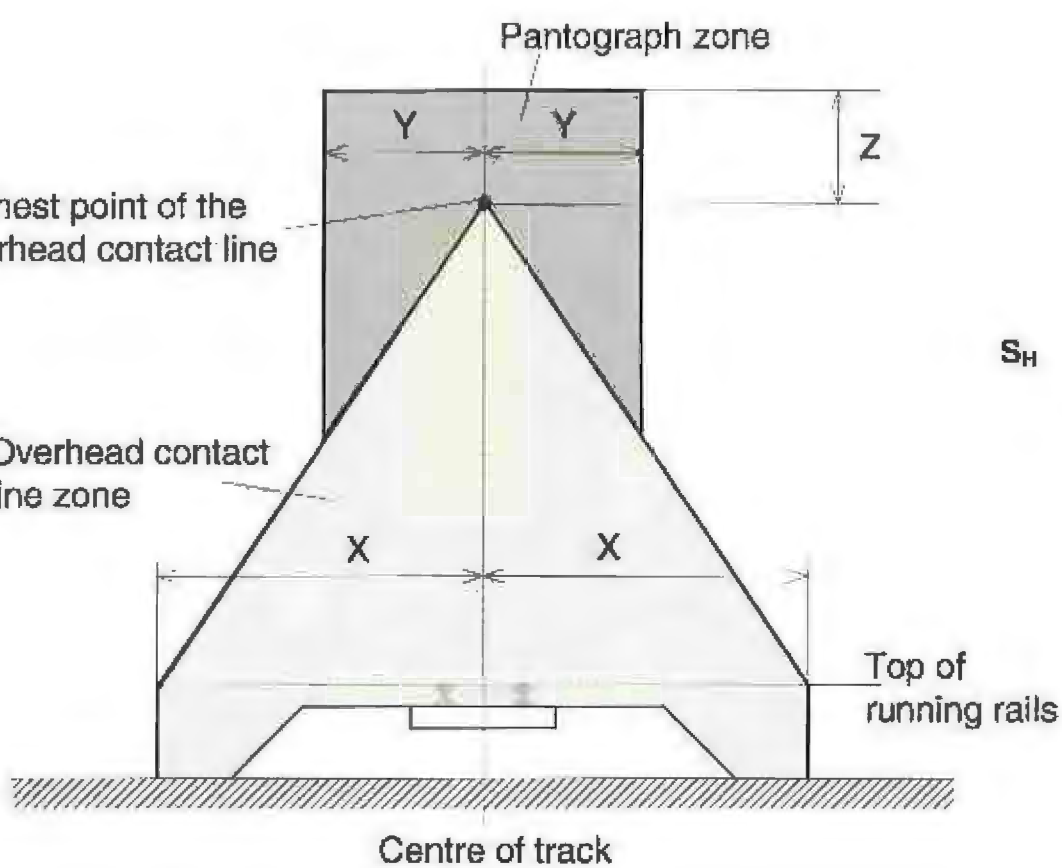

Figure 8-1: OCL zone and pantograph zone

8.2.2 Running rails

The running rails are the return conductors of the DC railway system. Opposite to an AC railway system the running rails of Edinburgh Tram Network are not earthed and shall be not connected with the structure earth, to any earthing conductor or to any part in contact to soil.

8.2.3 Unballasted track

A typical construction of unballasted trackbed for LRT-System is shown in following Figure 8-2.

Poles close to overvoltage protection devices shall be electrically connected to stray current collector for reducing of their earth resistance.

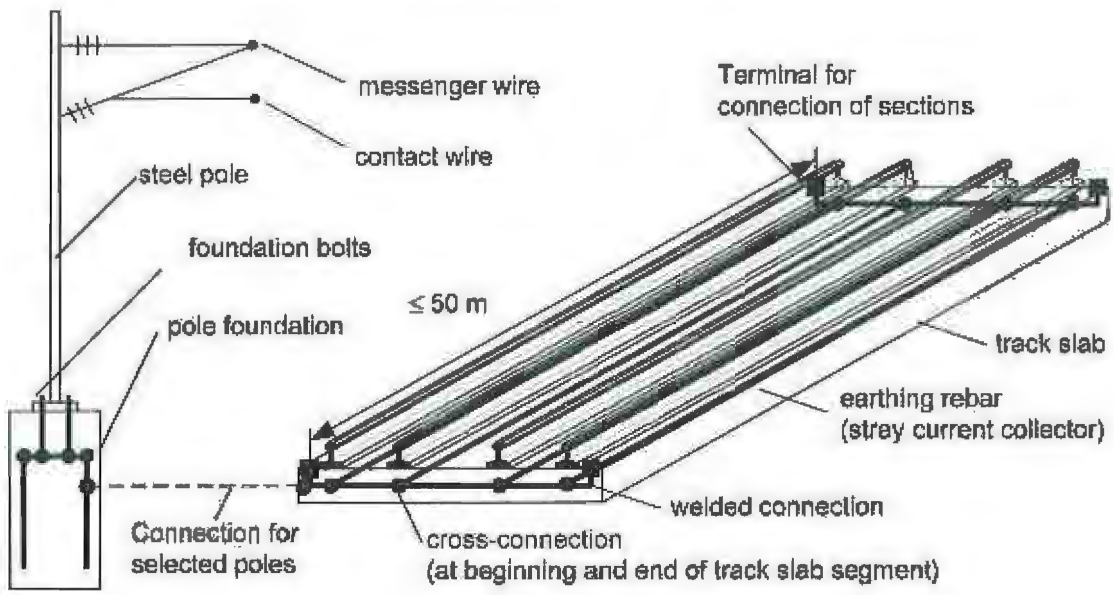

Figure 8-2 Unballasted trackbed with earthing terminal

The single segments of the running rails shall be welded together longitudinally in order to limit the longitudinal resistance of the track installation. If the transverse earthing rebars are installed inside track slab, one earthing terminal at slab side will be sufficient.

The conductance per unit length between the running rail and earth or structure earth shall be low. EN 50122-2 [2] recommends values for the conductance per unit length between running rails and earth or structure earth of a single track for design purposes. The specified values are

- 0.5 S/km for open formation in open air
  (this corresponds to 2 Ω·km)
- 2.5 S/km for closed formation in open air.

The clean initial track shall be tested for finding of possible installation faults e.g. random connection of fixation screw of running rail to reinforcement. Following values are recommended.

- Conductivity G of initial test of track for open formation shall be about *G <= 0.05 S/km* instead of *< 0.5 S/km in open air* according to EN 50122-2.
- Conductivity G of initial test of track in closed formation shall be about *G <= 1 S/km* instead of *< 2.5 S/km in closed formation* according to EN 50122-2.

A stray current collector for double track with a minimum crossection of 800 mm^2 is recommended according to experience.

8.2.4 Ballasted Track

Sections of ballasted track with reinforced substructure are treated like unballasted track. In line sections with ballasted track without conductive substructure no longitudinal earthing bars are embedded below the rails. Attention is required to conductive utilities crossing or in parallel to the track.

The conductance of ballasted track is 0.5 S/km for open formation in open air according to EN 50122-2 [2].

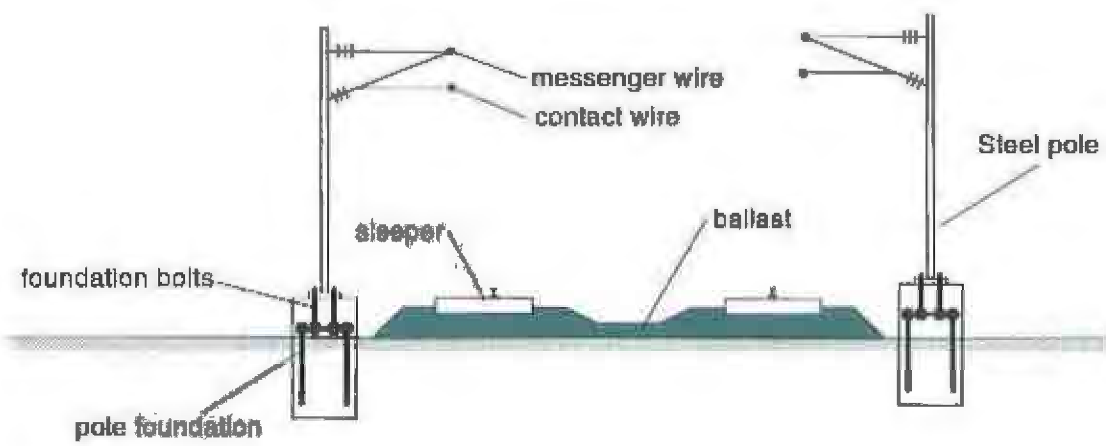

Figure 8-3: Example of ballasted track bed without reinforced substructure

8.2.5 Fences, Noise walls, Railings

Metallic railings, hand rails, noise walls, crash barriers may need to be earthed because of lightning protection. If located inside the overhead line zone they have to be handled according t requirements of EN 50122-1 by responsible party or subsystem (see also chapter 8.2.1).

8.2.6 Platforms/ Stops

The reinforcement of platforms has to be connected to structure earth and forms the local earthing system of the platform. Along the platform edge at least one rod must be continuously welded and bonded to the local earth to ensure switch-off of traction power supply in case of a broken overhead line. All protective wires of electrical installations and all metallic parts on the platform, like poles and handrails, must be connected to the local earthing system.

The voltage between the running rails and the local earthing system must be limited by a voltage limiting device like e.g. a voltage fuse.

The protection of passengers against direct contact to live parts or bridging between electrical equipment (e.g. escalator, ticket vending machine) and train must be settled by clearances according to Figure 8-4.

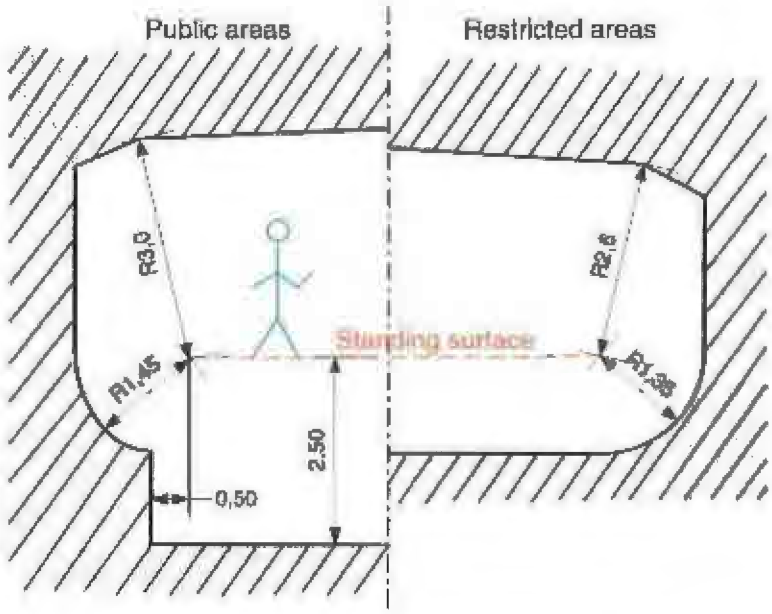

Figure 8-4 Clearances to accessible live parts

All other measures for trackside structures and installations described in the other paragraphs of this chapter 8.2 are valid for platforms too.

8.2.7 Passenger Stations

Station buildings shall be provided with a structure earth as described in chapter 7.2.

The earthing system of DC railways has to be independent from distant earth potential to avoid stray current corrosion problems.

Earthing terminals are necessary for LV power supply rooms, technical rooms and facilities like elevator & escalator.

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8.2.8 Viaduct

The reinforcement of the viaduct forms the structure earth of viaduct sections. Therefore the reinforcements of single segments have to be electrically interconnected and the dedicated earthing rebars shall be welded together via cross connections. Figure 8-5 shows the schematic earthing connections of viaducts. The foundations of the piers form the earth electrodes for viaducts. The reinforcement of the foundation shall be electrically connected to the reinforcement of the piers and the viaduct segments.

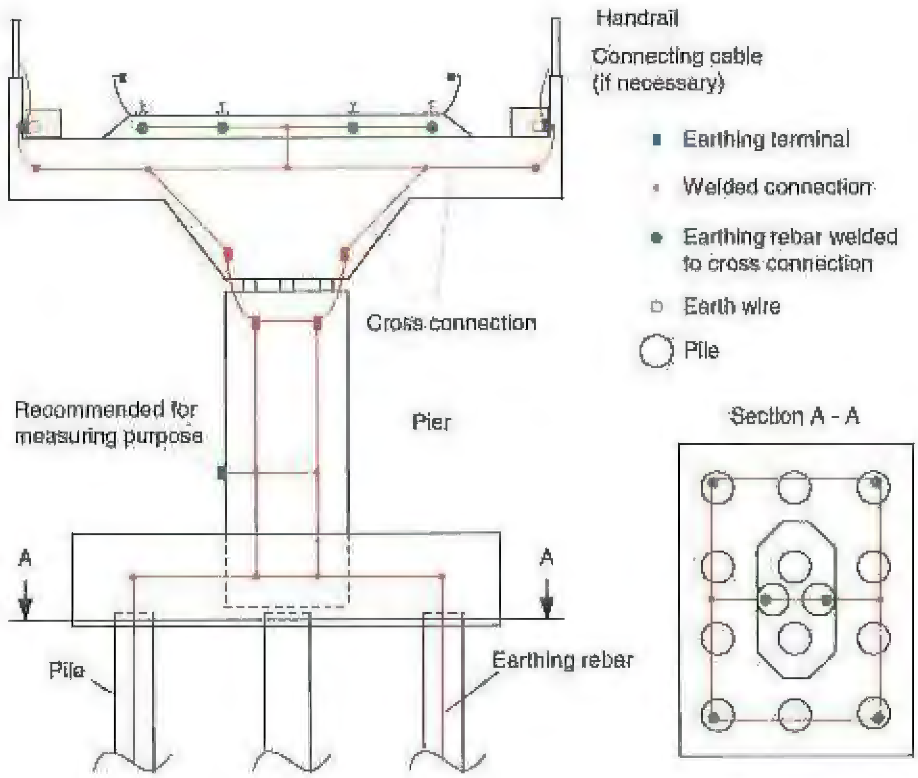


Figure 8-5: Schematic earthing connections for reinforced concrete viaduct

The required number and cross-section of the rebars used for earthing and the earthing wires have to be designed with respect to the maximum earth fault currents of the AC and DC installations on the viaduct and with respect to lightning protection and with respect to the requirements for stray current protection. All three items are subject of detailed design.

Earthing terminals for earthing measurements and bonds are recommended at approximately two metre above ground level of the piers of viaducts and within the cable ducts at the top of the viaduct.

An air termination network must also be erected according to the requirements of LPS [7].

8.2.9 Overbridges

Figure 8-6 shows typical earthing measures for existing overbridges, which are located fully or partly in the OCL and pantograph zone. In general, the same measures apply to new-built overbridges, while there is the chance to implement some of the measures embedded to the concrete.
The voltage between the protective measures of the overbridge and the running rails must be limited by a voltage limiting device.

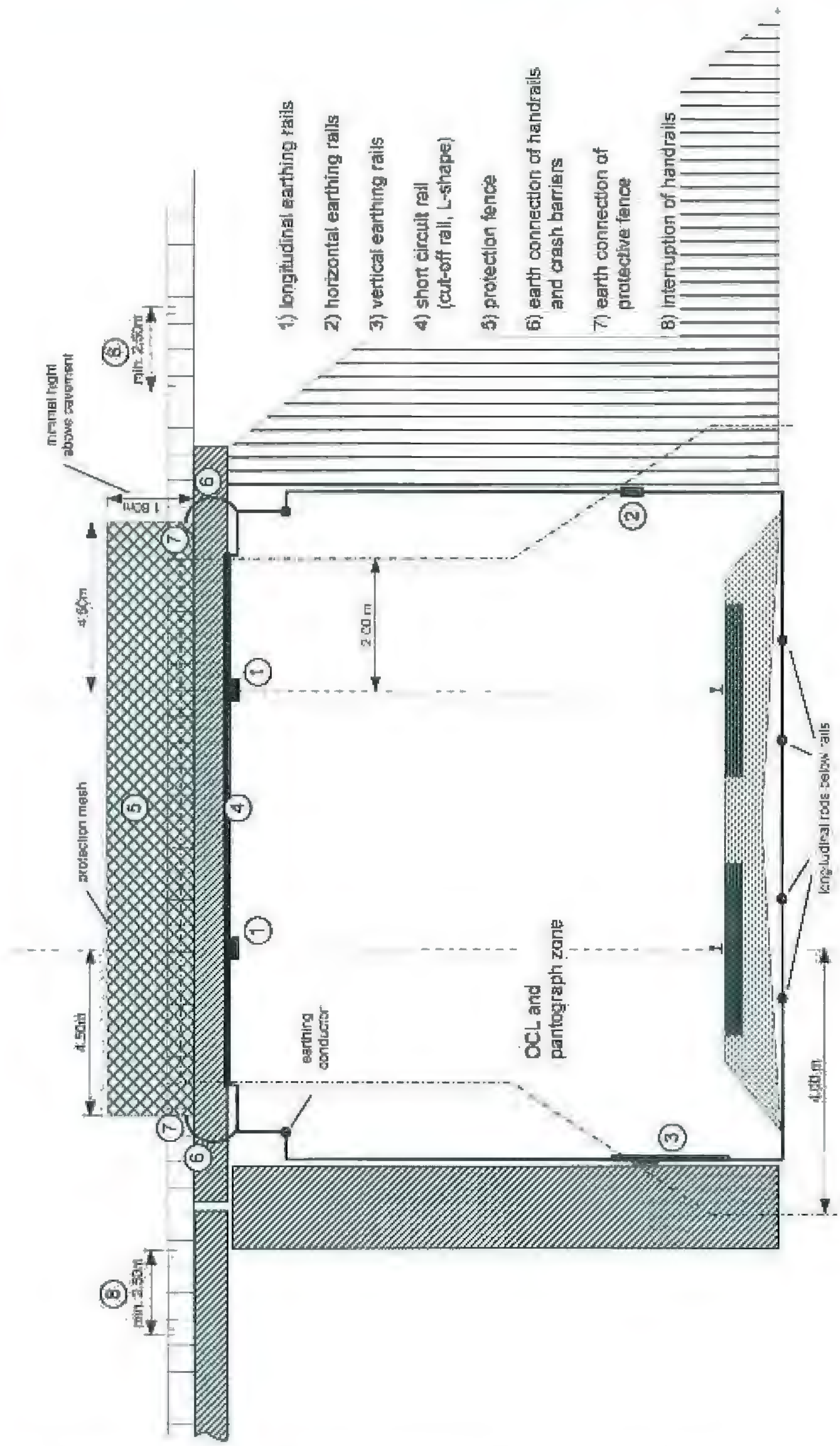


Figure 8-6 Earthing of existing Structures (Typical arrangement)

8.2.10 Low voltage power supply rooms

The traction and service power supply rooms and power substation buildings shall have a foundation earth electrode as specified in section 7.2.

In rooms containing power transformers or switchgear the floor reinforcement shall be used for internal potential grading.

This shall be connected to the foundation earth electrode by welding.

Earthing terminals as described in chapter 7.6 shall be provided near to each corner of the rooms. Additional earthing terminals shall be provided at the outside of the building near to each corner of the building and according to the specification of the power supply subsystem (lot).

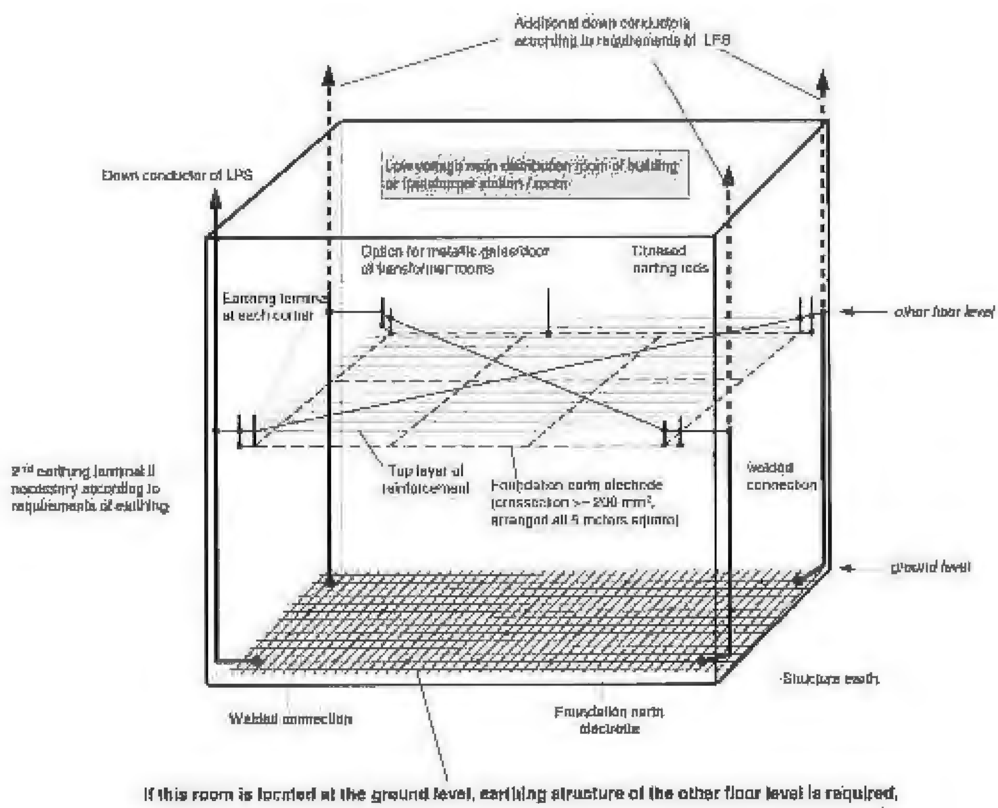


Figure 8-7: Earthing & bonding of low voltage power supply rooms

8.2.11 Technical Rooms

The technical rooms of each subsystem must include at least one earthing terminal about

30 cm above surface of floor level.

The locations of earthing terminals will be defined in the related drawings after detailed design.

The technical rooms of the subsystems signalling and telecommunication must have an arrangement of some earthing terminals according to their specific requirements.

The necessity of separated earth terminals from the foundation earth electrode will be clarified during the detailed design too.

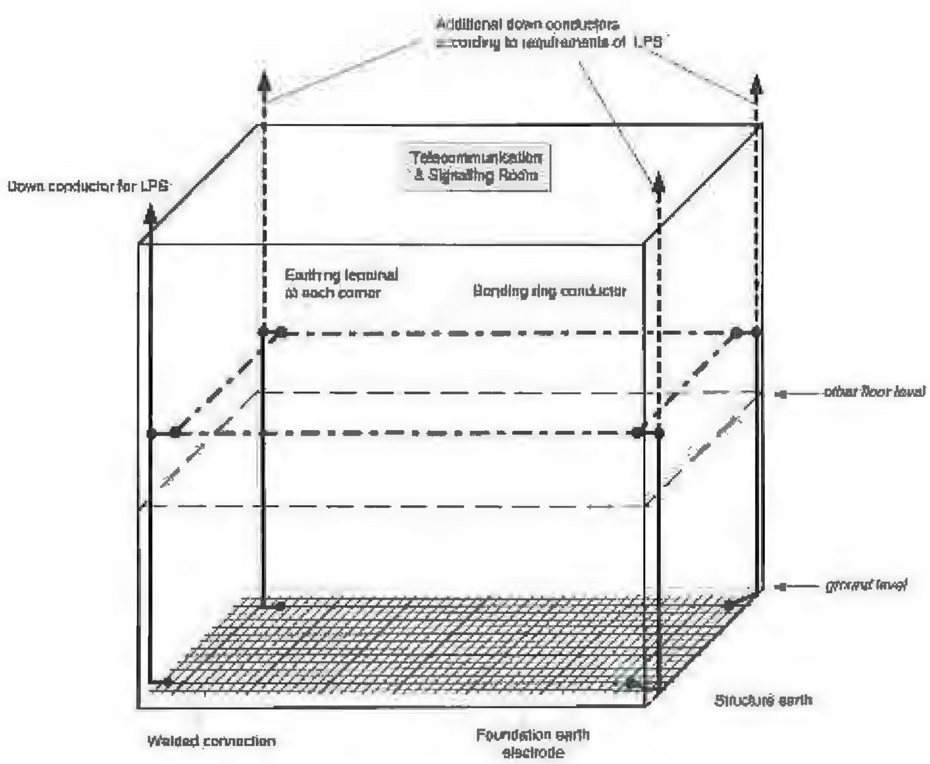


Figure 8-8: Earthing & bonding of technical rooms

8.2.12 Power supply stations

Power supply stations shall as a minimum consider the earthing requirements of chapter 8.2.10. Further requirements for Power Substations will be derived from the studies prepared by the power supply subsystem during the basic design phase.

8.2.13 Depot and workshop area

Depot buildings shall be equipped with a structure earth according chapter 7.2. In the depot and workshop area the return circuit shall be insulated against structure earth similar to the main line.

Potential differences between the structure earth of the workshop area and the return circuit cause restrictions to operation and service activities. Therefore the return circuit and the structure earth shall be connected. The connection between the return circuit and the structure earth shall be made centrally at one point.

In order to avoid non-permissible touch voltages caused by the train operation on the main line and to reduce stray currents the running rails and the structure earth of the depot and workshop area have to be separated from the main line track system and structure and the depot and workshop areas are supplied from separate traction rectifiers.

All individual earthing installations and conductive parts of the depot and workshop area shall be equipotential bonded. The totality of all earthing installations connected to the equipotential bonding conductor forms the structure earth of the depot and workshop area.

Additionally for all major workshop equipment terminals for direct earthing at the structure earth shall be provided like under floor wheel lathe, wheel press, maintenance platform, crane rails etc.

9 Stray Current Monitoring

Generally, the direct measurement of the current flowing through earth, in DC railways known as stray currents, is not possible. Current differential measurements between contact and running rails are complicated to be done, especially if the parallel feeding of substations is used.

The continuous measurement of rail potential, e.g. implemented in substations, is a practical possibility for the assessment of stray current behavior without increasing stray currents.

Taking reference measurements for a functioning system, the actual stray current situation and the rail potentials relating to that are recorded. Afterwards, along the entire line voltage monitoring during operation can be easily performed for comparative purposes.

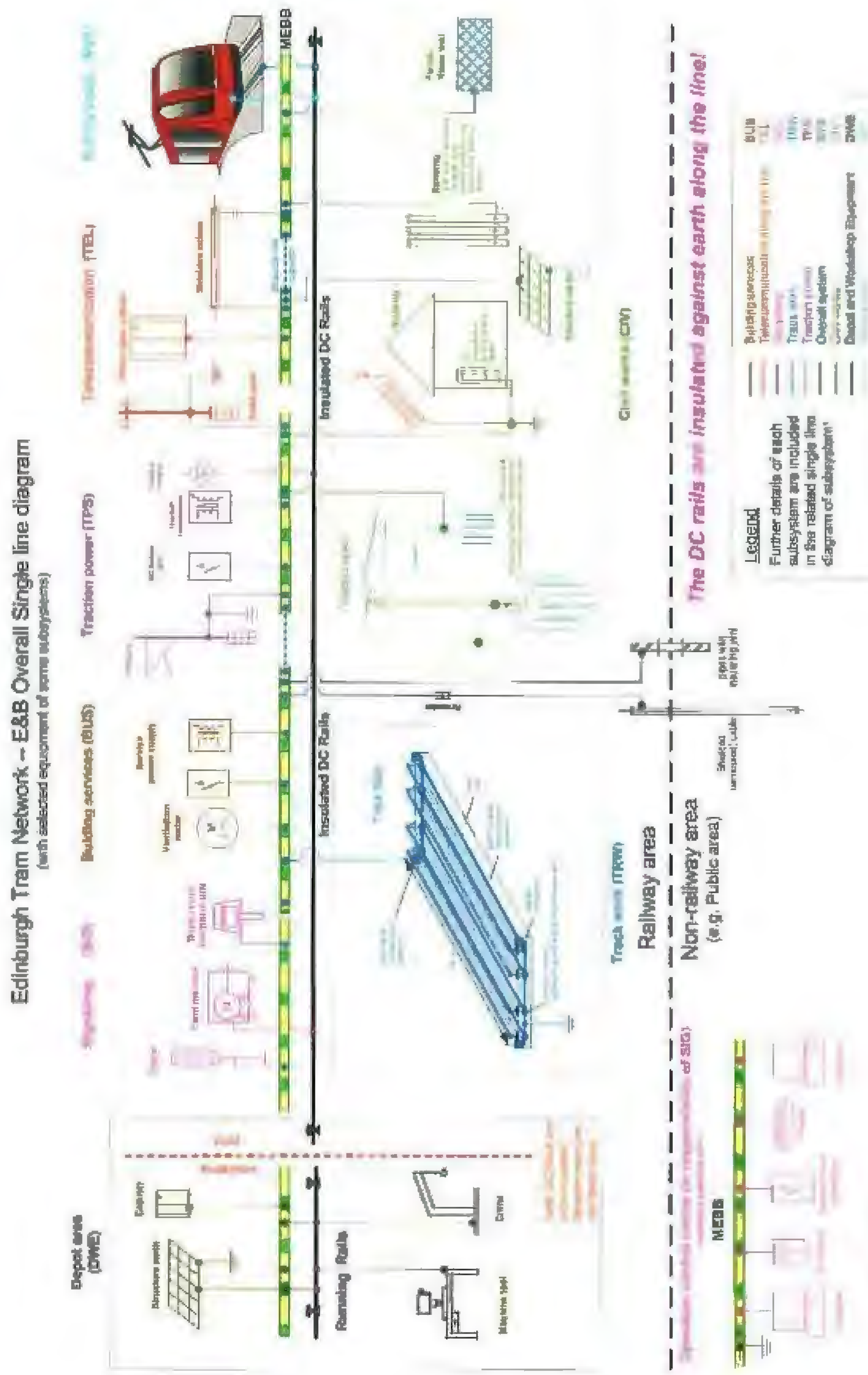
This method does neither affect the current distribution nor the rail potential in the return system. It can be implemented without high costs, because in many cases the required measuring equipment can be installed in the substations. Furthermore the SCADA system must be prepared for the data transfer to the operation control centre (OCC).

The **SITRAS SMS** stray-current monitoring system is used to monitor the track potential of DC railway networks.

This system permits evaluation of the stray-current conditions of the track and the early detection of insulation deficiencies, thus enabling measures to be taken to prevent damage due to stray-current corrosion.

- Continuous monitoring of track potentials during operation
- Automatic location of insulation deficiencies
- Representation, archiving and analysis of track potentials in a central evaluation unit
- Transmission of measured values via the communication network, existing networks can be used
- No interference with stray-current conditions because SITRAS SMS is based on potential measurement.

10 Overall single line diagram



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31st March 2008

Updated Proposal Submission

Edinburgh Tram Network

Section 2: Overall Technical Concept

Part 1 – System Engineering

Annex 4 – Electro Magnetic Compatibility Plan

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1 Compliance to proposed Electromagnetic Compatibility Management Plan

We will follow the principles outlined in the "Electromagnetic Compatibility Management Plan" ULE90130-SW-SW-SPN-00058V5, the "System Earthing Policy" ULE90130-SW-REP-00071V2 and the "Code of Practice for Stray Current Corrosion Control" ULE90130-SW-REP-00006V2. These documents are in line with appropriate European standards, mainly the EN 50121 and EN 50122 series.

The main principle is to provide one common earthing system for all purposes including electrical safety, lightning protection, stray current protection, EMC aspects and also functional aspects. The earthing system shall apply the meshed design to minimize voltage differences between any points in the system, which improves safety, EMC performance and minimizes stray currents at the same time. The conductive building structure like steelwork and structural reinforcement shall be part of the earthing system.

The whole traction system will be insulated versus earth and building structure, including the running rails and everything connected to the running rails or the return circuit.

31st March 2008

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Edinburgh Tram Network

Section 2: Overall Technical Concept

Part 2 – Outline Operation Concept

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Abbreviations

AC	Alternate Current
AIR	Edinburgh Airport (station)
AFC	Automatic Fare Collection
BAA	British Airport Authority
BAS	Balfour Street (station)
BBS	Bilfinger Berger – Siemens (Consortium)
BDE	Bankhead Drive (substation)
BOOT	Build-Own-Operate-Transfer
CAP	Caroline Park (station)
CCR	Central Control Room
CCTV	Closed Circuit Television
CAE	Cathedral (substation)
CEC	City of Edinburgh Council
CGE	Craigleith (substation)
COM	Communications
COS	Bernard Street (station)
CRT	Crewe Toll (station)
DC	Direct Current
DEH	Depot Halt (staff only)
DKE	Developed Kinematic Envelope
DOP	Degraded Operation Plan
DTS	Digital Transmission System
EARL	Edinburgh Airport Rail Link
E&M	Electrical and Mechanical
EDP	Edinburgh Park Central (station)
EMC	Electro-Magnetic Compatibility
EPS	Edinburgh Park Station
ERQ	Employer's Requirements
ETN	Edinburgh Tram Network
FOW	Foot of the Walk (station)
GDE	Gogar Depot (substation)

GDJ	Gogar Depot Junction
GME	Granton Mains East (substation)
GOG	Gogarburn (station)
GRS	Granton (station)
GRW	Saltire Square (station)
GYL	Gyle Centre (station)
HAY	Haymarket (station)
HMRI	Her Majesty's Railway Inspectorate
HTE	Haymarket Terrace (substation)
IPE	Ingliston Park & Ride (substation)
IPR	Ingliston Park & Ride (station)
IT	Information Technology System
ITN	Invitation to Negotiate
JDE	Jenner's Depository (substation)
JRC	Joint Revenue Committee
LoD	Limits of Deviation
LRT	Light Rail Transit
LRV	Light Rail Vehicle
LSE	Leith Sands (substation)
LTS	Local Transport Strategy
LV	Low Voltage
LWE	Leith Walk (substation)
MDR	McDonald Road (station)
MMI	Man Machine Interface
MOI	Memorandum of Information
MUDFA	Multi-Utilities Diversion Framework Agreement
MUR	Murrayfield Stadium (station)
NER	Newhaven (station)
NSA	St. Andrew Square (station)
O&M	Operation and Maintenance
OCC	Operation Control Centre
OCD	Port of Leith (station)
OCL	Overhead Contact Line

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OCT	Ocean Terminal (station)
OLE	Overhead Line Equipment
OM	Regular Operation Mode
OpCon	Operation Concept
ORS	Operational Radio System
PA	Public Address System
PABX	Private Automatic Branch Exchange
PHP	Passenger Help Point
PEHP	Passenger Emergency Help Point
PID	Passenger Information Display
PIP	Picardy Place (station)
PIS	Passenger Information System
PPI	Point Position Indicator
PPP	Public-Private-Partnership
PSW	Princes Street (station)
PVR	Peak Vehicle Requirement
RDA	Roads Demarcation Agreement
ROGS	Railway and Other Guided Transport Systems
ROJ	Roseburn Junction
ROTS	Railway and Other Transport Systems
ROW	Right-of-Way
RRE	Russell Road (substation)
RST	Rolling Stock
RVAR	Rail Vehicle Accessibility Regulation
SCADA	Supervisory Control and Data Acquisition
SCC	Supervisory Control and Communications
SDS	System Design Services
SIG	Signalling
SGA	Bankhead (station)
SHP	Shandwick Place (station)
SRN	Saughton (station)
TCU	Train Control Unit
TEL	Transport Edinburgh Ltd.

tie	Transport Initiates Edinburgh or tie Limited. **tie** is the client for the Edinburgh Tram Network (TN).
TMA	Tram Maintenance Agreement
TOR	Top of Rail
tph	trams per hour (per direction)
TPDS	Tram Position and Detection System
TPS	Traction Power Supply
TPSS	Traction Power Substation
Tramco	Rolling Stock Supplier
Transdev	Transdev Edinburgh Tram Limited (TETL) the Edinburgh Tram Network (ETN) Operator
TRS	Trunk Radio System
TRW	Track Work
TSA	Tram Supply Agreement
TRO	Traffic Regulation Order
TTRO	Temporary Traffic Regulation Order
UPS	Uninterruptible Power Supply
UTC	Urban Traffic Control
WGA	Pilton (station)
YOP	York Place (crossover)

Key Data

Item	Characteristic
Track lengths: Phase 1a Phase 1b total	 approx. 18.8 km approx. 5.5 km approx. 24.3 km
Track configuration Tramway configuration: integrated on-street segregated on-street off-street	double track approx. 25% approx. 5% approx. 70%
Line lengths (from / to station centre): Line 1: Phase 1a: Newhaven – Haymarket Phase 1a+1b: Newhaven – Granton Line 2: Phase 1a+1b: Airport – Ocean Terminal	 7.2 km 13.5 km 17.6 km
Number of Tramstops (network): Phase 1a Phase 1b Number of Tramstops (line): Line 1: Phase 1a: Newhaven - Haymarket Phase 1a+1b: Newhaven – Granton Square Line 2: Phase 1a+1b: Airport – Ocean Terminal	31 22 9 12 21 21
Track gauge (Standard Gauge) Rail type	1,435 mm UIC 60
Direction of traffic	Left-hand
Direction Convention: Airport – Ocean Terminal Ocean Terminal - Airport Granton – Haymarket Haymarket - Granton	 Inbound Outbound Inbound Outbound
Maximum gradient, desirable (exceptional)	5% (8%)
Minimum radius on line, desirable (exceptional)	50 m (25 m)

Maximum operating speed: Non street running street running depot	 80 km/h 50 km/h 15 km/h
Station platforms: platform style length minimum width height	 centre and side 43m + 2m stopping tolerance centre: 4m, side: 3m low level
Services Hours	05:15 h (first tram) – 00:45 h (last tram)
Average dwell time at tramstops	25 sec
Headways in peak hours (Standard Scenario): 8&8 trams per hour (tph) Design headway (+50%): 12&12 trams per hour (tph)	 7.5 min (each line) 3.75 min (on common section) 5 min (each line) 2.5 min (on common section)
Layover at terminals: minimum layover time at Airport (at 8 tph)	 4 min or 10% of run time 7.5 min
Operational Journey Time Allowance: Newhaven – Haymarket Ocean Terminal – Airport Newhaven - Granton	 1.5 min 1.5 min 45 sec
Maximum Journey Times (required): Airport – Ocean Terminal Granton – Newhaven Total Run Times: OCT – AIR / AIR - OCT NER – GRS / GRS – NER NER – HAY / HAY - NER Minimum round trip times: OCT – AIR – OCT NER – GRS – NER NER – HAY - NER	 42 min 15 sec 39 min 30 sec 48:50 / 49:40 45:04 / 43:56 29:13 / 29:07 1:50:55 1:37:22 1:06:20
Signalling System	'line-of-sight' operation, tram priority at signal controlled junctions

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Fleet Size: Standard Scenario 8&8 trams per hour (tph)	 Phase 1a: 27 Phase 1a+1b: 31
Train Mileage (per tram and year) (Standard Scenario 8&8)	Phase 1a: 96,167 km Phase 1a+1b: 105,600 km
Train dimensions: length width height (above TOR, lowered pantograph) floor height (above TOR)	 43.5 m 2.65 m 3.55 m 300 – 400 mm
Train capacity (places): seats standees (at 4 pers/m²) total	 80 190 270
Service brake rate Hazard brake rate	1.2 m/sec² 2.5 m/sec²
Traction Power System	750 V DC, Overhead Line

1 Introduction

Subject of this Outline Operation Concept is the Edinburgh Tram Network (ETN) System. The Operation Concept forms the overall basis for the operation of the proposed Light Rail Transit (LRT) System. The system engineers as well as the separate sub-system suppliers will use the information given in this Concept for the engineering planning of the different systems and sub-systems respectively to consider all kind of daily tram operations.

This Outline Operation Concept does not replace the operation plans or the general rulebook and operational manuals, which have to be developed by the Operator in due course of the project execution.

The descriptions, features and requirements mentioned in this Outline Operation Concept apply to the specifications as laid down in the Invitation to Negotiate (ITN) and the Employer's Requirements issued by the Transport Initiatives Edinburgh **(tie)**.

This Outline Operations Concept deals with the requirements for the Standard Tender to design and build the whole Edinburgh Tram Network, generally assuming a tram frequency of

- 8 trams per hour between the Edinburgh Airport and Ocean Terminal and further
- 8 trams per hour between Granton and Newhaven.

2 System Lines and Phasing

The Edinburgh Tram Network is being developed under the Edinburgh Tram Acts as a two line system comprising:

• Line 1:
A north Edinburgh loop connecting the city centre with Leith, Newhaven and Granton and passing through the Waterfront Development Area. The route will run from Haymarket along the former Roseburn railway corridor, along the shore front to Ocean Terminal Shopping Centre and onwards to Leith returning to the city centre via Leith Walk. The route through the city centre will be via Princes Street.

• Line 2:
The line starts at the shore front at Ocean Terminal, will run to Haymarket and follows a western corridor from the city centre to Gyle, Edinburgh Park and the Airport. A future spur will lead to Newbridge. The preferred corridor approximately follows the main Edinburgh – Glasgow railway line between Haymarket and the new station at Edinburgh Park, then heads north west to the Gyle, Gogarburn and the Airport respectively Newbridge. Most part of the route along the western corridor will be fully segregated from other traffic.

Transport Scotland and CEC have developed a prioritisation of separable phases from the two line system, as outlined below:

- Phase 1a: Newhaven to Edinburgh Airport
- Phase 1b: Roseburn to Granton
- Phase 2: Granton to Newhaven
- Phase 3: Ingliston to Newbridge North

The Edinburgh Tram Network relates to construction works for Phase 1a and Phase 1b only.

Future Phase 2 will close the loop for Line 1 along the sea front between Newhaven and Granton including provision of Lower Granton Road stop.

Future Phase 3 will extent Line 2 operation from Ingliston Park & Ride to Newbridge North.

Furthermore there are plans to add a Line 3 section starting from the junction of Princes Street/South St. Andrew Street to Royal Infirmary.

The track lengths of the Edinburgh Tram Network are:

- Phase 1a: approx. 18.8 km
- Phase 1b: approx. 5.5 km

Figure 1 shows the line configuration for Phase 1a and Phase 1a+1b.

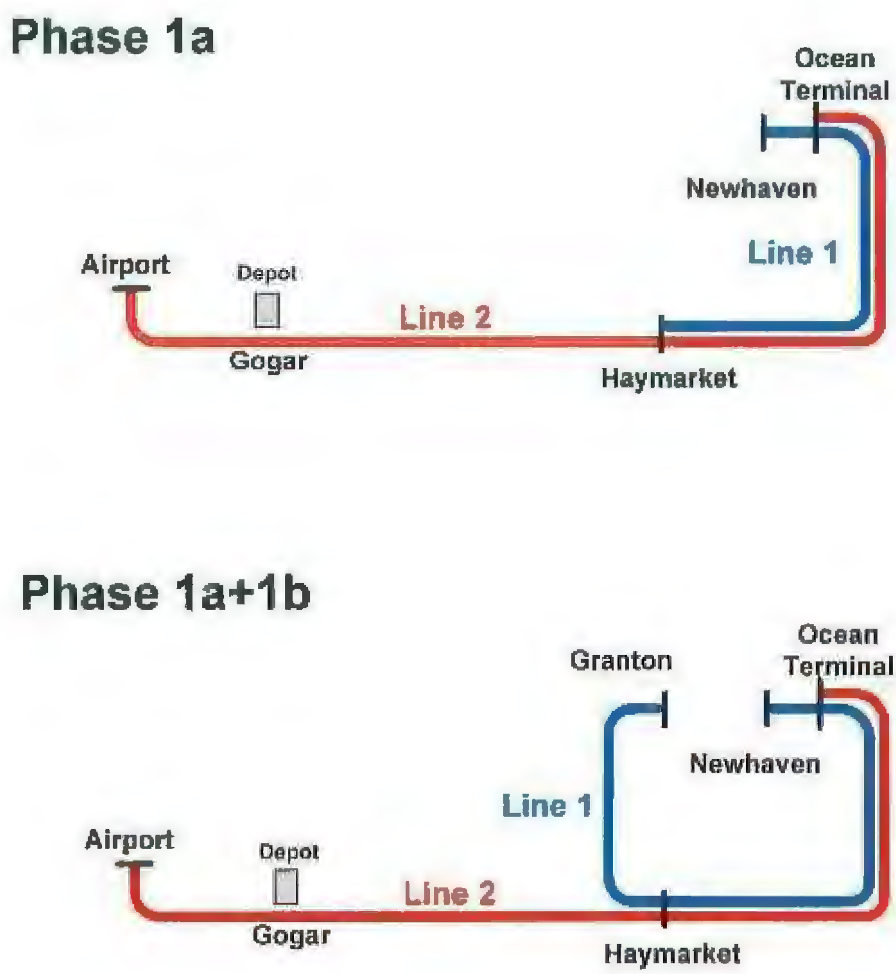

Figure 1: Line Configuration (Phases 1a and 1b)

The line lengths and the number of tramstops for Phases 1a and 1b are shown in the following table. The line lengths are valid from centre to centre of terminal:

Line	from terminal to terminal	Line length	No of tramstops	average stop distance
Line 1:				
Phase 1a	NER – HAY	7.2 km	12	655 m
Phase 1a+1b	NER – GRS	13.5 km	21	675 m
Line 2:				
Phase 1a+1b	AIR – OCT	17.6 km	21	880 m

Table 1: Line lengths and number of tramstops per line

The ETN will operate as a 'line-of-sight' tramway with tram priority at signal controlled junctions (see Track Layout).

The route in the city from Newhaven to Haymarket and from West Granton Access to Granton Square runs mainly on-street with varying degrees of segregation. The Roseburn corridor is a segregated off-street alignment, shared with a combined footpath and cycleway. Most of the route between Haymarket and the Airport is segregated from road traffic.

The Depot will be located at Gogar adjacent to Line 2. The Depot will be part of Phase 1a construction.

3 Ridership

Information on system ridership (passengers per day and/or hour) and/or maximum link loads (passengers per hour, direction) are not given.

It is assumed that all Transport–Modelling and patronage and revenue forecasts will be performed by the SDS-JRC Modelling Suite. BBS will address relevant requirements as defined from the SDS Agreement with **tie**.

The line capacity is determined by the given headways of the Standard Tender Service Scenario 8&8 and the capacity of the proposed 43m trams.

4 Tramstops

The Edinburgh Tram Network (Phase 1a+1b) comprises a total of 31 tramstops (stations), thereof 22 for Phase 1a and 9 tramstops for Phase 1b as shown in Table 2. An additional halt for staff only will be located at Gogar Depot.

Transport Interchanges to other transit modes will be provided at

- Edinburgh Airport
- Ingliston Park & Ride
- Edinburgh Park Station
- Haymarket
- St. Andrews Square
- Foot of the Walk
- Crew Toll

All tramstops are equipped with low level platforms. The platform height will match the requirements of the tram to ensure level access in accordance with RVAR (Rail Vehicle Accessibility Regulation).

Platforms will be long enough to cater for nominal 43m long trams. A stopping tolerance of +/- 2m will be allowed for in the platform length. Side platforms will have a minimum width of 3m, island platforms 4m.

Each platform will contain facilities to provide the passengers with weather protection in the form of a canopy or shelter.

Each shelter will include the following components:

- Passenger Help Point
- Passenger Emergency Call Point
- Braille assistance
- Lighting
- Information Panel
- System Logo and Stop Name
- Perch rail/seat

- Advertising panel

No	ID	Tramstop (Station)	Platform Style
		Phase 1a	
1	AIR	Edinburgh Airport	1 centre
2	IPR	Ingliston Park & Ride	2 side
3	GOG	Gogarburn	2 side
	DEH	Depot Halt (staff only)	2 side
4	GYL	Gyle Centre	2 side
5	EDP	Edinburgh Park Central	2 side
6	EPS	Edinburgh Park Station	2 side
7	SGA	Bankhead	2 side
8	SRN	Saughton	2 side
9	BAR	Balgreen	2 side
10	MUR	Murrayfield Stadium	2 side
11	HAY	Haymarket	2 side
12	SHP	Shandwick Place	1 centre
13	PSW	Princess Street	1 centre
14	SAS	St. Andrew Square	1 centre
15	PIP	Picardy Place	2 side
16	MDR	McDonald Road	1 centre
17	BAS	Balfour Street	1 centre
18	FOW	Foot of the Walk	2 side
19	COS	Bernard Street	1 centre
20	OCD	Port of Leith	1 centre
21	OCT	Ocean Terminal	1 centre, 1 side
22	NER	Newhaven	2 side
		Phase 1b	
23	GRS	Granton	1 centre
24	GRW	Saltire Square	2 side
25	CAP	Caroline Park	2 side
26	WGA	West Pilton	2 side
27	CRT	Crewe Toll	2 side
28	WGH	Telford Road	2 side
29	CRA	Craigleith	2 side
30	RAD	Ravelston	2 side
31	ROS	Roseburn	2 side

Table 2: Tramstops: Locations, Platform Style, Interchanges

Closed Circuit Television (CCTV) will be provided on each platform to enable coloured pictures to be displayed at the Control Room and other CCTV monitoring authorities.

Loudspeakers (Public Address) will be provided at each lighting pole location and within the shelter to enable passengers to receive audio messages.

Bench seats will be positioned on each platform and within each shelter a perch rail/seat.

Ticket Vending Machines (TVM) and/or ticket validators will be located within or adjacent to the shelters. Ticketing equipment is not within the scope of BBS Consortium.

5 Network Diagram and Track Design

The Network Diagram (Schematic Track Layout) is shown in Annex 1. The actual track layout includes 44 turnouts (without Depot area), automatic and manual operated (see Track Layout).

The whole Edinburgh Tram Network will consist of double track. Track gauge is 1,435 mm. The maximum operating speed will be 80 km/h.

Minimum desirable horizontal radius on running lines and in depot will be 50m, in exceptional cases 25m on running lines and 20m in depot.

Maximum desirable gradient value is 5%, exceptional limited value 8%.

The network differ various track categories as (% of total track length)

- Integrated on-street tramways (25%)
- Segregated on-street tramways (5%)
- Off-street tramways (70%)

The design of the network will allow services to be turned back at the locations detailed in the following table:

ID	Turnback Locations
EPS	Edinburgh Park Station
HAY	Haymarket Yards
SHP	Shandwick Place
YOP	York Place
FOW	Foot of the Walk (Leith Walk)
OCT	Ocean Terminal
CRT	Crewe Toll

Table 3: Turnback Locations (crossovers)

The turnback facilities will allow special maintenance working at certain times of the year and individual services when sections of the System will be closed for example for Hogmanay, the Edinburgh festival and other special events and festivals.

Trams are also allowed to be turned back at Gogar Depot. The facility to allow this will be provided. An additional siding is located at Haymarket (HAY) for turnback.

The terminals Edinburgh Airport (AIR), Newhaven (NER) and Granton (GRS) are arranged with double-crossovers in front. Ocean Terminal (OCT) includes an additional (third) track for reversing of Line 2 trams.

At Edinburgh Airport (AIR), Ocean Terminal (OCT), Granton (GRS) and Haymarket (HAY) facilities will be provided for driver comfort breaks. In addition, crew change facilities will be provided at the Depot Halt (DEH) and at Haymarket (HAY).

6 Operating Hours, Service Patterns and Frequencies

The Edinburgh Tram Network will support a daily service, all year around. The time period between the last tram returning to the Depot at night and the first tram leaving the Depot in the morning is anticipated with 4hrs 30 min. The operating hours are anticipated between 05:15 and 00:45.

The proposed service patterns for the Lines 1 and 2 are based on the headway scenario for the Standard Tender. Figures are to be understand as 'trams per hour' (tph) per direction:

- Standard Scenario: 8 & 8 tph (7.5min & 7.5min)

This Standard Scenario gives 16 tph (3.75min) on the common line section in the city between Ocean Terminal and Haymarket.

Trams will be co-ordinated between OCT and HAY to give an even service pattern.

The service scenario is based on following assumptions and conditions.

- Edinburgh Airport service tram frequency is ramped up/down from Ocean Terminal. Granton (Phase 1a & 1b) or Haymarket (Phase 1a only) service tram frequency is ramped down up/down from Newhaven.
- Trams going into service between Gogar Depot and Ocean Terminal/Newhaven will run 'in service' from the Gyle (first tram Gyle to Ocean Terminal approx. 05:15 Monday through Saturday).
- Haymarket or Granton service trams going 'out of service' running between Haymarket and Gogar Depot will run 'in service' as far as Gyle.
- Edinburgh Airport service trams going out of service will run 'in service' from Ocean Terminal to Edinburgh Airport with a short 'dead run' from Edinburgh Airport to Gogar Depot.
- Service proposals are based on the requirement to always have a tram present at the Airport tramstop.
- The period of time between the last tram returning to the Depot at night and the first tram leaving the Depot in the morning is about 4hrs 30min. Consequently the maintenance window will allow work on the System infrastructure for about 3hrs 45min, depending on location each night and allowing time for the implementation and withdrawal of isolations.

The network will be future proofed with the trams per hour increased by 50% throughout, resulting in:

- Standard Scenario: 12&12 tph (5min & 5min)

These increased frequencies result in 24 tph (2.5min) on the common section in the city between Ocean Terminal and Haymarket.

7 Speeds and Times

The maximum operating speeds will be:

- Non-street running: 80 km/h
- Street running: 50 km/h
- Depot: 15 km/h

The average dwell time at tramstops is 25 sec.

The following times stated are derived from Employer's Requirements. A runtime simulation will be carried out by BBS Consortium to demonstrate and confirm the required end-to-end journey times.

The required maximum journey times for the ETN, quoted as operational journey time including dwell times of 25 sec at each tramstop will be as follows.

- Phase 1a Airport to Ocean Terminal 42 min 15 sec
- Phase 1b Granton to Newhaven 39 min 30 sec

An operational allowance will be added to the developed runtime to ensure a robust operable timetable is constructed:

- Operational journey time allowance:
  Newhaven to Haymarket 1.5 min
  Ocean Terminal to Airport 1.5 min
  Newhaven to Granton 45 sec

- Layover:
  4min minimum or 10% of timetabled runtime, whichever is greater.
  Exception. At the Airport tramstop a tram is required to always be present.

The Depot halt at Gogar will be the location where drivers changeover.

BBS Consortium will continue to develop and refine the runtime model as the design progresses and provide updated reports demonstration that the maximum run times (journey times) can be achieved. BBS will also prepare a model for electricity consumption linked to the run time model.

The following Table 4 shows the results of preliminary calculations of the minimum round trip times as obtained from the revised Employer's Requirements, Part 2 Operations and Performance:

Time Elements	Line 1 Phase 1b		Line 2 Phase 1a+1b	
	NER-GRS	GRS-NER	OCT-AIR	AIR-OCT
Runtime	00:45:04	00:43:56	00:48:50	00:49:40
Minimum layover time 8 & 8 tph	NER 00:04:15 GRS 00:04:07 Total 00:08:22		OCT 00:04:55 AIR 00:07:30 Total 00:12:25	
Minimum round tip time 8 & 8 tph	01:37:22		01:50:55	

Time Elements	Line 1 Phase 1a	
	NER-HAY	HAY-NER
Runtime	00:29:13	00:29:07
Minimum layover time 8 & 8 tph	NER 00:04:00 HAY 00:04:00 Total 00:08:00	
Minimum round tip time 8 & 8 tph	01:06:20	

Table 4: Round Trip Times for Lines 1 and 2 – Standard Scenario 8&8 (refer to Employer's Requirements Part 2 Operations and Performance, Section 2.7.1.3)

8 Fleet Size and Mileage

Based on the minimum round trip times determined above the Peak Vehicle Requirement (PVR) and the total tram fleet size has been calculated as follows (refer to Employer's Requirements, Part 2, Section 2.7.2):

Standard Scenario 8 & 8	**Line 1 Phase 1a** NER-HAY	**Line 1 Phase 1b** NER-GRS	**Line 2 Phase 1a+1b** OCT - AIR
Headway	7.5 min	7.5 min	7.5 min
Trams per hour (tph)	8	8	8
Minimum round trip time	01:06:20	01:37:22	01:50:55
Actual round trip time needed to provide required headway	1:07:30	1:37:30	1:52:30
Peak number of trams	9	13	15
	Phase 1a	**Phase 1b**	
Peak Vehicle Requirement (PVR)	24	28	
O&M reserve	3	3	
Total tram fleet	27	31	

Table 5: Fleet Size for Phase 1a and 1b – Standard Scenario 8 & 8

The total size includes the necessary O&M reserve for standby, maintenance, repair and training. The proposed O&M reserve is 3 trams.

The trams are required to have a minimum mileage of at least 100,000 km per year.

According ERQ the annual mileage based on the proposed service patterns has been calculated as follows. 'Empty running' to and from the depot is included:

- Standard Scenario 8 & 8:
  Phase 1a: 96,167 tram km per year
  Phase 1a+1b: 105,600 tram km per year

9 ETN Sub-Systems

9.1 Trams

The delivery of trams is subject of the Rolling Stock Supplier (Tramco) and not within the scope of the BBS Consortium.

The trams will be articulated in order to negotiate the track alignment. They will be fully bi-directional and capable of being driven from either end. They will have doors on both sides. They will be capable of being operated by one person.

Normal service trams will comprise on vehicle, but trams will be capable of running coupled together for the purpose of one tram recovering another failed tram from any point on the System. An emergency coupler will be provided at each end of each tram. It will be used only for hauling or propelling a defective tram. An empty tram will be capable of both hauling and propelling another empty tram.

The length of a tram unit will be approx. 43m. The tram body will be a nominal width of 2.65m.

According the Employer's Requirement the passenger capacity (places) of the tram will be:

- Seated:: 80
- Standees: 190 (at 4 pers/m²)
- Total: 270

The trams will be capable of being operated continuously for twenty hours in each day.

The tram will have

- a maximum operating speed of 80km/h,
- a minimum operating capability of at least 100,000 km per year,
- a maximum axle load at AW5 loading (standees at 8 persons/m²) of 12 tonnes,
- a minimum of 66% adhesive weight on motored axles.

The tram will be equipped with at least 4 pairs of bi-parting sliding-plug doors on each side of the vehicle for the passenger saloon. The minimum clearance width will be 1,300 mm.

The trams will be fitted with equipment to automatically indicate their position to and communicate with the Operation Control Centre (OCC). A voice radio system will be permanently available between the driver and the OCC.

Rear-views will be provided by CCTV equipment. Automatic, audible announcements for destination and stops will be made by means of a digital voice announcement system.

The tram will be fitted with six external destination displays, one at each end above the cab and two on each side. Internal saloon displays will be used to show information concerning the next stop. They will also display the local time, and should also be able to display public service information.

Passenger alarm devices will also be located in the saloon area. Theses devices will allow communication with the driver.

The driver's cabs will be air-conditioned.

9.2 Supervisory Control and Communications

9.2.1 Tram Position and Detection System

The Tram Position and Detection System (TPDS) will monitor the efficient and effective movement and overall regulation of trams running on the Edinburgh Tram Network. TPDS will include both tram borne and trackside equipments.

Each tram driver will be responsible for safe operation using 'line-of-sight' principles, with the TPDS identifying and setting the correct route ahead of the tram and providing tram regulation and monitoring facilities to Control Room Staff.

The TPDS will collect in real time the following information from each tram for transmission to the Control Centre:

- Tram number,
- Tram run number,
- Tram destination,
- Driver staff identity number,
- Driver duty number,
- Tram in service / out of service.

The TPDS will provide a number of functions which will include:

- Tram identification,
- Tram position on network (outside depot),
- Tram progress monitoring,
- Route setting,
- Processing of manual and automatic 'Tram ready to start' and advance signal demand requests from trams,
- Permit tram to safely transverse tram/road crossings,
- Provide controlled entry to and exit from the depot facilities.

On the approach of a tram to each tramstop and at the termini, where scheduled departure time will also be displayed, the TPDS will provide updates to the Passenger Information Display system, via the Tram Management System.

The driver of each tram will enter the details of journeys for the particular tram for his entire operating day into the tram on-board computer at the commencement of service. Any change to these data e.g. as result of an incident affecting the service will be initiated by the driver.

Tramway signal heads will be positioned at all signal controlled Track and Road Junctions and Pedestrian Crossings to allow optimum sighting for the tram driver.

Tramway signal heads will indicate the acceptance of the signal demand by the system to the tram drivers.

At all signal controlled tram and road junctions there will be an interface installed between the TPDS and the Urban Traffic Control (UTC) System.

All tram signals at signaled controlled tram and road junctions will be driven directly by the UTC System controller, and not by the Tram Position and Detection System.

The TPDS/UTC System interface will implement an agreed Tram Priority at each signal controlled junction.

Each TPDS/UTC System interface will incorporate the facility for the initiation of a 'tram proceed signal in the event of either tram detection failure or local UTC System interface failure. This facility will be capable of being requested at all times by the Control Room Staff.

All interface configuration between the Urban Traffic Control System (UTC) and BBS Tram Position and Detection System (TPDS) will be subject to further revision and verification.

9.2.2 Passenger Information Display System

Each tramstop platform will be equipped with a real time Passenger Information Display System (PIDS) that will be connected to the Control Centre by the Operational Data Network.

Passenger Information Displays will also be provided at the following locations:

- Park & Ride facility,
- Edinburgh Airport,
- Ocean Terminal shopping Centre,
- Haymarket Railway Station.

Each Passenger Information Display will show variable messages including the destination and time to arrival (in minutes) of the next three tram service arrivals, or arrivals within the next 30 minutes, which ever is the less at the particular platform.

9.2.3 Telephone Network

The Edinburgh Tram Network (ETN) will be provided with a Telephone Network that will provide two-way voice communication between staff at fixed locations through the ETN and be integrated with Passenger Help / Passenger Emergency Help Points at tramstops.

The main operator interface with the Telephone Network will be provided by an integrated workstation at each Control Room staff position.

The Telephone Network will include all Private Automatic Branch Exchange (PABX) equipment, all necessary interfaces, configuration of the system elements, the connecting cables and management and diagnostic facilities.

The Telephone Network will provide voice communication to external agencies including the emergency services and the urban traffic controllers.

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9.2.4 Public Address System

Loudspeakers and Audio Loops located at each tramstop platform will form part of the ETN Public Address (PA) System. The Operational Data Network will connect amplifiers/controllers to the Control Centre. Public Address facilities will also be provided at Park & Ride facilities.

9.2.5 Operational Radio System

An Operational Radio System (ORS) will provide two-way communication enabling voice and data exchanges between the Control Room staff and:

- Drivers on board individual trams, group of trams and/or all trams,
- Drivers of road and other support vehicles for the ETN,
- Individually or in groups with other mobile ETN operations staff using hand portable equipment along the Network and in the Depot

The main operator interface with the ORS will be provided by workstations installed in the Control Room (for Control Room staff), and tram mounted mobiles (for tram crews), road vehicle mounted mobiles and portable equipment for other mobile staff.

9.2.6 Passenger Help / Passenger Emergency Help Points

Each tramstop platform will be equipped with at least one Passenger Help / Passenger Emergency Help Point that will be connected to the Control Centre by the Operational Data Network.

Each Passenger Help / Passenger Emergency Help Point will be sited so that it is visible by the CCTV camera.

Additional Passenger Help / Passenger Emergency Help Points will be provided, as a minimum, at Park & Ride facilities.

9.2.7 Closed Circuit Television

The Edinburgh Tram Network will be provided with a digital colour Closed Circuit Television System (CCTV).

The tram CCTV system will interface to the City of Edinburgh Council (CEC) citywide CCTV system.

Each tramstop platform will be equipped with at least one CCTV camera that will be connected to the Control Centre by the Operational Data Network.

Additional CCTV cameras will be provided to give full coverage of Park & Ride facilities.

The Edinburgh Tram Network Depot complex will be equipped with a dedicated digital CCTV System as part of the Depot Security System.

All CCTV cameras will be provided with pan, zoom and tilt facilities both automatically within preset limits and under manual control, and be programmed to zoom in on the Passenger Help / Passenger Emergency Help Point when they are used, and to the Ticket Vending Machine when an alarm is initiated.

9.2.8 Supervisory Control and Data Acquisition

A Supervisory Control and Data Acquisition (SCADA) System will be provided primarily to provide controls, status indications, alarm indications for the Traction Power System and log significant events.

In addition, the SCADA system will provide, as a minimum, indication and control of auxiliary systems and services at tramstops (e.g. Ticket Vending Machines and Ticket Validators) and trackside.

The current status of the Traction Power System as presented by the SCADA system will be available as a display to the Control Room staff at all times.

9.2.9 Operational Data Network

The Operational Data Network will provide the communications 'backbone' between tramstops, substations, other remote equipments and the Depot and will convey data for a variety of applications including

- Tram Positioning, Routing and Detection System,
- Passenger Information Displays,
- Telephone Network,
- Public Address,
- Operational Radio Network (optional),
- Passenger Help / Passenger Emergency Help Points,
- Closed Circuit Television,
- Point Control and Indication,
- Point Heating Control and Indication,
- Supervisory Control and Data Acquisition,
- Ticket Vending Machines.

9.2.10 Control Centre

The Central Control Room (CCR) is the focal point for the control and operation of the Edinburgh Tram Network. The Control Room will be located in the first floor of the Depot building.

The Control Room comprises a number of workstations, at which Control Room staff control or retrieve data from the System. The operator interface will be designed to carry out control functions in an ergonomically efficient manner.

The CCR Workstations will provide indication and control of auxiliary systems and services as follows:

- Tram Position and Detection System status and alarms,
- Operation of Passenger Help / Passenger Emergency Help Point System,
- Traction Power System,
- 'No-break' power supply status and alarms,
- Communications Systems status and alarms,

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- Communications network management,
- Ticket Vending Machines and Validator alarm indications,
- Closed Circuit Television,
- Video / Closed Circuit Television image printing,
- System Plant / Services status indications and alarm,
- Supervisory Control and Data Acquisition System,
- Operational Radio System,
- Emergency Telephones,
- Performance Monitoring System,
- Central data recording and storage,
- Central time,
- Security,
- Intruder alarms,
- Passenger Information Display management,
- Public Address announcements, volume level control and indications,
- Fire Alarm System.

Directly below the Control Room is the Equipment Room, which will accommodate the majority of the main subsystems from which the control system is constructed.

The Control Room will be designed to provide sufficient and effective area for the following operations personnel:

- Operations (Duty) Manager:

The Operations Manager will be responsible for overall control of the Edinburgh Tram Network and the safety of its operation.
The Operations Manager will also be required to be present to 'book' tram-crew on and off duty.

- Operations (Shift) Controller:

The Operations Controller is responsible for the minute by minute operation of the Edinburgh Tram Network ensuring service perturbations risks are minimized and tram-crew are aware of the current state of the Edinburgh Tram Network.

- Operations Information & Security Supervisor:

The Information & Security Supervisor provides support to the Operations Manager and the Operations Controller by monitoring the positions of trams, monitoring and editing of Passenger Information Displays, monitoring of CCTV and Passenger Help / Passenger Emergency Help Points. This post will also take the primary role in ensuring passenger information and security.

- Operational Support:

The Control Room will also need to allow for the provision of support post to the Information & Security Supervisor under certain perturbed situations.

Detailed descriptions of the Control Room Staff workplaces are contained in the Employer's Requirements, Part 3i, Section 3.

9.3 Traction Power

The provision of Traction Power will be derived from a number of suitably located Traction substations distributed around the Edinburgh Tram Network (ETN).

The trams will operate with 750 V DC overhead power supply.

Twelve traction substations (eleven plus Depot) will be provided:

No	ID	Substations
Phase 1a		
1	LSE	Leith Sands Substation
2	LWE	Leith Walk Substation
3	CAE	Chathedral Substation
4	HTE	Haymarket Terrace Substation
5	RRE	Russell Road Substation
6	JDE	Jenner's Depository Substation
7	BDE	Bankhead Drive Substation
8	GDE	Gogar Depot Substation
9	IPE	Ingliston Park & Ride Substation
Phase 1b		
10	CGE	Craigleith Substation
11	GME	Granton Mains East Substation
12	GRE	Granton Road Substation

Table 6: ETN Traction Substations

The 11 kV feed to each substation will be derived from and form part of the local Distribution Network Provider (Scottish Power) Network ring with a dedicated ring main unit or switchboard feeding the ETN rectifier of the traction substation.

Equipment located within the substations and the remote motorized isolators will be controlled and monitored over a SCADA system.

The 11 kV incoming supply to all traction substations will be able to be individually tripped by the System Controller located in the CCR via SCADA and by staff locally by means of a dedicated push button to be located in each substation lobby.

The Overhead Line Equipment (OLE) will also be able to be tripped in either direction by the System Controller from the CCR via SCADA.

The OLE will also be able to be tripped locally in both directions simultaneously by means of an emergency push button located in each substation lobby.

9.4 Depot

The Depot, located at Gogar, will provide maintenance and stabling facilities for the entire fleet of trams operating on the initial network, and the infrastructure. It will also contain the administration and management offices, including Operations and Control Centre (OCC).

The Depot layout will accommodate a minimum of 35 trams of 43.6m length. The stabling facility will accommodate a minimum of 31 trams.

The Depot building will include the main tram workshop, other workshops, stores, management, administration, operations and maintenance offices and staff welfare facilities and the Control Room for the complete Edinburgh Tram Network.

The building workshop will accommodate a minimum of two tram maintenance roads, a wheel lathe road and a further tram service road.

The Depot will be provided with the appropriate electricity supplies including 440V/415V for individual items of workshop equipment both inside and outside the building, 230V for internal domestic use and 110V for small tools.

Detailed description of the Depot and Workshop equipment are contained in the Employer's Requirements.

10 Regular Operations

10.1 Principles of Operation

The ETN System shall be operated according to 'line-of-sight' principles with tramway signalling provided at tramway crossings where appropriate.

For the operational scenarios it is assumed, that a pre–emption is installed at all signalled traffic junctions giving trams priority over public traffic.

Point Position Indicators (PPI) will be provided adjacent to all facing points so as to assist the driver in determining the position of the points.

10.2 Tram Driving

The tram driver, who will be the only operational staff present on the vehicle, shall observe safe tram operation. He shall be fully trained and examined before being passed as qualified for the role of driver. The Duty Roster based on the relevant operating day shall inform the tram driver about his actual shift and the service duties. The tram running number shall determine route and timetable to be run.

All drivers shall start their working time at the Gogar Depot or at pre-determined locations (e.g. terminals). When reporting for duty at the Depot, the driver shall receive information about the location of the tram from the Tram Crew Supervisor. He also shall be given special information about the daily operation.

Starting duty at the Depot tram drivers shall report to the Engineering Controller that the tram is ready for departure. When the driver has received orders to depart from the Depot, he shall proceed from the stabling area via the transfer track on the line (transition area).

Tram drivers starting duty have to ensure to be informed about special service conditions. They shall contact the Operations Controller in the event of any conditions deviating from Regular Operation.

During operation the tram drivers shall observe the tracks, potential obstacles and the selection of the correct route. The latter to be supported by the wayside signals and Point Position Indicators. He shall pay attention to public traffic especially cruising in shared traffic corridors and at signalled traffic junctions.

Beneath the parameters determined by the alignment or the operational regulations the general running speed shall be defined by the line side visibility. The tram driver shall stop the tram accurately at the proposed boarding and alighting zones at platforms. He shall operate the doors and decide when the vehicle is ready for departure. Before and during departure the tram driver has to observe the platform areas via the tram borne CCTV.

The tram driver shall be responsible for passenger announcements via the onboard Public Address System. In situations deviating from Regular Operations the tram driver shall report to the Operations Controller and support passengers as far as applicable.

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When returning from main line operation, the tram driver enters the transfer track in front of the Depot area. Informed via tram radio about the proposed stabling track the driver shall handle the route setting manually as required and proceed into the Depot. The driver shall stable the vehicle at the defined stabling position, check the vehicle on damages or failures for report to the Tram Crew Supervisor and sign off.

10.3 Operation on the Line

After passing the loops in the transition area to line or at dead end sections of the line the tram routes will be requested automatically according to the trip number. A cyclic data transmission will take place between the OCC and the onboard units, where the relevant static data like the numbers of the tram, the line, the trip, the car and the driver number will be combined with the dynamic data like the relevant location of the tram.

The provided interlocking system will ensure an release of the route selected by the tram identification after successful check, route setting and finally interlocking of the requested route.

Via the onboard information system the data will be transferred to the onboard information transmission unit. Here the data will be converted subsequently into route setting orders transmitted to the trackside information transmission equipment. This will include a safeguard of the chosen route and the information of passengers.

10.4 Timetables

The timetables of the ETN System will be determined by the basic system data and the passenger forecast and shall contain all data required for the expedient tram operation in Regular Operations.

The base of all timetable planning will be the graphical timetable, which is presented by means of ascending and descending time-distance-paths. It is showing all scheduled and proposed tram runs – even out of service runs - during the daily operating hours and constitutes the base for planned tram runs in Regular Operations and steps for Degraded Operations.

10.4.1 Working Timetables

As extract of the graphical timetable the working plans or schedules shall be provided for the use of operational staff only. Most of them will be elaborated in tabular form and contain all necessary information and data of every tram run, e.g. tram number, starting of turnaround, departure and arrival time.

The **Rolling Stock Diagrams** will be the basis for the service planning of the tram units and give details of when trams leave and return to the Depot. Derived from the graphical timetable, it shows service and maintenance times, periods of immobilisation and operations reserve standby times of each train unit.

The **Drivers Duty Rosters** will give full details about signing on and off times, meal reliefs and details of the journeys to be worked. They will be derived from the service times and the graphical timetable. Combined with the round trip data the

Duty roster displays the train driver's daily tasks. It will indicate the beginning and end of the driver's service time, trains to be operated, the round trips to be carried out etc. They will also indicate where reliefs are to be taken or drivers changed over.

The **Stabling Plan** will list all regular movements in the stabling area of Depot. Derived from the rolling stock roster, the Stabling Plan will help to co-ordinate the maintenance work, track occupation and shunting movements.

The **Servicing and Maintenance Schedule** will determine - in contrast to the stabling plan - the components of shunting movements in the Depot area. All maintenance tasks have to be planned and represented in the servicing and maintenance schedule. Under these conditions the occupation of the separate maintenance equipment, e.g. washing plant, underfloor wheel lathe, will be scheduled as far as applicable.

10.4.2 Public Timetables

The Public Timetables as an additional extract of the graphical timetable will be the commercial offer of the ETN System prepared for passenger utilisation. They shall be easy to use and to provide quick reference.

Additionally the ETN System will be equipped with line diagrams showing the line direction and stations indicating the interchange facilities with other public transport systems available. The line diagram will be displayed abundantly on the station platforms and inside of trams.

11 Depot Operations

11.1 General

The Depot will be provided and equipped for the required daily Revenue Service. Trams shall be fed into service from stabling at the necessary rate to meet the operating timetable. As mentioned above the Depot's operational service plans will be derived from this timetable.

Beneath the general function of stabling and cleaning of vehicles, the Workshop will provide facilities for the functions required for the handling of the Maintenance Concept, which will include the testing, repair by exchange of components, storage of parts and supplies, systems control and administration.

11.2 Tram movements within the Depot area

Movements within the Depot area shall be under direction and supervision of the Engineering Controller and generally be authorised via radio communication. Tram drivers will be responsible for the safe movement of their vehicle having regard to all the other activities within this area.

Generally trams shall be driven on-sight with a maximum speed of 15 km/h. Points shall be manually or spring operated. With reference to the reduced speed points within this area are generally not equipped with PPI (Point Position Indicators).

11.3 Leaving / Entering the Depot

Generally Movements into and out of the Depot will be agreed between the Operation and Engineering Controllers.

Trams ready for service will be parked in the Stabling Area either by tram drivers after previous service or by the maintainer after adequate attention.

Drivers signing on for service in the Depot will be instructed by the Tram Crew Supervisor for picking up a designated tram. The actual timetable or an abstract like a Duty Card will inform the tram driver about departure time and routing.

After preparation of duty the driver will require the permission for depart from the Engineering Controller. The tram will then leave the Depot and move onto the transfer track to join the main line tram services.

Trams returning from service will have scheduled movements within the Depot area indicated in the Duty Roster and Vehicle Diagram. The arrival time, routing and stabling location will be pre-determined with any last-minute change given to the driver via tram radio.

11.4 Cleaning Trams

Cleaning of trams shall be executed at the proposed areas, whereby the internal cleaning shall be done whilst the trams are parked in the Stabling Area.

The cleaning will be handled according to a schedule provided by the Operator.

12 Degraded Operations

12.1 Strategies for Service Disruptions

Degraded Operations may result from the failure of one of the system components, crush loaded trams, extreme meteorological conditions, or other external influences on the ETN System. The effects of the failure can be very different.

'Planned' Degraded Operations will also occur when sections of the ETN System will be closed to allow for example Hogmanay, the Edinburgh Festival and other special events and festivals.

The System and the separate sub-systems will be designed to minimise the effects on services in cases of Degraded Operations. Usually, only the combination of more than one failure of the sub-systems will reduce the quality of services due to redundancy of major sub-systems components.

The Operator shall attempt to minimise the effect of any service disruptions. The nature of the ETN network will offer a great flexibility in dealing with service disruptions. The sectioning of the power supply shall be designed to keep operational flexibility even during Degraded Operations.

The actual strategy to be adopted in the case of service disruption will depend upon the location of the disruption and an estimate of how long it will take to be cleared. Minor disruptions will be accommodated within the Tram Regulation process. Longer or more major disruptions may involve a significant re-casting of service. If there are any significant gaps or if the service is interrupted in a particular section of the line for a longer period of time, bus replacement services shall be provided.

12.2 Performance Monitoring System Capability

The whole ETN System will be supervised from the Operation Control Centre (OCC). All tram movements on the System will be automatically logged at key positions. Print outs from this monitoring equipment will be available for analysis any time after the event. In real-time terms specified levels of deviation from the timetable will come up on the screen in the Control Room to draw attention to the fact that a tram is running early or late. The Operations Controller may then take whatever action is considered appropriate to restore punctuality.

The ETN System's internal priority rules for trams shall be developed prior to operations and shall be influenced by the public traffic interfacing arrangements and the tram priority.

12.3 Failure Management

In preparation of the System Performance and Failure Management Analysis the operation design shall allow alternative operation which can be made available. The System shall be designed to support the use of alternatives, including the reversal of operating direction at certain pre-determined locations or breaking points on the lines at turnback locations. These steps shall minimise the impact on passenger service. For this purpose a Degraded Operation Plan (DOP) has to be established by the Operator as a part of the overall operation plan.

The DOP shall have to detail the most effective ways of returning the System to Regular Operations following faults, which are disruptive to passenger service. The plan shall not only consider alternative modes of operation, but also manual intervention that may be required prior to, or in association with, the alternative mode of operation to be employed.

Provisions have to be considered for dealing with system irregularities and accidents with the fixed installations and by the definition of strict procedures to be followed, whereby an effective communication between the Control Room and tram drivers will be essential. Plans of action have to be worked out and should be rehearsed regularly.

12.4 Recovery Strategies

Safety, security and convenience of customers shall be the prime objective of the System design. The duties of the individual members of staff shall be explained in detail in the DOP and the related manuals to be prepared by the Operator.

The objective shall be to minimise the impacts of failures on the whole network and service. Where the service has gone adrift from the timetable, steps will be taken to get the service back to this timetable as quickly as possible. The main target of the recovery strategies shall be to recover normal operation as soon as possible and as far as applicable.

12.5 Stalled Trams

The principal method for recovery of a stalled tram will be the pushing of the broken down tram by the following tram. The tram drivers shall receive instructions from the Operations Controller via radio communication. As far as applicable both the defective and the pushing tram shall move to the next platform where passengers of both trams will be able to disembark.

Considering the total length of both trams two stops of the coupled units will be required for this procedure. Due to the fact that the actual design of the alignment does not provide sidings, the defective tram has to be pushed 'out of service' to the nearest terminal or directly into the Depot.

This procedure will cause a disruption of service due to the fact that both trams may have to pass several tram stops 'out of service' resulting in a confusion of passengers waiting at platforms. Therefore special attention has to be paid to passengers while trams passing the platforms. In the event that the broken down tram, now stabled at one of the Terminals, cannot be repaired locally by the maintenance crew, this vehicle will be transferred to the Depot when the service time is finished.

Generally all operations will take place under the permanent co-ordination of the two tram drivers and the Operations Controller, whereby passengers shall be informed by using the onboard public address system. The detailed procedure will depend on the available communication facilities and the real failure of the stalled tram. Effects on the coupling procedure of both trams caused by the detailed failure and characteristic of line sections shall be explained in the DOP.

12.6 Disembarking of Passengers on Line

Generally, in cases of trams on the line being unable to proceed, where tram drivers must try to keep clear road junctions, the disembarking of a stalled tram on the open line is unavoidable. This might be required in event of loss of primary power supply or any kind of degraded situations, where the tram is unable or not allowed to move.

Since such special type of disembarking will be an extreme measure, the decision shall be made in co-operation between Operations Controller and tram driver, who has to pay special attention to the traffic situation for ensuring the safety of passengers.

To carry out a controlled disembarking of passengers from a disabled tram the following principles shall be observed:

- passengers shall be informed about the situation by the tram driver at all times;
- passengers shall leave the tram on the opposite side to the adjacent track;
- passengers have to be instructed and supported by the tram driver;
- the tram driver will be responsible for the safe disembarking of passengers;
- when the disembarking is caused by a catenary failure near the tram, passengers shall only be allowed to leave the tram after confirmation of power cut by the Engineering Controller.

12.7 Blocked Lines

Should a failure, obstruction, accident or any other exceptional cause stop a tram, the Operations Controller shall immediately inform all trams in the relevant section. The tracks of the relevant line section shall be blocked as far as applicable. With reference to the DOP the required procedures shall be applied.

At least the following tasks will be carried out by the Operations Controller:

- stop of all trams in the relevant section;
- switch–off of traction power if required;
- information of other operational staff and the Operations Manager as required;
- giving necessary instructions.

13 Sub-System Failures

13.1 Signaling

Failures of the remote route settings can be handled by tram drivers by operating points separately via the onboard information transmission equipment. As final redundancy an operating lever for the turnouts will provided on one of the driver cabs of each tram.

13.2 Catenary Failures

In any situation of mechanical disturbances of the catenary the affected section has to be blocked for operations to avoid further damages with possibly more serious impacts on service. The DOP has to be applied as far as applicable.

For the handling of simple catenary failures earthing poles shall be provided onboard of the maintenance vehicles and in the Depot area.

13.3 Electrical Failures

Electrical failures include short-circuits on line and in tram stops will cause the feeding energy to be cut off automatically at the Traction Power Substation (TPSS), while the restoring into operating function has to be done manually. In the event of electrical failures the line section has to be blocked by applying the DOP as mentioned above.

13.4 Traction Power Failures

The design of the traction power supply system, its distribution to the ETN network and the track feeding and sectioning arrangements shall be such as to minimise the effects of any traction power failure. The system shall be able to work without impacts on the operational headway of the ETN System even during outage of any one of the traction substations. Tracks shall be feed separately with traction power - with reference to the track layout at least in segregated corridors - where a bi-directional operation of trams in degraded situations will be feasible.

In the event of a traction power failure the Operations Controller, in conjunction with the Engineering Controller, must assess the situation immediately and put in place the appropriate procedure due to the DOP. The nature, extent and location of the failure will affect the OCC's detailed response, whereby the containment of the effects on service and quick rectification shall be key issues.

13.5 Telecommunications Failures

The tram radio principally is provided for communication between the Operations Controller and tram drivers. If the tram radio fails, the communication shall be maintained by use of mobile phones. As under regular operating conditions, the driver may continue the scheduled journey so that these failures will have no further influence on the service. In the Depot area drivers may also use the provided PABX system.

13.6 Rolling Stock Failures

13.6.1 Door Failures

The following door failures shall to be considered:

- failure to open or close doors,
- failure to lock doors,
- failure to indicate status of doors.

The driver shall lock the defective door and inform the Operations Controller, who shall decide in co-operation with the Engineering Controller when the tram shall be taken out of service for repair.

These failures may result in a decrease of transport capacity and affect passenger convenience.

13.6.2 Communication Failures

When a failure of the public address system on the tram occurs, the tram driver shall operate the tram and the tram borne facilities like doors at tram stops under utmost caution. The tram may, however, continue the scheduled service until relieved by a reserve tram or instructed otherwise.

Generally a tram will be equipped with tram radio sets, each one in one of the driver cab's. In the event that the total radio communication fails, driver's will be able to inform the Operations Controller using mobile phones and continue service as under normal conditions.

13.6.3 Brakes

In the event of a mal-function of the braking system the driver shall inform the Operations Controller immediately and analyse the situation. In the event of a failure of the electric brake the tram can be stopped using mechanical brake only. If the tram driver can restore the brakes to normal, he may continue the scheduled turnaround. Otherwise the tram will have to be taken out of service.

13.6.4 External Lights

Failures of a tram head or tail lights will not affect the safety of passengers and require the tram to be taken out of service, but should be reported to the Control Room. Effects on other public traffic partners shall be considered in detail. A complete failure of the external lights shall require the tram to be taken out of service immediately.

13.6.5 Bogie

The following failures shall be considered:

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- Wheel flats
- Hot boxes
- Brake rigging defect
- Broken axles, bogie frames, springs, hangers, etc.

In case of wheel flats, the tram driver shall check the failure and decide whether the tram may continue in service with full or restricted speed, or shall be withdrawn from service.

Due to the fact that failures of the running gear always bear an operating risk the tram driver shall stop the tram immediately and report to the Control Room. If the tram can be moved safely passengers shall disembark at the next platform. In case the tram cannot be moved under any circumstances, the procedure for disembarking of passengers on the line shall be applied.

The Operations Controller shall decide in co-operation with the Engineering Controller in which way the disabled tram will be transferred to the Depot or a temporary stabling.

13.7 Track Failures

Regular track inspections and maintenance will prevent track failures and their effects on operations. In some cases, rail fractures or other impacts on rail sections may cause a temporary speed restriction until rectification.

In the event that a temporary obstruction of a line section might be required the procedures determined in the DOP shall be applied.

14 Emergencies

14.1 General

Emergency calls may be made to the Control Room from tram or by staff by radio or mobile phone. The Operations Controller supported by the Engineering Controller and the Tram Crew Supervisor shall be responsible for taking quickly first appropriate emergency measures.

In the event of an emergency the safety of passengers shall be of utmost priority. In some events the blocking of both tracks of the affected line section might be required.

Decisions and actions of the Operations Controller will depend on information available from the scene. Especially here the Operations Controller will require the support of the tram divers and the Tram Crew Supervisor for clarification of circumstances and the effects on tramway operation.

Based on the available information the Operations Controller shall decided what action to take, including the involvement of the Emergency Services and the Operations Manager.

14.2 Internal Emergency Response

The Internal Emergency Response shall be organised by the Operator in such a way that every member of staff will have defined duties in the event of incidents, accidents and emergencies. Pre-arranged emergency plans, regulations and other necessary documents shall be prepared and distributed.

The Operations Controller shall assume the responsibility for the emergency response and call internal relief services in the event of incidents or emergencies. Until the Operations Manager or the Tram Crew Supervisor take over the responsibility at site the Operations Controller shall supervise and co-ordinate all activities.

The provided telecommunications facilities will allow immediate communication between the operations staff. Personnel on trams on the line, and other operational staff, will be informed via the radio communications system.

In emergency situations on board of trams, an emergency brake indication system shall inform the driver about the passengers request for an emergency braking, which shall allow the tram driver to decide where to stop the tram.

14.3 Liaison with External Emergency Services

In preparation for accidents, fire alarms or any other dangerous incidents, the Operator shall establish an External Emergency Plan. The Operations Controller shall alert the external emergency services and shall co-ordinate the activities until the Operations Manager will take over the responsibility.

The Emergency Services will be:

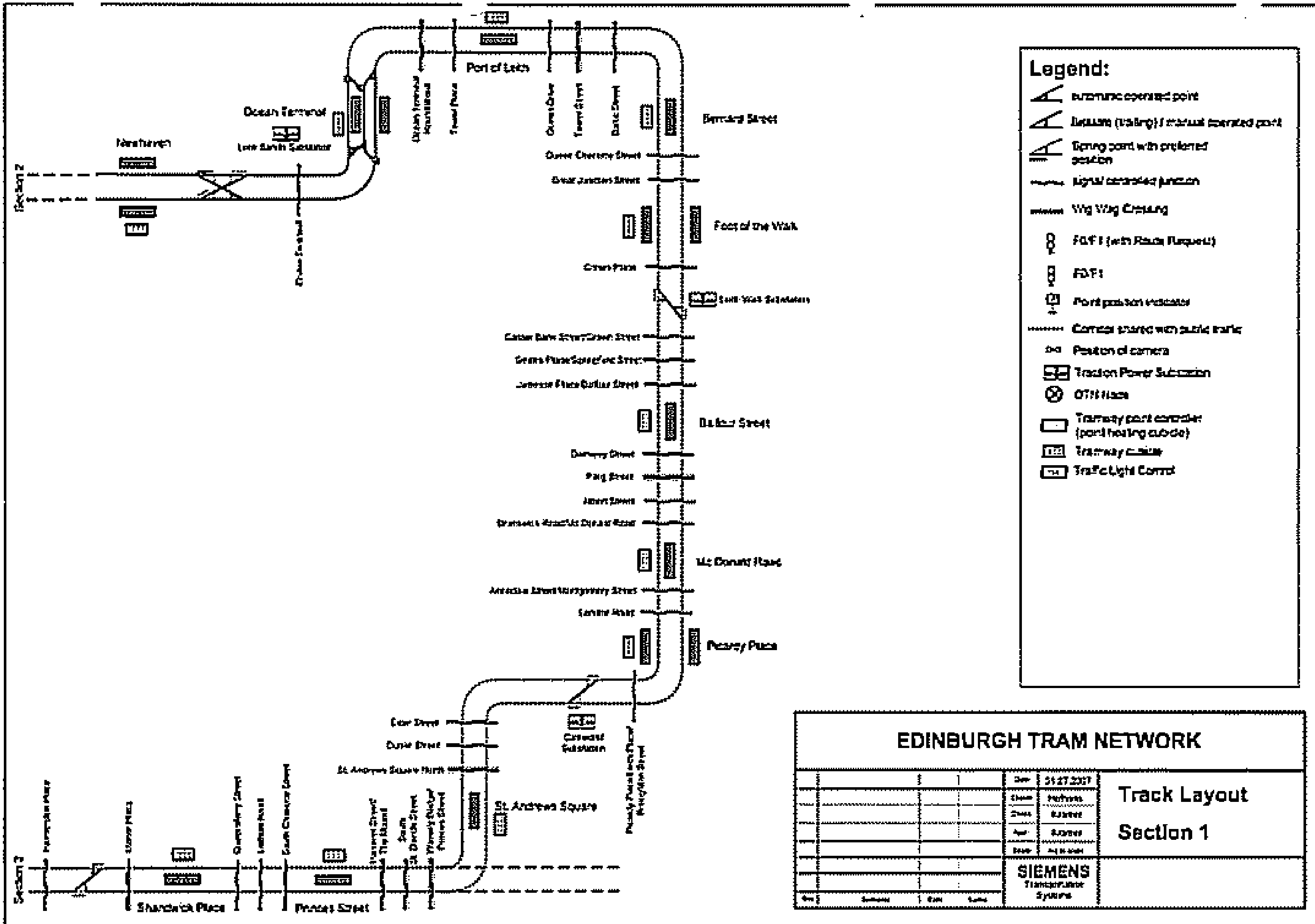
- Fire and rescue services

- Police
- Ambulance services

However, it will also be necessary to have pre-planned arrangements with the power supplier, and road authority.

When operations are disrupted as a result of external factors such as an incident at a road junction, the Operations Controller shall liaise with the responsible agency and decide which action is to be taken. In any of these incidents a checklist prepared by the Operator will give the required support. This list shall contain information about operational measures, influences on or off the system and necessary communications.

Annex 1 Track Layout



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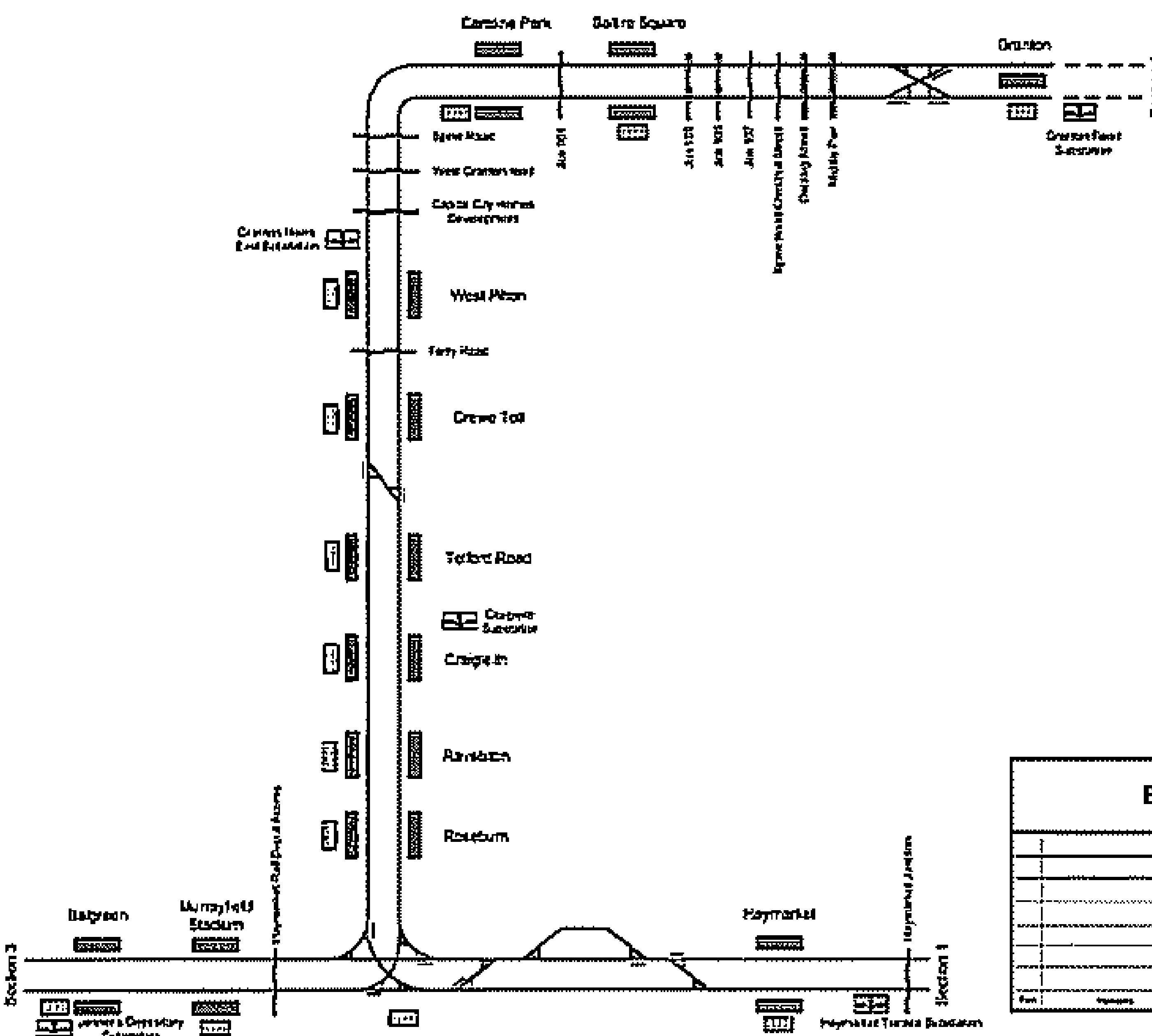

Legend:

- Automatic operated point
- Bistable (trailing) / manual operated point
- Spring point with preferred position
- Signal controlled junction
- Wig Wag Crossing
- FOPI (with Route Request)
- FOPI
- Point position indicator
- Corridor shared with public traffic
- Position of camera
- Traction Power Substation
- OHN Node
- Tramway point controller (point heating cubicle)
- Tramway cubicle
- Traffic Light Control

EDINBURGH TRAM NETWORK

Date	31.07.2007
Drawn	Hofherr
Check	Kramer
Appr	Kramer

Track Layout

Section 2

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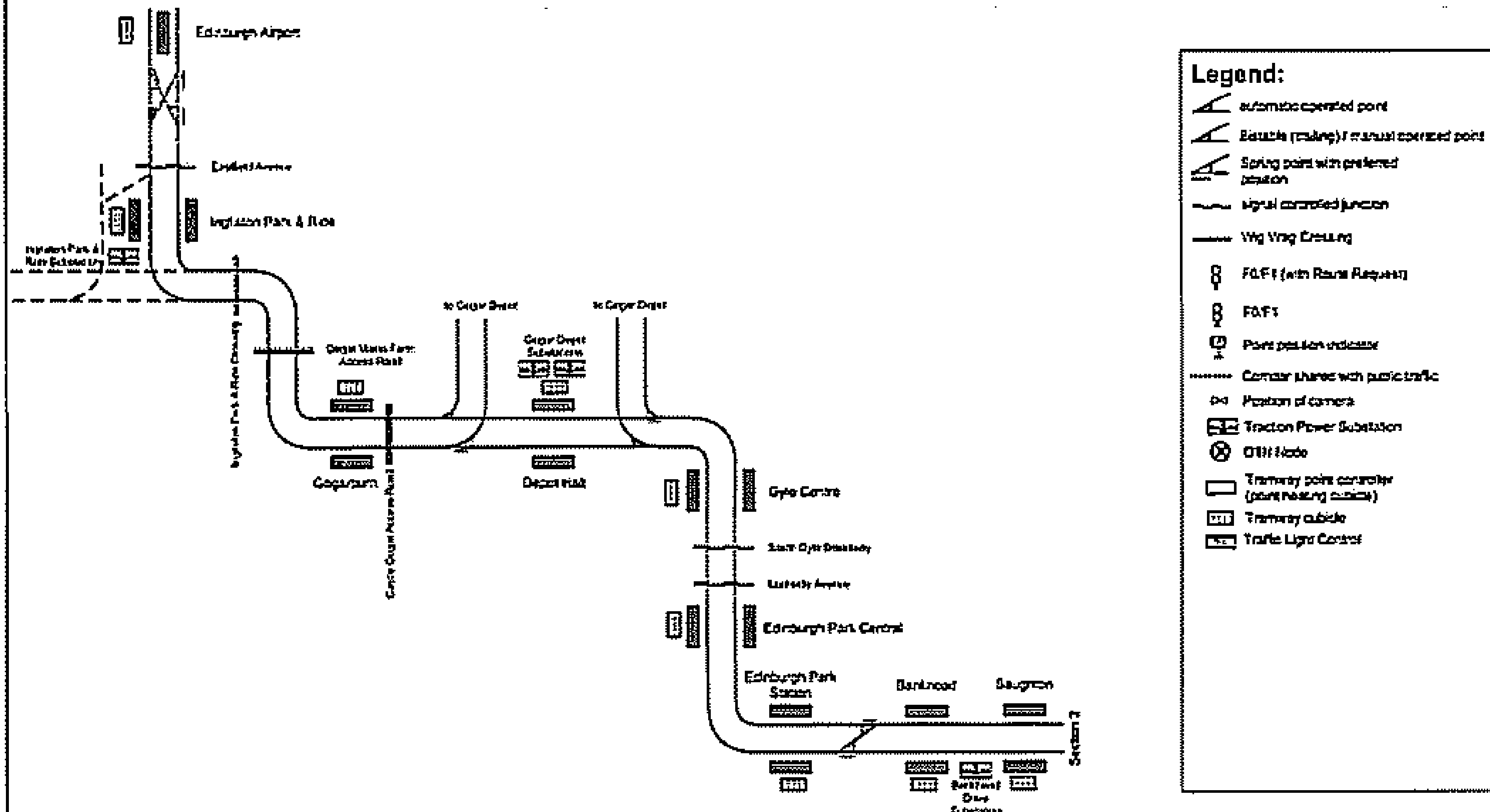
Transportation Systems



EDINBURGH TRAM NETWORK

Track Layout

Section 3

SIEMENS

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31st March 2008 Submission

Edinburgh Tram Network

Section 3: Technical Descriptions

Part 1 – Trackwork Superstructure

Table of Content

1 Introduction

This Document is prepared to provide an overview of the principles of the Design of the Trackwork Superstructure proposed for the Edinburgh Tram Network project.

2 General

The track will be of an economical design which reflects economy of use and maintenance in providing all the functionality required by tie.

The design, implementation and operation of the works will be in accordance with the functional and performance standards and limits specified in this document.

The following standards and regulations will be used:

- ISO International Organization for Standardisation
- UIC International Union of Railway
- EN European Standards
- VDV Verband Deutscher Verkehrsbetriebe (Association of German Transport Services)
- DIN (Deutsche Industrienorm – German Industry Norm)

Local specific requirements, practical and efficient will be observed.

2.1 Trackforms

Various trackforms are required to suit the different domains in which the track lies along the route and in the Depot and sidings. The different trackforms provided will comprise, but not necessarily be limited to:

- Street running track (System Rheda City);
- Grass track (System Rheda City);
- Direct fixation track (single fastening points);
- Ballasted track; and
- Special trackforms in the depot or at tramstops.

2.2 Track Alignment

The line comprises

- the tracks as shown in the ETN Track Layout_20080222 ,
- the stabling tracks and workshop tracks within the depot area as given in drawing ULE90130-06-DEP-00001 Version 7.

Due consideration shall be given to sight lines and clearances to existing infrastructure, in accordance with the Railway Safety Principles and Guidance and with the requirements of the developed kinematical envelope.

In all cases implemented solution shall take due cognizance of the interface with the party responsible for the Rolling Stock.

Track Alignment and Geometry criteria are contained in tables 1-1 to 1-18 (see Employer's Requirements, chapter "Track, Track Alignment and Geometry").

The tolerances in respect to the acceptance of the tracks will be in line with Trackwork Specification ULE90130-SW-SPN-00050 V3.

3 Track, Technical Description

The trackwork shall take account of the interaction with the tram and its running gear (wheel / rail interface), the need to meet the specified track installation and maintenance acceptance criteria and whole life cost assessment, reliability, availability maintainability, safety, operational, maintenance and spares requirements.

Track shall be a standard tramway track with steel rails set to standard gauge (1.435m).

Earthing will follow the overall earthing philosophy as layed down in the systems Earthing & Bonding Concept.

In order to minimise stray current, the rail insulation versus earth has to be of high quality.

The rail to earth resistance is defined as given in EN 50122-2.

The conductance per unit length between the running rail and earth or structure earth shall be low.

EN 50122-2 recommends values for the conductance per unit length between running rails and earth or structure earth of a single track for design purposes. The specified values are

- 0.5 S/km for open formation in open air (this corresponds to 2 W·km),
- 2.5 S/km for closed formation in open air.

The clean initial track shall be tested for finding of possible installation faults e.g. random connection of fixation screw of running rail to reinforcement. Following values are recommended:

- Conductivity G of initial test of single track shall be about G <= 0.1 S/km instead of < 0.5 S/km in open air according to EN 50122-2.
- Conductivity G of initial test of single track shall be about G <= 1 S/km instead of < 2.5 S/km in closed formation according to EN 50122-2.

Thus additional mats or collector bars in embedded trackforms for stray current protection are not necessary.

3.1 Trackforms

3.1.1 Embedded Track

On shared rights of way a safe passage of road vehicles and pedestrians has to be guaranteed, slab track with grooved rail, embedded in the road pavement will be applied.

The advantages of trams in local traffic, such as economy and environmental friendliness have always been recognised. In a period of increased environmental awareness appropriate vibration damping, track bedding and optimising compatibility between permanent way design and the vehicles deployed are of major importance.

In this respect the requirements of the Noise & Vibration Policy (Edinburgh Tram Network Operations) shall be the basis for the design of the track forms.

The embedded track constructions are characterized by dependences of the track layout. For the warranty of a high track quality and reliability, the installation of a slab track system is recommendable, such as RHEDA CITY.

RHEDA CITY System is optimized, modifiable and customized ballastless track system for different boundary alignment conditions. As an example for using on an embankment, in tunnel sections or integrated into existing traffic flows like buses or cars, RHEDA CITY could be adapted for all alignment specifications and can be covered with various layers like asphalt, concrete, grass vegetation or paving material.

Typical requirements and specifications for tram tracks, fulfilled by RHEDA CITY are:

- Simple and transparent system structure
- Modifiability and adaptability for different track requirements
- Elastic support of the rails
- Durability of quality
- Flawless of the track parameters: gauge and track geometry
- Low maintenance
- High availability and increased service life

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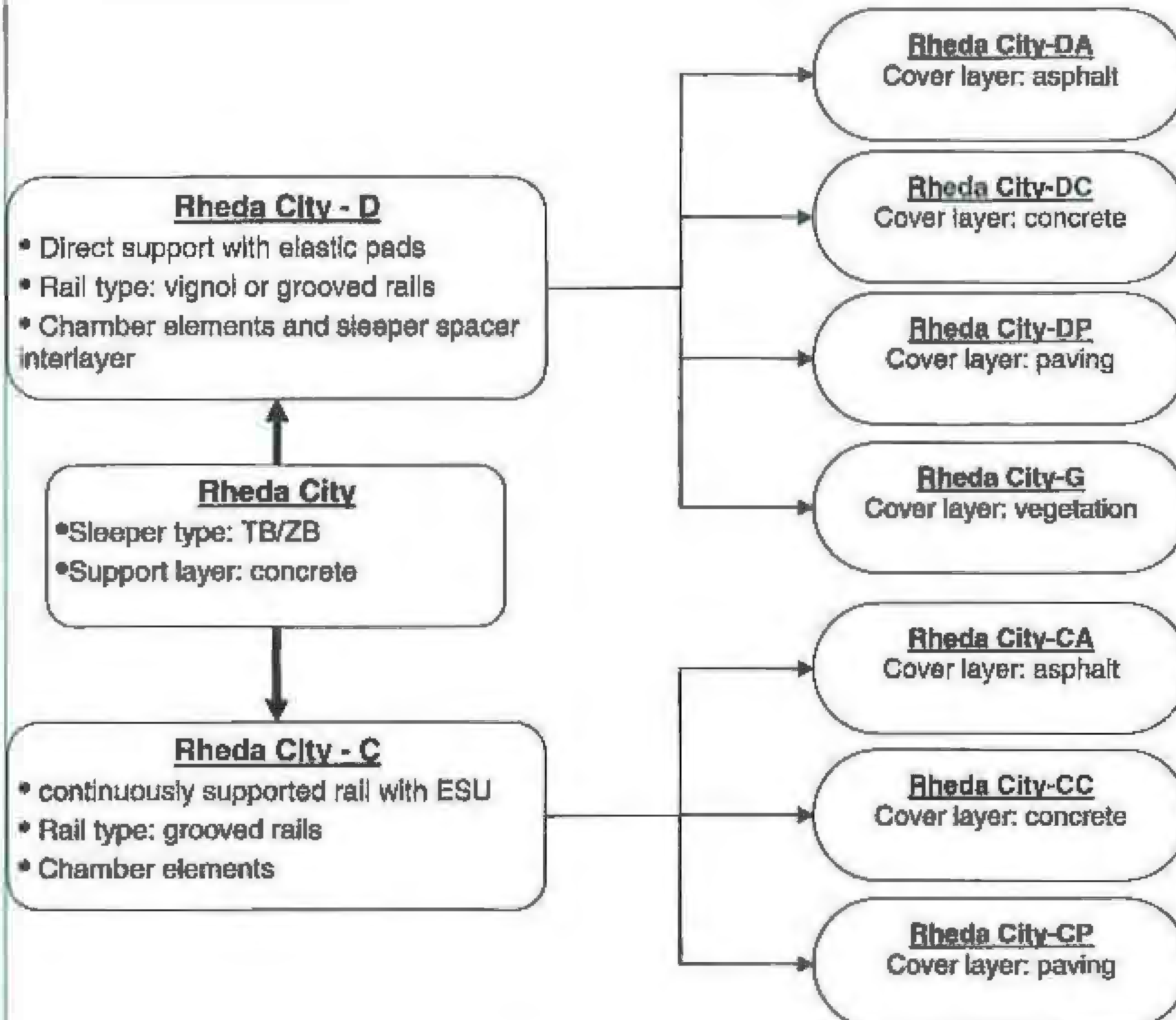
- Electrical insulation of the rails against stray currents
- Minimization of structure-born noise
- Components shall be recyclable.

3.1.1.1 Classification of the RHEDA CITY family

RHEDA CITY is characterized by a simple structural technology: modified bi-block sleepers are installed and guarantee a precise track gauge at the same time.

3.1.1.2 System structure

RHEDA CITY system consists of modified concrete bi-block sleepers concreted into place with lattice girders, to form a monolithic concrete track-supporting layer. The result here, depending on the track model, is either a system of elastic point support, or alternative a continuously elastically supported track. Means basically there exists two different basic approaches of RHEDA CITY systems: rail support on discrete supporting points „RHEDA CITY-D" (D = Discrete Supported Rail) and continuously supported rails „RHEDA CITY-C" (C = Continuous Supported Rail). Both construction principles will be described in detail:



Primary function of the slab track system is a safe transfer of the loads due to the track vehicles and road traffic into the sub-soil. In consequence of the rail deflection the loading cases will distributed on supporting points (RHEDA CITY -D) or onto the area of the bottom of the rails (RHEDA CITY -C). In the case of using supporting points, the vertical deflection of the rail is feasible by using of defined elastic rail pads. In the latter case of a continuously support system, by using of an elastically rail flange sheathing (ESU). The sleepers function as a connection between the rail fasteners and the supporting layer.

On straight lines will be implemented the Rheda City C-type, while on curves with a radius less than 100 m Rheda City D-type will be used.

For Green Track Rheda City G-type will be used.

The thickness of the concrete slab containing the sleepers will be 23 cm for Edinburgh Tram resulting in a total dimension of 40 cm from top of rail to formation. The deformation or stiffness modulus at formation will be in

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off street sections E_{v2} (stiffness) = 80 MN/m² and in on street section E_{v2} (stiffness) = 120 MN/m².

3.1.1.3 RHEDA CITY -C

In the present case that the rail is not mounted on a specific number of supporting points, but consistent on the total track length, this system is defined as a continuously supported rail. Hereby the sleeper takes over the function of a temporary tie rod during the track installation. For this kind of support, instead of the spring coefficient, the bedding modulus is the characteristic parameter for the design of the slab track. The sleeper intervals are set within 1.5 m. For an easier re-railing in curves < 100 m RHEDA CITY-D with sleeper intervals of 0.75 m. will be installed.

Due to the fact that the joint between the rail and the road surface will be critical, special attention will be paid to the specific requirements.

Picture: continuously supported rail

1 grooved rail
3 chamber elements a) outside b) inside
5 adjustment bolts
7 cover layer
9 concrete supporting layer

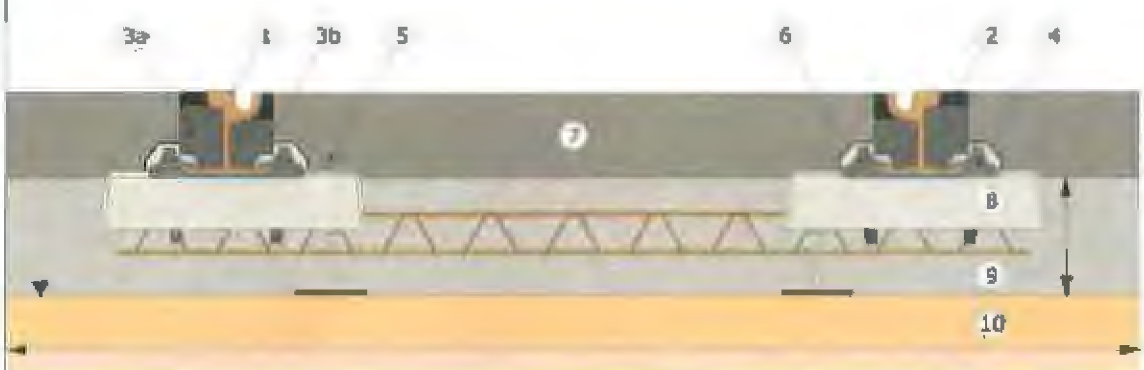
2 rail joint sealing compound
4 gauge and clamping profile, incl. ESU
6 caps (optional)
8 sleeper type TB/ZB
10. Intermediate layer (if applicable)

Picture: cross section RHEDA CITY –C, embedded in ESU

3.1.1.4 RHEDA CITY -D

In the present case of a discrete supporting rail, the rails will punctually fix over the range of the sleepers. Generally the sleeper interval is set to 0.75 m. The deflection of the rails results on the stiffness of the used elastic pads (Zw). As a characteristic parameter, the spring stiffness of the elastic pads under the rails is defined.

Picture: discrete supporting points (green marks)



1 grooved rail
2 rail joint sealing compound
3 chamber elements a) outside b) inside
4 rail fastening system K-W25 incl. Zw
5 adjustment bolts
6 caps (optional)
7 cover layer
8 sleeper type TB/ZB
9 concrete supporting layer
10 intermediate layer (if applicable)

Picture: cross section RHEDA CITY –D, supported on elastic rail pads Zw

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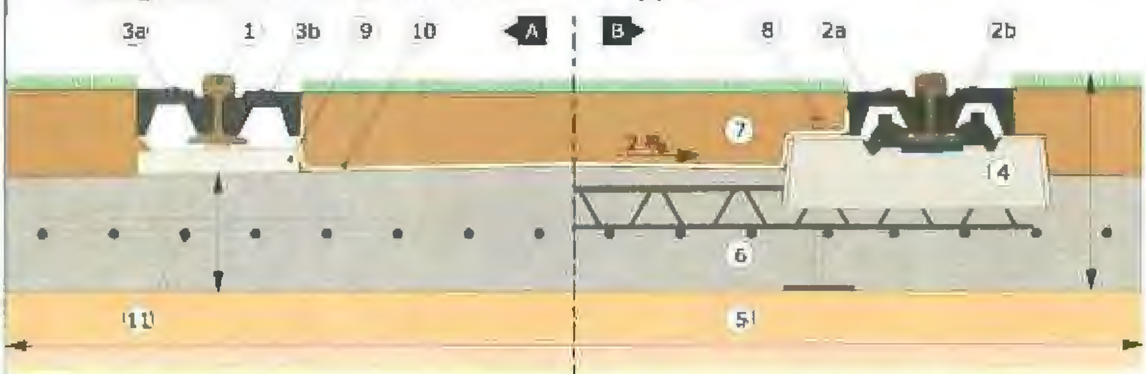
3.1.1.5 Grass Track (Rheda City – G)

The picture below shows a typically core cross section for green tracks. Because of the system components (chamber elements, fleece and elastically supported pads between the sleepers) the direct contact of the cover material (e.g. humus) and the rails is prevented. This includes also an effective electrical isolation against stray currents. Fleece (membrane) will be applied across the total double track formation.

Longitudinal reinforcement will not be applied.



1 vignol rail
2 rail fasteners a) W14 b) eZw
3 chamber elements a) outside b) inside
4 sleeper type TB/ZB
5. intermediate layer (if applicable)
6 concrete supporting layer
7 vegetation cover layer (e.g. grass)
8 adjustment bolts
9 elastically supported pads between the sleeper
10 fleece (if applicable)
11 longitudinal reinforcement (if applicable)

Picture: cross section RHEDA CITY–G

3.1.1.6 Floating Slab (Rheda City)

As a measure to mitigate significant noise impacts for residents and other noise sensitive receivers in the vicinity of the routes, a floating slab construction could be applied. Noise sensitive receivers like dwellings, schools, libraries, hospitals, theatres and concert halls, and places of worship currently bordering the route are not yet defined and has not been included in this proposal. However it should be noted that a minimum length of an installation will be around 120 meters.
An appropriate stiffness characteristic will be determined for each installation.

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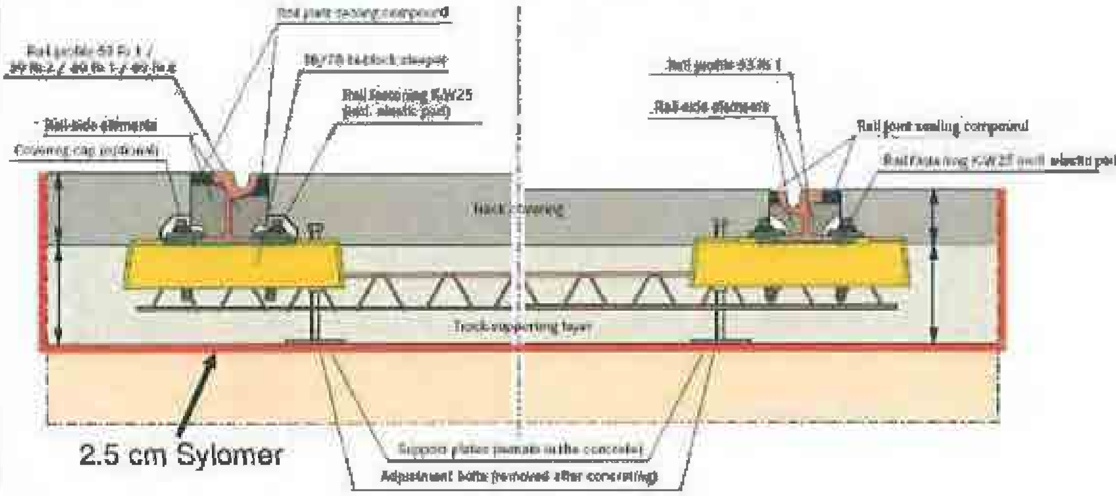


3.1.1.7 Installation sequence (Rheda City)

The basically construction steps for the system Rheda City will described in the following in detail. In all system variants, the system construction will be done in top-down. By this construction method the top of the rail is used as a reference point for the surveying and installation of the track components. In a result, inadvertent tolerances during the construction of the single layers got no effect to the exactness of the gauge and the positioning of the track.

The track slab will be installed as a cast concrete slab in one construction step with a thickness of 23 cm instead of 25 cm for the project Edinburgh with rail type Ri59. This reduction is possible when concrete with a strength category of C30/37 will be used. Because of the designed track, generally the track slab should not drop below the width of 240 cm. In the case of crowded clearances it is possible to modify the measurements of the slab track. Only in this case, a constructive reinforcement on the slab track sides is recommendable.

1. Checking the substructure supplied by the civil contractor.

   This will be done by testing the formation, examining the survey-data and a visual and physical inspection of the provided substructure. The relevant value of E_{v2} (stiffness) is subject to the final development of the track design and confirmation by the SDS before commencing of works.

2. Positioning of the bi-block sleepers

   The bi-block sleepers will be laid in the given intervals on the ready installed frost protection layer.

3. Assembling of the elastic rail flange sheathing (ESU)

   The rails will be fit in with the elastic rail flange sheathing.

4. Installation of the rails

After this, the rails are laid in the middle of the sleeper support.

5. Installation of the chamber elements

   The chamber elements are pushed in or glued in manually or with pneumatic machines into the rail chambers.

6. Track adjustment and surveying

   For the rough track adjustment the adjustment bolts are to be screw down to shifting the track into the exact vertical position. The track position will be monitored with normally reflectors and Tachymeter. The final adjustment will be done by use of the adjustment screws to the data of the surveying. After reaching the exact position the track must be fixed by using of different solutions.

7. Performing a final survey on the track and checking if all requirements are met with a formal acceptance of this part of the superstructure

8. Concreting of the track slab

   The concrete will be poured in and vibrated step by step for each sleeper panel. After reaching the required strength in the concrete slab, the covering or rail service can start.

9. Finish the installation by covering the slab track with various layers like asphalt, concrete, grass vegetation or paving material.

10. Handover of documents regarding this piece of track.

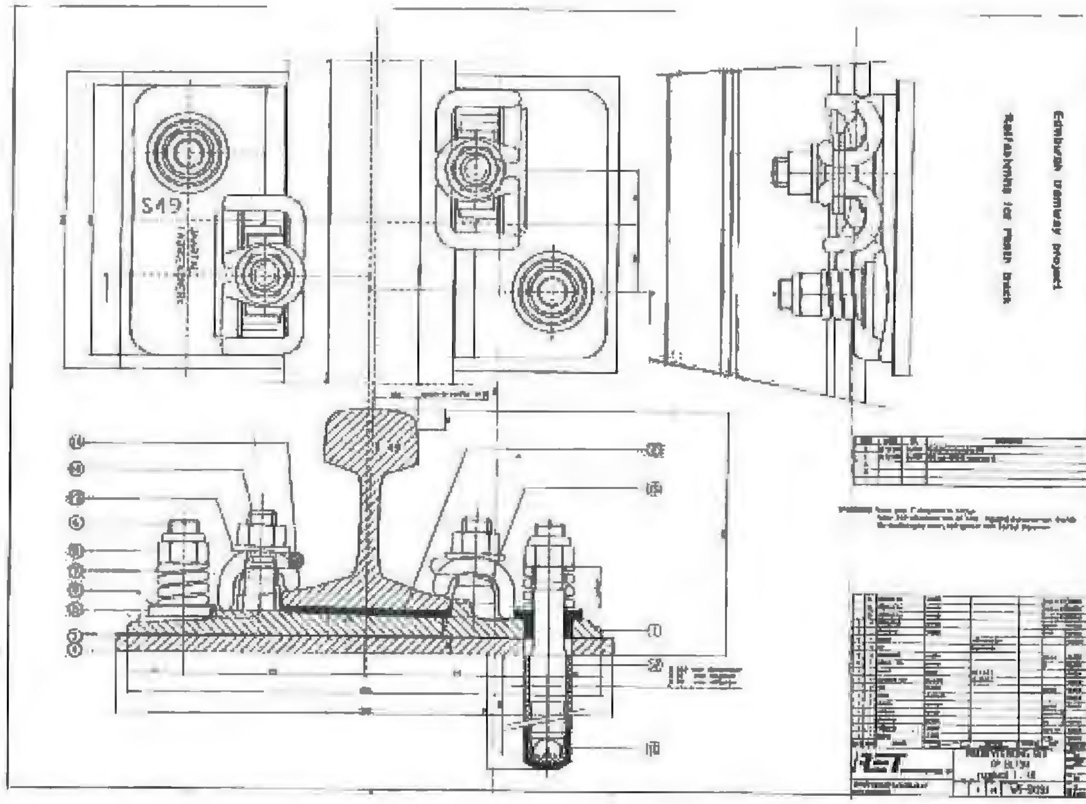
3.1.2 Direct Fixation Track

The track sections on structures shall be constructed as a non-ballasted system.

Ribbed base plates will be placed directly to the structure at all sections with exposed rails as mentioned in the drawings mentioned under "2.2 Track Alignment".

The existing guided bus way is assumed to be capable for a Tram system in terms of alignment, tolerances and bearing capacity. Adjustments in terms of grouting of the structure at it's surface may become necessary to meet the alignment criteria. The selection of grouting material will be subject to approval. It is assumed that coring of fixings into the guided bus way concrete is possible.

Additionally, an up-stand projection shall be incorporated as guard during derailment. This up-stand will be incorporated in the body of the structure.



Fixing for slab tracks

In addition to the characteristics of the VOSSLOH tension clamps like:

- Permanent continuous clamping of the rail
- Tilting (rotation) protection
- Simple distressing and replaceability of rails,

some further features are significant for the fastening system:

- Rail movements caused by pressure from the moving wheels are elastically cushioned such that reduction of both, transmission of vibration to the concrete and structure borne noise to the foundations of adjacent buildings can be mitigated.
- Gauge and cross level regulations of the rail can be adjusted to height and laterally to the requirements during the installation.

For the DC traction power system, the track needs to be electrically insulated. The steel parts of the track will be separated from the concrete by installation of insulating Bush Fbus and elastomeric pads with insulation shims. No additional insulator between tension clamps and rail foot is necessary.

SIEMENS

The shown system may be changed or adopted due to the findings made during the design phases, but will have equivalent features. As a result of these design activities and the cost efficiency, fastening systems by Pandrol or other suppliers may be used.

Installation sequence:

1. Checking the substructure supplied by the civil contractor. This will be done by examining the survey-data and a visual and physical inspection of the provided substructure. Special care is to be taken in checking the height of the concrete where the base plates are to be mounted.

2. Formal acceptance of (parts) of the substructure.

3. Checking if all measurements have been taken to ensure a safe working-environment.

4. Constructing slab-track. The main steps in this are:
   a. Determining the exact location of the anchors;
   b. Drilling holes for the anchors;
   c. Glueing the anchors and mounting the baseplates while checking the gauge and the alignment;
   d. Welding the rails;
   e. Mounting the rails on to the baseplates;
   f. Finetuning the rail-height by using metal plates under the baseplate (if necessary).

5. Performing a survey on the track and checking if all requirements are met.

6. Handover of documents regarding this piece of track.

7. Formal acceptance of this part of the superstructure.

3.1.3 Ballasted Track

The ballasted track is the most simple and in terms of initial costs most effective type of super-structure.

The ballasted track is a proven technology and it is commonly used in major railway systems world-wide. The tracks are installed on sleepers so as to keep the rails at the correct distance apart (the gauge) and to support the weight of trains. The sleepers conventionally are made of wood or pre-stressed concrete. The sleepers are placed in a layer of ballast.

Ballast is provided to give support, load transfer and drainage to the track and thereby keep water away from the rails and sleepers. Ballast must support the weight of the track and the considerable cyclic loading of passing trains. Ballast is made up of hard rocks and should be rough in shape to improve the locking of stones.

Figure: Example for Ballasted Track

3.1.3.1 Ballast

The wheel of the vehicle transmits horizontal and vertical loads towards the track. Additionally longitudinal loads resulting from the continuously welded rails come into account due to changes of the air-temperature. All these loads are transmitted via the rails and the sleepers to the ballast layer. The ballast transfers these loads via the sub-ballast layer (made of sand) to the sub-structure. In order to achieve a good transmission of the operational loads to the sub-structure, the thickness of the ballast should be as high as possible. For urban traffic a thickness of 20 cm (measured under the sleeper at the not canted rail) is the minimum value. This is to avoid an addition of the pressure transmitted by two adjacent sleepers. The following aspects are crucial to assure a track of high quality:

- quality of ballast
- installation procedure
- homogeneity of ballast.

A tamping of the ballast in layers with modern tamping machines will cause a higher stability of the track.

The ballast material is made of broken and sieved natural rock and has to fulfil the requirements as follow:

weather resistance (proven with freeze/thaw-test)

SIEMENS

durability (proven in drum mill)

- resistance against pressure (proven by compression or impact tests)
- no contents of organic materials, clay etc.
- shape of the stones shall be cubically and sharp-edged

The ballast used will be according European standards and will meet the requirements of a Tram system.

3.1.3.2 Sleepers and Fastenings

Pre-stressed mono-block concrete sleepers form the support for the ballasted track.

The sleeper carries both the loads of the vehicle and keeps the right gauge. It has to transfer the loads transmitted by the rail into the ballast and must have sufficient contact surface in order to avoid an overstress at the formation.

It transmits the

- horizontal forces resulting from the rolling of the vehicle rectangular to the track
- centrifugal forces in curves
- longitudinal breaking and accelerating forces
- longitudinal and buckling forces due to temperature caused stresses and strains of the continuously welded rails

The forces rectangular to the track will be taken by the typical shape of the sleeper. This ability is called breadth displacement resistance.

The sleepers are used on ballasted track and designed for load characteristics consistent with the design of the passenger and service vehicles and with the performance requirements of the system.

Figure: Example of Concrete Sleepers

The pre-stressed mono-block sleepers have a length of 2.400 mm or 2.600 mm. Four or more pre-stressing tendons will effect the tension. The reinforcement will be located uniformly. Every tendon shall be loaded with an equal force.

The surface supporting the rail will be inclined towards the track axis. As rail fixation the Vossloh W14 fastening is an appropriate solution. Plastic dowels will assure the connection of the fastenings to the sleeper. The dowels will not be canted or distorted and are removable.

The shown system may be changed or adopted due to the findings made during the design phases, but will have equivalent features. As a result of these design activities and the cost efficiency, fastening systems by Pandrol or other suppliers may be used.

Figure: Fastening for Concrete Sleeper

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The rail fastening is an elastic system, which is capable of attenuation of rail borne vibrations. This consists of two parts:

- the elastomeric pad,
- the elastic fastening.

The rail rests directly on the concrete sleeper with only a plastic pad in between. The position of the rail is fixed by plastic angled guide plates. Positive permanent tightening between rail and sleeper is achieved by using tension clamps. Sleeper screws are inserted in plastic dowels, which have been preassembled while fabricated into the concrete sleeper.

3.1.3.3 Wooden Sleepers and Fastenings

Wooden sleepers and ballasted track is also a common combination in track-laying. These sleepers are hardwood-made (e.g. oak) and capable for recreation, when worn-out. The sleepers are impregnated against rottenness and parasitic infestation.

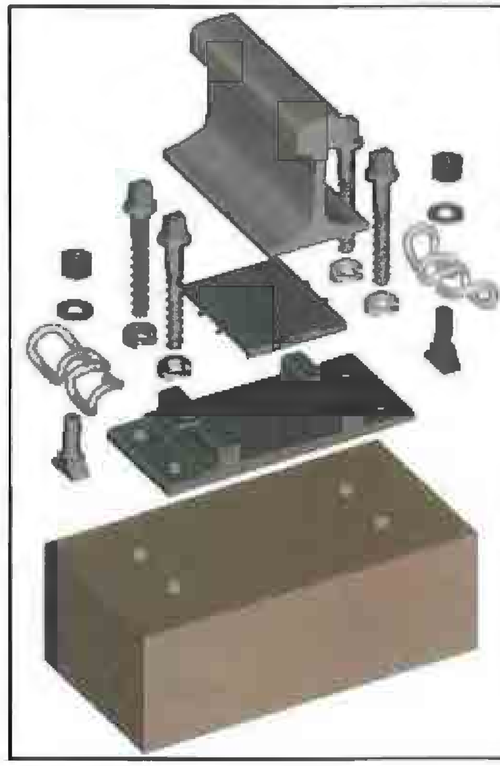
Wooden sleepers may be applied only at sections with turnouts or other special track components.

Wooden Sleepers

The sleepers will be designed for load characteristics consistent with the design of the passenger and service vehicles and with the performance requirements of the system. For increasing the horizontal track stability, sleeper anchors can be used.

The fastening system ensures permanent tension by means of elastic spring clips. All fastening components are already preassembled onto the sleeper, so the complete sleeper can be laid mechanically.

For quick replacement of the rail, tension clamps are easy to remove in preassembled position.



The shown system may be changed or adopted due to the findings made during the design phases, but will have equivalent features. As a result of these design activities and the cost efficiency, fastening systems by Pandrol or other suppliers may be used.

3.1.3.4 Ballast Track Methodology

1. Checking the sub layer of ballast supplied by the civil contractor. This will be done by examining the survey-data on excavation and -after filling and compacting, including a visual and physical inspection of the provided ballast layer.
2. Formal acceptance of (parts) of the substructure.
3. Checking if all measurements have been taken to ensure a safe working-environment
4. Constructing ballast-track. The main steps in this are:
    a. Building the turnouts;
    b. Putting the sleepers in position;
    c. Mounting the rail;
    d. Welding of the rail;
    e. Tamping the track.
5. Performing a survey on the track and turnouts and checking if all requirements are met.
6. Handover of documents regarding this piece of track.
7. Formal acceptance of this part of the superstructure.

3.1.3.5 Road Crossings

According to document ULE90130-SW-SPN-00050 V3, three at-grade crossings with panels are required. These panels will cover the ballast with a non electrically conductive material.

3.1.3.6 Re-railment platforms

In the depot area 9 turnouts and 1 crossing are foreseen with wooden flush finish for re-railment purposes.

3.1.4 Special Trackforms

For the tracks inside the workshops, special trackwork systems are required. Embedded track systems are foreseen for areas in which trains as well as cars, forklifts or similar vehicles shall be able to cross or pedestrians shall be able to walk safe. Some areas of the workshop are equipped with pits in order to enable access under the trains.

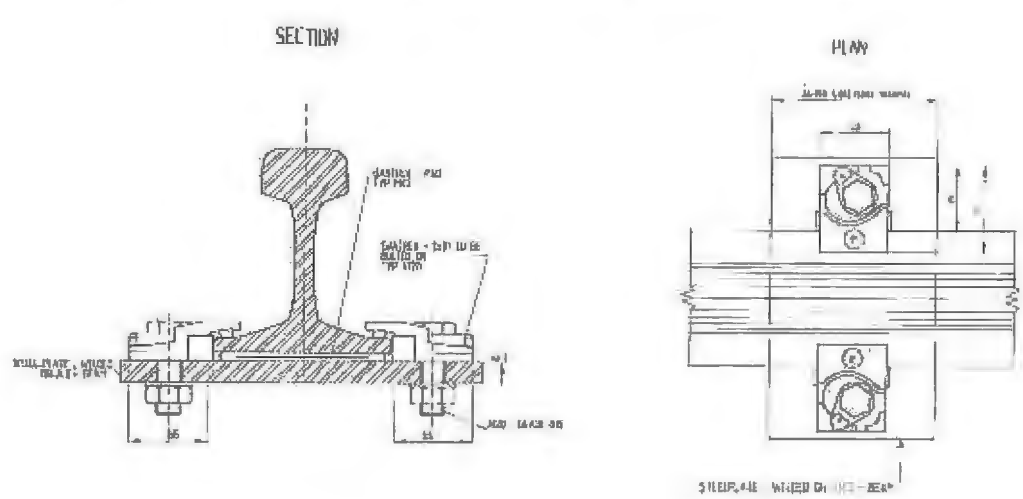
Special solutions, e. g. for the train washing plant, will be defined during the detailed design of the trackwork.

Embedded Tracks

The embedded tracks will be constructed in the workshop area. They will be incorporated in a reinforced concrete floor base. The rails will be installed in a rectangular recess in the floor base and casted in with grout.

Pit Tracks

Inside the pits the rails will be installed on columns or aprons (steel or concrete). For this purpose, special fastenings will be used.



Example for special fastenings on columns/aprons

3.2 Rails

The maximum length of the rails will be 18.00 m.

Flat bottom rails with a radius of less then 100.00 m and grooved rails with a radius of less than 500 m shall be pre-curved in factory or on site.

All welds will be alumino-thermic welds and tested ultrasonically. Particular attention will be given to the dressing of the weld area. Track in depot will be fishplated.

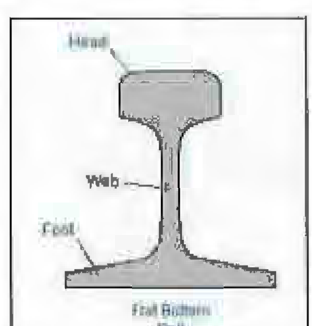
The standard rail in embedded track is of type 60R2 as stated in 3.2.2. All rails in ballasted tracks, plinth tracks, green tracks and in the depot and storage yard will be of type S 49E1.

All rails will be of a hardness of 700, except turnouts and crossings. These rails will be of a hardness of 900.

Guard rails will be applied over 200 m of the line adjacent to steep embankment alongside Murrayfield Stadium as required in document ULE90130-SW-SCH-00085 V1.

3.2.1 Standard Flat Bottom Rails 49 E1

The standard form of rail used around the world is the "flat bottom" rail. It has a wide base or "foot" and narrower top or "head".

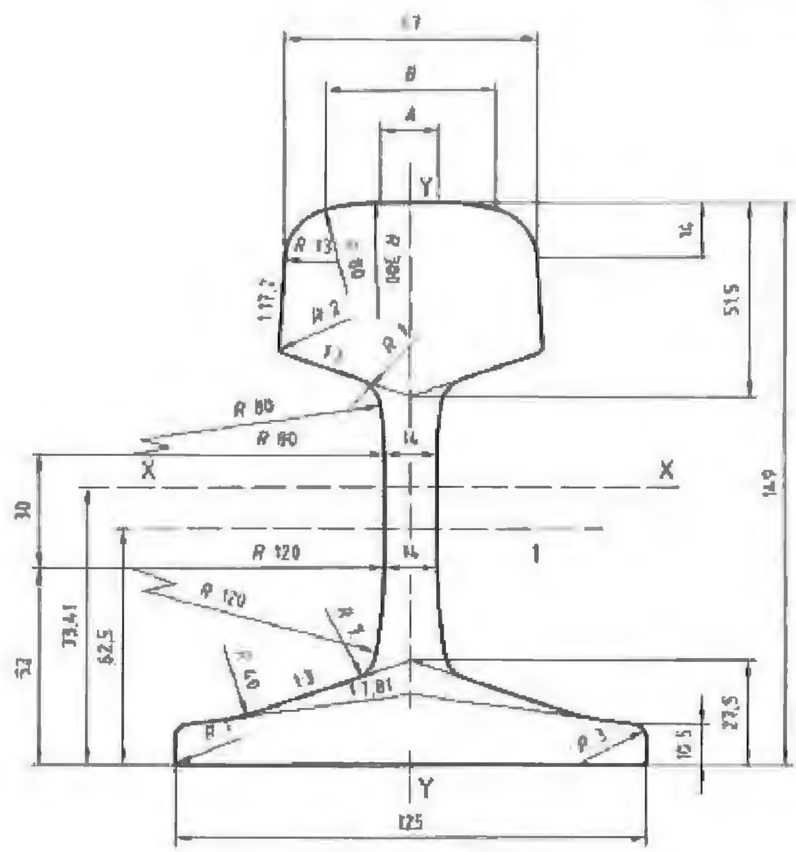


Rails are named according their weight per meter (for instance 49 E 1 = app. 49 kg/m).

During the manufacturing process the rails were rolled. In modern rolling mills the rails will be rolled in lengths of up to 120 m. For a better transport the rails after rolling are cut into pieces of 18 m or longer.

The standard EN 13674-1 is valid for the supply of the rails.

Dimensions in millimetres



Key

1 Centre line of branding

Cross-sectional area	62,92	cm^2
Mass per metre	49,39	kg/m
Moment of inertia x-x axis	1816	cm^4
Section modulus - Head	240,3	cm^3
Section modulus - Base	247,5	cm^3
Moment of inertia y-y axis	319,1	cm^4
Section modulus y-y axis	51,0	cm^3

Indicative dimensions ; A = 15,267 mm
B = 46,535 mm

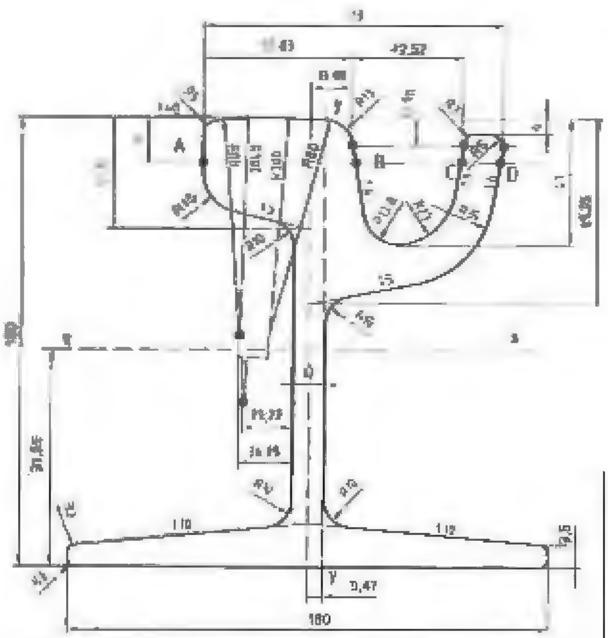
Figure: Rail Profile 49 E 1

3.2.2 Grooved Rail 60 R2

In the embedded track sections the 60R2 grooved rail is proposed to be used. The design is based on European standards. The rail head section matches the 49E1 rail head section.

The further development of the wheel/rail interface study will define where local modification of the rail to a wider groove (59R2) might be required.

Dimensions in millimetres



H	AB	BC	CD
8	54,40	44,52	13,57
10	54,97	43,88	14,08
14	56,00	42,17	14,39

Cross-sectional area 74,07 cm²
Linear mass 58,14 kg/m
Moment of inertia I_x: 3210,8 cm⁴
Moment of inertia I_y: 75,7 cm⁴
Section modulus W_x: 350,5 cm³
Section modulus W_x: 363,1 cm³
Section modulus W_y: 61,7 cm³
Section modulus W_{yr}: 103,6 cm³

Figure: Rail Profile 59R2

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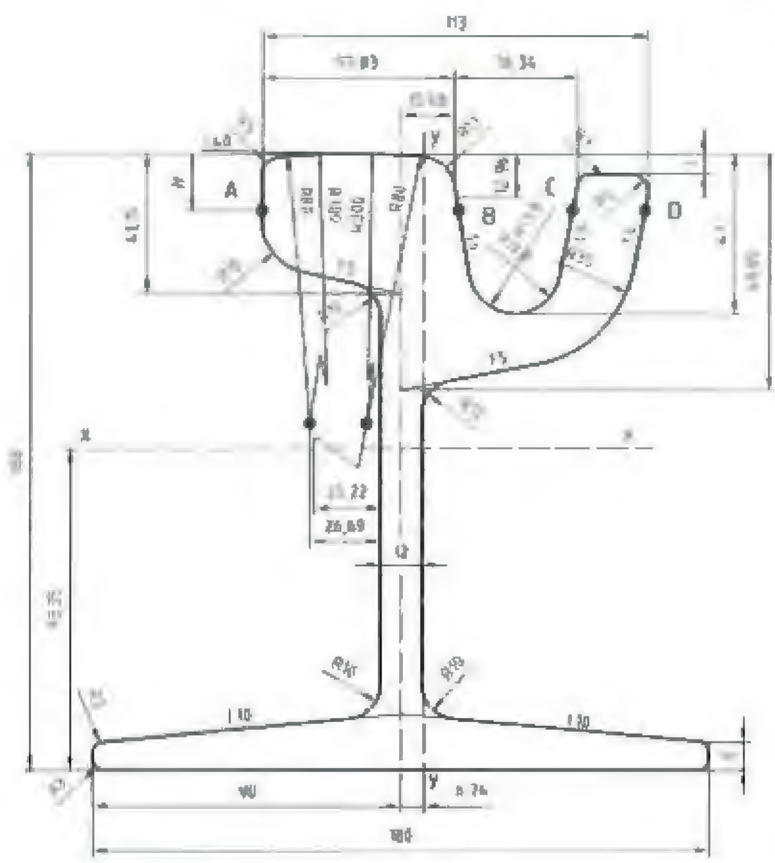
Maße in Millimeter



H	AB	BC	CD
6	54,40	39,34	19,75
10	54,97	37,70	20,24
14	56,00	36,00	20,57

Querschnittsfläche: 76,11 cm²
Längenbezogene Masse: 59,75 kg/m
Trägheitsmoment I_{xx} 3 296,1 cm⁴
Trägheitsmoment I_{yy} 920,1 cm⁴
Widerstandsmoment W_{xl} 353,3 cm³
Widerstandsmoment W_{xk} 380,6 cm³
Widerstandsmoment W_{yk} 95,1 cm³
Widerstandsmoment W_{ylk} 110,5 cm³

Figure: Rail Profile 60R2

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3.3 Turnouts and crossings

The turnouts and crossings applied for the LRT Edinburgh project are used to allow dividing a track into a diverting position to connect two routes or to provide changeover and crossing facilities for the rolling stock.

A typical turnout consists of the following components (please note Fig. hereto):

turnout switch section (1);

straight stock rail (1.1);

curved stock rail (1.2);

curved switch rail (1.3);

straight switch rail (1.4);

intermediate section (2);

straight intermediate rail (2.1) and (2.3);

curved intermediate rail (2.2) and (2.4);

frog section (3);

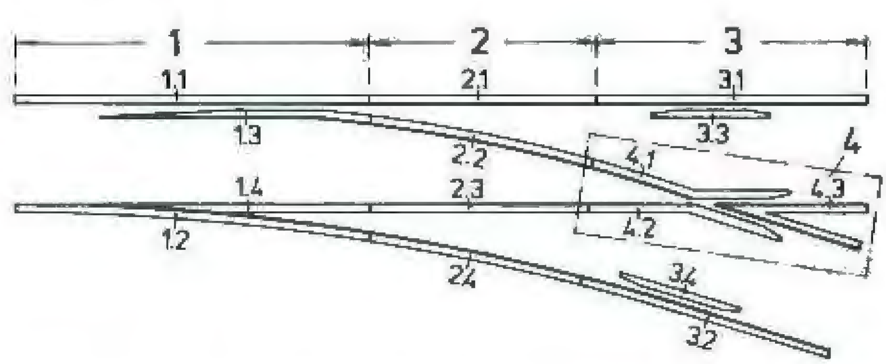
running rails opposite check rails (3.1) and (3.2);

check rails (3.3) and (3.4);

frog (4);

wing rails (4.1) and (4.2);

diamond (4.3).



For further information regarding turnouts please refer to Annexes 1(TS070015) and 2 (VAE_GRturnouts_en).

Definition of turnout types required – suitable for tamway operation!!

Scope of Supply

The scope of supply include switch and stock rail assemblies, frog, check rails, intermediate and closure rails, plates and fastening material.

Marking

To ease installation on site the turnout components that belong together are marked with paint and a particular turnout number before they are shipped. They are packed and supplied in suitable lots.

Storage

The switch devices as well as all other bundles shall be stored on a dry and level area. Parts should be supported by suitable wooden posts.

Radii and Geometry

The types and the geometry of the turnouts will be as given in the document ULE90130-SW-SCH-00072, V2 "Switches and Crossings Schedule" as far as applicable.

3.4 Expansion Joints

Expansion joints are structural elements enabling a compensation of rail length to be performed. Expansion joints are usually placed on the transition zone between bridge structure and embankment. They have to take up the longitudinal movement of the bridge (extension by temperature) without causing too high a compressive strain in the rails. Therefore, the slip resistance selected is lower than the resistance of the sleepers to the longitudinal displacement avoiding the occurrence of plastic deformations. Switch blade and stock rail are shifted against each other in the expansion joints.

Manufacture drawings, prepared by the contractor, shall contain all the dimensions by taking the track gauge of rails 1,435 mm.

The requirement and the location for expansion and / or isolation joints will be defined during design stage.

3.5 Continuous Welded Rails

The welding of the rail to form a continuous welded track reduces the dynamic forces exerted on the permanent way and the cars. The alumino-thermic welding technique shall be used in this project:

First a casting mould is fixed around both rail ends. In a crucible, the chemical reaction of iron oxide and aluminium powder yields fusible thermite steel that is poured into the casting form, welding the rails together. Different alloying elements are added to the thermite portion that make the characteristics of the butt comply with modern qualitative demands.

For the welding process the appropriate UIC standard and the technical description within the tender documents have to be considered.

3.6 Track Ends

At the end of tracks sand pits will be installed that prevent vehicles from moving beyond a designated point.

Rail Stops

Where buffer stops cannot be placed outside the workshop area rail stops will be provided.

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Bill of Quantities

Track material

Cons. Number	Description	Unit	Quantity
200020	Flat Bottom Rails 49 E1	m	46,588
200030	Grooved Rails 60/59 R2	m	33,028
200040	Turnouts (main line)	pcs	33
200050	Turnouts (depot)	pcs	28
200070	Rail expansion joints	pcs	49
200100	Crossings	pcs	4
200110	Buffer stops	pcs	0
200140	Rail fastenings for plinth track	m	7,577
200170	Pre-stressed concrete sleepers incl. fastenings	m	12,023
200180	Ballast	ton	23,700
200230	Specific material for embedded track	m	13,422
200240	Specific material for Tramstop	m	2,332
200250	Specific material for Grass track	m	3,564
200270	Rail fastenings for cast-in track in depot	m	760
200280	Rail fastening on columns in depot	m	130
200290	Transition rails	pcs	60
390010	Insulation Joints (as given in ULE90130-SW-SCH-00085 V1)	pcs	14
390020	Signing (every 100 m a simple plate)	ls	Incl.
390040	ACO-drain every 60 m in embedded track	pcs	275

390050	Water boxes in grass track	pcs	0
390060	Grouting at guided bus way	m	2,800
390070	Guard rails	m	400
390090	Road crossings	pcs	3
390100	Point bars as required in ER V. 3.3 under 26.10.1	pcs	70
390110	Adequate rerailment facilities for turnouts in depot area (for 9 turnouts and 1 crossing)	ls	1
390120	Isolated rail joints (as given in ULE90130-SW-SCH-00085 V1)	pcs	0

Gauge [mm]: 1435

Rail Cant: No inclination

laid on: wooden sleepers

Rail profiles

Rail Profile: 49E1 (S49)

Switch Rail Profile: 49E1A1 (Zu 2-49)

Check Rail Profile: 33C1 (UIC33)

Quality of material

Stock Rails: R260 (900A)

Switch Rails: R260 (900A)

Running Rails: R260 (900A)

Check Rail: R260 (900A)

Crossing - Closure Rails: R260 (900A)

Crossing - Wing Rails: R260 (900A)

Set of Spring Rail Switches "ZV-FSCH"

Description

A set of spring rail switches consists of switches made from the special asymmetrical or symmetrical switch rail profiles. They are forged at the heel end (forging) to match the standard rail profile and are electrically flash-butt welded to the adjoining standard rail. The weld is located in the moveable part of the switch and is secured with safety fishplates. The standard rails can be provided with a foot relief to reduce the setting forces.

One set of spring rail switches consists of:

a) Two finished stock rails, made from the Vignol rail profile (standard rail profile). The stock rails are machined in the switch-stock rail contact area, all holes are provided and deburred.
b) Two finished spring rail switches, made from the switch rail profile and welded to the standard rail. The switch profile is forged at the heel end to the Vignol rail profile. The forged area is machined so that it matches the Vignol rail profile. The forged switch profile is welded to the standard rail using electrical resistance welding and the weld is secured by 2-hole fishplates. The spring rail switches are machined on the running surface and the contact surface of the rail head and foot, bent and set and adjusted to the stock rails. If to be provided, the holes for the switch attachments are drilled in the rail foot or web.
c) The switch supports, adjusted to the stock rails and the spring rail switches, are mounted on the stock rails. In the case of outside supports, they are fitted and mounted on the stock rails.
d) The anti-creep device.

The complete and half sets of spring rail switches "ZV-FSCH" and "HZV-FSCH" are ready for installation and are delivered pre-assembled. If required, locks are fitted and supplied as well. If the set of switches of a single turnout is mounted on sleepers with plates, it is possible to deliver the switches completely mounted on the sleepers. If sets of switches are delivered without sleepers or if only half sets of switches are supplied, the switch is delivered bundled together with the corresponding and adjusted stock rail so as to prevent them from damage during transport and to avoid any confusion.

It is not recommended to exchange individual stock rails or switches without re-adjusting them to each other.

Advantages
- Well proven and cost effective design
- Low setting forces
- High wear and tear reserves
- Suitable for medium to high speeds
- Suitable for medium axle loads/annual loads
- For high demands on position stability and creep resistance
- Use of an elastic rail fastening is possible

Technical Characteristics
- The forged area is subjected to a heat treatment to prevent the formation of soft spots:
  - All switch rails > 63.14 kg/m, corresponds to profile 49E1A1 (Zu 2-49), in material grade R260 (900A) are normalized to guarantee a uniform hardness gradient
  - All switch rails </= 63.14 kg/m, corresponds to profile 49E1A1 (Zu 2-49), are normalized only after agreement
  - All head-hardened switch rails are treated in accordance with the material specification to guarantee a uniform hardness gradient

- For used switch rail profile and rail material grades see chapter 'Profiles' and 'Materials' and/or commercial offer

Quality Inspection
- Visual and geometry checks
- Penetration test: Flash-butt weld, forged area
- Hardness test: Forged area and heat affected zone for head-hardened switch rails

Common Built-up Crossing "EHZ COMPACT 1400"

Description

The crossing vee is machined from a rolled slab made of tempered steel. This makes it possible to use a homogeneous material (without welds) with a corresponding strength in the transition area.
The length of the crossing vee depends on the rail profile and the geometry of the crossing. The welding joint between crossing vee and closure rails is in any case in the area where the wheel overrun of wing rail/crossing vee is completed. Distance blocks are welded onto the crossing vee.
The closure rails are machined from rolled rail profiles. They are welded together in the area of the head and foot and connected to the crossing vee by means of flash-butt welding.
The wing rails are also made from rolled rail profiles, machined and bolted to the welded crossing vee by means of distance blocks.
All distance blocks are machined and adjusted to the support areas of the closure and wing rails during final assembly. This guarantees on the one hand an exact position of the distance blocks and on the other hand adherence to the required flangeway tolerances.

Advantages

- Design possible for all types, like
  - common crossings
  - optuse crossings
  - multiple and special crossings
- Excellent elasticity because of bolted design
  Therefore, optimal integration into the elastic behaviour of the track
- No special appliances and patterns required
  Therefore, economical even for small quantities
- Extension of service life by built-up welding in the track
- "Bending" of the assembled crossing at a later stage possible
  Therefore perfectly suitable for all types of curved turnouts
- Guaranteed interchangeability
- Can be thermit welded into the track
- Through tempering of the crossing vee a high yield point is achieved with at the same time sufficient elongation and thus high wear resistance is obtained in the wheel overrunning area with the typical dynamic compression stress

Technical Characteristics

Materials:

- Rails: Please refer to chapter 'Materials' and/or the commercial offer
- Crossing vee: 51CrV4 according to EN material no. 1.8159
  Tempered to tensile strength (elongation min. 8%) 1200 – 1400 N/mm²

Quality Inspection

- Visual and geometry checks
- Penetration test: Flash-butt weld, welding seams
- Hardness test: Crossing vee

Bolting of the Crossing "High-Tensile"

Description

This type of bolting is used for durably connecting the main components (wing rail, crossing vee, closure rail, guard rail and joggled rail) of common, obtuse and multiple built-up crossings.

The components are connected to each other by means of high-tensile metric bolts (property class 8.8 or 10.9) and hexagon nuts. In order to make sure that the seal of the rail head and the hexagon nut is level, special shims are used. These shims have a special form in the contact area of the rail web so that the best possible contact surface is achieved. Possible settling loss can thus be kept to a minimum. To achieve the rectangular contact of the head of the bolt and the nut, hardened spherical disks and ball sockets are used. They guarantee a 100% rectangular contact area of the head of the bolt and the nut. Self-locking nuts are used to make sure that the bolt does not get loose.

Advantages

- Secure and durable connection because of high pre-tension force
- Easy to re-tighten the bolting during operation, if necessary. Specified tightening torque has to be considered
- Bolting can be used various times (e.g. if single components of the crossing are exchanged)

Technical Characteristics

- Bolts: Property class 8.8 or 10.9

Rail Fastening:
Superstructure "VOSSLOH SKL 12" (Tension Clamp)

Description

For the fastening of turnout components on ribbed base-plates "SKL 12" tension clamps from VOSSLOH are used. The clamps guarantee a lasting clamping of the turnout components on the ribbed base-plates. Ribbed base-plates for turnouts are preferably made from rolled ribbed web material or from flat steel with welded-on rib cams. Tilting movements of the rails are resiliently absorbed by the middle bend of the tension clamp. The achieved creep resistance and torsion resistance fulfill the demands made on a continuously welded track (CEN EN 13481).

The tension clamps can be used with or without elastic pads between the turnout components and the plates. The defined mounting position guarantees the full tensioning force of the tension clamps for different rail profiles and pads of different sizes. A plastic deformation of the spring arms is not possible. The fastening needs no maintenance.

Preferred application of the "SKL 12" tension clamp from the point of view of turnouts:

- Universal clamp: approx. 13 kN tensioning force at approx. 14.5 mm spring deflection
- Torsion stability during mounting
- Suitable in the fishplated area
- Pre-assembly possible
- Large construction length sometimes inconvenient

If only limited space is available within the turnout, welded-on stop faces or specific clips are used according to the definition in the layout plan.

The tension clamp is fastened on the ribbed base-plate with T-bolt, double spring washer and nut. At the beginning of the tension, both torsion spring arms rest on the rail foot. When the T-bolt is tightened, the middle bend is lead to the rail foot. The optimal mounting condition is reached when the middle bend is max. 2 mm away from the rail foot. The necessary torque moment is approximately 180 - 200 Nm.

Tension clamps with special functions:
Tension clamps which allow the sliding of turnout components, e.g. rail expansion joints, are designed with less tensioning force. At the moment, a type called "SKL 12B" is available. These tension clamps secure the longitudinal guidance of the components and prevent tilting under the load of the wheel.

Advantages

- Good creep- and torsion resistance for use in the continuously welded track
- Durable elastic clamping
- High tilting stability through middle bend
- Long service life
- Low space requirement

Technical Characteristics

- The tension clamps are supplied with corrosion protection
- For clamp material see chapter 'Materials' and/or commercial offer (spring steel according to manufacturer's specification)
- For design attributes see VOSSLOH brochure

◆ **Quality Inspection**

- Test certificate 2.2 according to EN 10204 of the manufacturer

Stock Rail Supports:
Inner Stock Rail Fastening "IBAV-VAE"

◆ **Description**

For the fastening of rails, spring elements are frequently used. For turnouts, slide chairs are mounted on the inside of the stock rails, on which the switches slide. In the area of these slide chairs, conventional spring elements can not be used. This system represents a device for the flexible fastening of stock rails in the slide chair area.

Structure:
The slide chair has a tunnel-shaped recess into which the long plate-like spring element is loosely inserted towards the stock rail. A stop face is welded onto the base-plate and this stop face interacts with the end of the spring elements facing away from the stock rail and secures this spring element even in case of vibrations. Once the spring element is in its final position, a clamping wedge is hammered into a diagonal hole in the slide chair. In this way, the middle part of the spring element is clamped down and the stock rail is flexibly held down. The holding-down force corresponds to the one of a standard spring element.

Mounting:
After the spring element has been placed in the recess, the wedge is hammered into the diagonal hole of the slide chair by blows on the rectangular head. A square shoulder on the wedge limits how far it can be hammered into the hole. With a simple disassembly tool the wedge can be removed again.

◆ **Advantages**

- Good creep and twist resistance for the use in continuously welded track
- Permanent elastic fastening of the stock rail
- High stability
- Long service life
- Low space requirement
- Maintenance free
- The shape of the elements makes incorrect installation impossible

◆ **Technical Characteristics**

- Welded construction made from rolled steel

◆ **Quality Inspection**

- Visual and geometry checks

Fastening of Check Rails:
Arrangement of Check Rail 33C1 (UIC33) -
Check-Rail Chair in Block Construction

◆ **Description**

The check rail guides the axles of the vehicles in such a way that they can not enter the wrong flangeway and do not touch the front area of the point of the crossing and damage it. To be able to fulfill its function the check rail is positioned in such a way that the parallel flangeway lies opposite the unguided part of the crossing. It is absolutely necessary that the defined check gauge (the distance between running edge of the crossing and guiding edge of the check rail in the parallel flangeway) be complied.

The check rail is made from the rolled profile 33C1 (UIC33), which is machined in the area of the entry and the check end flare. The check-rail chair is made as a stable welded construction (block construction). The fastening of the running rails depends on the specific requirements. The check rail rests on the check-rail chair and is fastened with screws. For a correct adjustment of the check-rail flangeway and the check gauge, shims can be positioned between check-rail chair and check rail. Maximum possible compensation 13 mm.

Advantages
- Easy to mount, check-rail chair with check rail is not directly connected to the running rails
- The check-rail flangeway is easy to adjust and therefore also the check gauge by inserting shims in case of wear
- The worn check rail can be exchanged without manipulation of the running rail

Technical Characteristics

Materials:
- For check rail profile see chapter 'Materials' and/or commercial offer
- Check-rail chair: min. S275, tensile strength of 430 N/mm²

Quality Inspection
- Visual and geometry checks

Wooden Bearers "Oak" (H)

Description

Turnouts, diamond crossings and other layouts can be laid on wooden bearers. The bearers secure the gauge and geometry of the layout and transfer the loads of the railway traffic to the ground, preferably the ballast bed. In addition, they secure the position stability of the layout through their resistance to longitudinal and transverse displacements. Moreover, the excellent elasticity of wood is very compatible with a ballast bed.

Turnout bearers are made from hardwood according to UIC 863 resp. EN 13145. The bearers can be treated as per the "Rüping" method with wood preservative, type WEI C, with a content of Benzo (A) pyrene below 50 ppm. The average absorption quantity of oak bearers is approx. 45 kg/m³.

The processing of bearers takes place under ISO 9001-2000 controlled processes. The bearers are drilled just prior to the fastening of the plates. The diameter and depth of the pocket hole are adjusted to the used coach-screws. This guarantees optimal retaining force and electrical insulation.

VAE is certified to ISO 14000. Therefore, we mainly use wood from sustainably cultivated forests. The used preservation agent emits the lowest possible volatile substances, so-called VOC. Biocide concentration is also minimized with at the same time highest possible protection against dry rot.

Advantages
- Good damping behaviour
- Good compatibility with ballast
- Long service life
- Economical for single piece and small batch production
- Recyclable

Technical Characteristics

- Oak (Quercus robur, petraea, pubescens): 850 - 900 kg/m³
- Cross section and form according to UIC 863 cl. 2.3.2, see also chapter 'Materials' and/or commercial offer
- Impregnation, see 'Description' and chapter 'Materials' and/or commercial offer
- Braced ends
- Length increments: 0.2 m (or according to agreement)

SAFETY PRECAUTIONS
As far as the handling of treated bearers and wood is concerned:

- Care must be taken that gloves are used (type/quality generally contained in the safety sheet of the preservation agent).
- When treated bearers are cut or processed in a manner that creates dust, care should be taken that dust-proof protective masks and eye protection (glasses) are worn.
- National regulations concerning the wear of working clothes (a company cleaning service may be required) and possible demands for the storage of civilian and working clothes in separate lockers, etc. are to be observed (there exist no standardised regulations, but the aspect of civil law relating to the passing on of pollutants via clothing must be fully accounted for).

Quality Inspection

- According to UIC 863, for fresh-cut bearers
- According to EN 13145 and Technical Terms of Supply No. TL001 of VAE for bearers finished in the turnout plant

Scope of supply

- switch device
- build up crossing
- check rails
- running and intermediate rails
- all base plates incl. Fastening material
- all wooden sleepers up to the use standard sleepers

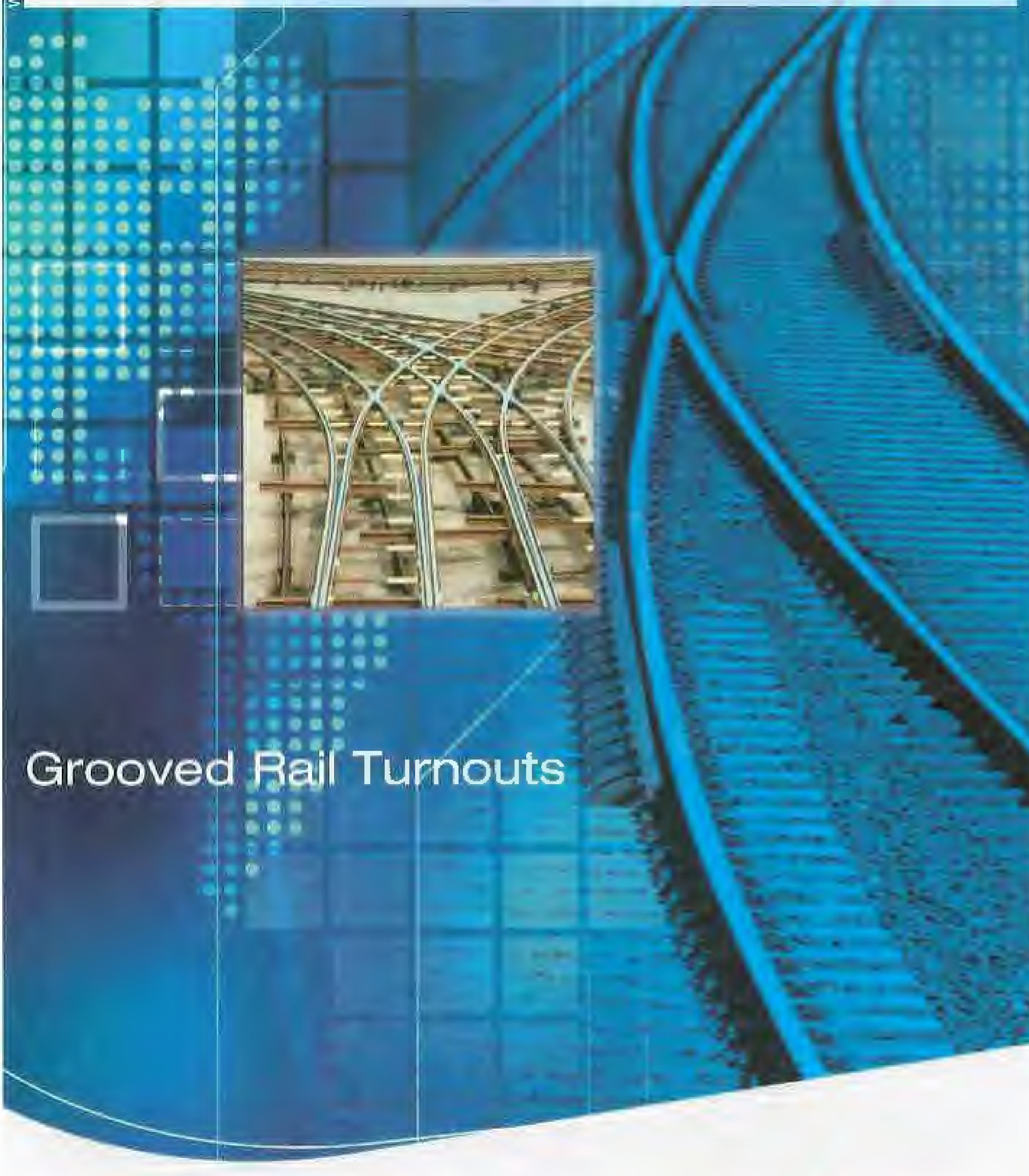
the scope of supply does not include:

- switch machine
- locking device
- fishplates incl. Bolts

VAE

WAR.05

VAE BASICS
ENGINEERING
QUALITY
Setting Devices
Electronic Systems
Special Trackworks Components
Logistics
Vignole



Grooved Rail Turnouts

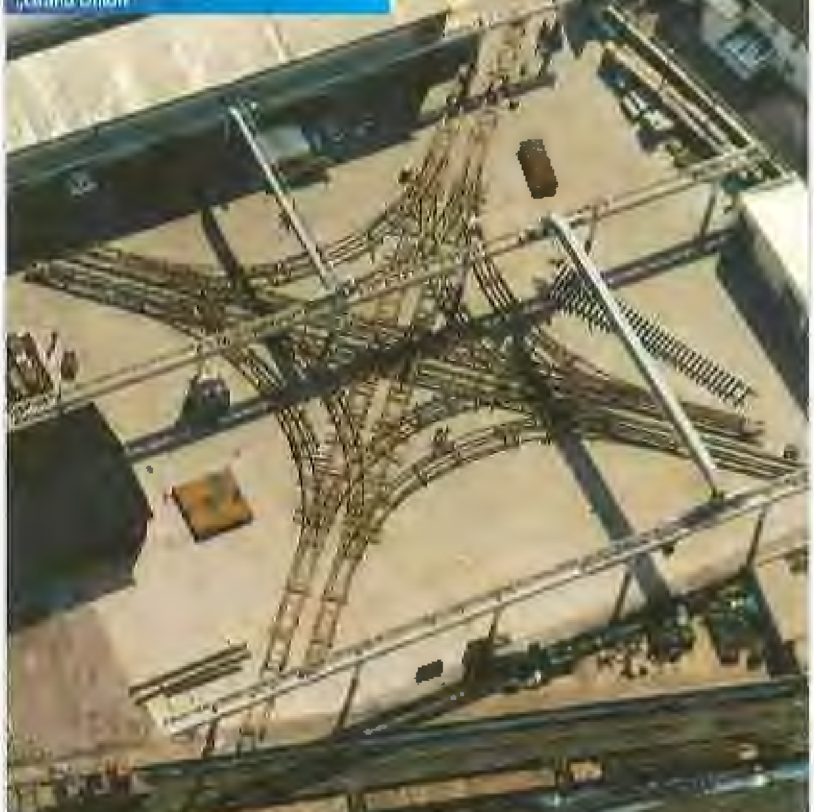
VAE GmbH
www.voestalpine.com/vae

voestalpine
ONE STEP AHEAD.

USB00000088_0257

Product Range

VAE

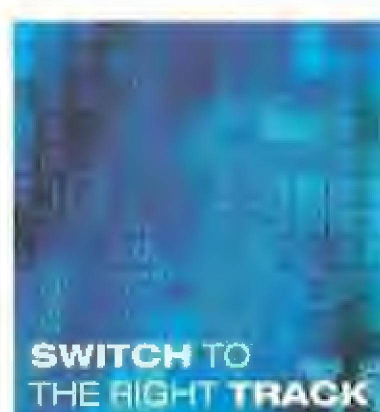


Complex grooved rail junction arrangement „Grand Union"

Product Range

- Single turnouts
- Similar and contraflexure turnouts
- Equal split turnouts
- Interlaced switch devices
- Diamond crossings
- Single and double slips
- Expansion joints
- Ramp crossing turnouts
- Track panels
- Twin tracks
- Double track junctions
- Fixed half switches
- Complex layouts
- Switch machines

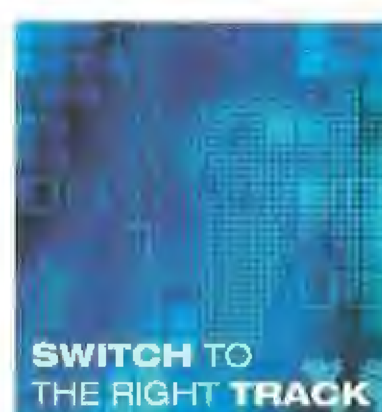
VAE has vast experience in the design and manufacture of grooved rail turnouts, diamonds and complete layouts as well as switch machines complying to international standards or specific customer requirements. For all applications and required gauges. In addition to standard grooved rail sections we also design for low sections like RI 53.



Grooved rail switch devices

From Hong Kong to Dallas – grooved rail turnouts from VAE are used worldwide

Grooved rail switch devices for light rail / tram systems consist of two sets, connected by tie rods. Standard geometries have radii of 20, 25, 50, 100 and 150 m. Special designs are also possible.



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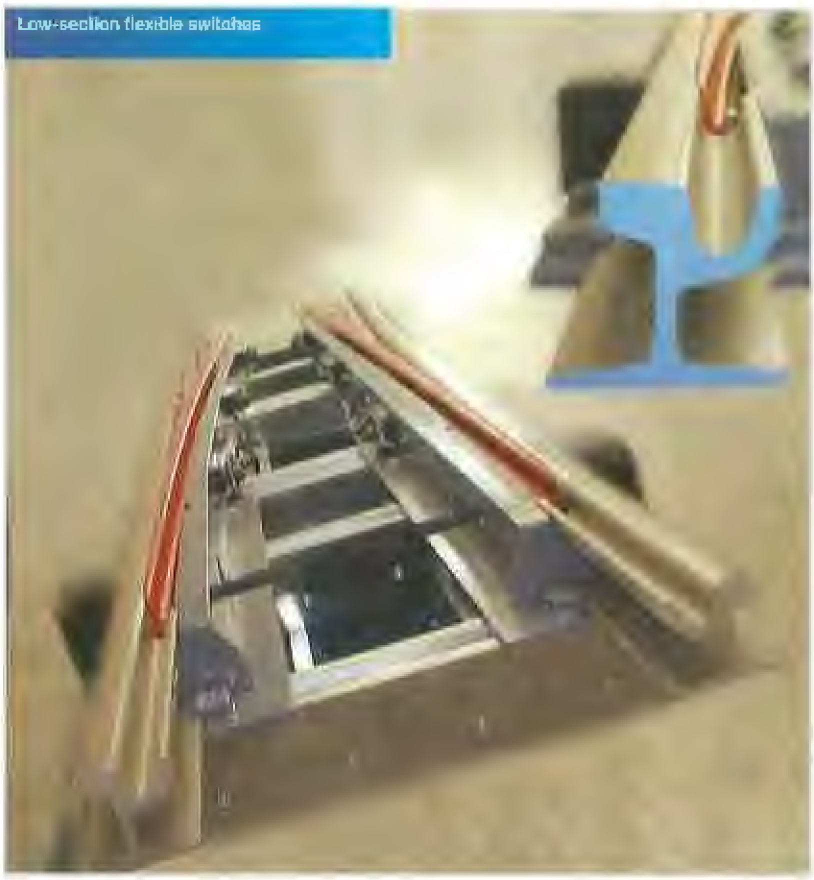
Grooved rail switch devices


Low-section flexible switches

Types

flat bed design

Switch section with flash-butt welded grooved rail
Switch section fastened by a wedge

deep bed design

Switch made from an asymmetrical switch section which is not fastened to a continuous sliding plate but is placed on individual sliding chairs.
Switch section fastened by a wedge


Spring rail switches with wedge fastening

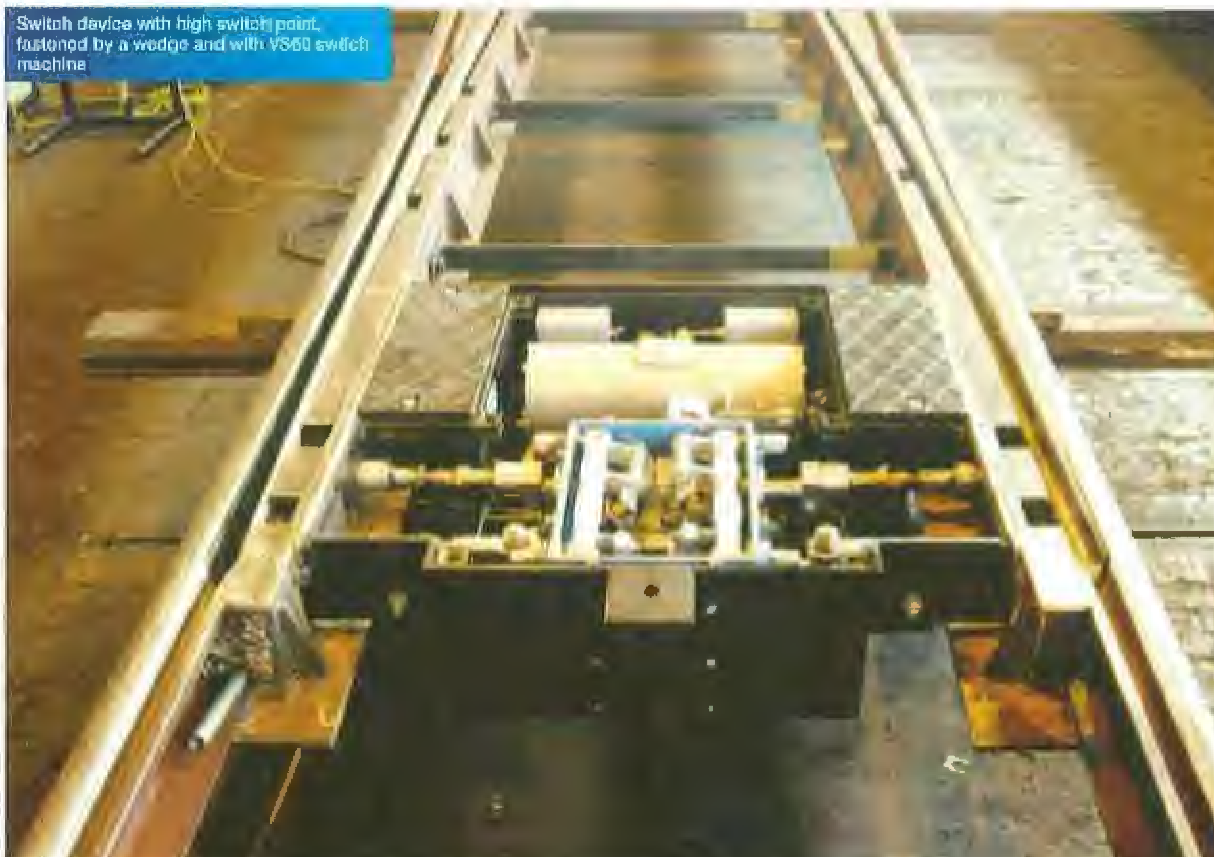
Advantages

Wedge fastening

- Quick replacement of the switches, no need for tearing open the road paving

Grooved rail switch devices

VAE



Switch device with high switch point, fastened by a wedge and with VS60 switch machine

Technical characteristics

Material grades of switches

S700 naturally hard (CEN:220) or with hardfacing at the running surface and/or the guiding surface

S900 naturally hard (CEN:260) or heat-treated

High-manganese steel, naturally hard

HSH (Head Special Hardened, CEN:350 HT), HSHM, HSHL

Advantages

Switch devices in deep bed design

- Longer intervals between cleaning are possible due to optimized design with regard to soiling

Diamonds, Crossings, Check Rails

Check Rails

- Depending on the crossing design, the check rails are manufactured either with shallow or deep grooves.
- Special RI 60 VK or VKD 180/105 sections are used with grooved rails RI 60 or RI 59 in case of shallow grooves.
- In case of deep grooves, the UIC33 check-rail profile is used for adjustable check rails and full-head profiles with machined grooves for the non-adjustable version.

Technical characteristics

Material grades of crossing blocks

S800 naturally hard (CEN 220) or with hardfacing on critical areas
S900 naturally hard (CEN 260) or heat-treated
High-manganese steel of natural hardness or explosion-hardened

Material grades of check rails

S800 naturally hard (CEN 220) or with hardfacing on critical areas
or tempered VKD 180/105 also possible

Crossings for grooved rail turnouts for light rail / tram systems with shallow or deep grooves, depending on wheel sets, grooves and crossing angle conditions.

Diamonds, Crossings, Check Rails

VAE


For smaller crossing angles


For larger crossing angles

Types

For smaller crossing angles

a forged or rolled block with welded-on full-head rails is used. For crossings subjected to highest loads a design with welded manganese or with a manganese insert is offered.

High-manganese steel is characterized by its excellent resistance against stress typical of crossings.

For larger crossing angles

a design consisting of welded block rails or full-head rails is used.

Track fastening system

In acordance with the specific demand, VAE's grooved rail turnouts are suited for laying on concrete slab with tie rods or for laying on wooden or concrete sleepers.

Terminal - laying in a shop

Grooved rail switch device on concrete sleepers

Grooved rail switch device on wooden sleepers

Grooved rail switch device on concrete slab

Grooved rail switch device on concrete slab

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voestalpine
ONE STEP AHEAD

BILFINGER BERGER Civil

SIEMENS

31st March 2008

Updated Proposal Submission

Edinburgh Tram Network

Section 3: Technical Descriptions

Part 2 – Depot Workshop Equipment

Table of Content

Depot and Workshop Equipment – Alternative Offer

1 Introduction

1.1 Document Scope

This Document is prepared to provide an introduction in the principles of the Depot Layout proposed at Gogar site for the Edinburgh Tram Network project and the functional relations and dependencies during Depot operation and Maintenance activities for the E&M part.

When BBS Consortium (BBS) is used in this document (or its Annexes), it stands only for the E&M part of the Edinburgh Tram Network."

Furthermore this document describes and defines the preliminary basic scope of maintenance equipment required for the maintenance of BBS scope to be provided for this Project adapted for the initial needs of the system. Deviations to the basic offer and to the Employer's requirements are marked. The indicated alterations will ensure the functionality of the system maintenance as well.

1.1.1 Compliance

This document is prepared to provide compliance with the Invitation to Negotiate (ItN) and the Employer's Requirements regarding Depot facility equipment aspects, as not indicated otherwise, and functional requirements to maintain the system.

2 General

The Depot will be of an economical design which reflects economy of use and maintenance in providing all the functionality required by tie.

The Depot will combine high levels of reliability and performance and will provide the operator and the maintainers with the facilities to operate, service, repair and maintain a completely reliable passenger service.

The Depot (also called Maintenance Facility) includes the following features that have been described in the ItN.

Main maintenance building with the main tram workshop, other workshops, stores, management, administration, operations and maintenance offices and staff welfare facilities (support accommodation) and the control room for the complete Edinburgh Tram Network.

- Car washing section to handle Trams
- Sanding facility with sand container to service Trams
- Stabling area for vehicle fleet

2.1 The Site

The proposed site in Gogar will be assumed as the location for the erection of the depot.

The Depot layout provided with the ItN documents will be the base for the future design works and the technical proposal is based in general on this layout.

Special design requirements, resulting on constraints imposed upon the Depot design by the Civil Aviation Authority due to the proximity of the Emergency Runway of Edinburgh International Airport or on factors and restrictions to be accommodated in the construction of the Depot that will necessitate detailed discussions with the aviation authorities, are not considered yet.

A separate building/area for the preparation works of larger line equipment (rails, catenary equipment etc.) required for corrective maintenance purposes as well as for storage of larger line side maintenance equipment should be considered in the next design steps.

Furthermore design requirements, resulting on the final tram car design have to be evaluated in the future design stages and the layout has to be adapted accordingly.

2.2 Access

Road access from the A8 Gogar roundabout link road will provide both entry for normal Depot operations traffic and also for delivery and egress of trams up to nominal 43,6 m in length with the minimum of impact on other facilities.

2.3 Maintenance Facility Equipment

The maintenance facility equipment is state of the art facility equipment with regards to industrial building design as well as the most current technology and equipment for maintenance and repair systems for E&M part and cleaning, wheel re-profiling, sand filling and lifting of Tram Cars featured by:

- energy performance/efficiency/conservation for materials and equipment
- water quantity and sewage treatment
- quality controls
- minimizing environmental impacts
- general environmental protection

3 Maintenance Facilities – Conceptual Design Overview

3.1 General

The configuration of the depot and the equipments contained therein will minimise disturbance to neighbors.

The Depot will be secure and be provided with security systems as appropriate.

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3.2 Description and Location of Facilities

The depot has to fulfill the following main functions:

- Inspection and Maintenance of Trams
- Stabling of Trams
- Shunting of Trams
- Cleaning of Trams
- Testing of Vehicles after repair and major overhauls during a re-commissioning
- Inspection and Maintenance of Railway Electrification system
- Inspection and Maintenance of Communication system
- Inspection and Maintenance of Signalling and Controlling system
- Inspection and Maintenance of Trackwork
- Inspection and Maintenance of Infrastructure

To assure the reliability and availability of equipment, the depot as well as the workshop is designed and equipped to meet the maintenance requirements of rolling stock and the other systems.

The maintenance facility design shall incorporate special tools and equipment required to consistently achieve the required preventive and corrective maintenance tasks within the cycle times required to meet the fleet availability for service.

The basic preconditions for this design are:

- the rolling stock maintenance requirements and technical details
- the system maintenance concept
- the system design
- the system emergency concept
- the system safety concept

3.2.1 Maintenance Yard & Facilities

The general arrangements for Maintenance Yard and Facilities are given in the corresponding layout ULE90130-06-DEP-00001, Rev.6. The area will readily accommodate the initial fleet of 27 Tram cars.

The Yard area is arranged in such a way that the Trams when entering and leaving the Yard will be able to do so over the two inbound and outbound tracks connected with the mainline.

For the future phase the stabling has to be built according drawing to stable in total 36 Tram cars.

This arrangement provides maximal flexibility for shunting operation and minimizes delays while putting the Trams in and out operation on the main track.

The take in and take out of Trams to/from the Yard will be arranged by switch-combinations from the main track, so that every Tram at any time in each direction can enter or leave the Yard without blocking the operation on the main track.

All Trams, which leave the line (first priority), will be controlled from this point by the Depot Controller.

All Trams will enter via the inbound tracks for entering the different locations according to the operating and maintenance requirements. The Depot controller will distribute the Trams to the stabling yard or passing the stabling yard to the tracks for inspection and light maintenance, heavy maintenance, washing and internal cleaning/sanding.

The exit of the Yard is given via the Yard lead track from the stabling area, from the washing plant and from the inspection and maintenance tracks.

The maintenance yard and facilities will be designed to provide sufficient storage space for the initial Tram fleet of 27 43,6m-tram cars, and a planned extension possibility to 36 tram cars. In addition, the yard will have a maintenance building to maintain both the Tram fleet and wayside equipment. Accordingly the yard and facilities will be built for:

- Servicing and maintaining the fleet of 27 Trams. (initial phase)
- Stabling for up to 27 Trams
- Two inbound and two outbound to the mainline for the Tram fleet
- Storage yard, maintenance building, washing plant, sanding facility, underfloor wheel lathe
- Access roads, guard house, parking area for 150 cars (automobiles) and with provisions for expansion of the parking areas to accommodate the future expanded system
- Fencing, paved walkways and gate.

3.2.2 Workshop Area

- The wash plant will be located inside a shelter (track 4) limiting the inside operating conditions to a minimum temperature of 0°C, allowing the equipment to operate effectively even when the ambient outside temperatures reaches temperature conditions of minus 5°C. The facility will be provided with suitable devices to remove excess moisture from the washed vehicles.

- The Wheel Lathe track (track 3) with a length of approx. two Tram cars (2 working positions), a central position for the Wheel Lath and on one working position equipped with a Gantry structures for access to the tram roof area from both sides and with middle- and side pits. The other working position of this track is designed as a floor leveled area. The track will be equipped with traction power interlocked with lathe operation.
- Maintenance track A, (track 2), (through tracks with each 2 working positions) with a Gantry structures for access to the tram roof area from both sides and with middle- and side pits on one working position and a tram car lifting system on the other working position. A bridge crane of 6.3 t capacity covers this area.
- Maintenance track B (track 1) with middle pits on one working position. A bridge crane of 6.3 t capacity covers this area. On this track also painting preparation and painting of Trams can be performed.
- Shops for auxiliary works and storage area
- Areas for technical system components, administration, social and staff welfare facilities

3.2.3 Yard Area

- Infrastructure Maintenance/Auxiliary Vehicle Area and open storage area (Track 7 and 20)
- Stabling Tracks, initial (Track 8 to 14) with future extension (track 15 and 16). Between the stabling roads, access paths alternately 1m and 2m wide with service points to provide facilities for Tram cleaning and minor maintenance on the 2m width will be arranged.
- Depot lead track (access and test) (Track 1)
- Boundary Fence;
- Lighting External;
- Storage External;
- Road Access;
- Parking
- Fire Emergency Access;
- Lorry turning space; and
- Lorry access to skip for wheel lathe swarf, for sand delivery etc.

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3.2.4 Maintenance Administration Building

- Office entrance vestibule
- Drivers reception area and dispatch
- Control Room, Equipment Room
- Offices, training room, meeting room and workstations
- Staff welfare facilities
- Technical rooms

The above mentioned areas will be arranged in order to guarantee an optimum operation of the depot without any obstructions. The track layout will be adapted in accordance with the maintenance throughput rate during off peak and night operations.

Access to the depot area and to the workshops for on-road vehicles are ensured by roads. Material for the workshop area can be provided by trucks and access for emergency cases is given.

3.2.5 Maintenance Tracks

The workshop is designed for inspections, heavy and light maintenance and repair works, exchange of larger components and for complete overhauls also on the roof area of Trams.

Tracks 3a and 2a are designed with central pit and with side pits plus roof working platform.

Track 2b designed for lifting of LRVs and changing of bogies.

Track 1a (with central pit) designed for lifting of LRVs and changing of bogies by mobile lifting jacks (option, not part of the scope).

Dismantled bogies from the vehicles shall be moved directly to the enclosed bogie repair area first by crane and then over rail.

An overhead crane 6.3 t for heavy transport work e.g. bogies, A/C units, containers etc. covers the area of track 1 and track 2.

3.2.6 Underfloor Wheel Lathe (UWL) track

The performance range of the wheel lathe is to check of the wheel profiles and the re-profiling of these wheels with a minimum waste of material to reach the recommended tolerances of wheel diameters within the reference values.

The under floor wheel lathe is positioned in a central position on track 3.

An additional mobile crane or jib crane 2 t for heavy transport work of axles and machine components shall be used.

Track section 3a is designed with central pit and with side pits plus roof working platform equipped with OCL interlocking and safety barriers.

For safety reasons a mechanical interlocking system between platform and OCL will ensure that when the OCL is under voltage the platform is not accessible, only when the OCL voltage is turned off will access to the platform be permitted.

Track section 3b is designed as a floor levelled track.

Track 3 can be used for Inspection and Light Maintenance tasks when the UWL is not used.

3.2.7 Painting and Painting Preparation

Painting and Painting Preparation can be done either on track 1b or on track 3b.

3.2.8 Sanding and Exterior Washing Facility Area

This track will be used for washing the exterior of the Trams.

Therefore this place is designed as a washing hall and equipped with a drive-through washing plant. The washing hall is constructed in the length of approx. one vehicle.

The train washing facility consists of washing brushes and detergent arches at fixed locations and with blow –down dryer. For front and rear washing a special brush unit will be provided. Front and rear washing can be only performed when the tram is stopped at a predefined position. Washing mode can be selected with or without front and rear washing.

A water treatment plant for recycling of the wash water and water tanks will be provided. The recycled water can be re-used during following washing processes.

The Trams will drive through the washing facility by their own power.

Closed to the entrance of the washing hall (outside) a drained Tram Wash Apron will be provided to clean the bogies by means of a moveable high pressure cleaner (Tramco scope).

Furthermore this track will be used for sanding of trains. Therefore a Tram sanding system shall be provided on this track. Near the sanding track a sand storage silo shall be provided (Tramco scope).

3.2.9 Workshops for Auxiliary Works

These workshops will be provided for maintenance, repair and inspection of components of the trains and infrastructure and will be located within the workshop adjacent to track 1.

The following areas will be foreseen:

- Infrastructure Workshop

- Dirty Workshop
- Clean Workshop
- Battery Room
- Equipment & Communications Room

The shops will be equipped with facilities and machines necessary to perform the maintenance works specified.

Equipment such as forklifts will be used for transportation purposes within the depot area.

Storage areas will be:

- Storage for heavy parts
- Storage for small parts
- Rolling Stock material
- Consumables/Spares

3.2.10 Areas for Special Functions

In the depot and workshop area technical rooms for building and services will be provided.

These rooms are mainly arranged within the maintenance/operation administration area of the building but depending on the required size and technical requirements to be covered, it is possible that a provision of separate technical buildings will become necessary.

3.2.11 Infrastructure Maintenance/Service Vehicle Area

This area of the maintenance building will be used for stabling of service vehicles and infrastructure components and is designed with a terminating track.

3.3 Preliminary Schedule of the Maintenance Equipment.

3.3.1 Subsystem Description

The following section describes the sub-system Depot and Workshop Equipment.

The scope of works will comprise the engineering, co-ordination, preparation of layout's, testing at factory, supply of materials and transportation to site, documentation, Installation, commissioning and training of the equipment specified for the maintenance services.

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Special tools and equipment solely dedicated for preventive and corrective maintenance works on single tram components should be provided within the Tramco supply. The initial spare part stock for the first years of operation as well as the special tools required for the BBS scope of supply and not contemplated in the employer's requirements are to be considered in the maintenance scope.

This subsystem is based on the following guidelines:

- Best and most efficient maintenance practice
- Reduction of the running costs
- Lower investment for maintenance and the required equipment
- Reduction of maintenance manpower capacity

The concept is, that all of the maintenance work, which can reasonably be subcontracted will be outsourced under a maintenance contract.

The remaining works will be done by Maintenance Company to be established for the LRT System.

All maintenance activities will be described in the maintenance concept. The workshop building is integrated in the depot and adapted to the requirements of the operational and maintenance concept. The main purpose of the workshop is to service, maintain and repair the components of the rolling stock system and the system components.

Therefore the indication of the rolling stock maintenance requirements and technical details are an essential part for all design activities regarding layout and arrangements within the depot area.

These works includes:

Type of Maintenance and Repair Works

Type of Maintenance	Works
Preventive Maintenance	regular service routine inspection scheduled preventive maintenance overhaul works
Corrective Maintenance	trouble shooting non-scheduled maintenance

Type of Maintenance and Repair Works	
Type of Maintenance	**Works**
Repair	trouble shooting non-scheduled maintenance component repair

3.3.2 Codes and Standards

3.3.2.1 General

The design, implementation and operation of the works will be in accordance with the functional and performance standards and limits specified in this document.

The following standards and regulations will be used:

- ISO International Organization for Standardisation
- IEC International Electromechanical Commission
- UIC International Union of Railway
- EN European Standards
- GS Predicate for trailed Safety
- UVV German Law for the Safety of Devices and the German Regulations for Accident Prevention and Storage of Dangerous Goods
- VDE Verband deutscher Elektrotechniker (Association of German Electrical Technicians)
- VDV Verband Deutscher Verkehrsbetriebe (Association of German Transport Services)
- DIN (Deutsche Industrienorm – German Industry Norm)

  Local specific requirements, practical and efficient will be observed.

3.3.2.2 Reference List

The following list gives a reference about used standards for essential equipment.

Underfloor wheel lathe

- Machine 98/37/CE

- Low Voltage electrical equipment 72/23/CEE, EN 60204-1
- Electro-magnetic compatibility 89/336/CEE
- Safety specification CEE 89/342
- Noise level CEE 86/188m
- Pressurized equipment 97/23/CE

Overhead Cranes

- BS, FEM Section IX
- AWS D14.1 Code for Welding.
- DIN 18800,Page 7 Construction for Quality of Welding
- DIN 15018, Page 2 Crane design and construction
- DIN 8563, Page 3 welding classes standards
- DIN 15401 Single Hooks
- DIN 15404 Certification of Hooks
- IEC 60204-32
- VDE 0113
- VDE 0100
- IEC Recommendations 24-1, 34-5 and 72-1
- Motor selection on Swedish norm IKH 6.30.01
- All motors are approved by the CSA
- ISO/DIS 6336/II-6336/V (DIN 51150)

Electronic Equipment

- DIN EN 61010 Safety regulations for electrical measuring, control and Laboratory devices
- VDE 0100 Erection of power installations with rated voltages below 1000 V
- VDE 0700-1 Safety of electrical devices
- UVV VBG-4 Protection regulations for accidents, Electrical plants

Washing Plant

- DIN 24446 Security of machines and vehicle washing plants
- Safety regulations for vehicle washing plants from Central Organization of Employer's liability insurance, Ref.-No. ZH 1/543.
- Guidelines for spraying equipment from Central Organization of Employer's liability insurance, Ref.-No. ZH 1/406.
- EC-machine guidelines dated June 14, 1989 (89/392 EWG) - 9th decree to equipment security regulation; EC-guideline for Electromagnetic pollution control dated May 03,1989 (89/336/EWG), EC-guideline for Low voltage control dated February, 19 1973 and July 22, 1993 (93/68/EWG)
- Actual guidelines for accident protection
- Guidelines of the Deutsche Bahn AG (German Federal Railway) including Internal regulations of the DB AG

Service Vehicles

- EN 60529 Protection class
- ISO 3864-1 Graphic symbols
- UIC 505-1 Railway vehicles-gauges
- UIC 510-2 Roller profile for railway vehicles
- UIC 533 Earthing of metallic parts
- DIN 20021-2 High pressure hoses
- DIN EN 6700 Welding of railway vehicles
- EN 50121-3-2 Electromagnetic compatibility/rail application
- 98/37 EG EC-directive for declaration of conformity of machines
- EURO III European emissions standards
- EU reg. 79/157/EU incl. 96/29/EU European regulation for exterior noise dampening
- EU reg. ECE-29 European regulation for cabin construction
- EG 94/20 European prescription for trailer couplers
- VDE 0879, part 1 and 2, DIN EN 55012 Regulations for electronic emissions for vehicles

3.3.3 Machines, Tools and Equipment

The functional areas as well as the auxiliary areas will be equipped with facilities and machines necessary for the maintenance and repair of the Trams and system components.

3.3.3.1 Bill of Quantity BBS

The following list gives an overview about the maintenance facility equipment supplied under BBS contract.

	Description	Required / Provided Qty	Comments
1	Set of Measuring Tools for Trackwork (hand tools)	1	Track Measurement Equipment (ER pos. 9.5)
2	Set of Catenary Tools	1	Stagger gauge, Stray current Tester (ER pos. 8.2)
3	Bridge Crane, 63 kN Maintenance Area	1	Workshop Crane (ER pos.2.4)
4	Tram lifting system	1	(ER pos.2.2)
5	Set of Lifting Attachment for the E&M part	1	Craneage (ER pos.2.12 / 2.13)
6	Set of general Lifting Attachment for the E&M part	1	Craneage (ER pos. 2.12 / 2.13)
7	Drive through Tram Washing Plant with fix mounted brushes	1	• Spray Bay to be within a shelter • Be complete with end wash facilities • To be suitable for operation at zero degrees centigrade and above (ER pos.1.4)
8	Ultrasonic cleaning bath for the E&M part	1	Parts washer (ER pos.1.6)
9	Fixed high-level Access Platforms	2	To access tram roof and pantograph with end gates for tram length (ER pos.2.3)
10	Shelving Pallet System	1	Stores, Shelving (ER pos.3.1)
11	Shelving Two Tier System	1	Shelving (ER pos.3.4)
12	Tool Distribution	1	Shelving (ER pos.3.4)
13	Set of Work Benches	1	Depot Furnishing (ER pos.3.5)
14	Set of workshop stools	1	Depot Furnishing (ER pos.3.8)
15	Set of special Racks (e.g. for door, window, AC-unit)	1	Shelving (ER pos.3.4)
16	Security Storage Cupboard	2	COSHH cupboard (ER pos.3.7)
17	Set of Ladders	1	Infrastructure tools (ER pos.5.1)
18	Set of Steel cabinet wardrobe, lockable	1	Cupboards (ER pos.3.6)

	Description	Required / Provided Qty	Comments
19	Demountable conductor wire maintenance man basket (>=2 man) for Road/Rail vehicle	1	(ER pos.10.1)
20	Road/Rail,, self-propelled two way vehicle with crane 6t and platform for approx. 6 t payload	1	Road/Rail type (ER pos.10.1) Able to transport the re-railing equipment mentioned below; Alternative reduced payload
	Remark: Snow plough and winch attachable to the above mentioned vehicle included.		
21	Rail groove cleaning equipment	1	Vacuum cleaner mountable on Road/Rail vehicle as defined under No 20 (ER pos.1.5)
22	Rail/road trailer incl. OLE siccors working platform	1	Road/rail trailer (ER pos.10.3)
23	Mini Bus	0	Other road vehicles (ER pos.10.,2)
24	Pick-up	1	Other road vehicles (ER pos.10.,2), not required for maintenance. Operator demands not considered
25	Fork lift truck, 30 kN	1	Fork lift truck (ER pos.2.9)
26	Set hand guided mobile transport equipment for the E&M part	1	Pallet truck + Hand trolleys (ER pos.2.10 / 2.11)
27	Set waste container for the E&M part	1	
28	Underfloor Wheel Lathe with swarf removal	1	UWL (ER pos.4.3)
29	Power Hacksaw	1	Machine tools (ER pos.4.5)
30	Hydraulic Press	1	Machine tools (ER pos.4.5)
31	Double Ended Grinding Machine	1	Machine tools (ER pos.4.5)
32	Column Drilling Machine, 30 mm with bits	1	Machine tools (ER pos.4.5)
33	Turning Machine, 1000 mm	1	Machine tools (ER pos.4.5)
34	Tools for Fibre glass work	1	Machine tools (ER pos.4.5)
35	Sheet Metal Bending Machine	1	Machine tools (ER pos.4.5)
36	Hand Lever Shear	1	Machine tools (ER pos.4.5)
37	Set of Trackwork Tools (Hand Tools)	1	Small tools (ER pos.9.2 – 9.4)

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	Description	Required / Provided Qty	Comments
38	Rail Grinding Equipment	1	Mobile Rail Grinding equipment (E'sR pos.9.1)
39	Set of Portable Electrical tools for the E&M part	1	Hand & Mobile tools (ER pos.5.1 – 5.2)
40	Set of Portable Compressed Air Tools for the E&M part	1	Hand & Mobile tools (ER pos.5.1 – 5.2)
41	Set of Mechanical Tools for the E&M part	1	Hand & Mobile tools (ER pos.5.1 – 5.2)
42	Set of electrical Tool for the E&M part	1	Hand & Mobile tools (ER pos.5.1 – 5.2)
43	Set of Tool Trolley for the E&M part	1	Hand & Mobile tools (ER pos.5.1 – 5.2)
44	OA welding equipment (autogenously)	1	Ferrous welding equipment (ER pos.6.1)
45	Electr. Welding	1	Ferrous welding equipment (ER pos.6.1)
46	Arc Welding kit	1	Ferrous welding equipment (ER pos.6.1)
47	MIG Welder	1	Aluminium welding equipment (ER pos.6.2)
48	Fume extractor, portable	1	Welding equipment (ER pos.6.1 / 6.2)
49	Welding Table	1	Welding equipment (ER pos.6.1 / 6.2)
50	Set of Welding Screens	1	Welding equipment (ER's pos.6.1 / 6.2)
51	Set of standard welding accessories	1	Welding equipment (ER pos.6.1 / 6.2)
52	Set of lighting equipment	1	Temporary Lighting stands / equipment (ER pos 9.4)
53	Mobile Generators	1	Generator (E'sR pos 9.4)
54	Set of safety equipment for the E&M part	1	Hand & Mobile tools (ER pos.5.1 – 5.2)
55	Pressure washer	1	ER 1.3

Table 1: Depot and Workshop Maintenance Equipment supplied under BBS contract

3.4 Draft Specification of major Workshop Equipment

3.4.1 Compressed Air System

The compressed air system consists of compressor plant , a piping system and the connection points at the workshop. The general pressure provided will be 7,5 bar.

To reduce the noise level the compressor is located in a separate compressor room at the workshop.

3.4.2 Vehicle Lifting System

The fixed Vehicle Lifting System is located at track 2 b of the Workshop Building.

It will be used for lifting one tram vehicle consisting of 4 bogies for maintenance- and repair works as well revision and overhaul.

After positioning of the vehicle on the track, the operator starts the lifting process with the 4 platforms. For safety reasons flashing lights will be installed on both sides of the track. These are for indicating the lifting sequence.

The lifting height has been chosen with a maximum of 1,6 m ToR to get mainly upright working positions on the tram vehicle. If the vehicle is at the preferred height, the car body supports can be positioned manually.

To change one bogie each platform can be operated separately.

This bogie can be pushed out by hand on track below the lifted vehicle.

A new bogie can be moved from the Bogie Repair area to the respective position in the same way.

After assembling the vehicle will be lowered to the floor and can drive out of the workshop.

The drive system of each lifting platform is mounted in an under floor pit to provide a floor leveled lifting system. The platforms will be operated via central control board and monitored by means of a PLC to assure a synchronous lifting of the tram.

The system is designed to deal with a load of 15 ton per platform or a fully functional, unladen tram vehicle with a load of 60t (AW01).

Example

3.4.3 Tram Washing Plant

The Tram Washing Plant is located at track 4 b with its main parts washing hall incl. drainage, control room and sump tank.

The washing plant is a single direction water / detergent system for automatic washing of the sides of single trams and the also for washing of the driver cab ends.

The principle design is a drive-through washing plant with fixed installed detergent and water spraying arches and rotating application brushes. The tram drives by its one power through the plant.

The train washing plant will be capable of allowing trains to pass through the plant in either direction without the washing sequence taking place at the full 'restricted manual' operating speed.

To avoid wetting of under frame equipment, no water or chemical solution will be sprayed below the lower edge of the car body.

The brushes will be arranged for easy replacement, preferably in sectional units, such that should one section be subject to more wear than another, the whole brush does not need to be discarded.

Washing plant operation will stop automatically after a pre-set time-delay if trains remain stationary within the plant.

A water recirculation and recycling system will be provided to minimise the water consumption. Water from the washing process and the rinsing process will be collected in underground sumps, recycled and re-used for pre-wet and other appropriate functions.

Facilities for manual rinsing will be provided if necessary, to avoid damage to train bodies from the applied cleaning chemical, in the event of a power failure.

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The train washer shall be equipped with a water recycle system which shall neutralize, remove solids and filter the water automatically. The PH level of the processed water and all effluent discharge to the sanitary sewer will be monitored.

The effluent to the sanitary sewer shall also be processed through an oil water separator.

The train washing plant will allow for different wash modes and the equipment provided will comprise the following main components:

- One (1) pair pre wet spraying stands
- One (1) pair detergent application brushes for sides
- One (1) pair water wash brushes for sides
- One (1) swivel brush for Tram front/rear washing
- One (1) pair final rinse stands
- Pre-wet pump and detergent solution / water wash pump
- Detergent metering pump
- Rinse pump
- Storage tanks
- Water reclamation system
- Driver indication entry lights
- Auto start up / shut down system
- Electrical control panel

The equipment supply will include system installation details including foundation, water supply, drainage and entry light requirements.

TECHNICAL DATA

LRV speed through wash plant	max. 3km/h
Number of vertical (side) brushes	4
Number of front/rear brushes	2
Water tank Capacity	approx.2000 litre
Wash plant Overall Size	50000 mm long X 8000 mm wide (through brush section)
Maximum Height	approx. 6000 mm (to top of rail)
Pump House Size	approx. 7000 mm X 5000 mm
Electrical Supply	400 Volts, 3 phase, 50 Hz
Water supply	approx. 4 bar max.

The complete system will be controlled via PLC.

The bogies can be cleaned at the tram wash apron outside of the washing hall by high pressure cleaner.

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3.4.4 Underfloor Wheel Lathe

The Underfloor Wheel Lathe used to re-profile the wheels of the tram is situated at track 3 b in pit with rails running on top.

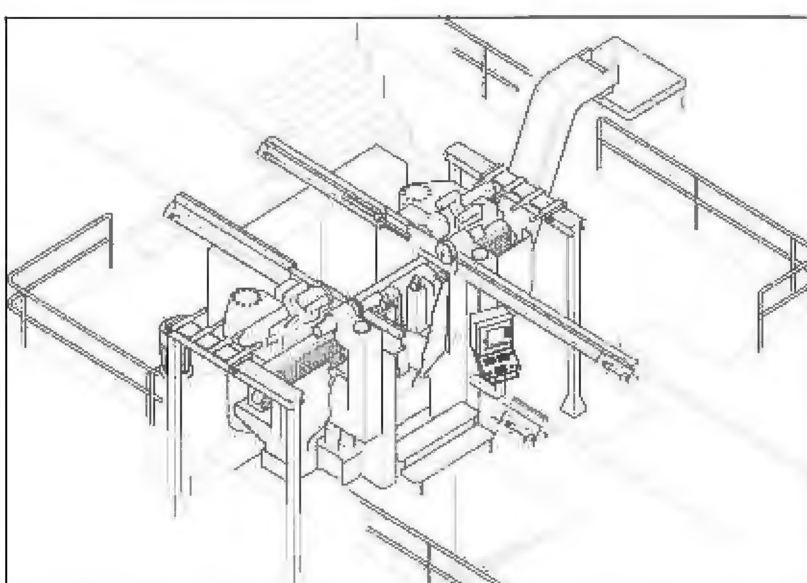
An Overhead line above the track provides the power to move the tram in and out themselves. During the re-profiling process of the wheels the tram will be moved by means of an electrical shunting vehicle to achieve the accurate positioning of the tram.

Once the tram is proper positioned above the machine the wheel will be support the rail removed and the axle or bogie clamped. After the wheel is measured the turning process starts to re-profile the wheel (one axle will machined at once). The whole process will be controlled via a special Numeric Control with integrated PLC.

The main parts of the machine are:

- moveable rails with connection to the standard rails used in the workshop
- machine with drive wheels, cutting tools, control, measuring unit etc.
- Downholder, to clamp the axle during cutting
- Chip container incl. conveyer

Principle sketch of a lathe on pit:



3.4.5 Rail Road Conductor Wire Vehicle with crane

The Conductor Wire vehicle will be a two ways rail /road vehicle based on a standard road truck e.g. Mercedes Benz Unimog U 400. This truck can carry up to 3 persons at the cabin during work on road and rail.

In addition to the standard truck this vehicle will equipped with:

1. Rail guiding system

Track guiding wheels fixed on swivel arms

The swivel arms are moved by hydraulic piston, controlled from the cabin

Hydraulic and mechanical lock of track guiding axles during road mode

Steering lock during rail mode

2. Crane and platform

Hydraulic crane type is fitted at the rear end

The crane is of at least 6 m/t class and has got a hydraulic reach of approx. 4 m

4 outriggers providing the required stability during crane works.

Furthermore a loading platform to transport equipment will be provided with the admissible payload given by the basic vehicle design.

3. Demountable conductor wire maintenance basket

To do the installation and maintenance works for the Overhead line.

Able to carry the load of 2 persons.

The turning and lifting function can be operated from the platform.

31st March 2008 Submission

Edinburgh Tram Network

Section 3: Technical Descriptions

Part 3 – Railway Electrification

Table of Content

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1 Railway Electrification

When BBS or BBS Consortium is used in this document (or its Annexes), it stands only for the E&M part of the Edinburgh Tram Network. All information regarding phase 1b) (Russel Road Junction to Granton Square) within this document are for information, only. This current proposal is for phase 1a), which is the tram line from Edinburgh Airport via Russel Road Junction to Newhaven. As far as design considerations are concerned, phase 1b) operation was also taken into account that phase 1a) can be considered as stand alone. As far as OLE extension is concerned, at the connections between phase 1a) and future extension to phase 1b), regarding poles of phase 1a) will be considered as appropriate to be able the attach phase 1b) without the need of replacing (as far as pole function and static is concerned). No further extension to phase 1b) is needed for phase 1a), since OLE of phase 1b) can be attached to phase 1a) within in couple of night shifts where no operation of phase 1a) can be allowed. Phase 1b)-poles closest to phase 1a) are estimated to be at least 10m from phase 1a). Therefore, to make pole foundations for these poles later on, when phase 1a) is already finished, should not be an issue.

1.1 Introduction

This document describes the technical system parameter, solutions proposed as well as the scope and services for design, manufacturing, installation, commissioning, documentation, operation and maintenance training and trial run for the railway electrification system (REL) composed of the Intergrated systems traction power supply (TPS) and overhead line equipment (OLE).

1.2 Referenced documents:

[1]	"Employer's Requirements", document number PRO-INFRACO-1399; Rev. 4, In particular.Part 31 for OLE and Part 30 for TPS
[2]	"System Wide – Section 1, 2 and 3; 750V DC Power; Feeding and Sectioning Diagram (3 sheets)"; document number ULE90130-SW-OLE-00007, Rev. 3
[3]	"System Wide – Electrification Demarcation Diagram", document number ULE90130-SW-OLE-00010; Rev. 2
[4]	Invitation to Negotiate ("ITN") for the Procurement if the Infraco for the Edinburgh Tram Network – Information Release – Infraco ITN and Appendices – 30 March 2007
[5]	"Edinburgh Tram – Tram Technical Information Submitted Data" "UKPB1-#52182-v9-Tram_Technical_Information.DOC; received 2007-11-28
[6]	Note on OLE clearances dec07 v03.doc; received 2007-12-13
[7]	refer to appendix 8.3.11

1.3 System Outline

1.3.1 Operational Concept

The proposed REL system will be capable to work with operational scenarios described in [4], which can be summarized as follows:

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1. Scenario:

8 TPH Airport to Ocean Terminal + 8 TPH Haymarket to Newhaven

2. Scenario:

10 TPH Airport to Ocean Terminal + 5 TPH Haymarket to Newhaven

In both scenarios Haymarket could also be replaced by Granton Square (supposed phase 1b (= Sections C + D, from Haymarket to Granton Square) is also put in operation).

An additional 50% increase of the number of trams per hour travelling on the Edinburgh tram network can be handled by the REL system in peak hours for 2 hours time. This would lead in the most frequented sections to up to 24 TPH (this equals a calculated average headway of only 2.5 min, which can be considered as very little for a LRT system). For more details, refer to revised traction study (8.3.1).

1.3.2 Vehicle and other traction simulation input data

Systemengineering work performed for this proposal is based on input data provided by tie . Compared to information provided with tender documents, these data were updated and completed by tie (e.g. vehicle data, topografical data, speed limits).For details on input data used for simulation refer to attached "Network calculation with train simulation", appendix 8.3.1.

Different input data may lead to different requirements for the REL system or parts of it (e.g. traction transformer power ratings, cable cross sections). Siemens also assumes, that the vehicle can meet the required timetable with the overhead voltage shown in simuation results (e.g. minimum overhead line voltage for worst case scenario: (8+8)TPH+50% plus substation outage is given in appendix 8.3.1). In case the used input data changes, the network calculation needs to be redone. With the outcomes it can be determined, if a modified REL system needs to be offered by Siemens.

1.3.3 Environmental Conditions

Altitude	
Height above sea level	0-200 m
Temperature and Humidity	
Absolute Maximum Temperature outside	43 °C
Absolute Minimum Temperature outside	-13 °C
Maximum average daily temperature outside	18 °C
Minimum average daily temperature outside	1 °C
Relative humidity outside	75 % – 84 %
Maximum long term temperature indoor	30°C

Maximum peak temperature indoor	43°C
Wind	
Mean wind speed	4.6 m/s
Maximum speed	19.5 m/s
Design wind speed (exposed route)	40 m/s
Design wind speed (normal route)	30 m/s
Rainfall	
Average monthly precipitation	39 mm – 83 mm
Wet days per month (> 0.1 mm)	14 - 18
Wet days per year (> 0.1 mm)	191

1.4 Scope of Supply

At this stage of the project, system defining information, like ratings, cable cross sections, number of cables in parallel, conductor material, components used, etc. may be subject to change, although they do reflect the current status of design activities and the general concept offered will remain unchanged. The functional parameters given in [1] and specified in this document will be met by the system offered. Further design optimization is one goal of the detailed design phase, which will be performed in an early phase of project execution.

1.5 Standards Compliance

In general the REL system follows European Standards currently valid, which in many cases, have also been issued as BS EN standards in the last years.

EN 50128 and EN 50129 are not valid for REL system and cannot be used for REL system. European Standard EN 50126[1] will be followed for REL as far as RAMS is concerned.

1.5.1 Standards for Overhead Line Equipment System

Standard	Title
DIN EN 50119 Draft (07.06) EN 500119 (01.06)	Railway Applications – Fixed Installations – Electric Traction Overhead Contact Lines
DIN EN 50122-1 (12.97) EN 50122-1 (06.97)	Railway Applications – Fixed Installations; Part 1: Protective Provisions Relating to Electrical Safety and

[1] Specification and Demonstration of Reliability, Availability, Maintainability and Safety for Railway Applications; September 1999

	Earthing
DIN EN 50124-1 (04.06) EN 50124-1 (03.01) +A1 +A2	Railway Applications – Insulation Co-ordination; Part 1: Basic Requirements; Clear-ances and Creepage Distances for All Electrical and Electronic Equipment
DIN EN 50149 (10.01) EN 50149 (03.01)	Railway Applications – Fixed Installations – Electric Traction; Copper and Copper Alloy Grooved Contact Wires
DIN EN 50152-1 (07.98) New Draft (08.06) EN 50152-1 (06.97) Draft (03.06)	Railway Applications – Fixed Installations – Particular Requirements for AC Switch-gears
DIN EN 50152-2 (03.98) New Draft (08.06) EN 50152-2 (06.97) Draft (08.06)	Railway Applications – Fixed Installations – Particular Requirements for AC Switch-gears; Part 2: Single-Phase Disconnectors, Earthing Switches and Switches with Um > 1 kV
DIN EN 50163 (05.9) EN 50163 (11.04)	Railway Applications – Supply Voltages of Traction Systems
DIN EN 60383-1 (05.97) (DIN VDE 0446 T1) EN 60383-1 (11.96) +A11 (10.99)	Insulators for Overhead Lines with a Nominal Voltage Above 1 kV; Part 1: Ceramic or Glass Insulator Units for AC Systems; Definitions, Test Methods and Acceptance Criteria. Note: also applies to insulators in DC contact lines.
DIN EN 60865-1 (11.94) EN 60865-1 (12.93)	Short-Circuit Currents – Calculation of Effects; Part 1: Definitions and Calculation Methods
DIN EN 50122-1:1997-12-01	Railway Applications; Special Provisions for Fixed Installations
DIN VDE 0141 (01.00)	Earthing System for Special Power Installations for Nominal Voltages Above 1 kV
DIN EN 50122-2:1999-05-01 DIN EN 50162:2005-05-01	Protection Against Corrosion Due to Stray Currents of DC Installations
DIN EN 50341-3-4:2002-03-01 DIN EN 50341-1:2002-03-01 DIN EN 50423-1:2005-05-01 DIN EN 50423-3-4:2005-05-01	Planning and Design of Overhead Power Lines with Rated Voltages Above 1 kV
DIN VDE 0216 (02.86)	Fittings for Overhead Contact Line and Conductor Rail Equipment; Static Mechan-ical Behaviour; Requirements and Testing
DIN VDE 0228 Part 3 (09.88)	Proceedings in the Case of Interference on Telecommunication Installations by Electric Power Installations, Interference by AC Traction Systems

DIN VDE 0228 Part 4 (12.87)	Proceedings in the Case of Interference on Telecommunication Installations by Electric Power Installations, Interference by DC Traction Systems
DIN VDE 0100 (05.73)	Regulations for the Erection of High-Tension Installations with Rated Voltages up to 1000 V
DIN VDE 0446 Part 2 (03.71)	Regulations for Insulators for Overhead Power Lines, Overhead Equipment and Telecommunication Lines; Regulations for Insulators for High-Tension Overhead Lines and Overhead Equipment up to 1000 V as well as Telecommunication Overhead Lines
DIN VDE 0446 Part 3 (05.73)	Regulations for Insulators for Overhead Power Lines, Overhead Equipment and Telecommunication Lines; Regulations for Fittings Permanently Connected to the Insulators
DIN 43138 (09.80)	Flexible Cables for Overhead Equipment and Return Current
DIN 43156 (03.78)	Electric Traction; Conductor Rail, Dimensions and Characteristics
DIN 43167 Part 1 (12.87)	Rod-Type Insulator for Overhead Contact Lines for Operating Voltages up to 1000 V AC and 1500 V DC; Assembly
DIN 43167 Part 2 (12.87)	Rod-Type Insulator for Overhead Contact Lines for Operating Voltages up to 1000 V AC and DC 1500 V; Caps, U-Bolts and Hook Bolt
DIN 43167 Part 3 (12.87)	Rod-Type Insulator for Overhead Contact Lines for Operating Voltages up to 1000 V AC DC 1500 V; Insulator
DIN 48201	Cables
DIN 48217 (06.78)	Notch Connectors for High-Tension Contact Wires and Rail Overhead Equipment
DIN EN ISO 9001	Quality Management System
BO Strab	Directive for the Construction and Operation of Tram Systems

Table 1: List of Standards for OLE

1.5.2 Standards for Traction Power Supply System

Erection of Electrical Installations	
EN 50110-1:2004	Operation of electrical installations
EN 50110-2:1996	Operation of electrical installations (national annexes)
Rectifier Transformer	
EN 50329:2003	Railway applications - Fixed installations - Traction transformers
IEC 60076-1, Edition 2.1:2000	Power transformators - Part 1: General
IEC 60076-2:1993	Power transformers - Part 3: Insulation levels, dielectric

	tests and external clearances in air
IEC 60076-3:2000	Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air
IEC 60076-8:1997	Power transformers - Application guide
EN 60146-1-3:1993	Semiconductor convertors; general requirements and line commutated convertors; part 1-3: transformers and reactors
Rectifier	
EN 60146-1-1:1993 EN 60146-1-1/A1:1997	Semiconductor convertors; general requirements and line commutated convertors; part 1-1: specifications of basic requirements
IEC 60146-1-2:1991	Semiconductor convertors; general requirements and line commutated convertors; part 1-2; application guide
EN 50327:2003	Railway applications - Fixed Installations - Harmonization of the rated values for converter groups and type test on converter groups
EN 50328:2003	Railway applications - Fixed Installations - Electronic power converters for substations
EN 50124-1:2001 EN 50124-1/A1: 2003 EN 50124-1/A2: 2005	Railway applications - Insulation coordination - Part 1: Basic requirements; Clearances and reepage distances for all electrical and electronic equipment
IEC 60971:1989	Semiconductor convertors - Identification code for convertor connections
DC Switchgear	
EN 50123-1:2003	Railway applications - Fixed installations; D.C. switchgear - Part 1: General
EN 50123-2:2003	Railway applications - Fixed installations; D.C. switchgear - Part 2: D.C. circuit breaker
EN 50123-3:2003	Railway applications - Fixed installations; D.C. switchgear - Part 3: Indoor D.C. disconnectors
EN 50123-6:2003	Railway applications - Fixed installations; D.C. switchgear - Part 6: D.C. switchgear assemblies
EN 60439-1:1999 EN 60439-1/A1: 2004	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies
IEC 60947-3, Edition 2.2: 2005	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units
EN 50124-1:2001 EN 50124-1/A1: 2003	Railway applications - Insulation coordination - Part 1: Basic requirements; Clearances and creepage distances

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EN 50124-1/A2: 2005	for all electrical and electronic equipment
Power and Control Cables	
HD 603 S1:1994 HD 603 S1/A1:1997 HD 603 S1/A2:2003	Distribution cables of rated voltage 0,6/1 kV
HD 620 S1:1996 HD 620 S1/A1:2001 HD 620 S1/A2:2003	Distribution cables with extruded insulation for rated voltages from 3,6/6 (7,2) kV to 20,8/36 (42) kV
HD 627 S1:1996 HD 627 S1/A1:2000 HD 627 S1/A2:2005	Power cables - Multicore and multipair cable for installation above and below ground
Earthing and Bonding	
EN 50122-1:1998	Railway applications - Fixed installations - Protective provisions relating to electrical safety and earthing
EN 50122-2:1999	Railway applications - Fixed installations - Protective provisions against the effects of stray currents caused by d.c. traction systems
HD 637 S1:1999	Power installations exceeding 1 kV a.c.
HD 60364-4-41:2007	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock
Electromagnetic Compatibility	
BS EN 50121-1:2006	Railway applications - Electromagnetic compatibility - Part 1: General
BS EN 50121-5:2006	Railway applications - Electromagnetic compatibility - Part 5: Emission and immunity of fixed power supply installations and apparatus

Table 2: List of Standards for TPS

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2 System Design

The aim of system design activities for this proposal was to propose an appropriate REL system considering the functional requirements described in tender documents. As a system designer, we did not follow all technical details to be able to propose a cost effective system, meeting the customer requirements e.g. as far as function and operation is concerned.

Therefore system design activities have been performed by Siemens for this proposal. Attached excerpt of traction study shows exemplary results of first simulations. These are to be considered as preliminary. A more detailed simulation will be performed as part of the detailed design phase. Results will be used for further definition of electrical equipment, like transformer ratings, cable cross-sections, number of cables used in parallel etc..

Some examples deviating from design described in detail in referenced tender documents ([1], [2]) with no effects on required system function are listed as follows:

1. No technical or operational need or advantage for building the (future) Russel Road Substation (initially to be provided as a track paralleling hut without DNO supply) was identified. Power supply is not and will not be in future (taking the information given in ERs into account) an issue at all in this part of the line (other substations are closer to full designed transformer rating than the ones adjacent to Russel Road). As far OLE sectioning is concerned no special building is required, too. We suggest not to build Russel Road substation/ track paralleling hut at all.

2. The reinforcement cable between GRE- and LSE-Substation as shown in tender document ULE90130-SW-OLE-00007, Rev. 3, sheet 1 of 3, is not needed at this point. This reinforcement cable should be designed and installed as appropriate when section 4 (delivery phase 2) will be realized in future. We suggest not to use a reinforcement cable between GRE- and LSE-substation for delivery phase 1 (phases 1a and 1b).

3. In part 3g/ chapter 3.3 of [1] it was asked to provide isolator enclosures for feeder and bypass isolators. For a LRT system as described in the tender documents we suggest to use section isolators mounted on OLE poles. This is common practice and proven design. The installation process is easier and more cost effective and special section pillars will not be needed at all. We suggest to install isolators located in substations in the OCS coupler room (refer to appendix 8.3.6) and to mount wayside isolators on OLE poles, outside City Center from Haymarket to Edinburgh Airport. However, in City Center from Haymarket to Newhaven section isolators will be located in trackside cabinets.

4. Cross sections and number of cables in parallel for power cables (e.g. DC-feeder cables or track paralleling reinforcement cables) are selected according to technical need, based on simulation results.

However, first simulation results (refer to 1.3.2) and further investigations proved the adequateness (regarding e.g. minimal OCS voltage (>500V), rail potential

(<60V, for very short times, in one location in one worst case scenario the rail potential is slightly above 60V; this can be handled with minor optimisation, for details refer also to appendix 8.3.1), current carrying capacity of cables and contact line, power rating of components (e.g. transformers, switchgear) offered) of following (refer also to appendix 8.3.1):

a) parallel reinforcement cable (where single trolley wire is proposed):

1 pc. 1 x 400mm^2 Cu for the line

or

1 messenger wire 120mm^2 (where catenary system is proposed)

b) feeder cable (substation to line)

2 pcs. 1 x 400mm^2 Cu in parallel

c) return cable (line to substation)

2 pcs. 1 x 400mm^2 Cu in parallel

d) 1 contact wire, 120 mm^2, copper

e) track bonds every 500m; rail bonds every 250m

f) type of rail

59-type rail in City Center (Newhaven to Haymarket)

49-type rail on Airport Link (Haymarket to Edinburgh Airport)

Items a) to e) also reflect the content of the proposal. Other componet ratings derived from this study are given in other locations of this document (e.g. transformer rating). With reference [5], we received first, not confimed CAF vehicle data. Thereafter, tie provided a complete set of input data to be used for a revised traction study to reevaluate the adequateness of the REL system proposed. Both, input data provided by tie and used for the traction power network simulation as well as the simulation results itself are given in appendix 8.3.1.

5. Interface between substation control and SCADA system databus via databus system rather than a hard wired interface cubicle.

Our proposal is based on the described suggestions. However, in case tie wants to insist on the original described system in the examples listed above, solutions can certainly be offered by Siemens.

More details regarding the offered REL system can be found in the following chapters.

2.1 Substation Control, Monitoring and Protection

As Substation Control System Sitras® SCS with Sitras® PRO is part of this proposal. Attachment 8.3.5 provides an overview about the substation control system and protection concept offered for ETN.

The central substation-control unit will be realized by a PLC (Simatic S7 635 touch, or similar) and does collect, evaluate and distribute all relevant substation control and protection data both substation internal as well as to SCADA system. It will also interface the medium voltage level protection unit from Scottish Power, to be able to trip their "consumer circuit breaker" for protecting tie's substation equipment. In addition some protection parameters will be provided from Siemens to Scottish Power for adequate protection of rectifier and DC-unit in project execution phase. Intertrip and Frame Fault Protection (FFP) are also functions realized in the substation-control unit. For more conceptual information on FFP, please refer to attachment 8.3.3.

The hard-wired emergency trip signal will also be read into this central substation-control unit, which initiates the tripping of overhead line feeder circuit breaker (refer also to "tripping functions" listed below). Industry type relays will be used for the hard wired emergency tripping line (refer also to appendix 8.3.2).

For 2nd-level protection, each substation-controller is connected via a multi-core pilot wire to the adjacent substation-control units. In case there is a short circuit on the overhead line, the SCS central unit detecting this short circuit first will trip the relevant adjacent substation via this hard wired connection.

Since we propose not to install a separate RTU with a hard wired interface between substation control and the substation node of SCADA system, the battery charger-, intruder alarm- and fire detection-status message will also be read into the central substation control unit and routed through the substation control system via substation node and SCADA to the central control room for information of the operator. For these status messages, substation control unit acts like a signal forwarding unit, only.

Protection functions for the feeders will be covered by Sitras® PRO unit. One of those units is located in each feeder panel.

For protection of persons characteristics defined in EN 50122-1 will be followed by Sitras® SCD, connecting the return line to earth (refer to chapter 4.3.2 and to single line in appendix 8.3.2) if rail potential limit is reached.

Substation feeder isolators and the bypass isolator will be controlled by the Simatic ET 200S units.

All these devices belonging to the substation control system do exchange relevant data using Profibus DP databus system. The interface to overall SCADA system is physically the local substation OTN node. The SCS central unit and SCADAs substation OTN node are connected via a databus interface using Ethernet TCP/IP or Modbus RTU (or similar).

Following protection functions can be implemented using Sitras® PRO DC protective unit:

- Overcurrent protection I_{max} and $I_{max\,rev}$
- Current step protection ΔI
- Current rise protection (dI/dt)
- Independent definite-time overcurrent time protection I DMT and I DMT $_{rev}$
- Undervoltage protection V_{min}
- Overvoltage protection V_{max}
- Monitoring of line voltage
- Impedance protection
- Circuit breaker failure protection (trip of higher-level circuit breaker)

Tripping functions for staff provided:

1. System Controller, located in control room, can trip 11 kV supply of each substation individually via SCADA.

2. Staff can trip 11 kV supply locally by means of a push button located in substations lobby of each substation, which is read into the central substation control unit.

3. System controller, located in control room, can trip 750 V overhead line in either direction starting from one substation via SCADA.

4. System controller, located in control room, can trip 750 V overhead line in both directions via hard wired mass trip line. The signal will be read into the central substation control unit and tripping of DC feeder circuit breakers will be initiated. DC-feeders of all substations of one group will be tripped by pushing the relevant push button. Substations are clustered into two groups.

5. Staff can trip 750 V overhead line in both directions simultaneously by means of a push button located in substations lobby of each substation, which is read into the central substation control unit.

6. System controller, located in control room, can trip 750 V overhead line section between two adjacent traction substations via SCADA. In addition to the control signals transmitted via SCADA to the substation control systems, the DC feeders of relevant adjacent substations can be tripped using the intertrip pilot wires.

In addition to the listed tripping functions, this proposal is based on, as clarified with tie in meeting on 2007-11-27, feeder and bypass isolator functions as described in appendix 8.3.10. In the depot wayside switches are offered to be manually operated, only.

2.2 EMC, Earthing & Bonding

For system wide EMC and Earthing & Bonding concept, please refer to Folder 3, Part 1 of 2, Section 2, Annex 3 and Annex 4.

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3 Overhead Line (OHL)

3.1 OHL System Description – Design

The contractor will design the complete system using the standards, parameters and layouts detailed in this documentation and the technical drawings given in tender documents as listed in appendix 8.3.11.

The OHL equipment is suitable for supplying current to pantographs mounted on the roof of the trains without any significant loss of contact and the resultant sparking, at all speeds up to 80 km/h under the operating conditions given in this documentation is within acceptable limits.

The OHL system has been pre-designed as trolley type without messenger wire and one contact wire per track from Newhaven to Russel Road Junction. A parallel bypass cable laying in the earth will be used. In this part of the line, the design tender drawings as listed in appendix 8.3.11 have been followed for this proposal (bill of quantity). The given design was considered being apropriate for autotensiong solution, which is offered with this proposal. Fixed tensioning solution could also be offered for this part of the line. More considerations regarding contact wire-panto contact quality, panto and contact wire wear/ impact on maintenance, ensuring that contact wire remains under all operational condition within the specified working range and disadvantages due to increased, if not even unacceptable sag needs to be made on this issue. To find an acceptable solution will probably, beyond other modifications, lead into an increased number of poles, and modified pole locations in some areas, compared with the design shown on tender drawings. Increased tensioning forces may help to limit the maximum sag, but needs also further considerations, e.g. as far as contact wire safety (worn condition) and statics of mounting parts (like pull offs) and poles are concerned.

From Russell road junction to the Edinburgh Airport as well as from Russel Road Junction to Granton Square the OHL system has been pre-designed as catenary system with both one single contact wire and one single messenger wire. For this part of the line, the design in tender drawings as listed in appendix 8.3.11 have been used as a basis. Bill of quantities, like number of poles and related equipment has been reduced/ adjusted to use the cost advantages provided by using a catenary rather than an autotrolley system with buried parallel reinforcement cable.

The OHLE shall be prefered auto tensioned along the whole line and depot.

Building fixings will be used where applicable and technically possible. Where building fixings cannot be applied poles shall be used at lines and depot to install OHL supports (cantilevers, cross or head spans and other OHL equipment). Cross spans will be used especially in the city centres, double track cantilevers mostly used in narrow curves, where location of centre poles is not possible.

Consequently, the OHL of the system will have to be designed taking into account different circumstances with priority in individual areas.

The contact wire is staggered to even out the pantograph wear.

According to the simulations carried out and described in the Traction Study a cross section of 120 mm^2 for contact wire has been found necessary to transfer the traction power during scheduled service.

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The material type (copper or aluminium), the cross section and the number of cables (one or two) of the bypass cable will be defined during a later stage.

The messenger wire will have a cross section of 120 mm², material is copper.

In principle the layout design follows the tender (refer to appendix 8.3.11), especially in areas with building fixings, since changes might have a major impact on design and consent process performed by tie. The same applies for the whole City Center (Haymarket to Newhaven), where the number and locations of poles and related equipment follows tender drawings as per appendix 8.3.11. Based on these requirements, the proposed design was modified to an autotensioning system to cope with e.g. the given pole distances and environmental requirements (in particular min/max temperature) as well as to provide state-of-the art technique with low maintenance needs.

3.1.1 Design for main line, city loop from Newhaven to Granton Square

For the portion of the City Loop from Newhaven to Russel Road Junction an auto-tensioned contact wire system will be installed for the main line. On the supports the contact wires are supported by bridle suspensions at cross wires or cantilevers. Single cantilevers are preferably mounted at the masts, which should be located between the tracks of the double-track section. For the city loop building fixings will be the preffered solution, wherever possible. The parallel bypass cable will be connected via Y-joints to the contact wire and also both contact wires will be connected to each other in appropriate distances. The exact distances will be defined according to the traction study during the basic design phase.

3.1.2 Design for main line, from Russell Road Junction to Edinburgh Airport

For the Overhead Line System outside the city centre a catenary system with one contact wire and one meesnger wire has been foreseen. The huge advantage of this solution is the possibility of direct connection between contact wire, which is the connection to the pantograph and the messenger wire. The long and often connection from cables laying in the earth to the contact wire could be saved. And in addition the span length from support to support could be enlarged, because the system with contact wire and messenger wire has a bigger mechanical stability. However, the bill of quantities for this proposal is based on tender drawings as listed in appendix 8.3.11 adjusted to use the cost advantages provided by using a catenary rather than an autotrolley system.

3.1.3 Design for the Depot area

An tensioned trolley system with one contact wire will be installed in the Stabling Yard and in the Workshop Building.

The contact wire will be tensioned by spring terminations or wheel tensioning devices respectively fixed terminated where applicable.

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The cross section of the contact wire will be calculated during basic design phase. Nevertheless it will be not more than 120 mm².

In the workshop a movable conductor rail will be installed on two tracks. One track will be 55 meter and a second track will be 110 meter length.

A locking device for the switches in the workshop is considered. The purpose is to interlock OLE sectioning disconnectors in workshop with high level access platform, movable conductor rail and craneage. The integration of these disconnectors, which will be mounted close by overhead contact wire at workshop building wall, into an overall interlocking concept will be supported by using padlocks.

3.1.4 Requirements for the OHL-System to Earthing

DC railway installations require an earthing and return current system to satisfy the requirements for safety of persons and for protective provisions against the effects of stray currents.

The earthing measures which affect civil works and all participants for the electrification, especially power supply and overhead line system will be coordinated in the overall earthing concept.

The insulation of the running rails is the main parameter for reducing stray currents. Therefore, all exposed conductive parts which are not insulated from earth shall be connected to earth and shall not be directly bonded to the running rails. The support structures of OHL need not to be connected to the running rails via voltage-limiting devices if the insulation of the overhead contact line has been doubled or reinforced.

3.1.5 Building Fixings

The requirement in the tender to use building fixings preferably instead of poles to support OHL equipment wherever it is possible have been considered. The design of building fixings follows the tender, since changes might have a major impact on design and consent process performed by Tie. It is assumed that all necessary permissions from house owners will be available if the contract comes into force and that those will be handled by Tie or others, not Siemens.

The feasibility for using of defined buildings (tender documents) for fixation of building fixings from static point of view will be verified by Tie or others, not by Siemens taking design requirements from Siemens REL into account. Legal permissions (e.g. building fixing agreement) will be handled by Tie or others.

3.1.6 Abnormal load routes

Abnormal load routes and contact wire heights are now in accordance with [6].

3.1.7 Protection of poles

Protection of poles against corrosion has been taken into account. OHL poles will be galvanized and painted. Cable arrangements e.g. for infeed purposes will be carried inside the poles to protect them against outer influences.

3.1.8 Overhead Line under Bridges

OHL equipment will either be fixed under bridges by means of special elastic supports (where necessary) or passed through without direct fixing to the bridge structure if neighboured poles can be used to support them.

The overall earthing concept will consider earthing conductors to be installed under bridges to react against an increase of the bridge potential in case of unintended touch with traction voltage (e.g. in case of faults, where derailed pantograph or broken OHL wire could get in touch with the bridge). Insulating plates shall be installed, if additionally necessary, to protect the bridge structure during those circumstances.

However, it will be part of the interface clarification during implementation of the project to coordinate those details considering local conditions.

3.1.9 Interface to OHL Foundation and Buildings

In general, poles will be mounted on block foundations by means of anchor bolts. The anchor bolts are welded to the reinforcement of the concrete and thus are used for the earthing of the poles.

Foundations of poles will be constructed by the civil work partner according to the design requirements of REL.

3.2 Description of Overhead Line Equipment (OHLE)

3.2.1 Cantilever, cross span and head span arrangements

The OHL system is supported and registered by means of single pole mast mounted cantilevers, back to back and 2 tracks cantilevers, cross span wires and in few cases by head spans. Under overpasses, the system is supported by modified supports (e.g. elastic supports) attached to the structure roof or wall. In the workshop the system is attached to the building structure, In the depot area outside the workshop the OHL mounted via head spans on poles.

The contact wires will be supported by means of bridle suspension at cantilevers or cross spans.

3.2.2 Cross Span Support

Where the localisation does not allow the use of cantilevers, especially in the city centres cross spans will be utilised. Where it is possible the span wire is fixed to a building anchor, otherwise it is installed between poles.

3.2.3 Span Wires

It is proposed at this stage that Bz–wires will be utilised for span wire purpose. The cross section will be determined according to the load requirement and safety factor to be applied. The design will establish some standard cross-sections most probably BZ II 35 mm^2, 50 mm^2 and 70 mm^2 in order to minimise the amount of spare part and fittings variety. To serve the overall insulation philosophy of the OHL all terminations of span wires will be double insulated.

3.2.4 Contact Wire Supports

The contact wire in shared track areas will be supported by a so called delta suspension with a synthetic bridle wire (type MINOROC). This serves already as the first insulation level. The contact wire will be clamped at both ends of the bridle wire with a spacing of approximately 2.5 m between.

The delta suspension wires will be made up of MINOROC wires. These wires consist of a high tensile polyester fibre core covered with an extruded outer sheath made of Polyamide in black colour. This wire design has been employed in similar OHL projects for more than 10 years with an extremely satisfactory performance. The outer sheath avoids any negative influence caused by UV radiation ensuring that the performance data of the wire remains unchanged over the service period. The termination ends of the MINOROC wire will be equipped with crimp connectors specially dimensioned to suit the MINOROC wire requirements.

The arrangement of the delta suspension will accommodate the full range of contact wire movement caused by temperature changes. This will be achieved by the hinged cantilever support or the pulley arrangement in cross span arrangements. The delta suspension design provides a flexible support of the contact wire avoiding hard spots at the support, which would reduce the lifetime of the contact wire.

From Russell Road Junction to Edinburgh Airport a overhead line system with both, simple contact and simple catenary wire will be considered. This so called catenary system will be carry out with droppers made of Bz (e.g. 25 mm^2).

3.2.5 Pull Off Arrangement

These arrangements are employed between regular supports to provide a contact wire pull off at tight curves or in transition areas of the track to take the heavy radial load of the contact wire and place the contact wire appropriately within the limits specified above the track. Often a conventional OHL support will not be required at such locations and during the layout design it may be decided to employ such a pull-off arrangement instead.

3.2.6 Tubes and OHL Fittings

We propose to utilise aluminium tubes with natural finish to make up the cantilever frame. The fittings will be made of hot dip galvanised malleable cast iron. All components employed for the system will be standard components having a long and reliable service record already.

In the area near the water, from Granton Square to Caroline Park and from Newhaven to Ocean Drive, stainless steel tubes could be used for the cantilever material. However, as discussed and agreed on with tie, also near the water, material as defined in the previous paragraph will be provided.

Contact wire clamps will be of the parallel groove bolted design ensuring the correct fixation of the contact wire even if that is in fully worn condition.

Turnbuckles will be employed at those locations which may need some adjustment during their service life. Keeping this requirement in mind these locations will be finally decided on in the detailed design stage. For the moment at least the terminations of cross span wires, anchoring wires and guy wires will be equipped with turnbuckles.

As an option fully insulated cantilevers made of GPR tubes could be offered. If such solution is favoured the offer has to be revised, because such solution is not part of our offer.

3.2.7 Isolators

Isolators will be used only in the depot area. Manually operated isolators will be operated by means of a permanently mounted handle connected to the isolator by tube or similar arrangement.

The feeding, coupling and switching of the main track is realized within the substations by adequate coupling equipment. Only the so called section isolators for coupling in longitudinal direction will be installed directly on the top of the poles outside City Center from Haymarket to Edinburgh Airport. However, in City Center from Haymarket to Newhaven section isolators will be located in trackside cabinets. A preliminary sketch of a cabinet is given in appendix 8.3.9.

A window, which may allow a view to disconnector, to check the position without opening the cabinet door is not planned. This may be subject to vandalism. In addition, disconnecting and earthing the contact line e.g. for maintenance purpose will happen rather seldom. However, the five safety rules needs to be followed in any case, thus e.g. the contact line needs to be earthed using an earthing gear in any case. This is a more obvious indication of contact line status which is in accordance with the five safety rules. That is also the reason, why we do not recommend and did not allow for section isolators with dedicated earthing function.

Further clarification led to the result, that tie insists on three position switches with earthing function. These will be provided. The description in appendix 8.3.10 describes two position switches. This is to be disregarded from now on therein.

Further information regarding the proposed functions of the offered isolators are given in appendix 8.3.10.

3.2.8 Insulators

For the open section insulators will be used in the terminations and in the cantilever. Except for the synthetic rope employed in the delta type suspension no flexible insulators will be used in the OHL.

Standard design insulators, which are proven in similar installations will be utilised.

3.2.9 Section Insulators

The design of the section insulators will avoid any negative effect on the reliable operation of the assembly which may be caused by any torque in the contact wire. The section insulator as well permits the full travelling speed in both directions.

3.2.10 Jumper Connections

Jumper connections to the contact wire will be required at feeding locations, overlap arrangements and crossovers. The jumpers will be arranged as to avoid hard spots on the contact wire, which otherwise would create potential safety hazards due to the increased contact wire wear.

One possibility of reducing the negative effect of these jumper connections would be to locate them as close to the suspension as possible. This arrangement would eliminate the negative effect of the weight additionally imposed on to the contact wire.

3.2.11 Poles

In principle the following pole types are the preffered types for a tram system:

Preferred solutions (variants not in order):
Variant 01: H-beam steel poles (no longer considered for ETN, except for depot, where H-beams may remain an option)
Variant 02: Round steel poles
Variant 03: Round steel poles (2-stepped)
Variant 04: Round steel poles (3-stepped)

Alternative solutions (variants not in order):
Variant 05: Conical tapered column poles
Variant 06: Hexagonal tapered column poles
Variant 07: Octagonal tapered column poles

Due to the fact, that the visual impact is very important in the Edinburgh City Centre, we considered there three stepped round steel poles. Also for the area from Russel Road to the Edinburgh Airport we considered three stepped round steel poles. For the depot three stepped round steel poles or H-beam poles will be used, depending on the detailed static calculations, which will be carried out during the basic design phase.

All poles are welded to a base plate incorporating holes for easy attachment on to the mast foundations. The variety of pole diameters will be limited as far as reasonable due to the tension applied to it. All feeding poles will have cable access by means of an embedded conduit to the centre of the pole.

Pole lengths are considered between approx. 7.5 and 9.5m. Diameters at the pole base are estimated between approx. 280 and 470mm. This large variation is due to different pole types (function, system, forces and moments applied) and is dependent on further design evaluation in basic design phase.

SDS reference design shows a high number of pole variants for both stepped and tapered poles. Our offer consideres stepped poles for the complete line. For this

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proposal, the number of pole variants was reduced to a minimum as technically required.

3.2.12 Tensioning

Contact wires will be auto-tensioned to give nominally constant tension over the entire operating temperature range of the equipment.

The automatically tensioned wires will be tensioned by the following forces:

contact wire	12 kN
Messenger wire, where applicable	12 kN

Tension lengths of max. 1500 m will be equipped with tensioning device at both ends. Weight type tensioning devices will be installed with a ratio of 1 : 3.

Short tension lengths which do not carry through current, e. g. crossovers, may be tensioned by means other than weights, e. g. springs, but the characteristics of these devices proposed are such that satisfying operation of the system is obtained over the full working temperature range.

3.2.13 Rail and Track bonding

Rails shall be bonded with connections rail to rail and connections track to track.

Depending on the Detailed Traction Study, which will be carried out during the basic design phase the rail bonds and track bonds will be installed in the required distances.

3.2.14 Tie Back Anchors

The proposed design includes tie back anchors. It was based on tender drawings as per appendix 8.3.11, which also considers tie back anchors. Alternative solutions with no tie back anchors could also be offered. Where tie back anchors are used anti climbing measures will be considered.

3.2.15 Combined Poles

OLE Poles, combined with street lights will be considered in this proposal where shown as per SDS design as of November 2007.

3.2.16 Contact Wire Height: Railway Safety Publication 2

In BBS former proposal, a contact wire height of 5,6m was considered. In above mentioned "Guidance on Tramways", refer to following excerpt, two requirement are found with impact on contact wire height/ design.

Excerpt:

"
...

180 *The design of the overhead line supports should aim to minimise the vulnerability of each support to damage. The loss of any one support (eg as a result of a fire loosening a building fixing or of a pole being struck and damaged by a road vehicle) may release tension in the overhead line system but the design should allow other supports to*

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prevent live equipment from sagging below 5200 mm above the highway. Off highway, it may sag lower provided that it remains out of reach of pedestrians. Connections between the pole and the contact wire should be mechanically weaker than the contact wire system itself to ensure that if a pole is damaged, the connection will break before the live equipment is dragged down.

...."

3.2.16.1 "5,2 m" – Requirement

The proposed design in City Center (shared tracks) was revised to comply with this requirement.

For off highway sections, where catenary system is offered (refer to chapter 3.1 and 3.1.2), it is assumed that pedestrians do not have access to general parts of the line. Where crossings are, the situation is different. However, it is noted, that reference [6] considers 4m as minimum contact wire hight, It is also noted, that EN50122-1 asks for 3m in public areas and 2,6 in non-public areas in normal situation. During design phase, this subject will be investigated further. If necessary, outcomes could be further evaluated in a risk assessment.

3.2.16.2 "Support Weaker than Contact Wire" – Requirement

The "Support Weaker than Contact Wire" – Requirement cannot be met by BBS. As discussed in meeting with tie on 2007-12-05, it is also believed by tie that this requirement does not need to be demonstrated. However, compliance to this requirement is excluded from this proposal.

3.3 OHL Assembly Drawings in the annex

Number of drawing package: UK4-Z1100-0201 (32 pages).

Page	Title	Date
1	Cross section cross span (wall anchor)	16.03.2007
2	Cross section with single track cantilevers	16.03.2007
3	Cross section with two track cantilevers	16.03.2007
4	Manufacturing and installation tolerances for OHL Equipment	16.03.2007
5	Simple contact wire system simple cantilever with steady arm on center pole	27.03.2007
6	Simple contact wire system simple cantilever with steady arm on side pole	27.03.2007

7	Single contact wire system under bridges, with elastic supports	16.03.2007
8	Simple contact wire system simple cantilever with steady arm for two tracks on side pole	27.03.2007
9	Simple contact wire system cross span pole ploe with bridle-pulley- suspension for two tracks	27.03.2007
10	Examples for Foundations	16.03.2007
11	Return conductor connection at rail cable distribution cabinet with cable connector	27.03.2007
12	Exampel of return cable connection at segregate tracks	16.03.2007
13	Exampel of return cable connection at embedded tracks	16.03.2007
14	Track and rail current connection for two tracks	27.03.2007
15	Principle arrangement of track and rail bounds for embedded track	16.03.2007
16	Current connector	16.03.2007
17	Simple contact wire system sectioning for simple cantilever at swichtable with disconnector for one pole	27.03.2007
18	Terminations for contact wire/s or catenary system	16.03.2007
19	Flexible termination at pole for contact wire with spring	27.03.2007
20	Fixed termination for single contact wire	27.03.2007
21	Fixed termination for catenary system with cable roll	27.03.2007
22	Building fixing for multiple fixation	27.03.2007
23	Building fixing arrangements	27.03.2007

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24	Fixing accessories arrangements for contact wire poles	16.03.2007
25	Fixing accessories arrangements for contact wire poles	27.03.2007
26	Fixing for double cantilever at steel pole	27.03.2007
27	Overvoltage protection for pole intallation	27.03.2007
28	Single (Trolley-type) contact line system, tension length with overlap	27.03.2007
29	Overlap contact wire system with single contact wire	16.03.2007
30	Overlap catenary system with messenger wire and contact wire	27.03.2007
31	Simple contact wire system with bridle-and-pulley suspension	27.03.2007
32	Cantenary system with cantilever suspension	27.03.2007

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4 Traction Power Supply

The traction power system for LRT Edinburgh is basically located in the substation buildings. Sketches showing first possible layouts are attached (cross reference to appendix 8.3.6). The therein shown "substation incoming circuit breaker" is included in this proposal. However, BBS still does not have a full picture regarding different types and layouts of substation buildings for ETN. The BBS proposal is based on two different substation layouts as attached to be used for all substations except depot substation (which will be integrated in depot buildings). Contrete buildings are planned for substation buildings.

	Substations	Nomenclature
	Phase 1a	
1	Leith Sands Substation[2]	LSE
2	Leith Walk Substation	LWE
3	Cathedral Substation	CAE
4	Haymarket Terrace Substation	HTE
--	Russell Road Substation[3]	RRE
5	Jenner's Depository Substation	JDE
6	Bankhead Drive Substation	BDE
7	Gogar Depot Substation	GDE
8	Ingleston Park and Ride Substation[4]	IPE
	Phase 1b	
9	Craigleith Substation[5]	CGE
10	Granton Mains East Substation	GME
11	Granton Road Substation[6]	GRE

Table 3: Substation Abbreviations

The locations of the substations are considered to be given by tie and to be fixed, although some unbalances in terms of power loads from traction line exist. These can and will be handled with an appropriate customized design which may lead to specific requirements and solutions in different sections of the network (e.g. power ratings and cable cross sections). The proposed system is more defined following and in subsequent chapters.

Basically, Table 3~~Table 3~~ provides an overview about the number of substations each substation contains components and switchgear as shown in substation

[2] In some tender documents/ tender drawings named as „Tram North Leith Sands Substation (NLE)"

[3] no need for this (possible future) substation identified; therfore not part of Siemens' proposal; refer also to page 11 item 1

[4] In some tender documents/ tender drawings named as „Tram Eastfield Road Substation (ERE)"

[5] In some tender documents/ tender drawings named as „Tram South Groathill Avenue Substation (SGE)"

[6] In some tender documents/ tender drawings named as „Tram Granton View Substation (GVE)"

single line which is part of appendix 8.3.2. From there, a bill of quantities, reflecting the proposed system, can be derived.

4.1 Medium Voltage Level/ Interface to DNO

Medium voltage level is 11kV for Edinburgh tram network. As described in the tender documents, medium voltage connections between the substations are, or will be realized by Scottish Power (=local DNO in Edinburgh) and is therefore not considered whithin the scope of this proposal. The requested separate "SP Compartment" for Scottish Power gear, like MV-switchgear, metering unit, etc. will be provided in substations (refer to substation layout sketches). The Scottish Power Room was enlarged in attached layout, as advised by tie in meeting on 2007-11-13 to a size of 4mx4m.

For the interface of MV-level switchgear to the rectifier and DC-unit, also as far as scope of supply is concerned, different scenarios may apply:

1. Scenario

All SP Compartment contents (e.g. RMU MV switchgear, metering, protection, "SP Consumer Circuit Breaker") are in Scottish Powers' scope of supply. Siemens will provide control cables and required parameters to enable Scottish Power to adjust their protection unit in an agreed on and appropriate way (e.g. that the SP Consumer CB can be tripped by Siemens' control system for protection of rectifier transformer).

2. Scenario

For most possible independability from Scottish Power in terms of technical intefaces, Siemens could provide tie's own MV switchgear, which would comprise basically one incoming and one outgoing feeder for each substation together with an own MV protection unit. In contrast to the 1. scenario, this would not have a (wired) connection to Scottish Power's protection system (although technical clarification and mutual fine tuning with Scottish Power would still be important). On the other hand, the two mentioned additional feeders are technically pure not needed and are therefore leading to extra costs (for e.g. switchgear, protection unit, room).

3. Scenario

Except the MV cables entering the substation building, everything could be considered within Siemens' scope of supply. Meaning even Scottish Powers' incoming feeder, the "SP Consumer Circuit Breaker", Scottish Powers' MV protection unit, Scottish Powers metering. Although this scenario seems to be the most comfortable solution for tie, it is certainly not the most cost effective e.g. as far as interface clarifications are concerned. Furthermore, DNOs usually have their preferred switchgear, metering and protection units, etc.. That is why we suggest, that these units should remain in SPs scope of supply (design, procurement, installation and testing).

As being instructed by tie in meeting on 2007-11-13 one 11 kV circuit breaker is to be considered per substation in addition to Scottish Power 11kV switchgear. This applies also for substation in depot for both, depot and mainline, not for auxiliary

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power transformer in depot (total of two AC circuit breakers in depot substation). Thus for this proposal, the second scenario was considered.
Solutions for scenarios 1 and 3 could also be offered. For scenario 3, first interface clarifications (e.g. technical meetings with Scottish Power) would be required before.

However, appendix 8.3.12 provides more information regarding the 11kV switchgear, offered.

4.2 Rectifier Unit

The rectifier unit basically comprises the dry type cast-resin rectifier transformer and the 12-pulse rectifier itself.

Differing from the arrangement shown in the tender documents, the rectifier is arranged in one cubicle row together with the panels of the DC switchgear. The transformer will be located in the vicinity of the rectifier, keeping the AC cable connections from the transformer to the rectifier short. The diodes will be equipped with fuses, disconnecting a single diode which has lost its blocking ability. The fuses have contacts which indicate activation to the control system. Hence it is not necessary to immediately disconnect the rectifier unit in case of a single diode failure.

The base load resistor and RC-snubber-circuit are designed short-circuit proof and therefore need no fuse.

4.2.1 Rectifier Transformer

The rectifier transformers are of cast resin type for indoor installation with two primary and two secondary windings. The HV windings are made of single foil-type aluminum coils wound with high quality double-layer insulating foil and potted with an epoxy resin/ powered quartz mixture under vacuum at a high temperature or alternatively made from copper coils (depending on manufacturers standard.
The core is made of grain-oriented low loss electro-laminations insulated on both sides. Limbs and yokes will be shaped and assembled with a minimum of core bolts. Lamination will be joined, compressed and braced to minimise stray loss and noise. The core will be carefully assembled and rigidly clamped to insure adequate laminations during shipment and operation.

The core is protected against corrosion by varnish. The insulating materials used are flame-resistant and self-extinguishing.

The transformers are free of partial discharges at least up to app. 2 times the rated voltage and they are resistant to short circuits and impulse proof like oil-fitted transformers acc. to IEC 60076.

The rectifier transformer are designed to produce a 6 phase secondary AC-system with a phase shift of 30° in order to produce with the connected diode bridge a sound 12 pulse DC system.

For attainment of the overload conditions according to IEC 60146, class VI, the transformer will be rated for 2h-overload 150% or 1min overload 300%.

Each transformer will be equipped with temperature sensors for alarm and for tripping.

Technical Data:

Type	cast-resin acc. IEC 60076 Part 11
Environmental Class	E2
Climatic Class	C2
Fire Behaviour Class	F1
Installation	Indoor
Max. Ambient Temperature	40°C
Cooling System	AN
Type of Duty	IEC 60146, class VI
Rated power	1330 kVA
Rated Power LV1	665 kVA
Rated Power LV2	665 kVA
Rated voltage HV	11 kV
Rated voltage LV 1 / 2	0.293 / 0.293 kV
No. of phase	3
Frequency	50 Hz
Vector group	Dy5Dd0
Primary taps	+/- 2 x 2.5 %
Tap links	no load
Insulation level Primary	LI 75 kV / AC 28 kV
Insulation level Secondary	AC 10 kV
Impedance voltage (approx.)	uk 6 %
Temperature rise	95 K
Insulation class	F
No-load losses (P0)	6500 W
Load losses at 75 °C	17500 W
Outer dimensions (HxWxL) mm	2000 x 1000 x 1760 mm (LxWxH)
Weight (approx.)	3950 kg

4.2.2 Rectifier

The traction supply rectifier is naturally cooled consisting of two three-phase bridges connected in series, forming the 12 pulse rectifier.

Each rectifier is fitted into a cubicle with an uplifted top for natural ventilation. It will be installed by means of non-tracking insulating supports. Venting slots are provided in the lower half of the front doors.

Effective ventilation is ensured by using special mitered aluminum heat sinks to cool the silicon disc-type diodes. The parallel high-capacity diodes are arranged one above the other. They are hermetically sealed between the cooling bar and heat sink by means of plastic barriers. The diode fuses are mounted on the horizontal DC busbars and are electrically connected to the heat sinks via flexible connectors. Micro switches with NO or NC potential free contacts are inserted in

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the top heat sink and will generate an alarm signal. A combined RC and base load circuit is integrated into the cabinet on a separate support.

The rectifier is suitable for free-standing installation with cable entry from the bottom.

The rectifiers convert alternating current into direct current. They are employed for supply of electric power to the overhead contact line of electrified railway systems (traction network).

The rectifiers are mounted in a frame made of steel profile and are designed for fixed installation in closed electrical operating areas. The outer walls of the switchgear panels consist of sheet steel.

The rectifier is a non-controlled, three-phase bridge circuit of 12-pulse design. The main components for rectification are high-power silicon disk-type diodes. The units are air cooled employing natural convection. Fans are not required.The rectifier is devoid of moving parts. No logic or closed-loop controller electronics are employed. The rectifier is mounted on insulated stripes.

Covering is attached to the frame, with the exception of the roof and floor:

- To the front side: Door.
- At the sides: Side walls or partition walls (where a number of cubicles are to be mounted side by side)
- At the rear: Rear wall

The lower part of front doors and rear wall are provided with ventilation slits. The doors can be opened and locked by means of a switchgear key (double key bit). The key is removable.

Six sectional heat sink busbars are vertically installed in the frame. The six AC connections are welded to these busbars. The connections are routed upwards. The individual diodes are attached to the sectional heat sink busbars. One side of each diode lies on the sectional heat sink busbar, while on the other side a dedicated heat sink is attached to the diode.

The diode is pressed between the sectional heat sink busbar and the dedicated heat sink by means of a leaf spring.

In addition to their cooling function, the heat sink busbars and the dedicated heat sinks are also employed for conduction of the electric current.

A fuse mounted on a horizontal busbar is connected to each dedicated heat sink by means of two flexible stranded copper conductors. Each busbar is provided with a connection lug, which represents the common plus or minus connection. These DC connections are connected via cables with the incoming and return-line panel of the DC-switchgear.

All electrical components (diodes and fuses) can be changed from the front. Thus, it is possible to mount the units in a back-to-wall position to provide optimum device installation.

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The rectifier is designed according to the listed International Standards.
The function of a traction diode rectifier in a DC substation is to convert the three-phase voltage from the transformer into DC voltage for the overheadline traction network.

The rectifiers are designed as an air self-cooling type (convection), uncontrolled diode rectifier comprising of two three-phase bridge interconnection arrangements in series forming the 12-pulse output voltage.

Mechanical Design

All components are installed in a sheet metal cabinet and are easily accessible from the front. The rectifier is designed for indoor installation and can be fitted with the back to the wall. The front is provided with a door.

The air inlet is through cooling slits in the lower one-third of the rear panel and front door. The cabinet roof is IP21 (grid on the roof).

Equipment

The rectifier cabinet contains two three-phase bridge circuits connected in series to form a 12-pulse circuit.

It will be designed in such a manner, that with one parallel diode out of service the rectifier will be capable to carry the rated load of operating current.

Disc-type diodes with ceramic housing are used. The diodes are clamped between aluminium heatsinks with a black surface finish to achieve a better heat transfer resistance. For better accessibility, the heatsinks on the front are designed as individual heatsinks for each diode whereas the rear side is cooled by a cooling bar which has the length of several diodes and thus provides high mechanical stability. Each diode is provided with a fuse which disconnects it if it looses its blocking ability. A group signal (potential-free contact) is provided at the terminal strip of the rectifier for evaluation purposes.

Two group signals with the following 2-stage status:
1. Stage: 1 diode in a bridge arm failed.
2. Stage: 2 diodes in a bridge arm failed.

The group signals will be connected to the annunciation unit, installed in the DC switchgear.

Base load resistors and a DC-side RC-snubber-circuit provide protection against internal overvoltages (caused by commutation) and against external switching overvoltages.

External short-circuit

Protection of the rectifier against external short-circuits will be carried out by Scottish Powers consumer circuit breaker of the 11 kV rectifier transformer feeder in conjunction with a thermal / overcurrent time relay (provided by Scottish Power).

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This concept and the corresponding design of the component itself enables the rectifier to carry a DC-side busbar short-circuit until the HSCB in the Incoming Feeder panel opens.

4.3 DC 750 V Switchgear

The DC switchgear will be a Sitras® DSG system, consisting of a combined incoming and return current panel (as discussed and agreed on with tie in meeting on 2007-11-27), two (three for depot) line feeder circuit breaker panels.
The combined incoming and return current panel uses disconnectors, one each for the incoming and the return line. Both devices can be integrated into one panel to save room in substations refer to appendices 8.3.2 and 8.3.6.
For more information on Sitras® DSG, refer to appendix 8.3.7.

4.3.1 DC rectifier and feeder circuit breakers

In each section feeder panel, one HSCB will be located.

HSCBs (high-speed circuit breakers) are mounted on trucks as draw-out units. Each section feeder panel includes the HSCB with arc chute, the line testing device and the associated components necessary for a smooth and effective operation of the switchgear.

The circuit-breaker panels are erected in a standard profile section construction and clad with steel panel walls. They closed off at the front by two lockable steel panel doors. The upper door leads to the partitioned-off low voltage compartment in the upper part of the panel and the lower one gives access to the switchgear truck. The lower door is able to be closed in any defined truck position.

Each circuit-breaker panel consist of a stationary part and a switchgear truck.

Stationary part

The stationary part consist of a standard sectional construction and partitions. The busbars with the isolating mating contacts are installed in this part. Furthermore, the mechanical parts for locking the withdrawal movement, the truck guide bars and the truck grounding bar as well as the devices at traction voltage (test contactor, test resistor, isolating amplifier) are provided here. The test circuit is completely isolated from the traction voltage when the truck is withdrawn.

Current or voltage indicators, alarm indications and Softbuttons will be realized with Sitras PRO displays. In the upper lockable steel panel door remote/local selector switches. The control devices are behind this in a low-voltage recess.

Switchgear truck

The switchgear truck is moveable and operable. It is capable of being withdrawn without the use of tools or other aids.

The switchgear truck frame is made from the same standard sectional construction as the stationary part. The DC high-speed circuit breaker with its self-coupling

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isolating contacts to the busbar is installed in the central section on the switchgear truck.

The switchgear truck is equipped with a safe withdrawal and locking device. In the operating and isolated/test positions the switchgear truck is completely located behind the closed lower door.

Limit switches on the interlock lever, switch-OFF / disconnect the breaker before unlocking and releasing the draw-out unit. The breaker cannot be switched ON / connected, unless it is in connected or disconnected position. A mech. pin indicator is protrude from the panel in the isolated/test position.

The high-speed circuit breaker has been developed especially for use in DC traction systems. It provides highest protection of the DC circuit in conjunction with the integrated digital protection and control equipment SITRAS PRO, which provides inter alia the following functions:

- detecting near and distance short circuits by way of current variation (di/dt)
- individual adjustments of tripping characteristic
- thermal monitoring of the OLE and the DC power cables
- memory functions
- display with function keys

After the circuit breaker has tripped, the DC line is tested by a line testing device, to determine whether the fault has been cleared or not. If the fault is cleared, the breaker will be re-closed automatically. If the fault is permanent, the auto-reclosure unit will lock the circuit breaker after an adjustable time has elapsed.

4.3.2 Short Circuit Device – Sitras® SCD

The short-circuiting device Sitras® SCD is installed for personnel safety reasons and to ensure the voltage limitation between running rails and structure earth. This equipment assures that inadmissible touch potential as specified in EN 50122-1 cannot happen.

If the voltage exceeds the limits, the running rails will be connected to the structure earth. For safety reasons, such a device is located in each traction substation. Each device is interfaced to the SCADA system for remote monitoring, control and annunciation.

4.3.3 OCS coupling switchgear

OCS coupling switchgear consists of one panel for the two feeder isolators and one panel for the bypass isolator.

Behind the lower steel panel door the disconnectors and the busbars are mounted. In the upper steel panel door group-alarm indicating lamps, remote/local selector switches and illuminated pushbuttons / indicating lamps as well as a mimic diagram will be located, in case of motor operated devices. The control devices will be situated behind this inside the low-voltage recess.

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4.3.3.1 DC feeder isolators

Two manually operated disconnectors (rated current: 1900A) with earth position will be used.. Further details on isolators are described in appendix 8.3.10.

4.3.3.2 DC bypass isolators

One motor driven single-pole load break swith (rated current: 2000A) with emergency hand operation will be located in the lower compartment.

Two illuminated pushbuttons, the local/remote selector switch and group alarm indicator will be mounted on the door of the top compartment, the related control and protective equipment inside the upper compartment.

4.4 Low Voltage Power in Substations

4.4.1 Low Voltage Power Supply

For all low voltage loads within a substation, Scottish Powers 230V/ 50Hz low voltage supply will be used. An extra low voltage supply transformers per substations fed by 11 kV medium voltage does not seem to be required and is therefore not part of this proposal.

4.4.2 Battery & Charger

Please refer to Section 3, Chapter 4 "Signalling, SCADA and Communication".

4.5 Stray Current

In order to minimise stray current, the rail insulation versus earth has to be of high quality. Recommended values for conductance to earth can be taken from EN50122-2, section 6.1.1.

As the quality of insulation deceases over the time, caused by ageing of insulation material and pollution, it is highly recommended set initial resistance at least five times as high as given in EN50122-2. This means:
0.1 S/km (10 Ohms*km) for open formation (e.g. ballast track)
0.5 S/km (2 Ohms*km) for closed formation (e.g. embedded in street surface)
0.02 S/km (50 Ohms*km) for tunnel or viaduct sections or similar track bedding

Adequate isolation will be monitored by Siemens Stray Current Monitoring System. A stray current collector cable as shown in [3] will not be needed is not part of this proposal.

A stray current monitoring system will be provided to monitor the potential between running rail and structure earth along the line. The degree of insulation is equivalent to the mitigation against DC stray currents.

The Sitras® SMS stray current monitoring system will be used to monitor the track potential. The stray current monitoring system permits evaluation of stray current

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conditions of the track and the early detection of insulation deficiencies, thus enabling measures to be taken to prevent damage due to stray current corrosion. The continuous measurement of rail potential, e.g. implemented in substations, is a practical possibility for the assessment of stray current behavior without increasing stray currents.

Taking reference measurements for a functioning system, the actual stray current situation and the rail potentials relating to that are recorded. Afterwards, along the entire line voltage monitoring during operation can be easily performed for comparative purposes.

This method does neither affect the current distribution nor the rail potential in the return system.

The **SITRAS SMS** stray-current monitoring system is used to monitor the track potential of DC railway networks.
This system permits evaluation of the stray-current conditions of the track and the early detection of insulation deficiencies, thus enabling measures to be taken to prevent damage due to stray-current corrosion.

- Continuous monitoring of track potentials during operation
- Automatic location of insulation deficiencies
- Representation, archiving and analysis of track potentials in a central evaluation unit
- Transmission of measured values via the communication network, existing networks can be used
- No interference with stray-current conditions because SITRAS SMS is based on potential measurement.

The measured values are transmitted from the sensors to the central evaluation unit via OTN.

4.6 Traction Power Supply for the Depot

The traction power for the depot shall be supplied separately from the main lines in order to ensure the specific requirements of the Depot supply and those for the main lines in respect of the different earthing concepts for the running rails.

For auxiliary 400 V AC supply for the depot, one auxiliary 11kV/ 400V transformer is part of this proposal. The interface to Scottish Powers 11kV switchgear follows the same concept as described in chapter 4.1.

Besides the fact, that this auxiliary transformer is a regular 3-phase/ 3-phase transformer and not a rectifier transformer with two secondary winding with a phase shift of 30°, the general parameters are similar to the rectifier transformers described in chapter 4.2.1, rated power is taken from tender documents with 800kVA. This transformer is considered to be procured from the free market.

4.7 Cables

Power and control cables will be manufactured and tested in accordance with the related european standards as described in the subsections below. Cross-section and number of cables are dimensioned based on the results of the simulations described in the traction study and may be subject to change during detailed design phase.

4.7.1 Medium Voltage AC Cables

Halogene-free single core cables with stranded copper conductor, XLPE insulation, copper wire screen and PE outer sheath will be used.
Type of cable 2XS2Y 1 x ...RM/.. 6/10 (12) kV
Standard HD 620 S1 Section 5C and IEC 60502-2
Conductor circular stranded plain annealed copper in accordance with IEC 60228, class 2
Conductor screening halogen-free extruded semi-conductive XLPE
Insulation halogen-free dry-cured XLPE
Insulation screening halogen-free extruded semi-conductive XLPE
Semi-conductive tape A halogen-free semi-conductive tape will be applied for embedding the copper screen and ensuring the electrical contact between insulation screen and copper screen
Metallic screen copper wires with copper contact helix
Outer sheath extruded black halogen-free PE compound
Conductor screen, insulation and insuzlation screening will be applied simultanously in a triple extrusion process.

Similar cables with aluminum conductor and similar electrical parameters may be used instead of the described copper cables.

4.7.2 DC Traction Power Supply Cables

Halogene-free single core cables with stranded copper conductor, XLPE insulation and PE outer sheath will be used.

Type of cable 2X2Y 1 x 400 RM 0.6/1 (1.2) kV
Standard HD 603 S1 Section 5G and IEC 60502-1
Conductor circular stranded plain annealed copper in accordance with IEC 60228, class 2

Insulation halogen-free dry-cured XLPE
Outer sheath extruded black halogen-free PE compound

Similar cables with aluminum conductor and similar electrical parameters may be used instead of the described copper cables.

4.7.3 Emergency Trip Pilot Wires

Halogene-free multi core cables with solid copper conductor, XLPE insulation and PE outer sheath will be used.

Type of cable 2X2Y 1 x ...RM 0.6/1 (1.2) kV

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Standard	HD 627 S1 Section 4H and IEC 60502-1
Conductor	circular solid copper in accordance with IEC 60228, class 2
Insulation	halogen-free dry-cured XLPE
Outer sheath	extruded black halogen-free PE compound

5 Training

Training will be provided for the client's staff for the maintenance and operating of the railway electrification system and its components. Training will be based on the "Train the Trainer" principle.

The language of the training will be English. The persons who will be trained shall be skilled and qualified.

The training program will consist of both, classroom and practical training. The training will take place at site in Edinburgh.

The duration of training for the TPS System will be 3 weeks as a maximum. The number of persons will be limited to 6 students.

The duration of training for the OLE System will be 3 weeks as a maximum. The number of persons will be limited to 6 students.

In addition to the afore mentioned training, "training on the job" for key personnel can be arranged by participating and doing the installation as well as the commissioning work on own expenses. The "training on the job" will be finalized during system integration.

6 Documentation

The co-operation of designated Contractors is generally required in the planning and installation of the Transportation Systems. The documents delivered within the Contractor's scope of supply will be in accordance to DIN VDE standards; their quality and execution will comply with the manufacturer's quality standards. The documents that are required for the works of the Power Supply System must be made available according to the milestones of the detailed works schedule.

The documentation structure of the Power Supply System will be subdivided in a hierarchical order presenting the information for service, operation and maintenance in the form of:

- General Documentation
- Station Documentation

The **General Documentation** shall present an overview of the Power Supply System and contains system wide information such as

- Designation System
- Symbol List

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- Overall System Single Lines and sectionalizing diagrams
- Information concerning interconnections and inter-tripping between stations

The **Station Documentation** shows details of the equipment like

- Equipment arrangement drawings
- Station single lines
- Circuit manuals and electrical schematics
- Cable lists

6.1 Operating and Maintenance Manuals

The General Documentation shall also serve as a support to the Operating and Maintenance (O&M) Manual.

The project specific O&M manual as well as standard equipment documentation, such as manufacturer's literature or brochures, which serves as additional information to the O&M manuals, shall be in English.

6.2 Quantity of submissions, drawings and manuals

Drawings and documents submitted for approvals shall be of 3 paper copies and one electronic version as a maximum.

As-Built drawings derived from the detailed installation design drawings shall be provided as a maximum with

- two copies in the same size as the original working copy
- one set electronic version

The As-Built drawings will be combined to the final documentation and will be handed over after the Temporary Acceptance of the Railway Electrification System. The final documentation shall not be subject of any approval procedure.

Software documentation is limited to the user manual only.

Computer Software

The software to be used for this project shall be identical for each and every party working on the project. Software used shall not be limited to the following proposed Software:

- MS - WINDOWS
- MS - OFFICE
- PRIMAVERA or MS - PROJECT
- DESIGNER

- VISIO

Final version and software to be used shall be determined and mutually agreed.

Drawing Standards

All drawings shall be in accordance with the DIN VDE respectively IEC regulations. Most of the drawings shall be electrical circuit diagrams that are grouped to circuit manuals for each component. The circuit diagrams shall be part of the electrical documentation showing the wiring and the arrangement of the electrical equipment within a cubicle and the interconnection between the cubicles.

They shall comply with the standards mentioned above.

These standards lay down the layout of drawings, the lettering, and the documentation and designation system.

CAE/CAD Systems

In general all drawings for TPS System, besides the drawings for detailed installation design, shall be produced by the CAE (Computer Aided Engineering) System ELCAD, which is the Contractor's standard system for preparing electrical schematics. This system is qualified to produce this kind of drawings according to the IEC standard. The symbols used by the system shall be stored in separate libraries and shall comply with the relevant IEC standard.

ELCAD drawings can also be converted to DXF files, which can be read by the AutoCAD software, but it is not intended to prepare CAD files in AutoCAD format, because the system features are not available in AutoCAD. Converted files in AutoCAD are only graphic symbols like lines, numbers and characters without any function and layer information.

Software and Hardware supply of any CAE/CAD system is not included in this scope of supply.

However, for preparation of supplementary documents (lists, descriptions, schematics, etc.) the MS-Office package can be used as tool. PDF-files shall be accepted if manufacture's standard literature is not available in any other format.

Paper size

Paper sizes in the ISO "A" series shall be used for all drawings. The manuals shall be A4 or A3, arrangement drawings up to a maximum size of A1.

ISO"A" series	sheet [mm]	size border [mm]
A4	210 x 297	200 x 287
A3	297 x 420	287 x 410
A2	420 x 594	410 x 584
A1	594 x 841	584 x 831

Language

All documents including shall be written in English language.

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Equipment identification

All major equipment will be labeled with nameplates in English. Cable lists with important information will be provided. Individual wires are only marked at outgoing terminals. Internal cubicle wiring will be performed as per the manufacturer's standard and may not be labeled.

6.3 Approvals by the Client or his representatives

The following documents will be prepared and submitted to the Client (reviewable design data) according to progress of the design:

- DC Traction Study
- DC Short Circuit Study
- Single line diagrams of substations
- Layout of the Traction Supply Substations on typical basis
- Circuit diagrams and terminal lists of main components (e.g. transformer, cubicles)
- Cable lists
- Maintenance manuals
- Training documents

Submissions with specification of the equipment will be prepared as described above. Therefore, these documents will be elaborated in close co-operation with the Client and based on the information of the other partners. They will be presented to the Client for approval and will then be the basis for the project planning.

In particular it shall be emphasized that the project schedule dates depend on the approval of the Client being made in time. For technical clarifications the Client shall, if necessary, provide information at short notice.

Design documents shall be forwarded by the Client (where necessary) after their approval to any third party to be involved so that the approval period of time is limited as much as possible.

If any documents submitted have not been answered in writing within a certain period of days (not jet defined) after submission it shall be deemed as approved by all parties involved.

7 Testing and Commissioning

The proposed testing and inspection is given to optimize the testing and commissioning phase with respect to schedule, time duration and resources and to ensure a sufficient cross-check of the contractual requirements with reasonable effort.

A test plan for testing and commissioning of items whose installation and construction are described in this document will be prepared regarding contractor scope of supply. The plan will include:

- Scheduling of testing
- Tests to be carried out

The test equipment and staff necessary for appropriate testing and commissioning of the railway electrification system will be provided.

7.1 Type and Routine Tests

The contractor's equipment is type tested and test certificates will be available for type testing performed in the manufacturer's factories or external institutes.

Any execution of additional type tests or repetition of tests is not included and will be charged extra.

Short circuit tests, if required for specific equipment, are already covered by type tests and additional short circuit tests or repetition of these tests is not included and will be charged extra.

Routine tests and factory acceptance tests will be carried out for all main components on the basis of the test plan to be submitted and approved. Routine tests will be carried out at the location of manufacture and they may exemplarily be witnessed by the client or his representative (travel expenditure and accommodation at his own cost).

Only factory assembled equipment (e.g. switchgear) will be subject to factory acceptance tests. For components (e.g. current or voltage transformers , etc.) the routine test certificates of the respective suppliers shall be sufficient. Those tests will be carried out in the manufacturer's test-field.

7.2 Commissioning and Integrated Tests

During the commissioning work, the site tests according to the manufacturer's recommendation will be performed. The manufacturer's standard site test forms shall be used.

After the commissioning of the Railway Electrification System tests will be carried out for the acceptance of the system. Those tests will be performed under the observation of the client. Therefore the client provide personnel at short notice which is authorized to sign the acceptance certificates.

Tests that refer to the integration of the subsystem after the completion of a location or section shall be witnessed by responsible persons regarding the railway electrification system, to follow up the tests and to sign the certificates accordingly.

8 Appendices

8.1 Glossary

AC	Alternating Current
ACR	AC Rectifier Circuit Breaker (= Scottish Power Consumer Circuit Breaker)
BS	British Standard
C	Capacitor
CB	Circuit Breaker
DC	Direct Current
DNO	Distribution Network Operator (for Edinburgh Tram: Scottish Power)
EMC	Electromagnetic Compatibility
EN	European Norm
ETN	Edinburgh Tram Network
FFP	Frame Fault Protection
HSCB	High Speed Circuit Breaker
LRT	Light Rail Transit
LV	Low Voltage
MV	Medium Voltage (for LRT Edinburgh: 11 kV)
NC	Normally Closed
NO	Normally Opened
OHL	Overhead Line System
OLE	Overhead Line Equipment
OTN	Open Transport Network
PLC	Programmable Logic Controller
R	Resistor
REL	Railway Electrification
RMU	Ring Main Unit
SCADA	Supervisory Control And Data Acquisition
SCD	Short Circuit Device
SCS	Substation Control System
SMS	Stray Current Monitoring System
SP	Scottish Power (local DNO)
TPH	Trams Per Hour
TPS	Traction Power Supply

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8.2 OHL – Appendices

8.2.1 Assembly Drawings OHL (Bid Phase), 32 pages

8.3 TPS – Appendices

8.3.1 Excerpt - Traction Study

8.3.1.1 Report – Traction Study

8.3.1.2 Spreadsheet – Input Data

8.3.2 Single Lines (Overall and Substation)

8.3.3 Frame Fault Protection Slides

8.3.4 Stray Current Monitoring Slides

8.3.5 Traction Substation Control – Conceptual Overview

8.3.6 Substation Room Layouts

8.3.7 DC Switchgear Sitras® DSG

8.3.8 Short Circuit Device – Sitras® SCD

8.3.9 Trackside Cabinet – preliminary Sketch

8.3.10 Feeder and Bypass Isolators – Description of Function in proposed REL-System

8.3.11 List of SDS OLE drawings used for proposed OLE Design

8.3.12 11kV Medium Voltage Switchgear

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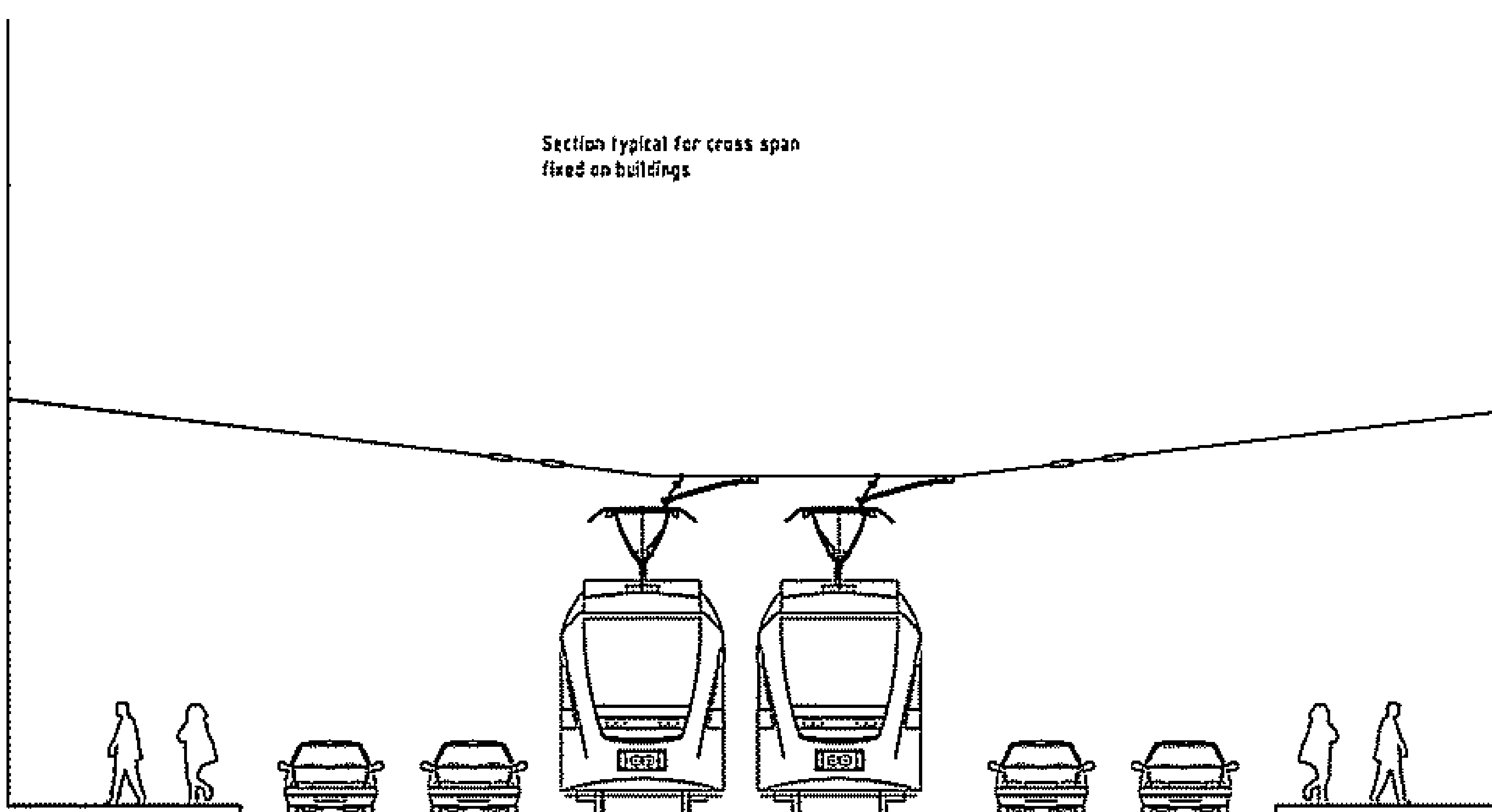

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Scale: none | Size: A4

Assembly Drawings OHL (Bid Phase)

Cross section
cross span (wall anchor)

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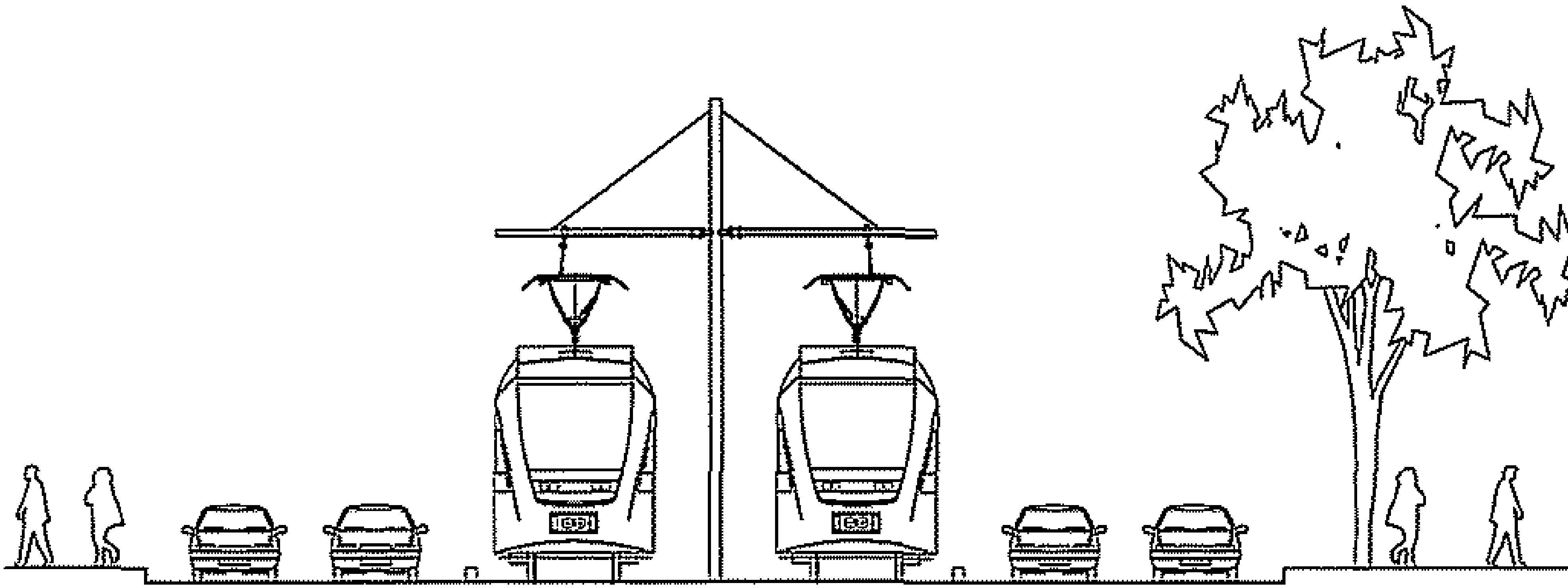
Section typical for centre pole
with back to back cantilevers



LRT EDINBURGH

Scale: none | Size: A4

Assembly Drawings OHL (Bid Phase)

Cross section
with single track cantilevers

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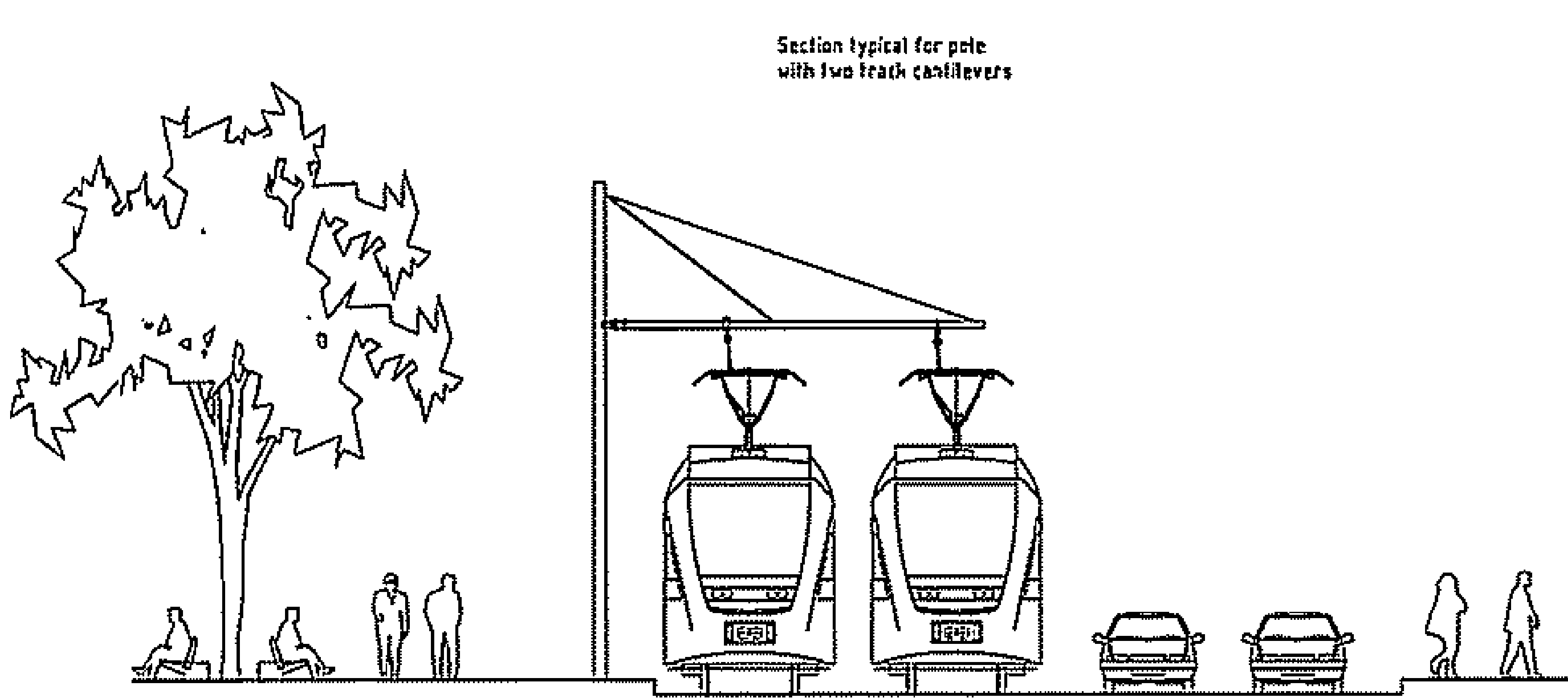

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Scale: none | Size: A4

Assembly Drawings OHL (2nd Phase)

Cross section
with two track cantilevers

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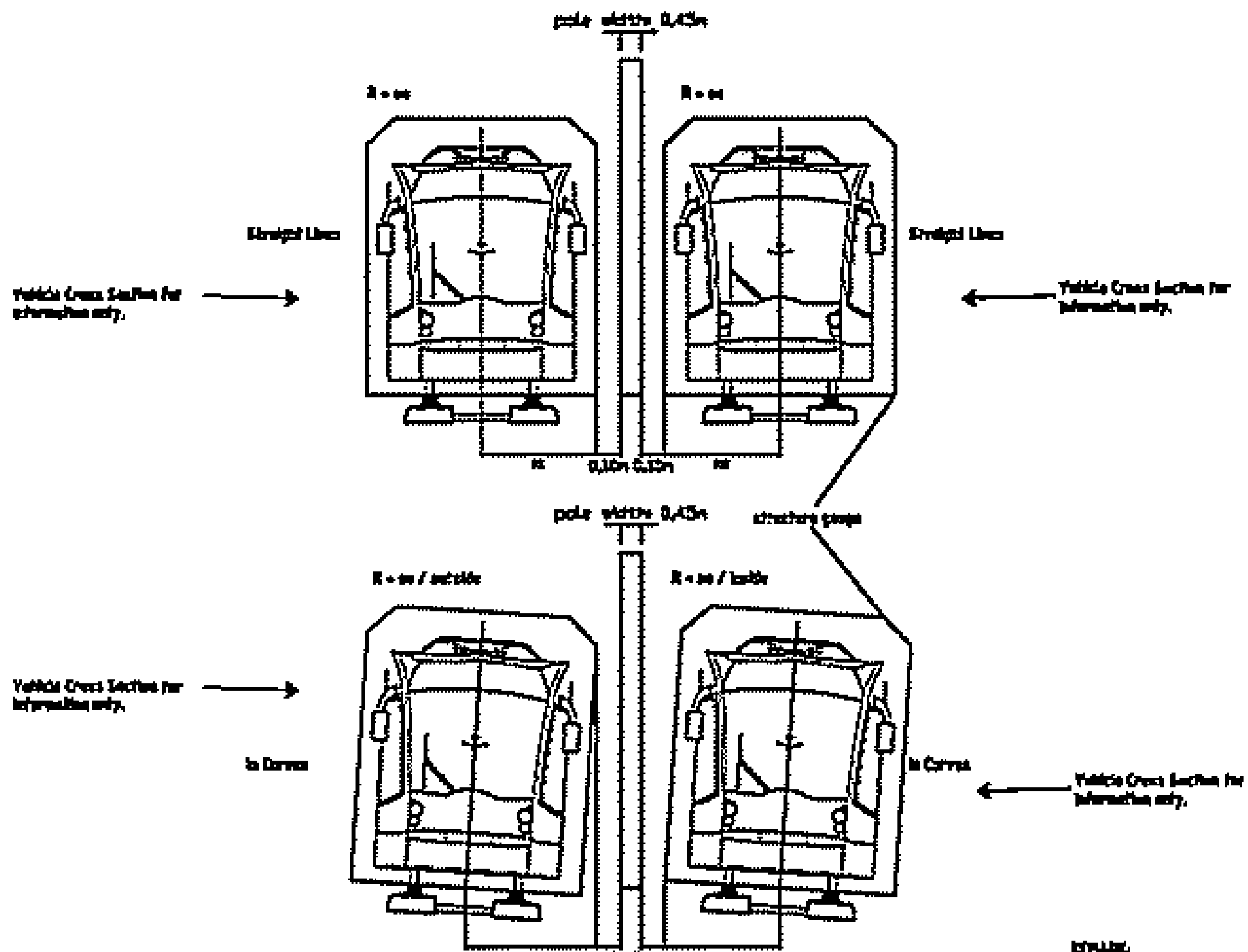
Manufacturing and installation tolerances for OHL Equipment



REMARK:
Manufacturing and installation tolerances to be considered for definition of distance between tracks and structure gauge.
Not applicable for depot area, Will be defined during detailed design.

LRT EDINBURGH	Scale: none	Size: A4
	Assembly Drawings OHL (Bid Phase)	
	Manufacturing and installation tolerances for OHL Equipment	
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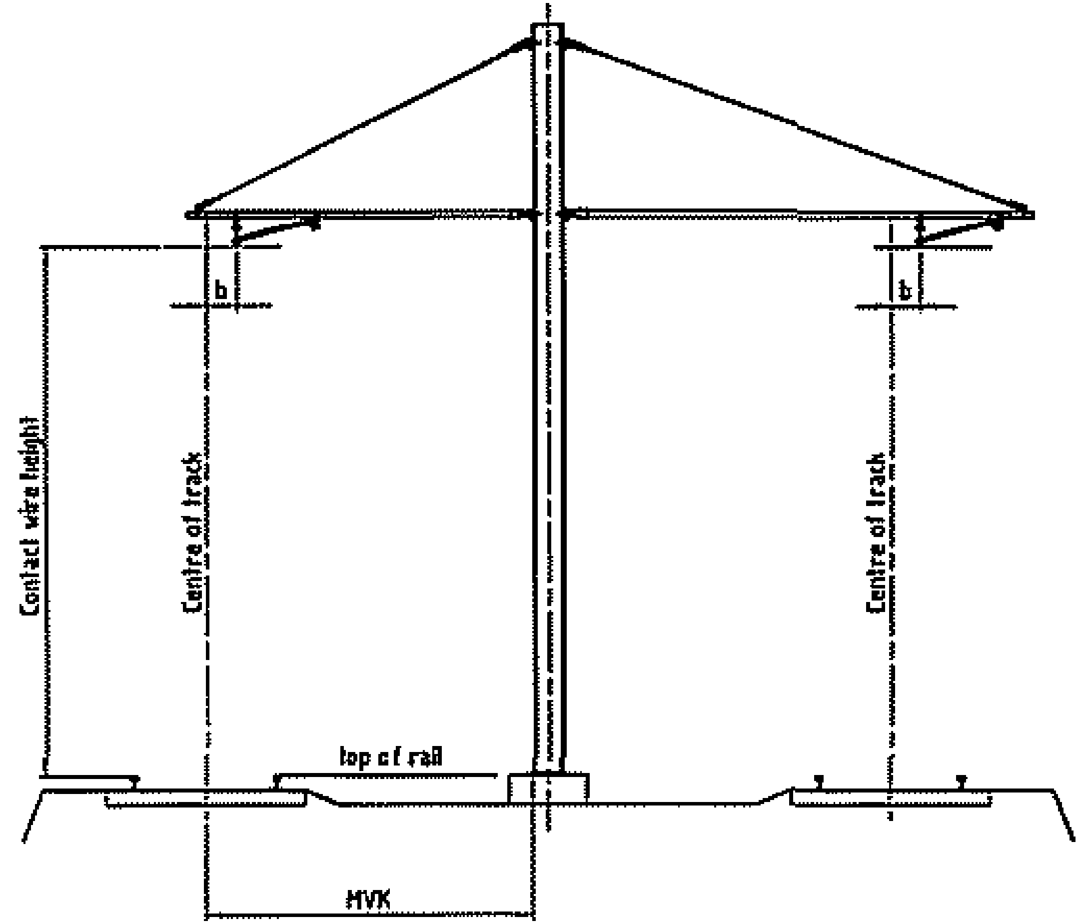
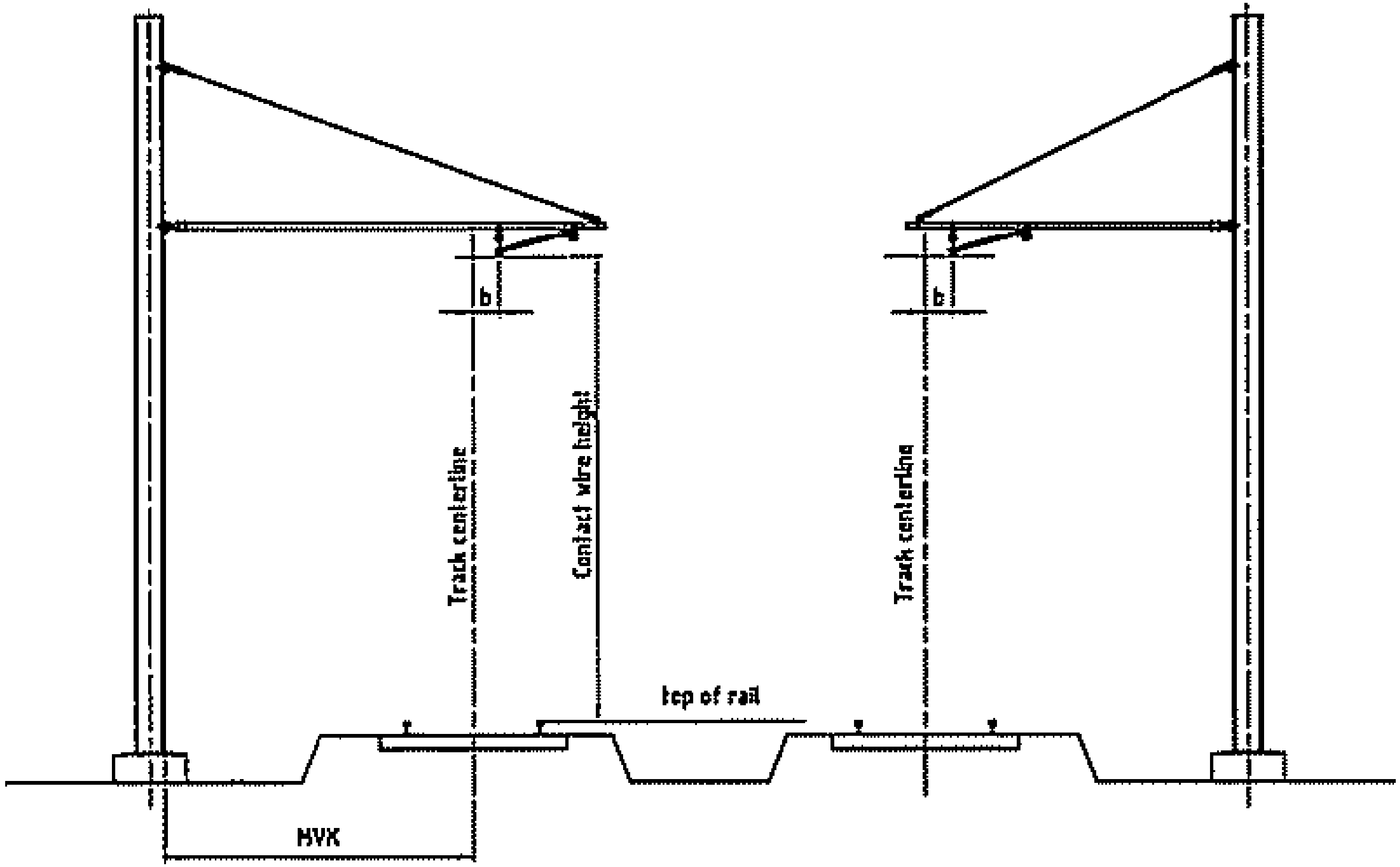


MVK = distance track centerline
to face of pole
b = stagger of contact wire

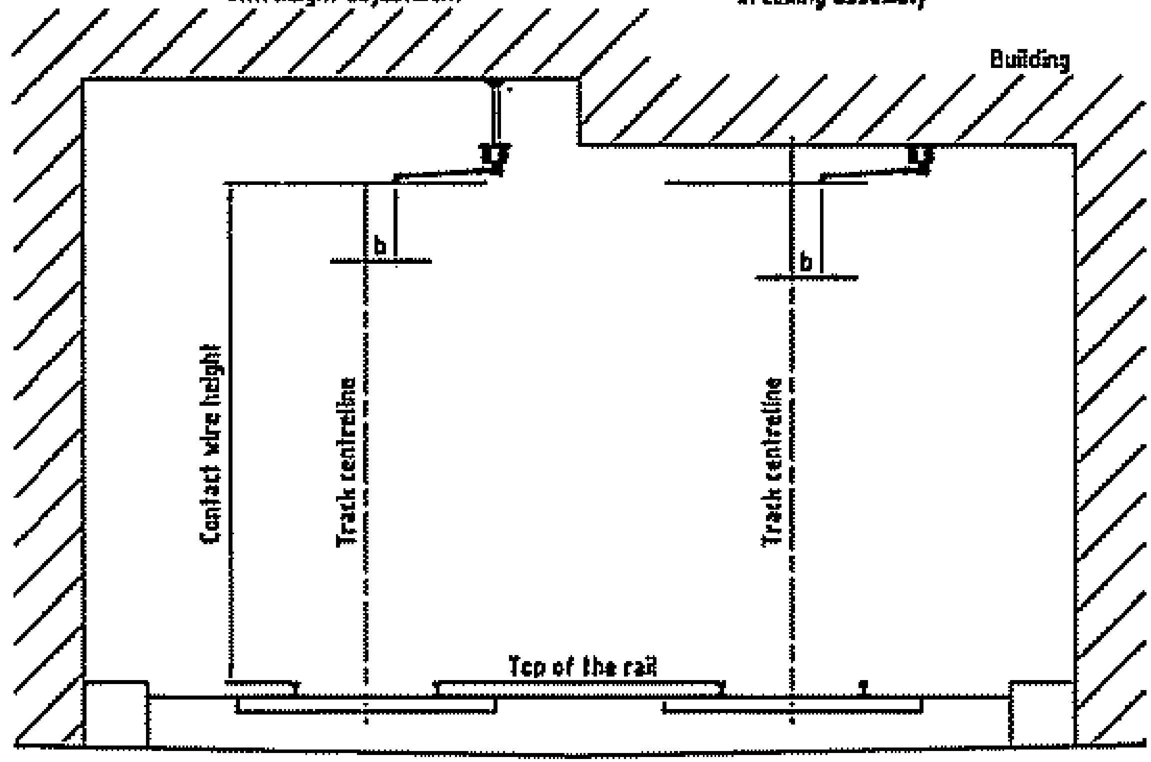
LRT EDINBURGH	Scale: none	Size: A4
	Assembly Drawings OHL (1st Phase)	
	Simple contact wire system simple cantilever with steady arm on center pole	
SIEMENS	ULA -2100-0351	

USB00000088_0335



HVK = distance track centerline
to face of pole
b = stagger contact wire

LRT EDINBURGH	Scale: none Size: A4
	Assembly Drawings OHL (Bid Phase)
	Simple contact wire system simple cantilever with steady arm on side pole
SIEMENS	[illegible]



b = contact wire stagger

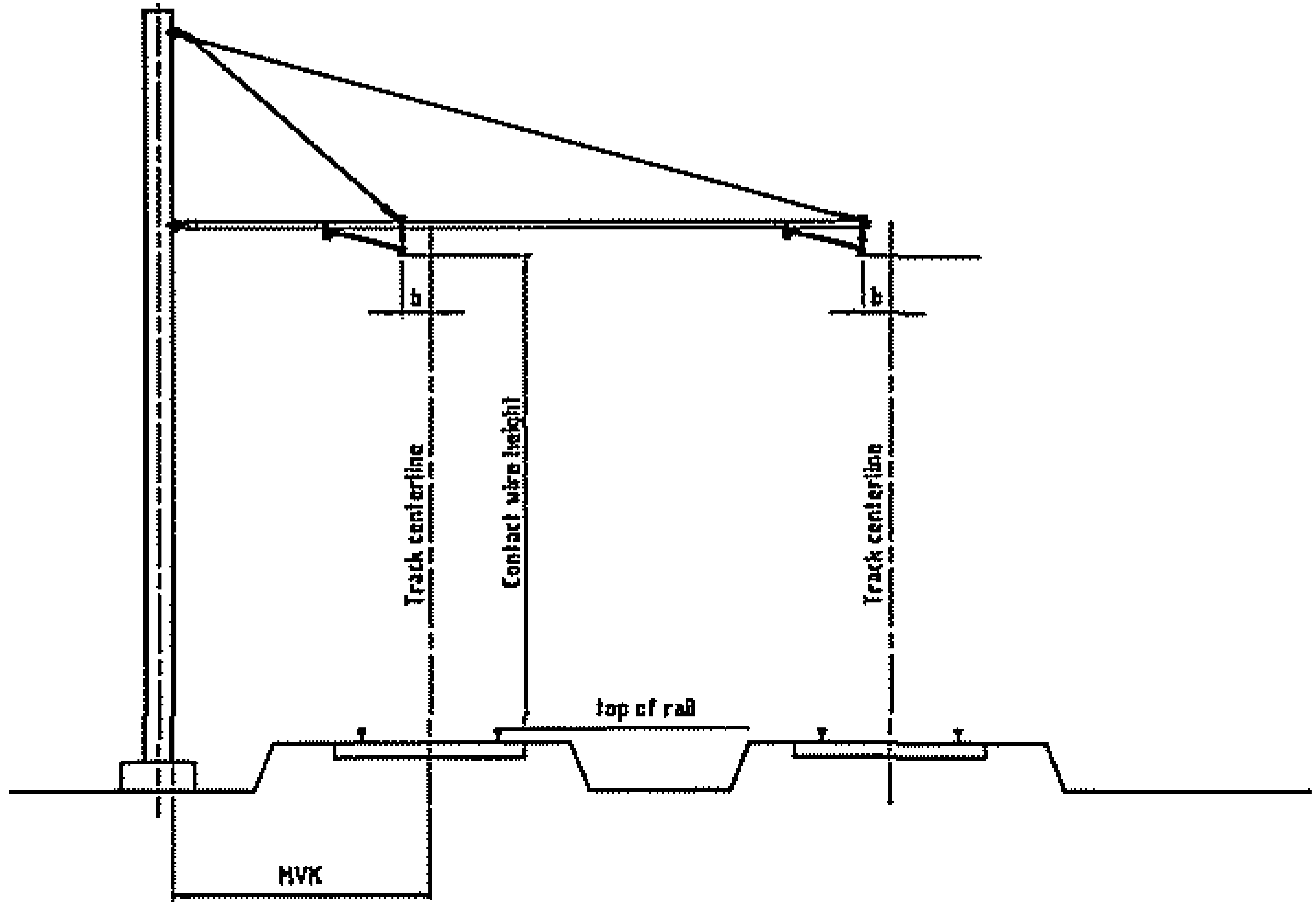
LRT EDINBURGH

SIEMENS

Scale: none | Size: A4

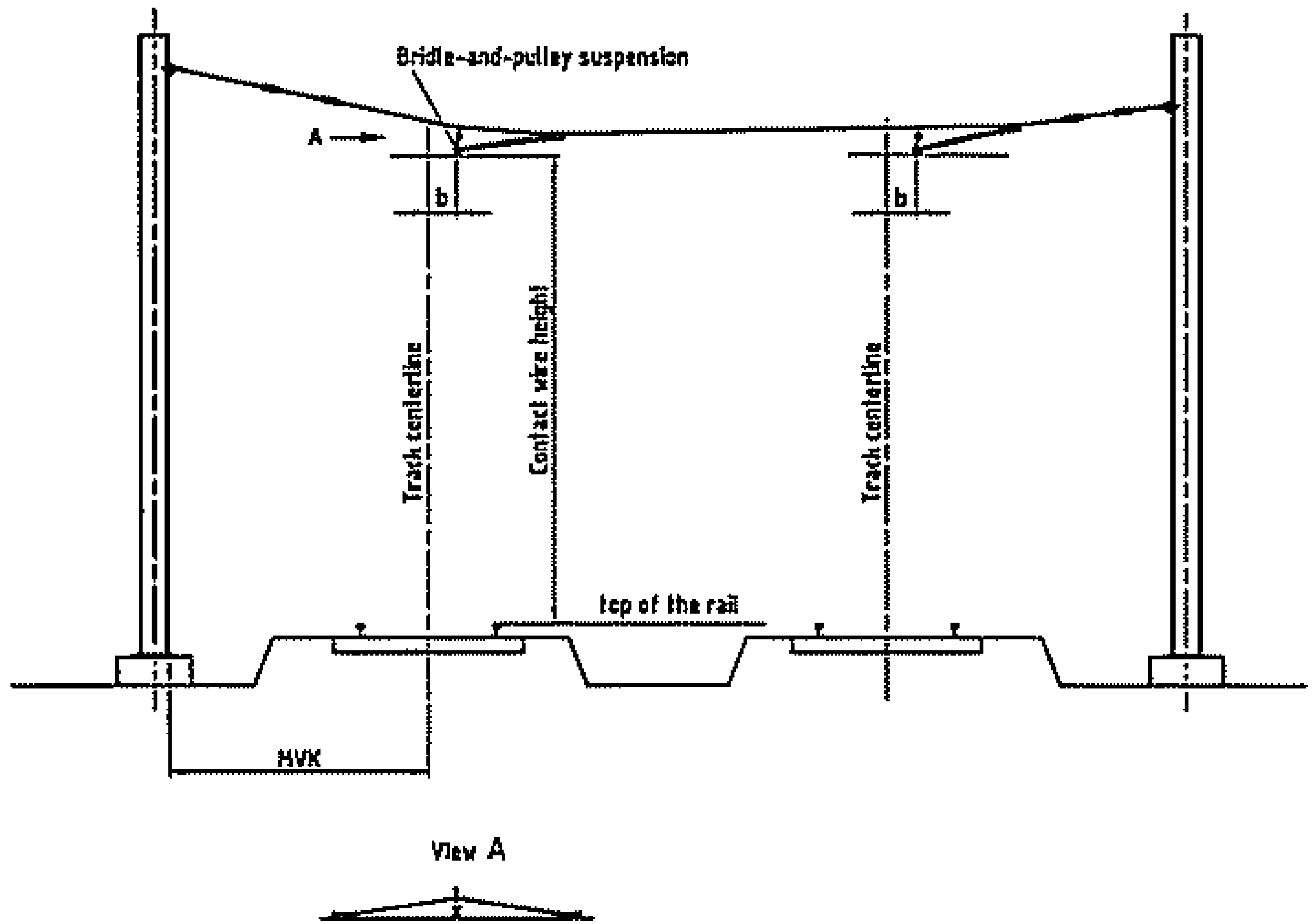
Assembly Drawings OHL (3rd Phase)

Single contact wire system under bridges, with elastic supports



HVK = distance track centerline to face of pole
b = stagger of contact wire

LRT EDINBURGH	Assembly Drawings Ord. (Bid Phase)
	Simple contact wire system simple cantilever with steady arm for two tracks on side pole
SIEMENS	ULA -2100-EZ11



HVK = distance track centerline
to face of pole
b = contact wire stagger

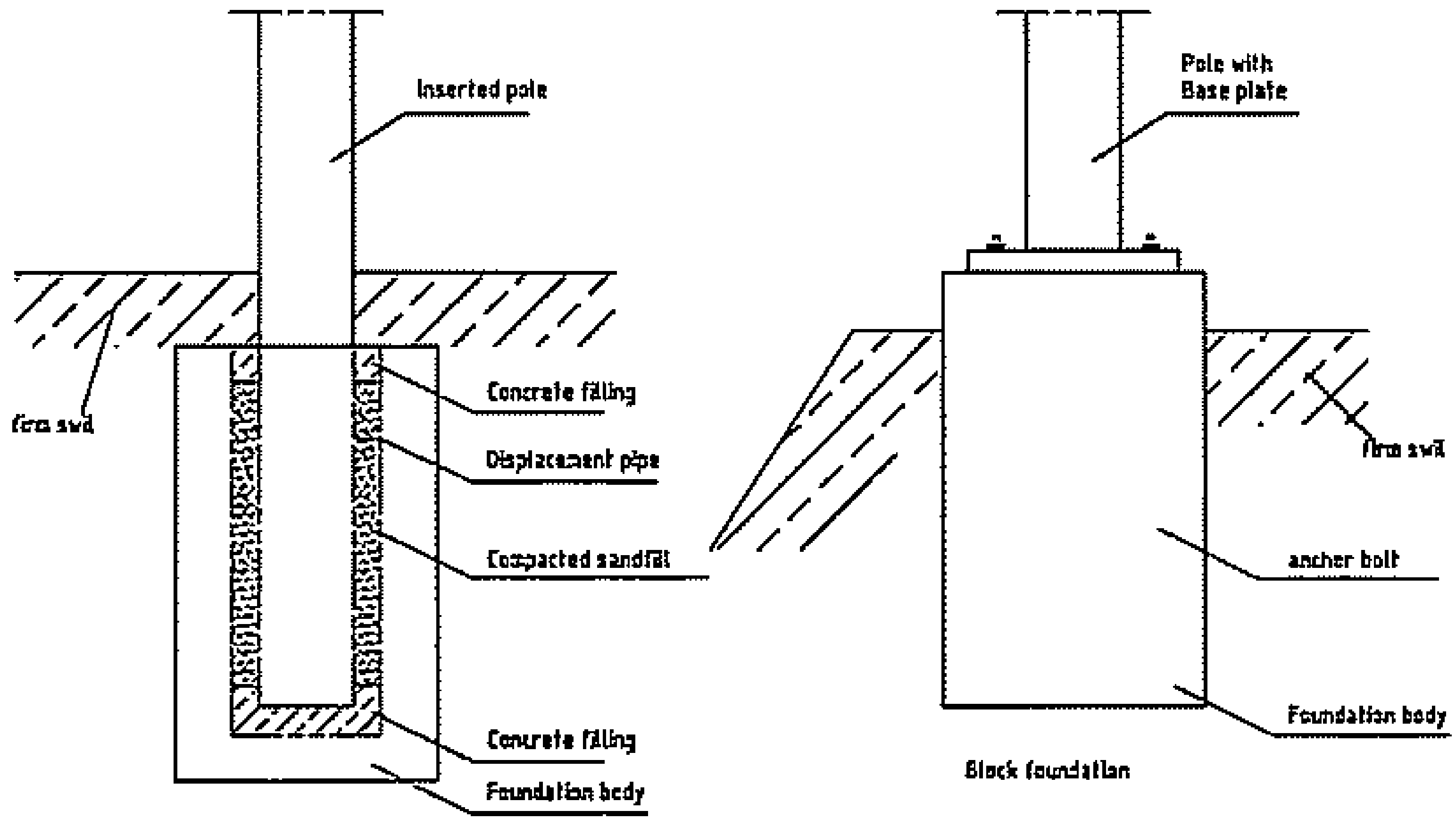
LRT EDINBURGH

Scale: none
Size: A4
Assembly Drawings OHL (3rd Phase)

Simple contact wire system cross span pole ploe with bridle-pulley- suspension for two tracks

SIEMENS

UK4 -Z110-8211

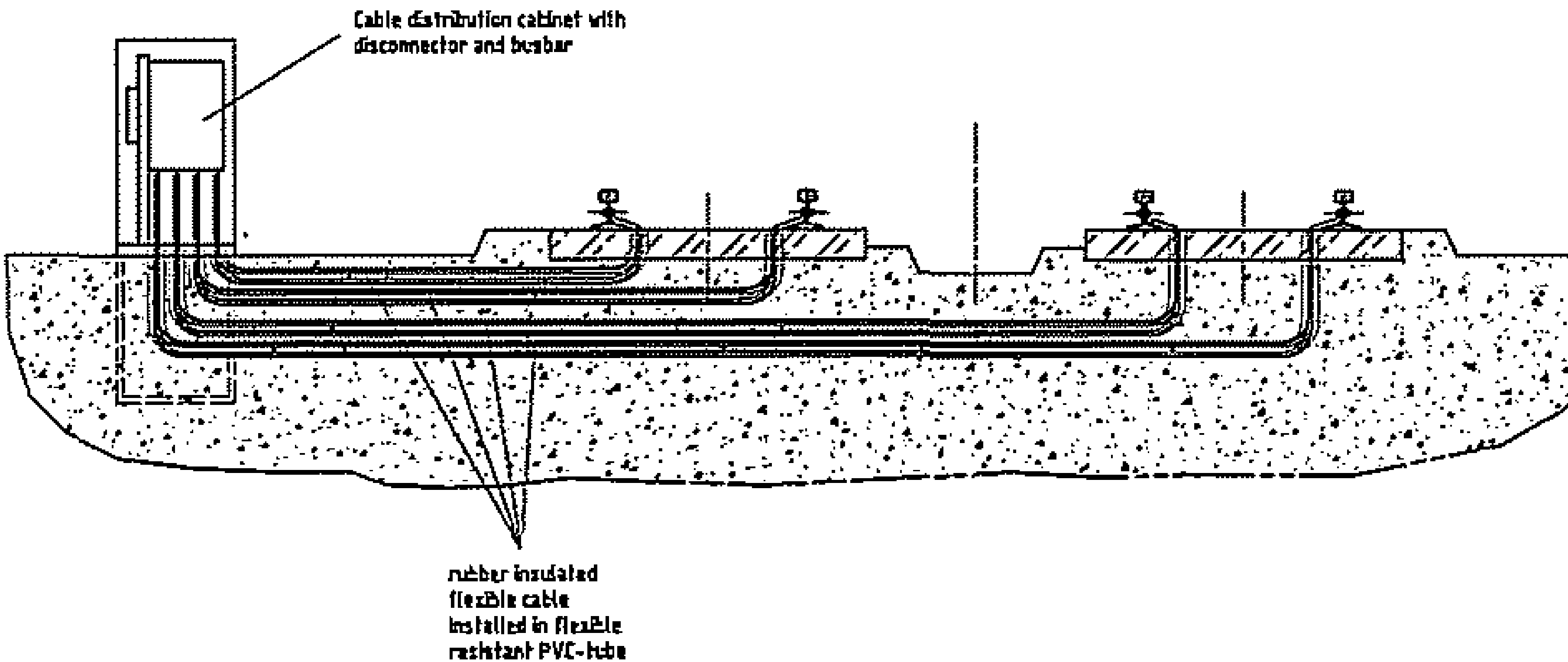


LRT EDINBURGH

Assembly Drawings OHL (Bid Phase)

Examples for Foundations

SIEMENS



The exactly arrangement of the return conductor connection depending on plant design in relation of the local conditions

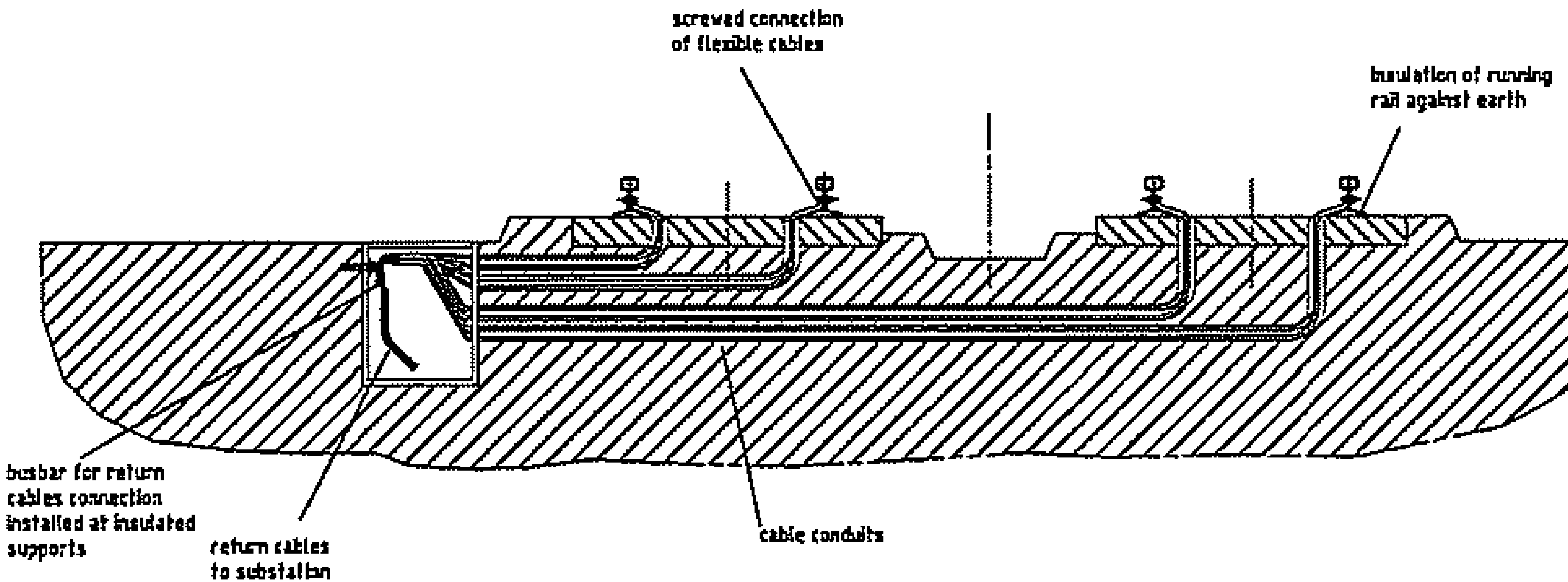
LRT EDINBURGH

Assembly Drawings

Return conductor connection at rail cable distribution cabinet with cable connecter

SIEMENS

USB00000088_0341



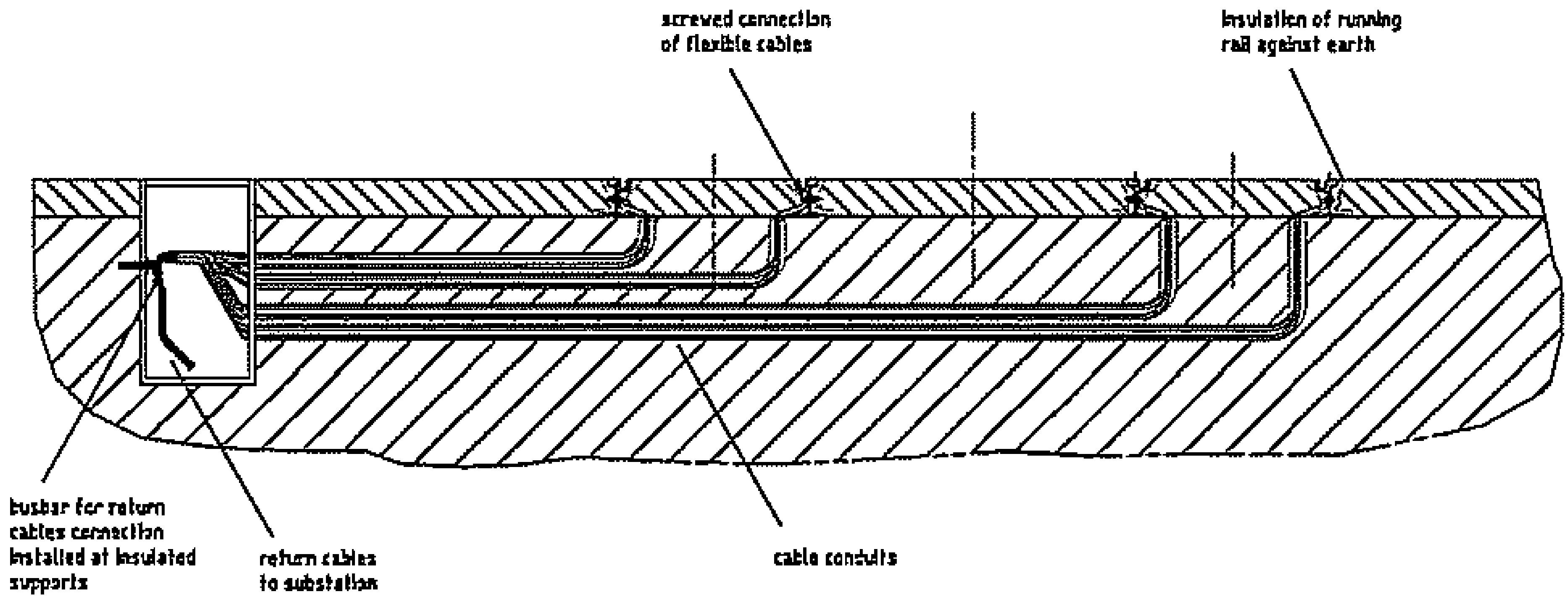
applicable at traction substation

Exact arrangement of the return conductor
connection depending on Track work design
related to local conditions

LRT EDINBURGH

Exampel of return cable connection at
segregate tracks

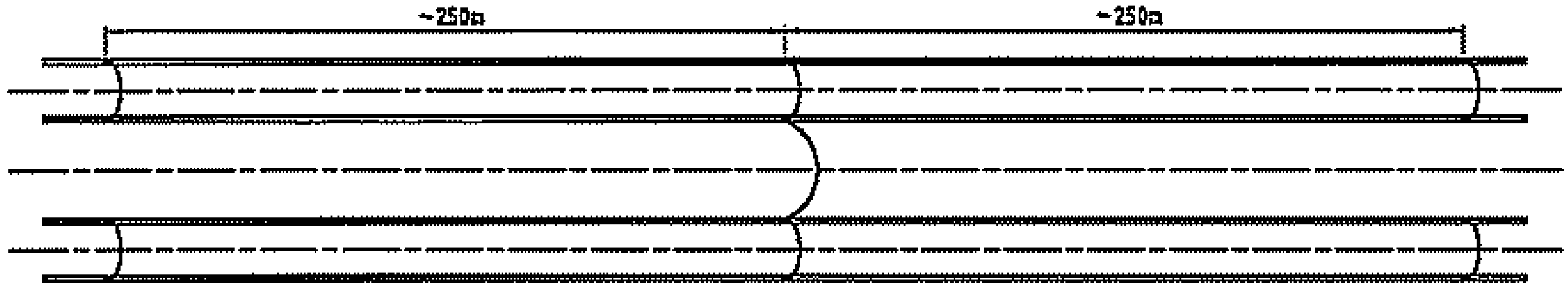
SIEMENS

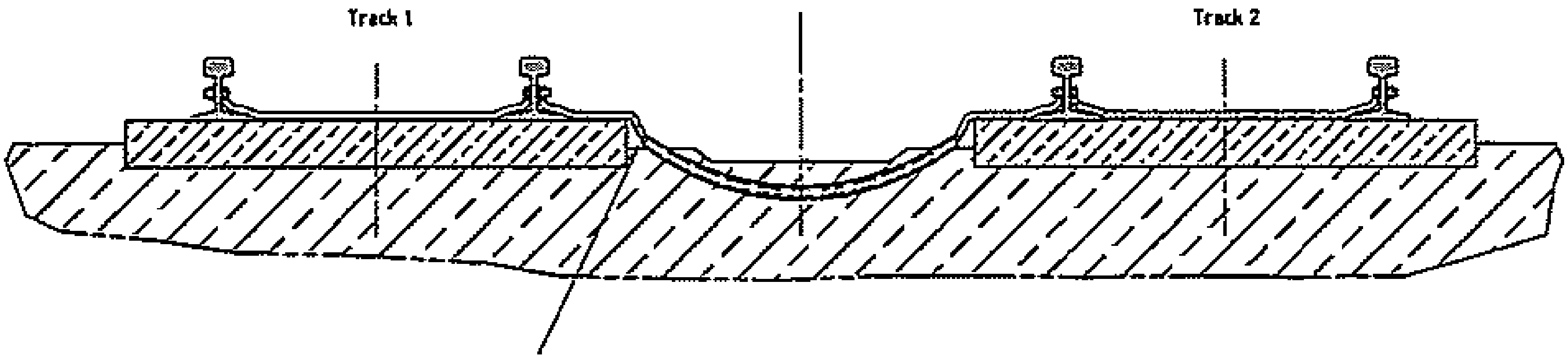


applicable at traction substation

Exact arrangement of the return conductor
connection depending on Track work design
related to local conditions

LRT EDINBURGH	Scale: Size: A4
	Assembly Drawings OHL (Bid Phase)
	Example of return cable connection at embedded tracks
SIEMENS	[illegible]

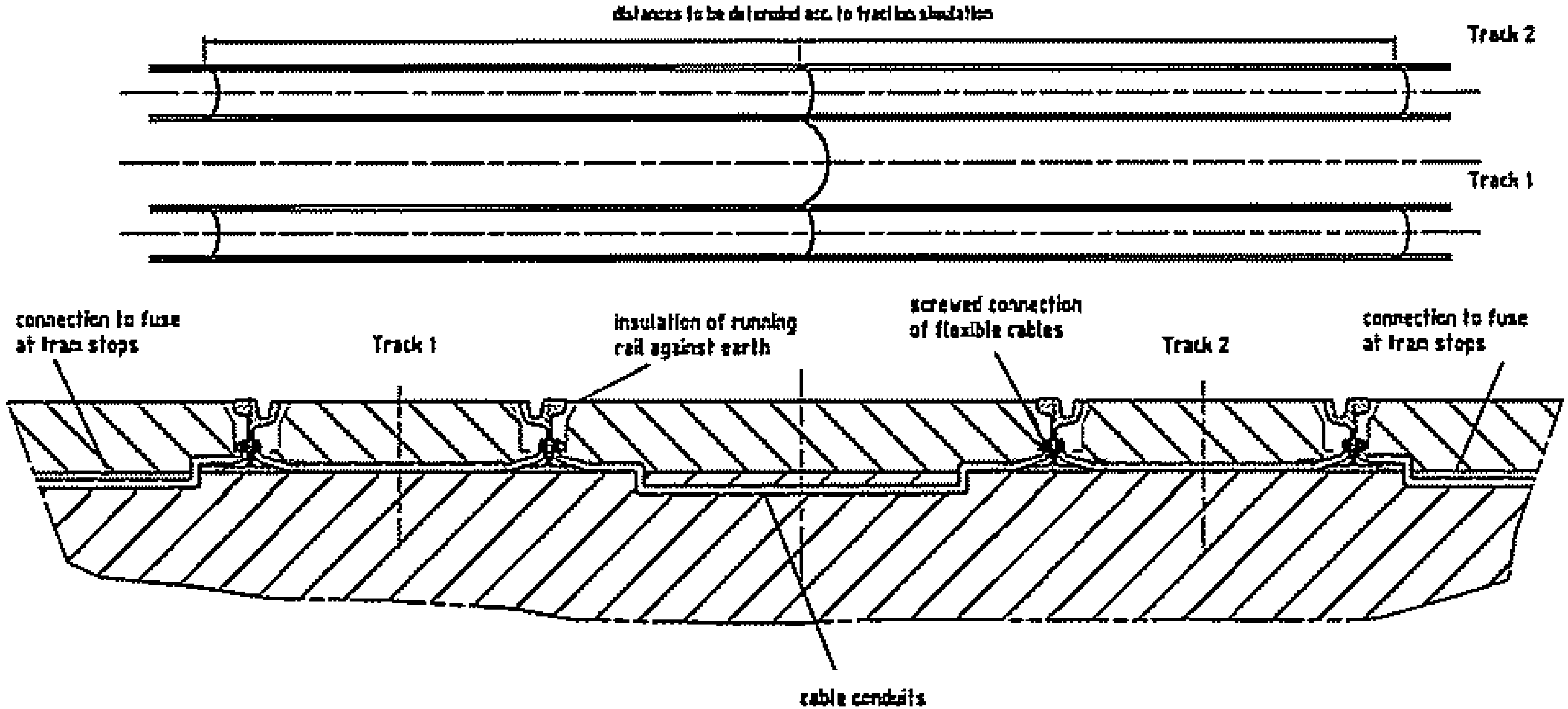




The arrangement of the track and rail current connectors depended on the plant configuration especially in relation with insulated track sections.

LRT EDINBURGH	Scale: none — Size: A4
	Assembly Drawings OHL (2nd Phase)
	Track and rail current connection for two tracks
SIEMENS	ULE-2106-0755

USB00000088_0344

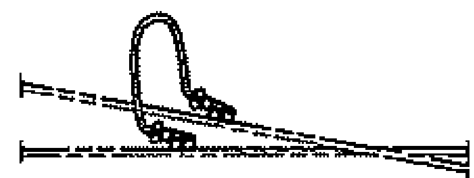


Exact arrangement of the track and rail bounds
depending on Track work desing related to local condition

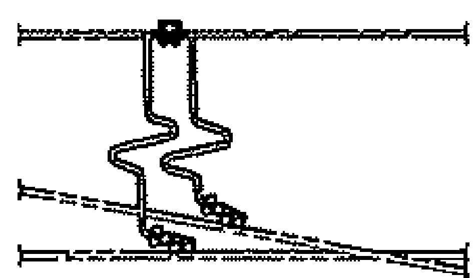
applicable at tram stops

LRT EDINBURGH	Scale: none — Size: A4
	Assembly Drawings OHL (Bid Phase)
	Principle arrangement of track and rail bounds for embedded track
SIEMENS	

Current connector
contact wire–contact wire
between two single contact wires



Current connector
contact wire–messenger wire–contact wire
between catenary line and single contact wire

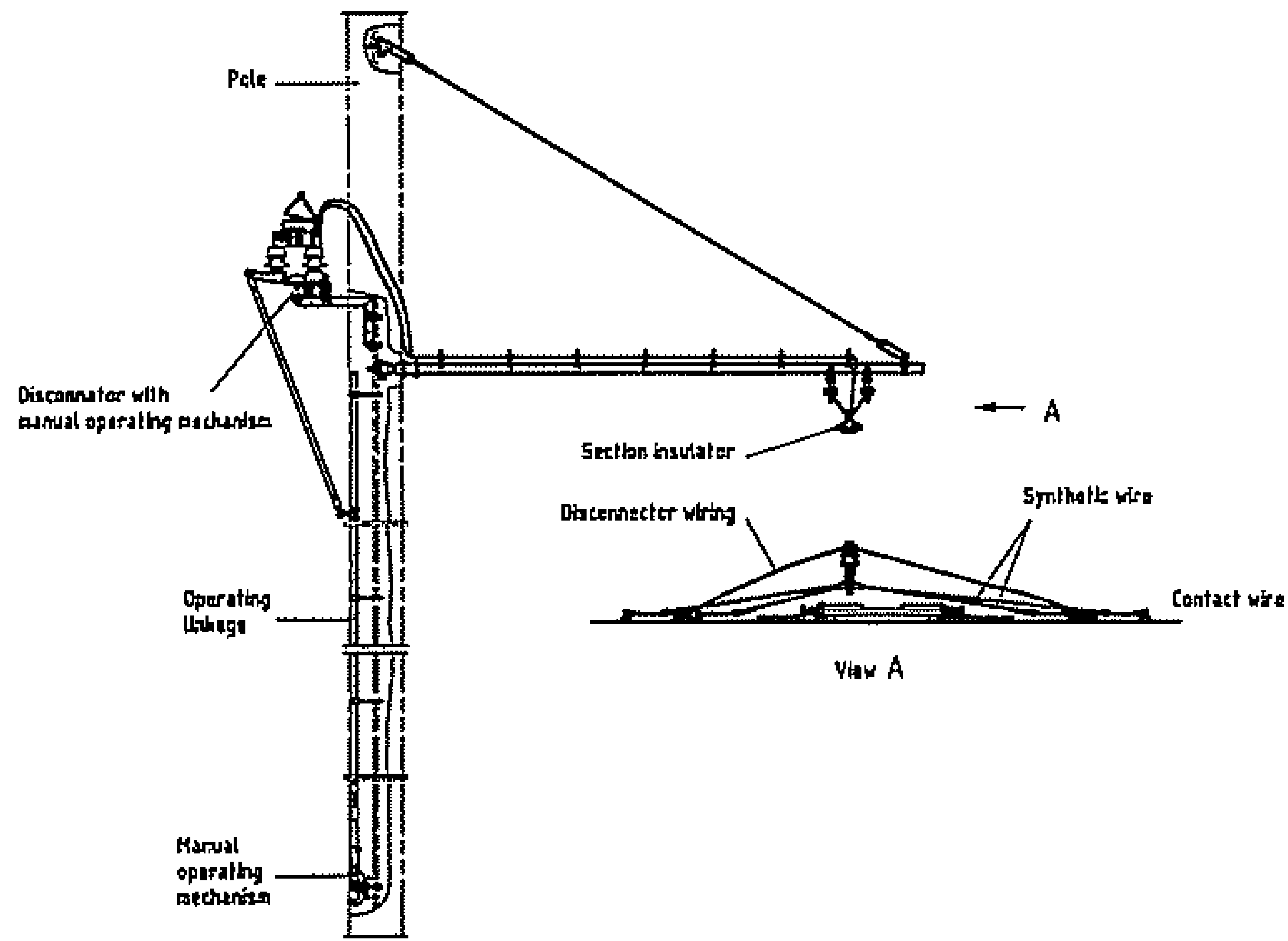


Wire connector:
E-copper 120mm² flexible

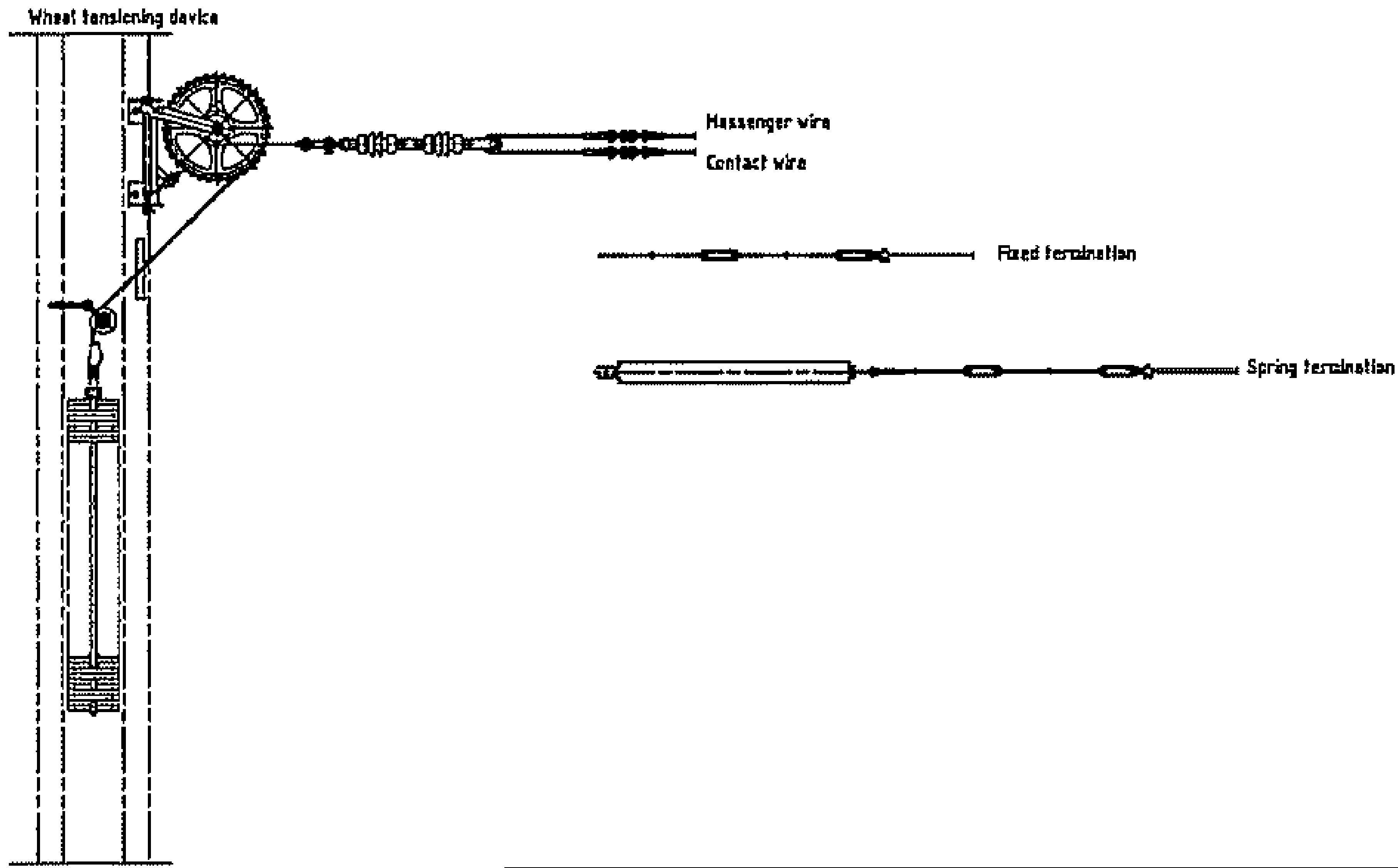
The arrangements of the current connectors depended on the contact line system configuration

Double arrangement current connectors a vailable

LRT EDINBURGH	Scale: none Size: A1
	Assembly Drawings OHL (Bid Phase)
	Current connector
SIEMENS	[illegible]



LRT EDINBURGH	Scale none	Size A4
	Assembly Drawings OHL (Bid Phase)	
	Simple contact wire system sectioning for simple cantilever at switchable with disconnector for one pole	
SIEMENS	ULL-2?03-0?0? [illegible]	



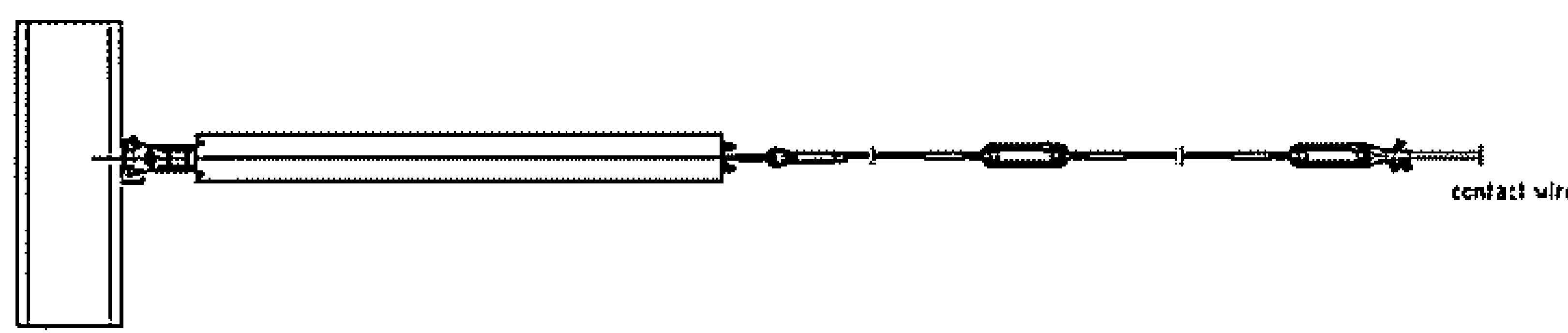
LRT EDINBURGH

Scale: none | Size: A4

Assembly Drawings (Int. Bid Phase)

Terminations for contact wire/s or catenary system

SIEMENS



LRT EDINBURGH

Scale: none | Size: A4

Assembly Drawings OHL (3rd Phase)

Flexible termination at pole for contact wire with spring

ULA -2706-2231

SIEMENS

LRT EDINBURGH

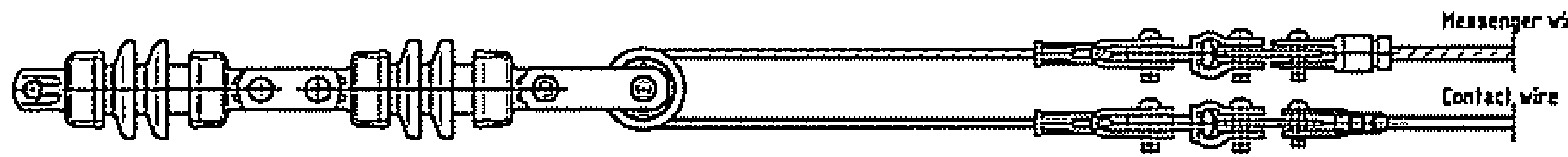
Scale: none | Size: A4

Assembly Drawings OHL (Bid Phase)

Fixed termination for single contact wire

ULA - 21100-0331

SIEMENS

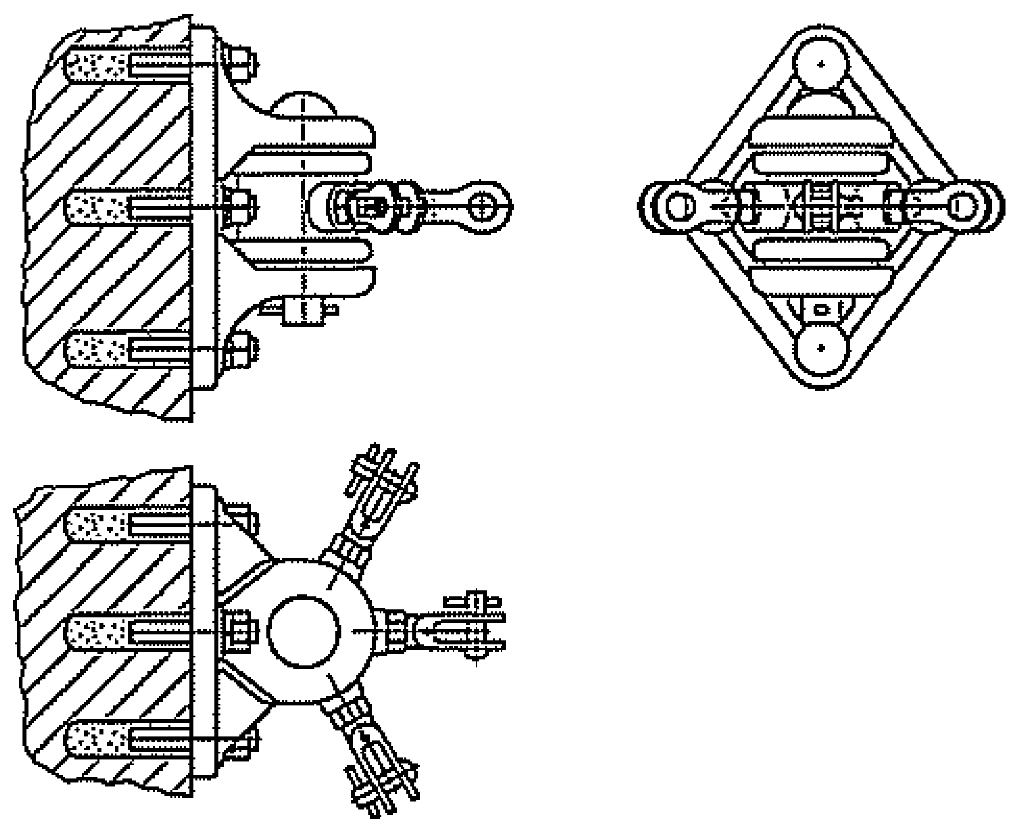


LRT EDINBURGH

Assembly Drawings OHL (3rd Phase)

Fixed termination for catenary system
with cable roll

SIEMENS



LRT EDINBURGH

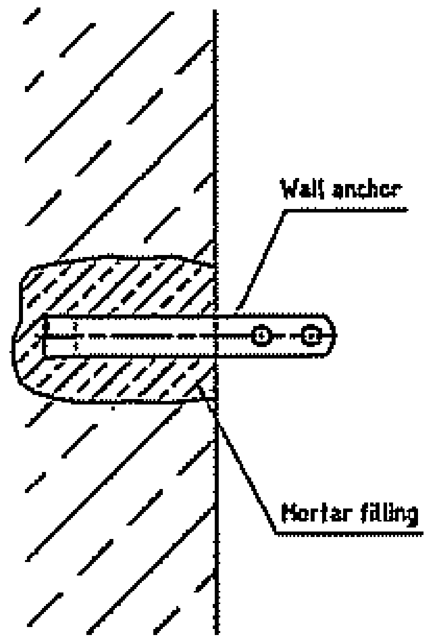
Scale none

Assembly Drawings OHL 2nd Phase

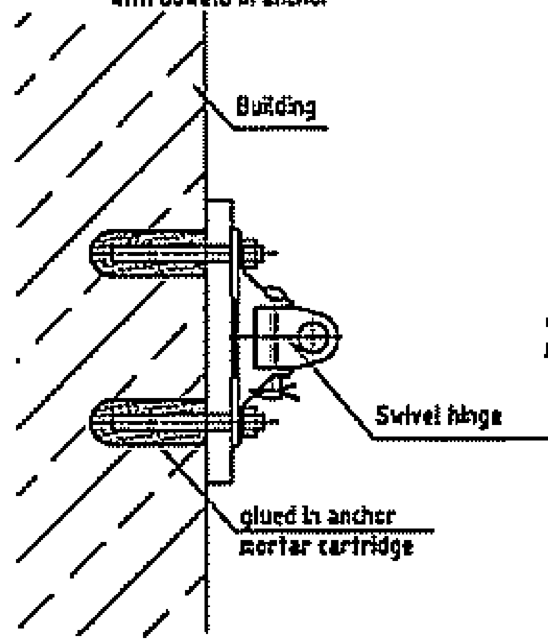
Building fixing for multiple fixation

SIEMENS

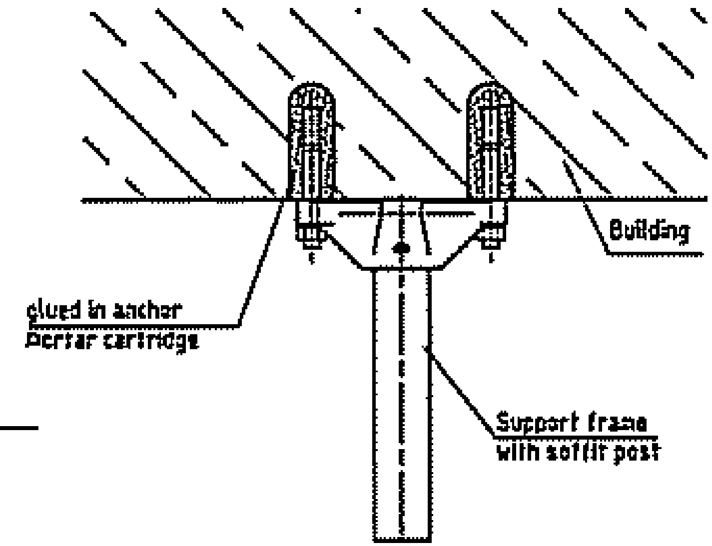
Wall anchor in mortar filling



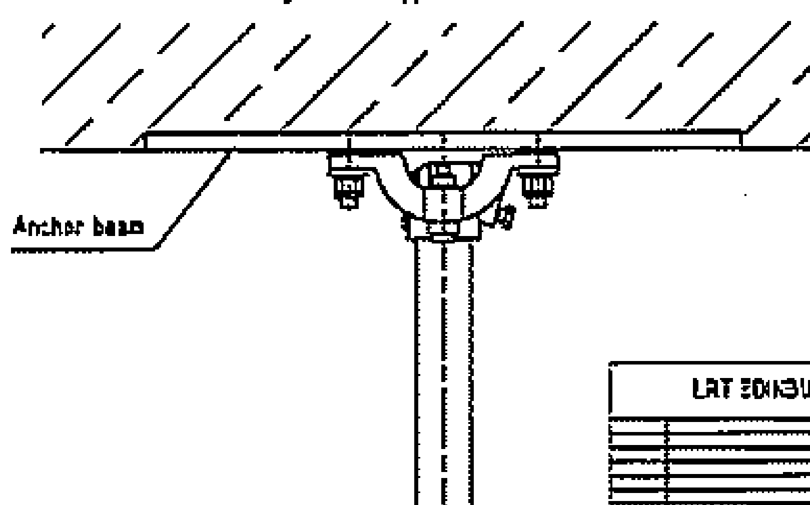
swivel hinge, bracket arrangement
with doweld in anchor



Support frame with doweld in anchor



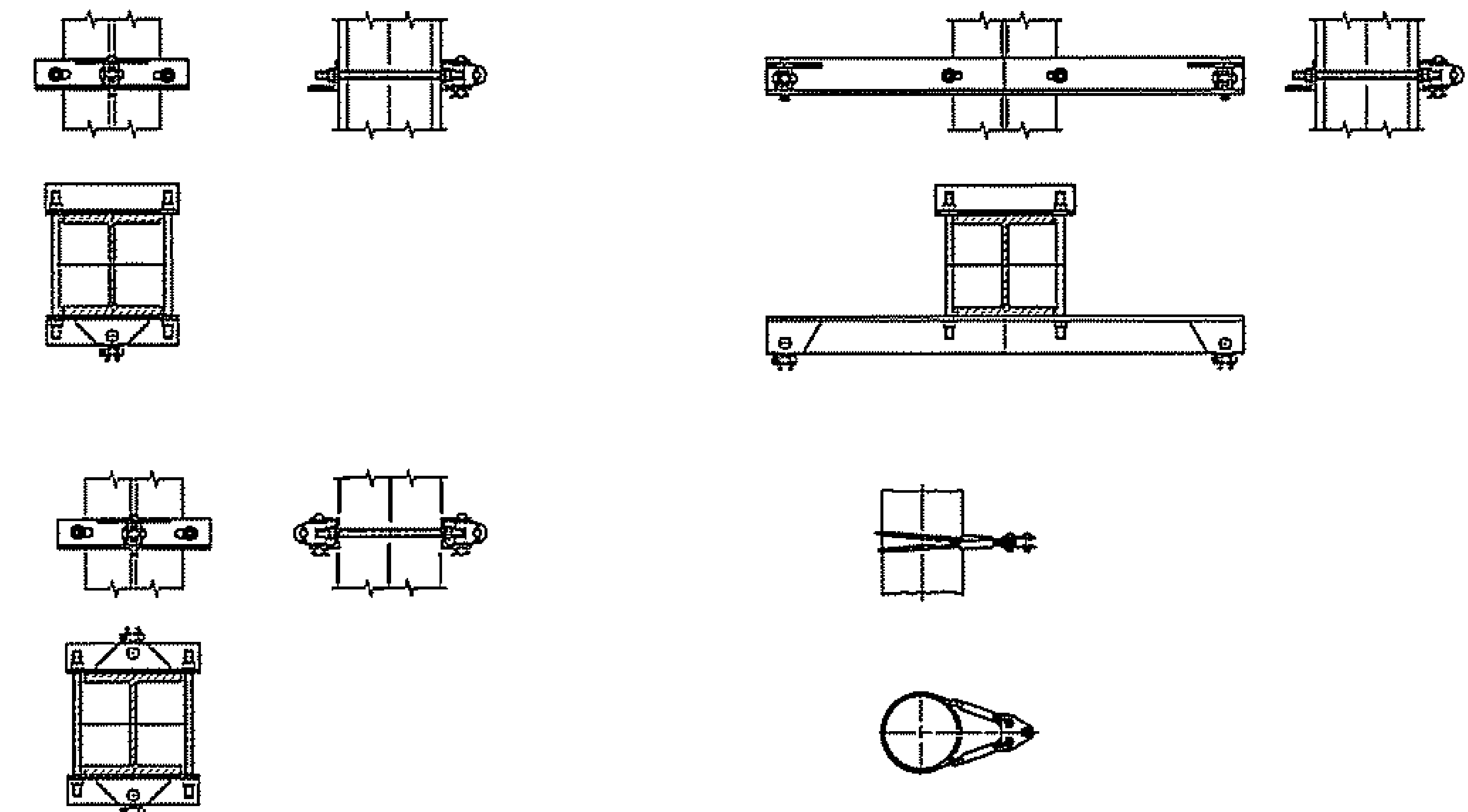
adjustable support frame at anchor beam



LRT EDINBURGH

Building fixing
arrangements

SIEMENS



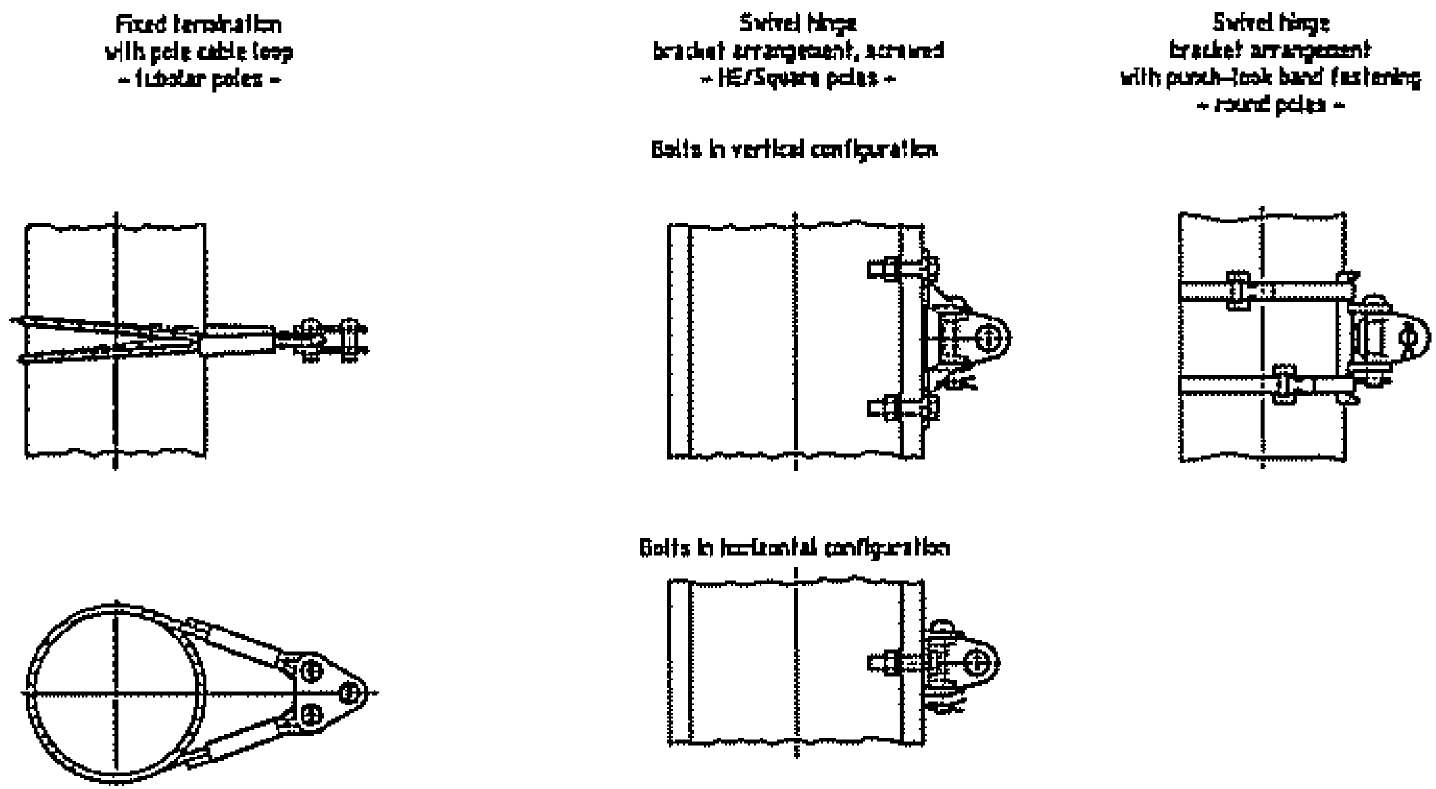
LRT EDINBURGH

Scale none | Size A4

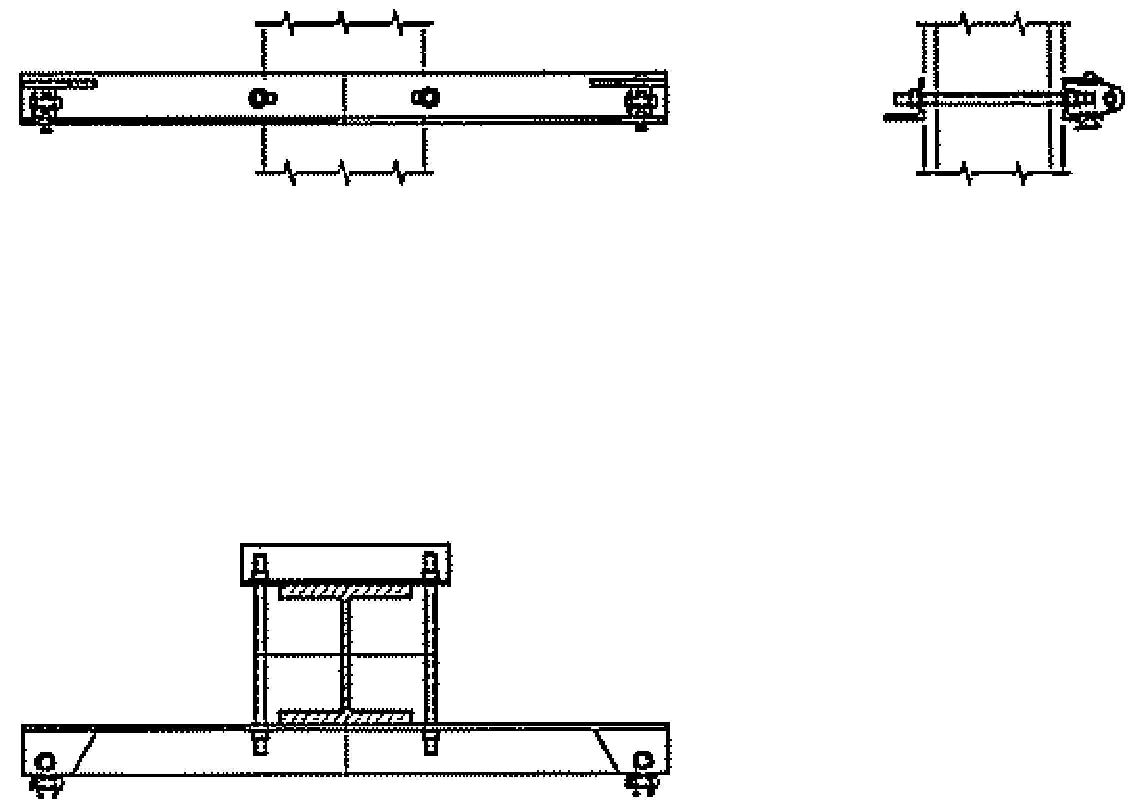
Assembly Drawings OHL (3rd Phase)

Fixing accessories arrangements
for contact wire poles

SIEMENS



LRT EDINBURGH	Scale none — Size A4
	Assembly Drawings OHL (Bid Phase)
	Fixing accessories arrangements for contact wire poles
SIEMENS	[illegible]



LRT EDINBURGH

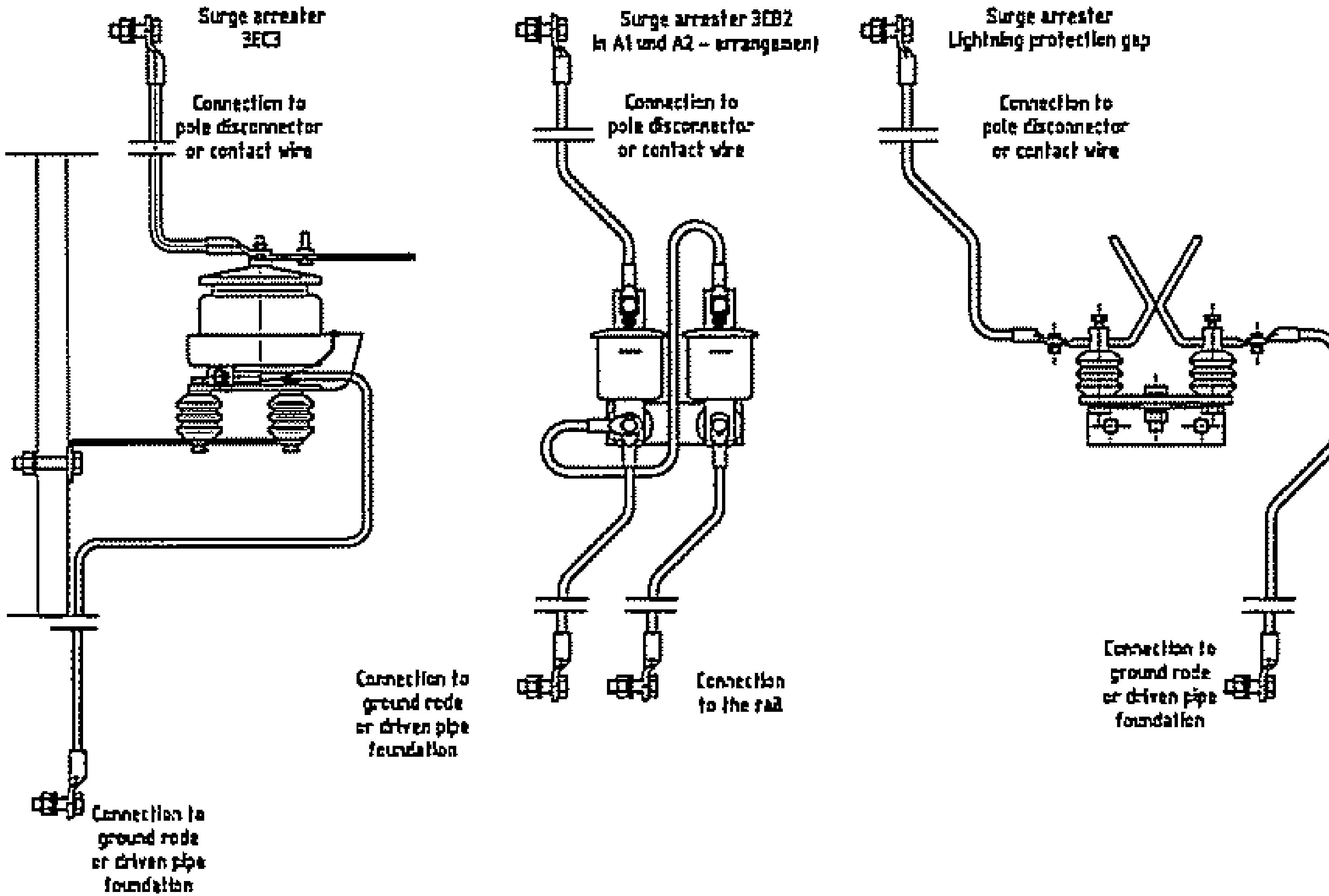
Assembly Drawings OHL Bid Phase

Fixing for double cantilever
at steel pole

SIEMENS

UKA -21103-0231

A4



LRT EDINBURGH

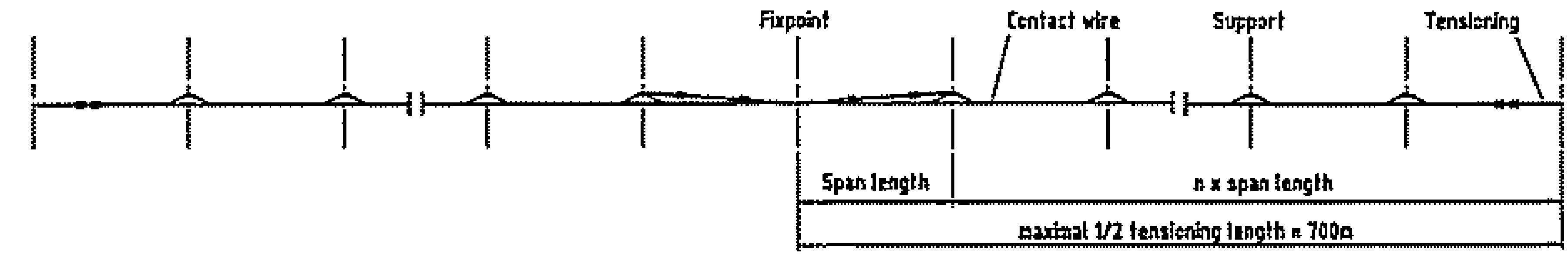
Scale: none | Size: A4

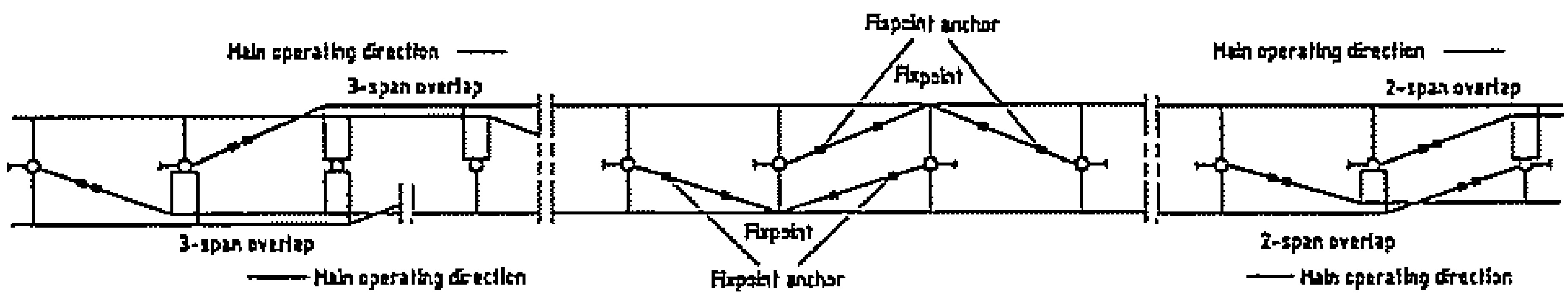
Assembly Drawings OHL (3rd Phase)

SIEMENS

Overvoltage protection for pole istallation

ULE -2705-0231



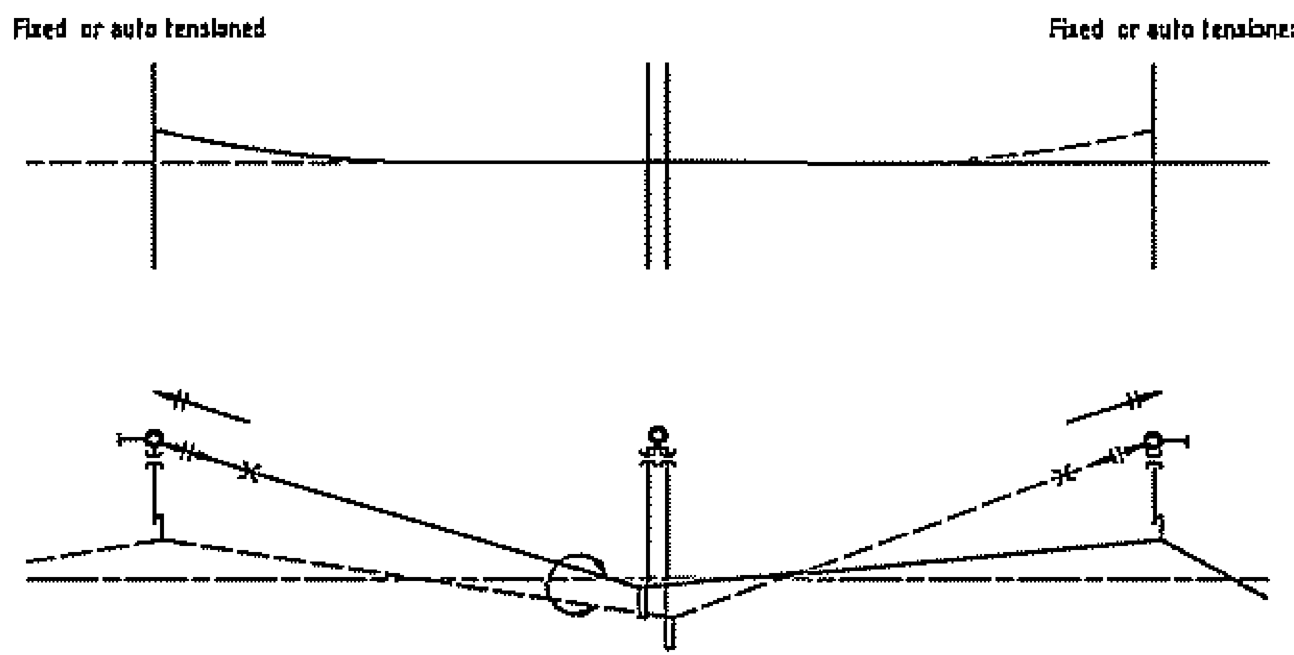


Span length = 35m

LRT EDINBURGH

SIEMENS

Single (Trolley-type) contact line system, tension length with overlap



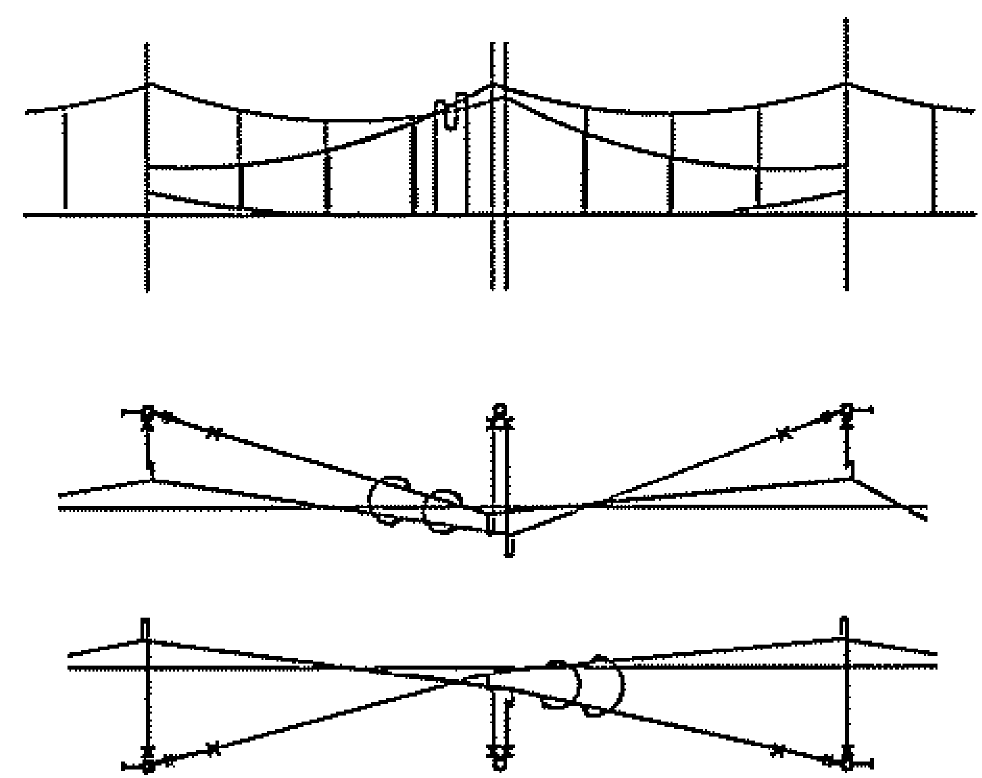
LRT EDINBURGH

Assembly Drawings OHL Old Phase

Overlap contact wire system
with single contact wire

SIEMENS

USB00000088_0359

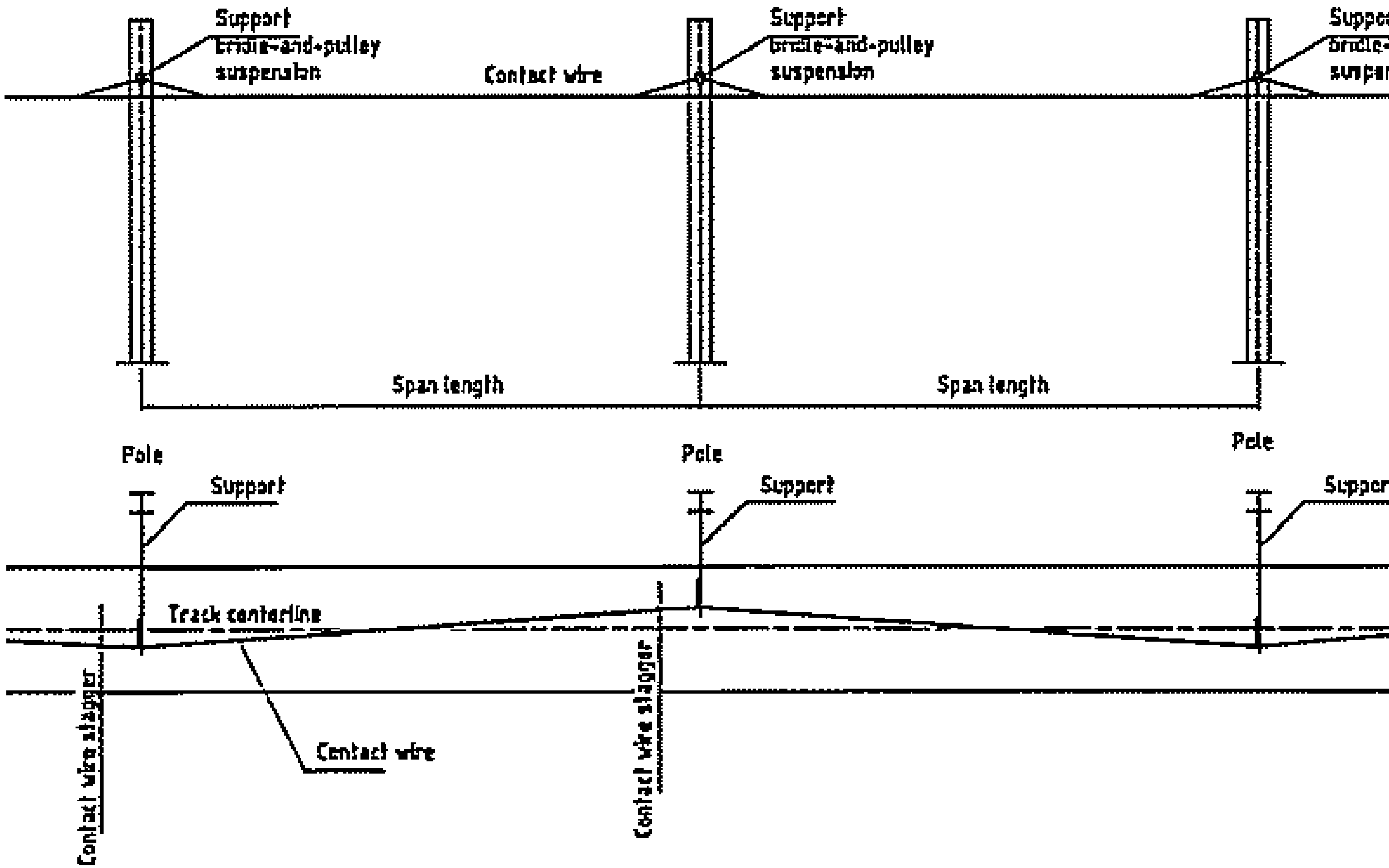


LRT EDINBURGH

SIEMENS

Assembly Drawings OHL

Overlap catenary system
with messenger wire and contact wire

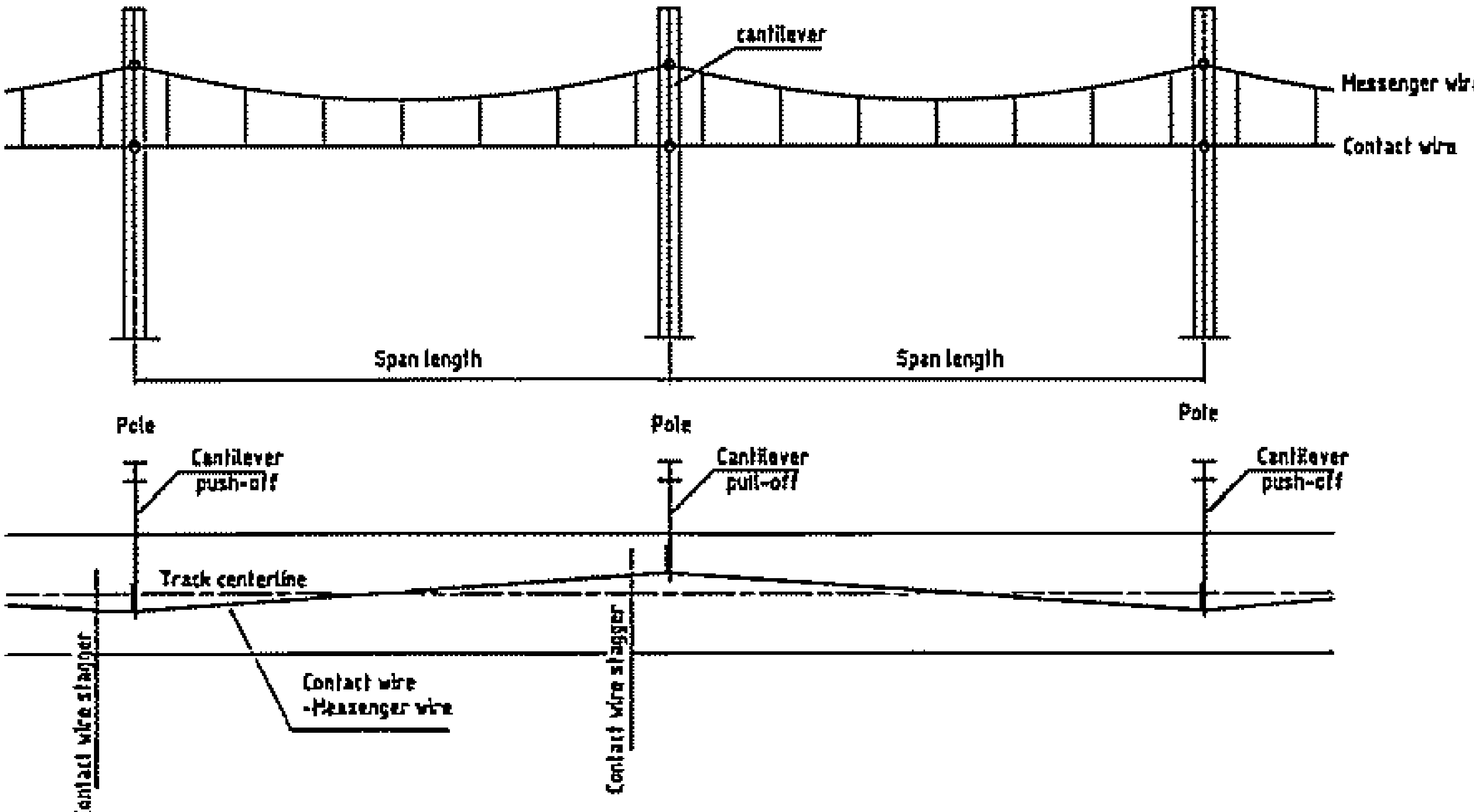


Characteristics:
contact wire tensioned
span length < 35m

LRT EDINBURGH

Simple contact wire system
with bridle-and-pulley suspension

SIEMENS

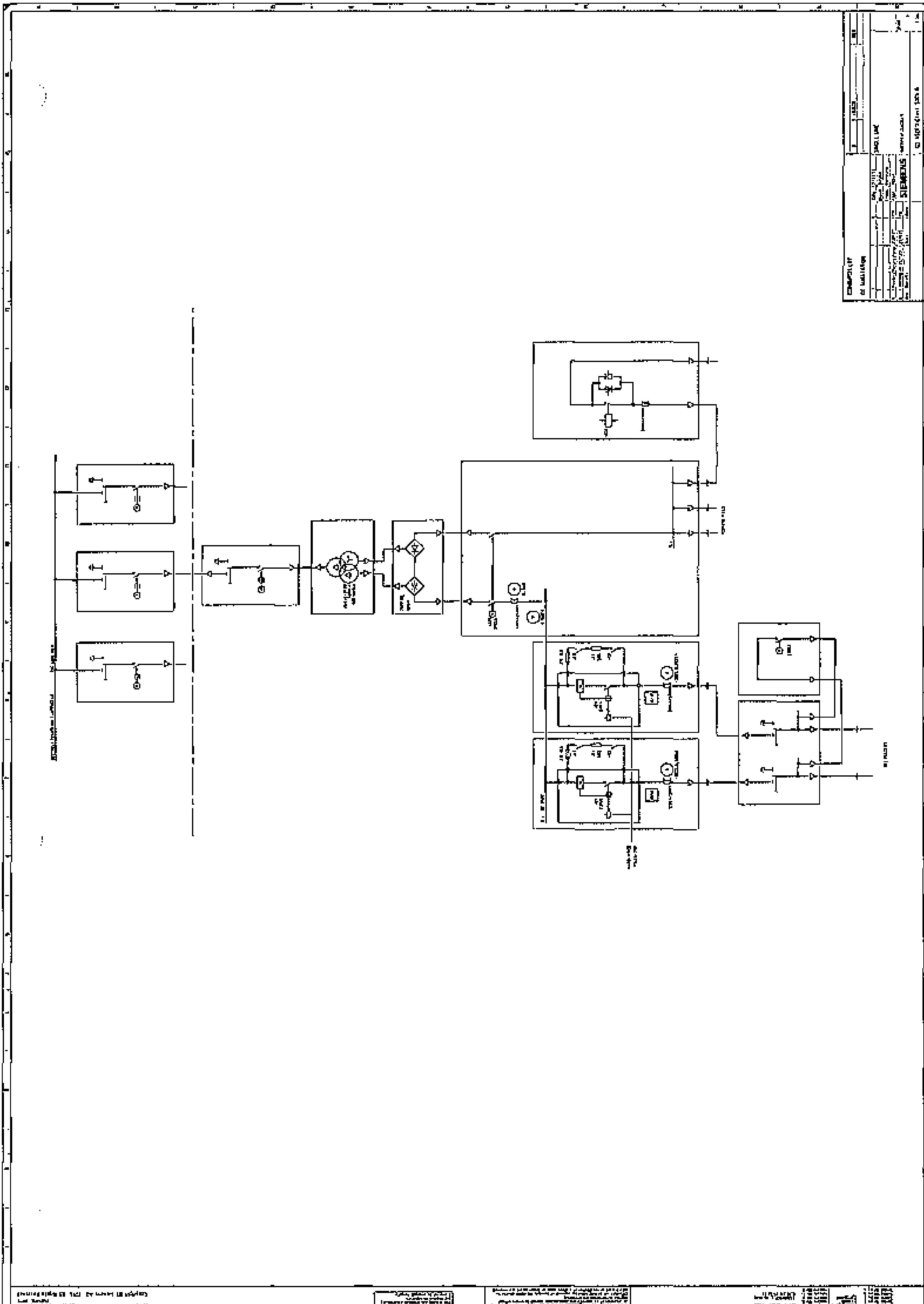


Characteristics:
contact wire + messenger wire tensioned

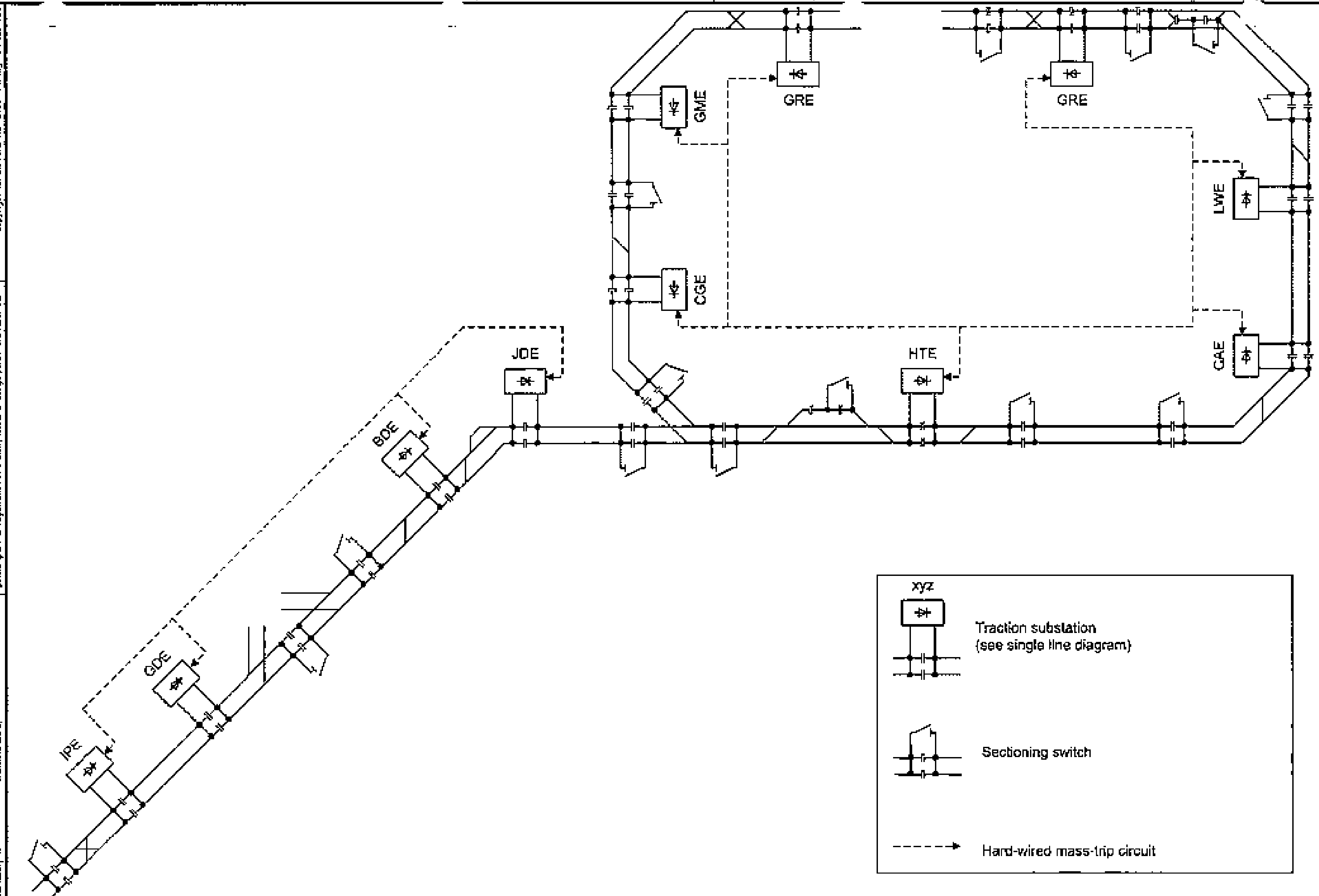
LRT EDINBURGH

Cantenary system
with cantilever suspension

SIEMENS



USB00000088_0363



Unless otherwise specified, wires are

Date	23.03.07	EDINBURGH LRT
Drawn	Bufzke	
Check.	Herrmann	DC SUBSTATION
Appr.	Müller	Orig./Repl.f./Repl.by

Rev. | Remarks | Date | Name

SIEMENS

LINE OVERVIEW

OVERVIEW DIAGRAM

B =AA00 BE2

(1) A52B11-Exxxx-S000

Sheet 2- 2 Sh

USB00000088_0364

USB00000088_0365

Revised Maintenance Proposal, based on BAFO Submission

Edinburgh Tram Network

Folder 1– Section 3

Maintenance

Part 1 - Maintenance Proposal

SIEMENS

Table of Contents

1 General

The submitted offer is based on applied maintenance procedures that are either prescribed by law in Germany (e.g. BO Strab or its guidelines), recommended in guidelines or publications of VDV (Verband deutscher Verkehrsbetriebe) or in DIN/EN standards or have been defined on the basis of corresponding experience. This offer is also based on the ROGS and relevant Railway Group Standards and law in Scotland.

Maintenance is described in DIN 31051 and comprises the sub processes of service (slowing down of the usage of existing wear reserve), inspection (determination of actual condition) as well as repair and improvement (restoration or improvement of reference condition):

This offer is based on the following documents:

- employer's requirements, chapter 40, Maintenance Version [3.1.1]; dated 3rd January 2008
- Infraco Agreement and Schedules which are currently being finalised to address the remaining maintenance issues as identified on the list (to be accomplished by Jan 10, 2008) Proposed BBS system design submitted [December 12, 2007]

This offer contains the (periodic) measures of preventative maintenance (service and inspection) as well as the measures of corrective maintenance that may become necessary.

The pricing schedules have been prepared on the basis of:

a) no synergies of overhead with Tram Maintainer, and
b) with assumed synergies (shared utilisation of staff)

and in all cases with no mark-up on the tram maintenance price.

2 Integrated maintenance plan

2.1 Introduction

The Infraco Maintainer will be responsible for the execution of the infrastructure maintenance in conjunction with the operation plan. The maintenance will be carried out on the basis of the maintenance documentation of the individual systems and components. Furthermore the Infraco Maintainer has taken assumptions out of experiences with other projects.

The objective of this proposal is to provide a maintenance scheme that can ensure high reliability and availability of the Edinburgh Tram Network Infrastructure.

The maintenance scheme is based on a pre-designed system, including the announced subsystems. This proposal includes 10 years of maintenance period commencing with revenue service of phase 1a of the ETN.

2.2 Maintenance plan

The Infraco Maintainer will develop a maintenance plan identifying activities, resources, timing and frequency of maintenance activities to be carried out and the circumstances in which maintenance intervention will be necessary. The maintenance plan shall also schedule the protocols, standards and records to be retained in respect of each system.

The maintenance plan will include:

- A programme of activities
- Maintenance requirements matrix
- development of the maintenance organisation and engineering support;
- safety management;
- maintenance procedures;
- strategies for dealing with reactive maintenance activities including details of response and restoration times and recovery plans;
- duties and responsibilities;
- scheduling of preventative (planned) maintenance activities;
- Corrective Maintenance Reporting
- human resources required
- recruitment, training, and competency management of maintenance resources
- quality assurance, quality control and testing;
- spare parts and consumable stores and reorder scheme (including minimum stock levels, supplier details and reorder lead times);

- tools, special tools and plant equipment
- health and safety of staff;
- data recording and trend analysis;
- design fault identification and correction activities; and
- Documentation and reporting,
- Details of required insurances.

The Maintenance Plan will be approved by the client, prior to operational service.

2.3 Maintenance Activities

The Infraco maintainer will undertake two types of maintenance, the major activity being preventative maintenance, and corrective maintenance (faulting) being the other smaller type. The mix of these types will be optimized to ensure availability of the system to the required level through the contracted duration.

2.3.1 Preventative Maintenance

Preventative maintenance (PM) is a program in which wear, tear, and change are anticipated and continuous corrective actions are taken to ensure peak efficiency and minimize deterioration. PM involves a planned and controlled program of systematic inspection, adjustment, lubrication, and replacement of components, as well as performance testing and analysis.

The result of a successful PM program extends the life of the facilities and equipment, and minimizes unscheduled downtime that causes major problems. It ensures that equipment is operating properly, and reduces unscheduled breakdowns to a minimum.

The PM program will be produced utilizing our extensive experience in other projects. This program will allow for the maintenance intervals to be variable within certain constraints to ensure that the highest possible Reliability and Availability can be maintained (see Figure 1). This will also enable the workload for our maintenance teams to be balanced to ensure a cost effective maintenance solution.

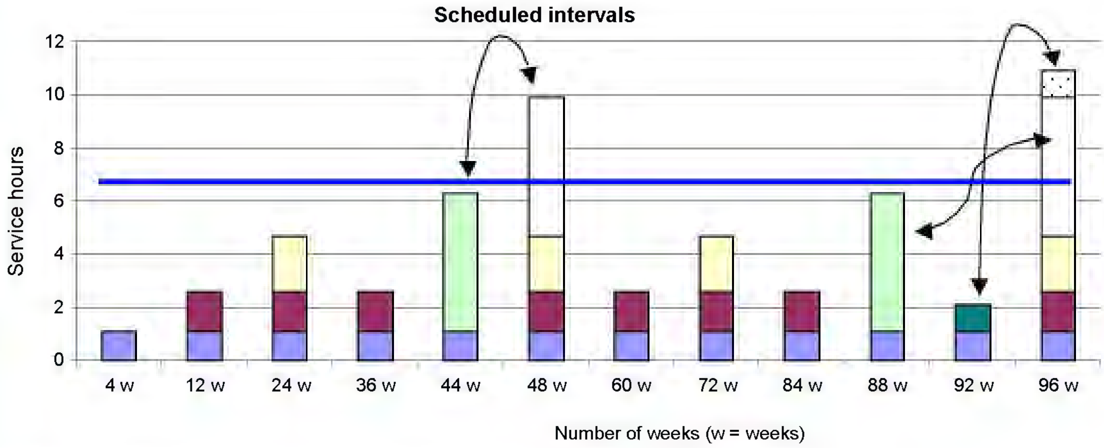


Figure 1 – Example of Maintenance Schedule

2.3.2 Corrective Maintenance

The application of an effective preventative maintenance program will not remove the need of corrective maintenance.

Corrective maintenance consists of the action(s) taken to restore a failed system to operational Service. This will usually involve replacing or repairing a component that is responsible for the failure of the overall system. The objective of corrective maintenance is to restore the system to satisfactory operation within the shortest possible time. Corrective maintenance will be carried out in three steps:

Diagnosis of the problem

The technician will locate the failed parts or otherwise satisfactorily assess the cause of the system failure.

Repair and/or replacement of faulty component(s)

Once the cause of system failure has been determined, action must be taken to address the cause, usually by replacing or repairing the components that caused the system to fail.

Verification of the repair action

Once the components in question have been repaired or replaced, the maintenance technician must verify that the system is again successfully operating.

Repeat and “No Fault Found (NFF)” incidents

The management of repeat faults will be undertaken as part of the duties of the Performance Engineer (PE). The PE will monitor the system faults through the MMS and when it becomes apparent that repeat failure (same location or equipment type), an investigation plan will be implemented to identify the cause of the repeat failure. Once the cause of the failure has been established an action plan will be prepared and implemented to eradicate the issue.

The PE will also be responsible where NFF incidents are occurring, this will be dealt with in exactly the same manner as repeat faults.

Where necessary support will be requested from OEM’s to assist in the activities outlined above.

Understanding the cause of a failure is essential and will be recorded and analysed. This analysis will used to make any changes (if required) to our preventative maintenance program or procedures.

2.4 Safety Standards

There are two important aspects of safety standards in maintenance regime:

- safety standards, which are directly related to personal safety, and
- safety procedures, which are assigned to job/tasks.

Concerning the personal safety of the workers, the European Railway Standard (UIC) combined with the Rules and Regulations that apply in UK will be adopted.

The safety procedures will be developed according to UK regulations and industry standards. These standards will be applied within the Infraco maintenance documentation.

2.5 Quality Assurance

The Infraco Maintainer will define and establish Quality Assurance and Control Procedures for the maintenance of the Infrastructure Systems which comply with EN ISO 9000 Quality Standards. The Infraco Maintainer is certified according to EN ISO 9001, which succeeded the EN ISO 9002 in 2000 (please find attached certificate). The maintenance work will be executed in compliance with the EN ISO 9001 standard.

The implementation of a QA/QC - Regime and the certification through external auditors require the designation of a SQE Manager, who will be directly responsible to the Maintenance Manager of the Infraco Maintainer. The SQE Manager will be responsible for implementing and maintaining the quality regime within the Organisation.

2.6 Communication between Operator and Infraco

Communication between the Infraco Maintainer and Operator is essential to ensure that the maintenance plans and schedules are effective and do not adversely effect Operator's ability to deliver the passenger service.

A meeting shall be held on an agreed timetable to ensure that coordination of maintenance and operational activities is achieved. This shall discuss and agree any issues or activities related to or influencing the tram system, including but not limited to the Infraco maintainer, Tramco maintainer and Operator.

3 Basis for calculation

3.1 Edinburgh Tram Network System Criteria

This proposal is based on the following configuration. Changes, modifications or extensions to this configuration will lead to changes of the price. Maintenance activities on the systems components will be performed exclusively by the Infraco Maintainer.

The Maintenance offer is based on the following system criteria:

- Maintenance period: 10 years, Start of Maintenance: January 2011 (start of revenue service for phase 1a)
- Number of vehicles: 31 Tram sets
- Length of sections A&B&C 18.455 m (Phase 1a)
- Length of sections D&E 5.980 m (Phase 1b)
- Depot at Gogar
- Tram schedules (timetables) as described in the Employer's Requirements

3.2 Working and Service Time

The Infraco maintenance works will be executed on basis of the following information:

- Service Time: Joint teams of Civil Works and E'&M maintenance, covering daily maintenance period from 06:01 to 22:00, Monday to Sunday
- Response time: 06:01 to 22:00, 15 minutes response time
  22:01 to 06:00, 60 minutes response time (one person being on-call)
- 3 mixed teams of 5 respectively 4 people (full time) will cover all preventative and corrective maintenance tasks for the mainline and the depot system.
- Activities that require to be undertaken in non-traffic hours will be planned to make best advantage of staff's time. The staff required to undertake these works, will be rostered from the 3 mixed teams.
- Normal working days (for additional chargeable work): Monday to Friday
- For Public Holidays and times when service levels are reduced it is intended to undertake any intrusive works that are required, these works will only be undertaken after consultation with the Operator.
- Civil defects, landscaping and specialised civil inspections will be undertaken as required by personnel sourced outside of this maintenance organisation.
- 1 caretaker will be provided for Gogar depot only.
- The preventative tasks for Infrastructure will be performed during dayshift.
- Tram Network operating hours per day: 19 h 30, starting 5:00 a.m.

- Minimum non traffic hours per night 4h 30

3.3 Maintenance project planning

The maintenance concept for the Edinburgh Tram Network will be implemented in stages according to the overall system implementation. The responsibility for the systems remains with the Infraco design and construction team until the handover to the Infraco maintenance team (start revenue services Phase 1a).

During the commissioning and trial running phase, maintenance will be undertaken in line with the maintenance plan by the Infraco Maintainer. This will allow the maintenance plans and procedures to be tested and verified that the planned maintenance meets the needs of the Edinburgh Tram Network. This will be undertaken by a day shift team only during this phase (2 shifts are planned during the last month prior to commencement date).

The maintenance activities will commence with start of Revenue Service Phase for the defined scope and will run throughout the 10 years contract period.

3.3.1 Mobilisation phase

Prior to the commissioning and up until commencement of Revenue Service the Infraco Maintainer will build up the maintenance organisation. (see section 5)

3.3.2 Maintenance phase

During the 10 years maintenance period, the Infraco Maintainer will provide maintenance to the system implemented under the responsibility of the Infraco.

This includes planning, implementation and execution of preventative and corrective maintenance managed by a professional maintenance organisation. Sufficient and qualified staff will be hired, trained and managed by experienced personnel under the full and sole responsibility of the Infraco Maintainer. The components and materials required for the execution of the maintenance shall be supplied supported by a professional procurement. Storage area as well as storage management will be organized in cooperation with the Tramco.

3.4 Standards and Regulations

The maintenance will be executed following the guidelines of the following standards and regulations such as:

- International standards (International Electrotechnical Commission - IEC)
- European standards

The most important standards for the maintenance of the system are as follow at the date of bid submission:

Table 1: Standards and Regulations	
Standard	Description
EN 8402	Quality, Reliability and Safety
EN 13306	Definitions of Maintenance
EN13816	German Version of Transportation and Service
EN 50126	Reliability, Availability, Maintainability (RAM)
DIN 31051 (2003/06)	Basics of Maintenance
ISO 9004	Quality Management and Quality System Elements - Guidelines
ISO 14001	Environmental
BoStrab (German Ordinance of the Construction and Operation of Rail Systems for Light-Rail Transit)	English translation of German version

It should be noted that standards will be frozen upon the award of the Infraco Agreement.

All changes of existing standards as well as mandatory standards that are issued after contract award that are required to be adhered to will be reviewed and assessed. Any impact to execution of the program as well as any financial implications will be brought to the attention of TIE. Prior to adoption of the revised standards TIE will instruct its use.

It will also be necessary for any new standards to be implemented by Infraco Maintainer to be understood by the Tramco Maintainer and Operator. This will ensure they are aware of any implications of their operations.

4 Scope and Conditions of Supplies and Services

4.1 Scope of Provisions, Supplies and Services

The following supplies and services are included and executed during the contract period by the Infraco Maintainer for the systems:

- Maintenance Management
- Maintenance Plan
- Maintenance Schedules
- Quality Assurance Plan
- Health & Safety Assurance Plan
- Performance Concept
- Procurement Plan
- Provision of maintenance staff
- Training of maintenance staff
- Inspections (function-, safety and maintenance-related)
- Corrective and preventative maintenance
- Repair of components
- Revisions, Renewals and Overhauls of components / on component level (within planned preventative maintenance for 10 years of maintenance)
- Maintenance Management System (IT-based)
- Jobs descriptions based on documentation and maintenance manuals from suppliers
- Procurement and Logistics for required spare parts and material (preventative and corrective, planned overhauls and revisions if any) in cooperation with System deliveries and in cooperation with the operator
- Lubricants
- Return management of failed parts
- Hand tools for maintenance workers

4.2 Services provided by others

As part of the contractual documentation the following parties will also provide services to ensure the operation of the Edinburgh Tram Network.

These services will be provided by:

- Tramco/Tramco Maintainer
- Operator
- City of Edinburgh Council (CEC)

The activities they shall undertake are detailed in *Edinburgh Tram – Infrastructure Equipment Responsibilities Allocation*

This includes but is not limited to:

- Maintenance coordination between Operator, CEC, Infraco Maintainer, Tramco Maintainer and others
- Repair of damages due to vandalism, graffiti, theft, derailments, external influences and force majeure; Repair of damages due to improper handling or operation of the systems. However, in the event that the Infraco Maintainer has caused and is responsible for a damage, as a result of action or inaction, the Infraco Maintainer will bear the costs for rectifying the defect. *
- Subsystem replacements (i.e. after end of design life)
- Cosmetic repairs *

* These services and supplies can be provided by the Infraco Maintainer on the basis of individual task orders, to be agreed upon based on this agreement. A list of menu-priced tasks will be submitted, discussed and agreed between the TIE and the Infraco prior to contract award (appendix 5).

4.3 Assumptions and Prerequisites

Supplies and Services as described in this proposal shall be delivered considering the following premises:

1. 3rd party systems and infrastructure of Edinburgh Tram Network (i.e. not provided by Infraco as part of Infraco works) have to be properly designed and installed as to the requirements stated in the tender. Failures resulting from deviations to these requirements will not be covered by the Infraco Maintainer.
2. Services which are currently excluded from the scope of the Infraco Maintainer shall be performed under responsibility of the Operator, CEC or others.
3. Maintenance activities shall be undertaken from Gogar depot, that means Gogar depot will be the organisational centre of the Infraco maintenance activities. Maintenance staff will be sent out for preventative as well as corrective maintenance from there. No outbased depots are planned
4. All facilities (depot, stores, staff rooms, offices incl. IT- and Communications infrastructure, electricity connections, water supply, sanitary rooms etc) and equipment (depot equipment and machines, workshop equipment, test equipment), service vehicles (incl. road/rail vehicles, cranes etc) required for the professional execution of the maintenance of the systems will be provided to the Infraco Maintainer in time, in sufficient dimensions and conditions. It is assumed that all facilities and materials as referred to above are in best conditions and ready for use. The Infraco Maintainer does not assume any responsibility for the provision of electricity, water supply and wastewater disposal.
5. The Maintainer will be granted full and unlimited access subject to agreed possessions if effecting the Transport Service to all facilities and equipment needed to perform the maintenance services (i.e. entire Tramway System

including the related technical plant rooms, equipment and the workshop area as well as the initial stock). This will include access to an operational store.

6. Insurances of buildings, stores and the installed tramway-system infrastructure will not be covered by the Infraco Maintainer. The Infraco is however responsible for the deductible amount in connection with insurance claims that are Infraco's responsibility.
7. The operation of the infrastructure systems by Operator shall only be performed by personnel that are qualified and trained for this purpose.
8. Cost for repair of damages due to vandalism, graffiti, theft, derailments, accidents, external influences and force major, are not covered by Infraco. If support by the Infraco Maintainer is needed, this will be invoiced separately, subject to change mechanism in the Infraco Agreement. In such cases as mentioned above TIE and the Infraco Maintainer will mutually agree on temporary relief from the performance measurement regime.
9. Changes to the Systems in terms of modifications, extensions, adaptations and down-sizing will have to be considered in a review and possible modification of the maintenance price.
10. The Maintainer is not responsible for communication with: Fire Fighting, Emergency medical services, Police or other state or local authorities in cases of accidents, derailments or vandalism.
11. The Maintainer is not responsible for the supply of financial reports or statistical reports for governmental organisations or local authorities (except legal obligations).
12. All appropriate matters in relation to human resources of the Infraco Maintainer will be managed under the full and sole responsibility of the Infraco Maintainer.
13. All matters concerning safety and security for the Tramway System beyond Infraco's obligations related to the infrastructure maintenance will be undertaken by Operator. The Infraco Maintainer will support Operator in this duty
14. As a technical solution for the Edinburgh Tram Network has yet to be fully defined the scope of maintenance is based on the information available to date. The maintenance proposal will have to be reviewed in line with the final technical solution to ensure compliance. An example of this is our assumption that the trams will not be supplied with *"real bogies"* (based on the available information).
15. We anticipate and recommend that a tower road rail vehicle is provided. This has not been calculated by the Infraco Maintainer.
16. All items provided by TIE or Operator are assumed to be free of charge to the Infraco Maintainer
17. The exchange of brushes for the wash plant, detergent for the wash plant, removal of swarf from the wheel lathe are excluded
18. The contractual obligations under the maintenance part of the Infraco Agreement regarding the execution of regular preventative and corrective maintenance works shall commence with start of revenue service of the entire Edinburgh Tram Network. Required maintenance prior to start revenue service (degraded maintenance) will be executed under the responsibility of the Infraco construction team Delays not caused by Infraco will be assessed and shall be subject to the change mechanism in the Infraco Agreement if applicable.

5 Organisation

5.1 Schedule for Recruiting, Training and Qualifying

The recruiting of the maintenance employees will be performed in advance of the training schedule. The Infraco Maintainer intends to recruit the necessary key personnel from the suppliers or construction companies of Edinburgh Tram Network project. Other personnel will be chosen in accordance with the job requirements and levels of qualification.

This recruitment will be scheduled prior to the commencement of commissioning. This will be limited to key positions

5.2 Personnel organisation

Personnel requirements have been determined based on experience gained from previous projects and considering the following factors:

- Equipment usage forecasts
- Equipment quantities
- Equipment reliability's
- Diagnosis, removal and replacement times
- Response times due to geographical dispersion
- Corrective Maintenance tasks
- Preventative maintenance tasks and frequencies
- Necessary coverage period
- Overhead for weekends, vacations, holidays, continuous training, sick leave and administration

The organisation charts show (See appendix 1) the structure of the maintenance organisation. The proposed organisation covers the specified response time between 06:01 and 22:00 as well as the reduced service availability from 22:01 to 06:00.

The leader of the maintenance organisation made up by BBS will be the Project Manager. The Project Manager will be responsible for all issues related to infrastructure maintenance.

The Commercial manager will be a significant role within the maintenance organisation providing the commercial and administrative support required by modern maintenance organisations. He is the coordinator of the accompanying measures of the maintenance activities and requirements.

The E&M maintenance organisation is built around the E&M – Manager and the Team Leaders in order to optimise staffing levels and to limit associated labour costs. The E&M – Manager will be the contact for the operator during daily operation. The maintenance activities will be controlled and managed by the Team Leaders. Teams will consist of specialised electrical, mechanical and civil technicians. The E&M maintenance teams will be available as stated under para 3.2. The personnel will be prepared to carry out preventative maintenance activities according to the maintenance plan and undertake corrective maintenance when required.

A civil manager is responsible for the organisation of the civil maintenance activities. The civil maintenance activities like civil defects, landscaping and cleaning will be undertaken as required by personnel sourced outside of this maintenance organisation and will be controlled and managed by the civil manager, who will also be the contact for the operator during daily operation.

5.3 Job descriptions

5.3.1 Project Manager

The Project Manager shall be responsible for directing and coordinating the activities within the maintenance organisation. Having full authority to speak and act on behalf of the Maintenance Consortium. The Project Manager will schedule and attend meetings with TIE and Operator designated representatives in order to share information, assess the performance of the maintenance services, and discuss any problems, service changes, relations, security and any other issues.

The Project Manager is the contact to TIE and Operator working in close relationship towards the common goals of the organisation.

5.3.2 Commercial Manager

The Commercial Manager is the coordinator of the accompanying measures of the maintenance activities and requirements. Responsible for establishing procedures and work processes which lead to the timely and efficient provision of personnel resources, materials and information to support system maintenance. Furthermore, he will be responsible for carrying out the administrative functions.

5.3.3 E&M Manager

The E&M Manager is responsible for the operational maintenance work and will report directly to the Project Manager. He will also coordinate the infrastructure maintenance activities with the tram maintenance and the civil maintenance.

His duties and responsibilities also include:

- The management and supervision of the leaders of the 3 combined teams
- Scheduling maintenance activities in accordance to the planning defined by the MMS and the Maintenance Planner.
- Allocating appropriate resources for unscheduled interventions according to the technical needs and prioritisation of maintenance tasks
- Verify that equipment installation meets the operational needs of the organisation.
- Assist in development of standard maintenance programs, safety procedures and work rules for start-up and revenue operations.
- Cooperation with Procurement & Logistic and the Operator to assure that adequate spare parts, tools and other necessary equipment is on hand to support revenue operations.

5.3.4 SQE- / Performance Engineer

As part of the Infraco organisation we have allowed for a combined SQE- / Performance Engineer.

The role of the Safety, Quality and Environment Engineer (SQE) is the direct responsibility for the matters relating to system and workplace safety throughout the organisation including:

- Safety orientation and training
- Safety audits and inspections
- Accident/incident reporting and investigation of the equipment
- Environmental issues

Furthermore the Safety, Quality and Environment Engineer (SQE) has the responsibility for enforcing the quality assurance program establishing the following relationships:

- The quality organisation will maintain close working relationships with the project elements to enlist their commitment in achieving quality program objectives.
- Interface with his counterparts of the organisation to coordinate quality program implementation and resolve issues related to it.
- Actively participant in program status reviews, presenting the status of the quality program and major issues,

as well as the responsibility for implementing comprehensive Quality Assurance and Quality Control procedures for the maintenance of the Infrastructure Systems which go along with EN ISO 9000 Quality Standards and as well as the authority to maintain the highest quality levels throughout the project execution.

The SQE Manager will be responsible for initial and regular training programs.

The role of the Performance Engineer is the direct responsibility for ensuring that the infrastructure system performance is in line with the requirements of TIE. Additionally the performance engineer will monitor the response times in line with the performance requirements of the contract. This role will also monitor the performance of the system along with the maintenance team and identify any performance improvements through maintenance activities.

The SQE- / Performance engineer shall report to the Project Manager

5.3.5 Maintenance Planner

The Maintenance Planner is responsible for the planning and scheduling of the maintenance works. This comprises the preventative maintenance tasks for infrastructure maintenance. The tool to be used is the MMS software. The planning of the preventative tasks will be coordinated with the operator.

The Maintenance Planner shall report to the Project Manager.

5.3.6 Civil Manager

The Civil manager reports directly to the Project Manager.

The Civil manager will ensure that civil faulting and maintenance is undertaken in line with the maintenance plan.

His duties and responsibilities include:

- The management and supervision of the workers and other staff required to perform maintenance tasks.
- Administration of maintenance history for their technical responsibility (Fault Reporting and Monitoring) by updating the MMS-System.

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- Scheduling maintenance activities in accordance to the planning defined by the MMS and the Maintenance Planner.
- Allocating appropriate resources for unscheduled interventions according to the technical needs and prioritisation of maintenance tasks
- Verify that equipment installation meets the operational needs of the organisation.
- Assist in development of standard maintenance programs, safety procedures and work rules for start-up and revenue operations.
- Cooperation with Procurement & Logistic and the Operator to assure that adequate spare parts, tools and other necessary equipment is on hand to support revenue operations.

6 Maintenance of Infrastructure System

6.1 Scope of the Maintenance

The Infraco Maintainer will be responsible for the maintenance of the infrastructure systems delivered and installed under the responsibility of the Infraco. The following systems will be maintained according to the Maintenance Plan of the manufacturer:

- Depot Equipment
- Traction Power Supply
- Overhead Contact Line System
- SCADA
- Signalling System
- Telecommunication System
- Security Systems
- Track, Civil and Buildings

6.2 Maintenance Activities

6.2.1 Electrical and Mechanical

6.2.1.1 Traction Power

As a result of the maintenance analyses, a schedule for preventative maintenance will be established for the delivered traction power system (with regard to the scope of supply). This section describes the reliability-oriented inspection and maintenance work for each major component as well as the maintenance intervals and the down times for the operations. The maintenance tables also specify the required level of preventative maintenance.

The works will be carried out in fixed intervals as shown in the maintenance plans (appendix 2). The purpose of this table is to enable the customer to gain an understanding of what the Maintenance organisation intends to do regarding the maintenance of traction power systems.

The Traction-power system consists of 2 groups:

- Power supply and distribution
- Catenary system

<u>Traction Power - Preventative Maintenance Programs</u>

<u>Inspections</u>

The inspection comprises the measures to be performed to determine and evaluate the actual state of technical equipment within the scope of supply of Edinburgh Tram Network. The inspection covers the following activities:

- Function-related,
- Safety-related, and

- Maintenance-related activities.

Service technicians carry out inspections on mechanical, electrical and electronic plants in accordance with the working schedules. The results are documented and evaluated. During inspection, service technicians carry out minor maintenance work immediately. If the scope of the required work is larger they will undertake the necessary maintenance measures for keep the equipment in available state.

Preventative maintenance

The preventative maintenance covers all measures necessary for keeping the technical equipment or plant in the required state. According to specified working schedules, the periodic maintenance tasks are carried out on mechanical and electrical plant. The results are recorded and evaluated. Based on the experience gathered with a growing number of maintenance activities and documented results, it will be possible to make statements on the condition and wear behaviour of parts and systems.

During preventative maintenance tasks small parts such as mounting parts, indication / pilot lamps, etc. are replaced. Only components, which either might have a safety impact or are heavily corroded or no longer meet functional requirements due to other damage, will be replaced.

The preventative maintenance includes:

Inspection (visual checks)

Inspections are required from time to time. Usually, the work will be carried out in fixed intervals. Inspection intervals depend on the type of equipment and the possible damage. The parts have to be inspected with the following criteria:

- Damage (fracture, scorching, change of colour, etc.)
- Dirt, corrosion
- Missing equipment (earthing devices, indicator shields, etc.)

Preventative maintenance

Preventative maintenance will be performed normally from Monday to Friday either during operating hours or at non-operating time during night.

Functional tests (Checking)

- Switchboards
- Low-voltage supply with batteries
- Catenary system
    a. Masts
    b. Droppers
    c. Catenary
    d. Isolators
    e. Expansion
    f. Joints
- Earthing system
- Wear points (abrasion)
- Cleaning of the TEL/SCADA technical equipment

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Measures that become necessary due to improper use, faulty operation, accident damages and other external effects, force majeure, vandalism, alterations and extensions, etc. are excluded in so far as these are not due to the actions or omissions of Infraco. Such works are handled as non-contractual performance, and therefore are separately charged and invoiced according to the change mechanism in the Infraco Agreement.

Corrective Maintenance

The corrective (unscheduled) maintenance work covers the activities for restoring the required state (not original) of technical equipment in a plant/line. Unscheduled maintenance works are carried out to remedy spontaneously occurring operating faults, which will interrupt service operation.

These tasks cannot be planned. Immediately after the maintenance staff have received a trouble message that a fault will interrupt service operation, the measures necessary to quickly restore service operation will be taken (according to our repair strategy). Effective coordination and execution of repair works as well as provision of spare parts form the basis for a quick and economical form of unscheduled maintenance.

Measures that become necessary due to improper use, faulty operation, external effects, force majeure, vandalism, are handled as non-contractual performance, and therefore they are separately charged and invoiced.

Specialized and Heavy Maintenance Equipment

The special equipment required for the execution of the maintenance tasks on the traction system will be either included in the scope of the depot equipment by the Infraco or within the scope of the Infraco Maintainer (besides the equipment mentioned under para 4.3 item 5) before the start of the maintenance service.

Special equipment for the maintenance tasks will remain in the depot for the execution of the different maintenance activities over the contract period and will be part of the Handover procedure by the Maintenance organization after the 10 years of maintenance contract has finished.

6.2.1.2 Train Control and Signals

Preventative and Corrective Maintenance analysis

As a result of the maintenance analyses, a schedule for preventative maintenance will be established for the train control and indoor/outdoor signalling-systems. This section describes the reliability-oriented inspection and maintenance work for each major component as well as the maintenance intervals and the down times for the operations. The maintenance tables also specify the required amount of preventative maintenance. Please refer to the maintenance plans (appendix 2).

Preventive Maintenance Programs

Inspections

The inspection comprises the measures to be performed to determine and evaluate the actual state of technical equipment within the scope of supply of Edinburgh Tram Network. The inspection covers:

- Function-related,
- Safety-related, and
- Maintenance-related activities.

According to working schedules coordinated and suitable intervals, service technicians carry out inspections on mechanical, electrical and electronic plants. Results are documented and evaluated. During inspection, service technicians perform the minor maintenance tasks immediately that they can do by using their tools. If the scope of necessary work is larger, they will undertake necessary maintenance measure required for keeping the equipment in an available state.

According to specified working schedules and intervals preventative maintenance work is carried out on mechanical and electrical facilities. Results are recorded and evaluated. Based on the experience gathered with a growing number of maintenance activities and documented results, it will be possible to make statements on the condition and wear behaviour of parts and systems.

During preventative maintenance activities inexpensive small parts such as mounting parts, indication / pilot lamps, etc. will be replaced. Major wear parts as well as incidentals and operating materials, such as inking ribbons, incl. printing paper, and batteries are exchanged or supplemented. Minor repair tasks are performed during maintenance.

These tasks can be scheduled for the maintenance of components at site or in the workshop. Type and scope of works as well as available spare parts are decisive criteria when determining the most economical form of maintenance becoming necessary due to natural wear.

The preventative maintenance includes:

Inspections (visual checks) are required from time to time. Usually, the work will be carried out in fixed intervals. Inspection intervals depend on the type of equipment and the possible damage. The parts have to be inspected with the following criteria:

- Damage (fracture, scorching, change of colour, etc.)
- Dirt, corrosion
- Missing equipment (earthing devices, indicator shields, etc.)

Preventative maintenance will be performed normally from Monday to Friday either during operating hours or at non-operating time during night.

Functional tests (Checking, measuring, adjusting)

- Indoor equipment (electronic interlocking including peripheries)
- Operation control
- UPS (power supply system)
- Point Machines
- Point Lock Checking Device, Point Position Checking Device
- Signals (track- and road-signals)

Cleaning of the control and signals technical equipment

Measures that become necessary due to improper use, faulty operation, external effects, force majeure, vandalism, alterations and extensions, etc. are excluded. Such works are handled as non-contractual performance, and therefore are separately charged and invoiced.

Corrective Maintenance

The corrective (unscheduled) maintenance work covers the activities for restoring the required state (not original) of technical equipment in a plant/line. Unscheduled maintenance tasks are carried out to remedy spontaneously occurring operating faults that will interrupt service operation.

These tasks cannot be planned. Immediately after our maintenance staff has received any trouble message, appropriate measures necessary for quickly eliminating the trouble will be taken (according to maintenance strategies previously fixed). Good coordination and execution of repair works as well as provision of spare parts form the basis for a quick and economical form of unscheduled maintenance are essential.

Measures that become necessary due to improper use, faulty operation, external effects, force majeure, vandalism, are handled as non-contractual performance, and therefore they are separately charged and invoiced.

Specialized and Heavy Maintenance Equipment

Necessary special equipment for the execution of the maintenance tasks on the train control and signals will be delivered as scope of the depot equipment or with start of the maintenance service.

Special equipment for the maintenance tasks will remain at the depot for the execution of the different maintenance activities over the contract period.

6.2.1.3 Communications Systems

The installations under this heading do not only comprise the means for verbal communications such as telephones or radio, but also different alarm systems, operational monitoring systems PIS- and CCTV-system, etc.

Preventative and Corrective Maintenance analysis

As a result of the maintenance analyses, a schedule for preventative maintenance will be established for the communications systems. This section describes the reliability-oriented inspection and maintenance work for each major component as well as the maintenance intervals and the down times for the operations. The maintenance tables also specify the required amount of preventative maintenance. Please refer to the maintenance plans (appendix 2).

Maintenance and repair work will partially be executed in places where the equipment is installed and partially be executed in the electronics workshop. The detailed maintenance planning will include detailed instructions for the maintenance of the communication subsystems. However, the imposed maintenance concept requires a permanent observation of the telecommunications system in order to prevent casual/accidental faults of components as far as possible.

Preventive Maintenance Programs

Inspections

The inspection comprises the measures to be performed to determine and evaluate the actual state of technical equipment within the scope of supply of Edinburgh Tram Network. The inspection covers:

- Function-related,
- Safety-related, and
- Maintenance-related activities.

The large variety of the equipment involved makes it difficult to establish fixed periods for maintenance purposes and inspections. The recommendations of the manufacturers and the usage of the different systems are the basis on which maintenance programs will be developed and later adjusted in accordance to operational experience.

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According to working schedules coordinated and suitable intervals, service technicians carry out inspections on mechanical, electrical and electronic plants. Results are documented and evaluated. During inspection, service technicians perform the minor maintenance tasks immediately that they can do by using their tools. If the scope of necessary work is larger, they will undertake necessary maintenance measure required for keeping the equipment in an available state.

Preventative Maintenance

According to specified working schedules and intervals preventative maintenance work is carried out on mechanical and electrical facilities. Results are recorded and evaluated. Based on the experience gathered with a growing number of maintenance activities and documented results, it will be possible to make statements on the condition and wear behaviour of parts and systems.

During preventative maintenance activities inexpensive small parts such as mounting parts, indication / pilot lamps, etc. will be replaced. Major wear parts as well as incidentals and operating materials, such as inking ribbons, incl. printing paper, and batteries are exchanged or supplemented. Minor repair tasks are performed during maintenance.

These tasks can be scheduled for the maintenance of components at site or in the workshop. Type and scope of works as well as available spare parts are decisive criteria when determining the most economical form of maintenance becoming necessary due to natural wear.

The preventative maintenance includes:

Inspection (visual checks) required from time to time. Inspection intervals depend on the type of equipment and the possible damage. The parts have to be inspected with the following criteria:

- Damage (fracture, scorching, change of colour, etc.)
- Dirt, corrosion
- Missing equipment (earthing devices, indicator shields, etc.)

Preventative maintenance Preventative maintenance will be performed normally from Monday to Friday during operating hours.

Functional tests (Checking, measuring, adjusting)

- CCTV
- Public address
- OTN
- Telephone

Cleaning of the communications systems equipment

Measures that become necessary due to improper use, faulty operation, external effects, force majeure, vandalism, alterations and extensions, etc. are excluded. Such works are handled as non-contractual performance, and therefore are separately charged and invoiced.

Corrective Maintenance

The reliability of telecommunications is a precondition to the working of the initial system according to the agreed quality standards. A high degree of availability will be achieved through adequate provision of telecommunications. The repair philosophy is based on faulty units being replaced. The telecommunications equipment is mainly designed in a modular way. Repair will normally be performed by replacement of individual units. Faulty equipment is returned to the electronics workshop for investigation and possible repair. Selected faulty equipment shall be returned to the supplier for repair on request.

The corrective (unscheduled) maintenance work covers the activities for restoring the required state (not original) of technical equipment in a plant/line. Unscheduled maintenance tasks are carried out to remedy spontaneously occurring operating faults that will interrupt service operation.

These tasks cannot be planned. Immediately after our maintenance staff has received any trouble message, appropriate measures necessary for quickly eliminating the trouble will be taken (according to maintenance strategies previously fixed). Good coordination and execution of repair works as well as provision of spare parts form the basis for a quick and economical form of unscheduled maintenance are essential.

The equipment for CCTV and Public Address System needs a permanent control but generally only minor corrective maintenance tasks (mainly in case of vandalism or sabotage).Measures that become necessary due to improper use, faulty operation, external effects, force majeure, vandalism, are handled as non-contractual performance, and therefore they are separately charged and invoiced.

6.2.1.4 Track Works

Preventative and Corrective Maintenance analysis

As a result of the maintenance analyses, a schedule for preventative maintenance will be established for the delivered track system incl. Roadbed and track, fencings (in regard with the scope of supply). All scheduled activities will be planned in regard to the requirements of a high available system. This section describes the reliability-oriented inspection and maintenance work for each major component as well as the maintenance intervals and the down times for the operations. The maintenance tables also specify the required level of preventative maintenance.

Preventative Maintenance Programs

Inspections

The inspection comprises the measures to be performed to determine and evaluate the actual state of technical equipment within the scope of supply of Edinburgh Tram Network. The inspection covers:

- Function-related,
- Safety-related, and
- Maintenance-related activities.

According to working schedules coordinated and suitable intervals, service technicians carry out inspections on track as necessary. Results are documented and evaluated. During inspection, service technicians perform the minor maintenance tasks immediately that they can do by using their tools. If the scope of necessary work is larger, they will undertake necessary maintenance measure required for keeping the equipment in an available state.

Preventative Maintenance

Preventative maintenance on track covers all measures necessary for keeping the technical equipment of the track in the required and secure state. According to specified working schedules and intervals maintenance works are carried out on mechanical facilities. Results are recorded and evaluated. Based on the growing

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number of maintenance works and the results gained from that the ability to make statements on the condition and wear behaviour is increasing.

During preventative maintenance work, inexpensive small parts such as screws will be replaced.. Repair tasks are carried out during maintenance.

The preventative maintenance includes:

Inspection (visual checks) required regularly. The parts have to be inspected with the following criteria:

- Damage (fracture, scorching, change of colour, etc.)
- Dirt, corrosion
- Missing equipment

Preventative maintenance work for all track facilities and the rail bed

- Grinding or alignment of rail joints
- Gauging, shimming and alignment of track and switches
- Surfacing of rails in short track sections and turnouts by grinding, welding, etc.
- Checking of rail welding, exchange of defective welds or defective sections of rails
- Measures and preventative maintenance for rail flaw, abrasion and rail profile
- Preventative activities for drainage-system
- Checking and adjustment

Preventative maintenance will be performed normally from Monday to Friday either during operating hours or at non-operating time during night.

Functional tests (Checking, measuring, adjusting)

Cleaning of the track equipment

Measures that become necessary due to improper use, faulty operation, external effects, force majeure, vandalism, alterations and extensions, etc. are excluded. Such works are handled as non-contractual performance, and therefore are separately charged and invoiced.

Corrective Maintenance

The corrective (unscheduled) maintenance work covers the activities for restoring the required state (not original) of technical equipment in a plant/line. Unscheduled maintenance tasks are carried out to remedy spontaneously occurring operating faults that will interrupt service operation.

These tasks cannot be planned. Immediately after our maintenance staff has received any trouble message, appropriate measures necessary for quickly eliminating the trouble will be taken (according to maintenance strategies previously fixed). Good coordination and execution of repair works as well as provision of spare parts form the basis for a quick and economical form of unscheduled maintenance are essential.

Measures that become necessary due to improper use, faulty operation, external effects, force majeure, vandalism, are handled as non-contractual performance, and therefore they are separately charged and invoiced.

Specialized and Heavy Maintenance Equipment

Special equipment required for the execution of the maintenance tasks on the track work will be delivered as part of the depot equipment and will remain at the depot for the execution of the different maintenance activities during the 10 years maintenance period.

In addition, as we are of the opinion that the vehicles which are within the depot scope of supply are not sufficient to reach the availability criteria requested, the Infraco Maintainer will include in his scope

- Emergency vehicle including emergency generator, welding equipment, manual grinding equipment, crane and high-pressure cleaning equipment.

6.2.2 Civil

A Defects Correction team comprising four operatives, equipped with a van/pickup, a compressor, an excavator with driver and access scaffold will execute the maintenance activities. The operatives will be skilled in various building/construction disciplines thus giving the capability to handle the vast majority of works that may arise.

The van/pickup will be fully equipped with the necessary tools and supplies to prepare and repair the vast majority of agreed defects.

This team will operate for approximately 12 weeks per year for the first three years and approximately four weeks per year for the next seven years. This will be at the operational requirements of the Infraco Maintainer

A Caretaker will be located at the Gogar Depot. He will be equipped with the necessary tools and supplies for the maintenance of the fabric of the Gogar Depot, for which the Infraco is responsible.

Three full time operatives are integrated into the 3 joint maintenance teams for maintaining the constructed fabric of the Edinburgh Tram System, for which the Infraco is responsible. They will be fully equipped with the necessary tools and supplies to carry out the majority of maintenance requirements.

A maintenance gang for maintaining the landscaping element of the Edinburgh Tram System, for which the Infraco is responsible, will be employed on a seasonal basis.

The gang will comprise three operatives (of whom one will be a landscaping specialist), a van/pickup, and landscape maintenance equipment.

This seasonal gang will operate for a total of two months per annum.

Specialists will be called up as required.

6.3 Maintenance Escalation

In the event that the Edinburgh Infraco teams are unable to clear an issue or incident, arrangements have been made for the escalation of the issue in the first instance to the technical support teams based in the UK, these are provided by the individual organisations or suppliers. Should further support be required, support from the product houses of the suppliers in there home countries has been arranged. This escalation will be managed in the first instance by the E&M Manger, however if further support is required this will be managed by the Project Manager. Any escalation will be recorded on the MMS system and will be monitored to ensure any pre agreed response times.

As part of the Infraco Maintenance process and procedures a detailed procedure will be provided to ensure maintenance and incident escalation is clearly defined.

7 Maintenance of the Rolling Stock

The maintenance of the rolling stock is not included in the proposal and the price of the Infraco Maintainer.
However, the proposal is based on the assumption that Infraco and Tramco will form a consortium to jointly provide the maintenance services to tie.

8 Performance Management

The Infrastructure Maintenance Performance shall be measured against the Performance Targets. The results of the evaluation of fulfilment of those targets can be used for the calculation of performance /reductions and bonuses, if applicable.

The detailed concept for respective application of performance/reductions and bonuses is defined in the ["Schedules to the Infrastructure Agreement" dated 01. Nov 2006 (incl. our comments)[.

Prior to contract award the above mentioned concept needs to be agreed between tie and Infraco.

9 Maintenance Management System (MMS)

9.1 MMS - modular components

The MMS is a tool for ensuring efficiency, consistent high quality Maintenance activities. The MMS is a comprehensive modular tool developed to meet the requirements of maintaining rail infrastructure systems.

The MMS consists of the following modular components with related functionalities:

- Vehicle and Asset Information Management and Serial Tracking,
- Maintenance Planning (scheduling) Operations and Incident Management,
- Work Order Management: Distribution, tracking and control of Preventative and corrective maintenance activities,
- Tracking statistics on the performance of repairs and other maintenance actions,
- Fault and Incidents reports and analysis,
- Maintenance history and archive
- Materials and spare parts management,
- Cost Control of the maintenance activities,
- Allows set up of parent-and-child component hierarchies.

Appendix 3 – MMS presentation

9.2 Application of the MMS

The MMS allows the preventative maintenance activities to be planned and work orders generated, distributed and tracked. This is made possible by access to a comprehensive product structures, analysis and history of systems in service. As more data is captured asset relationships can be monitored, controlled and analysed.

Any work orders for unplanned works (corrective maintenance), following fault notification can be dispatched and tracked.

As the MMS allows the monitoring of equipment on a modular basis it is possible for the life of a product to be monitored, capturing the history and type of events that occur during a products life and the effort expended upon its preventative and corrective maintenance. This information will allow the maintenance regime for products to be changed to ensure the optimum performance of individual types of products through there lifecycles.

Reports can be raised from a standard menu or new reports can be created to meet the user's requirements. A quarterly report will be generated by the system. This report will provide details of all the preventative and corrective maintenance activities carried out.

The MMS supports management of personal and their skill (competence profile). Furthermore the maintenance plan is managed with the instructions and their required competence profile (skill). All maintenance tasks can be planned, distributed and controlled regarding their required competence profiles.

The MMS is a key part of the stores management process providing a traceable and auditable history of all materials. This will ensure that a minimum stock holding is always held.

This is not limited to materials and will also be applied to specialist tools and equipment used to maintain the Edinburgh Tram Network.

The MMS will also assist in the purchasing of equipment and consumables, ensuring that when stocks are replenished that orders are tracked.

The purpose of utilising an integrated maintenance management system is to ensure that the maintenance of the system is provided on time to the correct quality using the correct materials.

10 Training

10.1 Overview

The proposed courses provide maintenance personnel the level training required to perform their activities. The preliminary training plan describes the initial training for Infrastructure maintenance staff for the Edinburgh Tram Network

The main aims of this training program are:

- enable the maintenance staff to maintain a safe and reliable system
- to ensure continuous learning and development

The training will be supported by a continuous professional development (CPD) programme.

10.1.1 Training Plan description

The objectives of the training process are to enable the maintenance staff dedicated to the Edinburgh Tram Network to benefit from the Maintainer experiences from former projects.

The proposal is based on the 'train the trainers' model: A qualified trainer trains key instructors, which will train the personnel of the maintenance staff from the Maintainer

- Step 1 of the training courses: The Maintainer will provide training for the key instructors. They will participate in theoretical courses and on the job activities during the implementation of the project.
- Step 2 of the training courses: at the end of step 1, the instructors will train newly engaged staff.

The 'train the trainers' process provides advantages for the organisation of the maintenance team:

- high educated maintenance staff for the life time of contract
- the instructors acquire technical expertise enabling them to better understand the complexity of the system
- high efficiency in preparing the training courses

The instructors are qualified for the future training of new personnel. In the following chapters, only the maintenance issues will be addressed.

Course Module	Duration in days	Number of trainings
Onsite Classroom Training		
MAT CR ON1 Management In this module management will be trained in running infrastructure maintenance skills.		
Duration in days	5	
Number of trainings		1
Subtotal	**5**	
MAT CR ON2 Supervisors (Infrastructure) In this module supervisors will be trained in handling infrastructure equipmentthe		
Duration in days	10	
Number of trainings		1
Subtotal	**10**	
MAT CR ON3 Maintenance staff (Infrastructure) This training is subdivided into a couple of modules, which depend on the detailed training plan. The maintenance staff will be trained for executive maintenance works.		
Duration in days	10	
Number of trainings		1
Subtotal	**10**	
MAT CR ON4 Heavy Duty (Infrastructure) This training is subdivided into a couple of modules, which depend on the detailed training plan. The heavy duty driver staff will be trained for emergency works.		
Duration in days	5	
Number of trainings		1
Subtotal	**5**	
Total duration of training	**30**	

10.2 Initial training for instructors

10.2.1 General organisation

The instructors will receive an initial theoretical and practical training according to their future responsibilities. After this initial training, they will improve their skills by carrying out on-the-job training during the implementation of the project.

This training will be organised by the Maintainer. The Maintainer coordinates the training courses with the construction team and the trainers of the different sub-systems.

10.2.2 Training plan

The detailed training plan will describe at least:

- the goal of each course
- the breakdown of each course into units
- the contents of the program of each unit and its duration
- the profile of participants and the prerequisites
- the equipment required and the course material corresponding to each unit
- the overall schedule of training

The maintenance core training courses are focussed on:

- Overview of the Tramway infrastructure system
- Telecommunication systems
- Power supply
- Track-work
- Depot and workshop equipment

The training courses will also focus on maintenance of specific equipment such as access management system, fire fighting, smoke detection etc. These courses will be performed by the suppliers. The modules will be specified in the training plan at a later stage.

10.3 Initial training for maintenance team

Before the start of the revenue service, trainers of the maintenance staff will train the technicians and workers. This initial training will be organised under the overall training plan and managed by a responsible Trainer of the project team for Infraco. The Trainer is responsible for the organisation, the compatibility of the courses with the project schedule.

The training part for management and organisation level has a scope of 2 weeks. The category of participants should have maintenance manager level. The training part for maintenance personal for infrastructure has a scope of 5 weeks. The category of participants should have engineers, electricians and mechanics.

The maximal number of participants for each course is 10 trainees. Each course will be performed max. twice. At the end of each training course, multiple choice type tests will be used to assess the ability of the candidates to carry out their tasks and to transfer their skills to other employees.

11 Appendices

11.1 Appendix 1 : Organisational Structure

11.2 Appendix 2: Maintenance Plans

The maintenance plans are a preview of the work to be expected for scheduled maintenance from the manufacturer's perspective. As a rule, however, the design of the maintenance intervals and contents must focus on the actual performance of the wear parts and consumables in the respective operating environment of the systems. This means that the maintenance plans that are defined at the beginning of the revenue service is only of a preliminary nature. They will be adapted by the Infraco maintainer upon approval by the client to the specific service requirements and general conditions in the course of running and maintaining the system. Possible adjustments should be discussed on a regular basis between the client and the Infraco maintainer.

11.3 Appendix 3 : MMS

11.4 Appendix 4 : Vandalism Repair Items

Notwithstanding that we have excluded physical vandal damage as part of the scope of any maintenance contract. We are aware that vandal damage is a problem that will need to be addressed on the entire Edinburgh Tram Network.

We also recognise that the nature of the maintenance contract puts the maintainer in the ideal position to identify and carry out these repairs.

Consequently we list below a selection of items that might be the subject of vandal damage.

	Unit	indicative Prices
1. Replace pane in tram-stop shelter	no	975,00 £
2. Replace litter bin	no	818,00 £
3. Replace platform lighting column	no	2.250,00 £
4. Replace pedestrian guardrail	no	217,00 £
5. Replace street lighting column	no	2.625,00 £
6. Replace Metal Benching	no	2.163,00 £
7. Replace Security Fencing	no	113,00 £
8. Replace Complete tram-stop Shelter (8 meters)	no	22.635,00 £
9. Replace CCTV Camera	no	2.611,00 £
10. Replace PIS Indicator Panel	no	4.264,00 £
11. Replace Loudspeaker	no	417,00 £
12. Replace Electrical Cabinet	no	22.074,00 £
13. Replace Signal	no	2.609,00 £
14. Replace Point Indicator	no	2.314,00 £
15. Replace Points Heating	no	10.293,00 £
16. Replace Point Machine	no	19.260,00 £
17. Replace Passenger Help Points	no	1.971,00 £
18. Replace Advertising Panel		

The above list is not exhaustive and is provided for indicative reasons. We would welcome the opportunity to discuss this matter with you.

PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE-90130	1	ACC	1		1	Newhaven Road To Haymarket Sub Section 1A	Issued for External Approval	Works are under Provisional Sum
ULE-90130	1	ACC	2		1	Newhaven Road To Haymarket Sub Section 1A	Issued for External Approval	Works are under Provisional Sum
ULE-90130	1	ACC	3		1	Newhaven Road To Haymarket Sub Section 1A	Issued for External Approval	Works are under Provisional Sum
ULE-90130	1	ACC	6		1	Newhaven Road to Haymarket Section 1A	Issued for External Approval	Works are under Provisional Sum
ULE-90130	1	ACC	7		1	Newhaven Road to Haymarket Section 1A	Issued for External Approval	Works are under Provisional Sum
ULE-90130	1	ACC	10		1	Newhaven Road to Haymarket Boundary	Issued for External Approval	Works are under Provisional Sum
ULE-90130	1	ACC	11		1	Newhaven Road to Haymarket Boundary	Issued for External Approval	Works are under Provisional Sum
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ULE-90130	2	ACC	3		1	Haymarket to Roseburn Junction	Issued for External Approval	Works are under Provisional Sum
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ULE-90130	5	ACC	4		1	Murrayfield Stadium - Elevation B & Sec A-A	Issued for External Approval	Works are under Provisional Sum
ULE-90130	5	ACC	5		1	Murrayfield Stadium Site Plan	Issued for External Approval	Works are under Provisional Sum
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ULE-90130	5	ACC	7		1	Murrayfield Stadium Elevations & Sec A-A	Issued for External Approval	Works are under Provisional Sum
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ULE-90130	2	BRG	4	S19	A	Haymarket Station Viaduct	Issued for External Approval	

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PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
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PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
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ULE 90130	5	BRG	80	S21A	5	Roseburn Street Viaduct	Issued for External Approval	
ULE 90130	5	BRG	81	S21A	3	Roseburn Street Viaduct	Issued for External Approval	
ULE 90130	5	BRG	82	S21A	2	Roseburn Street Viaduct	Issued for External Approval	
ULE 90130	5	BRG	83	S21A	2	Roseburn Street Viaduct	Issued for External Approval	
ULE 90130	5	BRG	84	S21A	1	Roseburn Street Viaduct	Issued for External Approval	
ULE 90130	5	BRG	85	S21A	1	Roseburn Street Viaduct	Issued for External Approval	
ULE 90130	5	BRG	86	S21A	1	Roseburn Street Viaduct	Issued for External Approval	
ULE 90130	5	BRG	161	S22	1	Balgreen	Draft	
ULE 90130	5	BRG	221	S23	C	Carrick Knowe Underbridge	For Tender Purposes Only	
ULE 90130	5	BRG	226	S23	2	Carrick Knowe Underbridge Structure	Issued for External Approval	
ULE 90130	5	BRG	227	S23	2	Carrick Knowe Underbridge Structure	Issued for External Approval	
ULE 90130	5	BRG	281	S24	1	Saughton (As Built)	For Tender Purposes Only	
ULE 90130	5	BRG	341	S25	A	Broomhouse (As Built)	For Tender Purposes Only	
ULE 90130	5	BRG	431	S26	1	South Gyle Access	Issued for Tender Purposes Only	
ULE 90130	5	BRG	432	S26	2	South Gyle Access	For Tender Purposes Only	
ULE 90130	5	BRG	433	S26	2	South Gyle Access	For Tender Purposes Only	
ULE 90130	5	BRG	420	S26	1	Roseburn Junction to Gogarburn	For Tender Purposes Only	
ULE 90130	5	BRG	421	S26	2	Early GA	For Tender Purposes Only	
ULE 90130	5	BRG	423	S26	2	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Proposed GA Sheet 1 of 2	For Tender Purposes Only	
ULE 90130	5	BRG	424	S26	2	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Proposed GA Sheet 2 of 2	For Tender Purposes Only	
ULE 90130	5	BRG	425	S26	2	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Sequence of Construction	For Tender Purposes Only	
ULE 90130	5	BRG	426	S26	1	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Setting Out Details	For Tender Purposes Only	
ULE 90130	5	BRG	427	S26	1	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Substructure General Arrangement	For Tender Purposes Only	
ULE 90130	5	BRG	428	S26	2	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Pile Details	For Tender Purposes Only	
ULE 90130	5	BRG	429	S26	2	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Steel Column Details	For Tender Purposes Only	
ULE 90130	5	BRG	430	S26	1	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Reinforced Earth Details 1 of 2	Issued for External Review	
ULE 90130	5	BRG	431	S26	1	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Reinforced Earth Details 2 of 2	Issued for External Review	
ULE 90130	5	BRG	432	S26	2	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Deck General Arrangement	For Tender Purposes Only	
ULE 90130	5	BRG	433	S26	1	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Bar Schedule	NO STATUS	
ULE 90130	5	BRG	434	S26	2	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Deck Reinforcement	For Tender Purposes Only	
ULE 90130	5	BRG	435	S26	1	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Diaphragm Reinforcement	For Tender Purposes Only	
ULE 90130	5	BRG	436	S26	1	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Run on Slabs GA and RC Details	For Tender Purposes Only	
ULE 90130	5	BRG	437	S26	2	Roseburn Junction to Gogarburn Structure S26 South Gyle Access Bridge Parapet & Fencing Detail	For Tender Purposes Only	
ULE 90130	5	BRG	468	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	469	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	470	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	471	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	472	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	473	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	474	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	475	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	476	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	477	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	478	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	479	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	480	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	481	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	482	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	483	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	484	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	485	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	486	S27		Edinburgh Park Station Bridge Structure S27	Issued for External Approval	No revision number
ULE 90130	5	BRG	487	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	488	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	489	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	490	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	491	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	492	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	493	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE 90130	5	BRG	494	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number

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ULE90130	5	BRG	495	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE90130	5	BRG	496	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE90130	5	BRG	497	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE90130	5	BRG	498	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE90130	5	BRG	500	S27		Edinburgh Park Station Bridge Structure S27 U12 Precast Beams Plan Setting Out Details	Issued for Information	No revision number
ULE90130	5	BRG	501	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE90130	5	BRG	502	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE90130	5	BRG	503	S27		Edinburgh Park Station Bridge Structure S27	Issued for Information	No revision number
ULE90130	5	BRG	521	S28	3	A8 Underpass	For Tender Purposes Only	
ULE90130	5	BRG	522	S28	2	A8 Underpass	For Tender Purposes Only	
ULE90130	5	BRG	523	S28	2	Traffic Management	For Tender Purposes Only	
ULE90130	5	BRG	524	S28	2	Traffic Management	For Tender Purposes Only	
ULE90130	5	BRG	525	S28	2	Traffic Management	For Tender Purposes Only	
ULE90130	5	BRG	526	S28	2	Traffic Management	For Tender Purposes Only	
ULE90130	5	BRG	527	S28	2	Traffic Management	For Tender Purposes Only	
ULE90130	5	BRG	528	S28	2	Traffic Management	For Tender Purposes Only	
ULE90130	5	BRG	529	S28	2	Traffic Management	For Tender Purposes Only	
ULE90130	5	BRG	530	S28	3	Construction Sequence	For Tender Purposes Only	
ULE90130	5	BRG	531	S28	3	Construction Sequence	For Tender Purposes Only	
ULE90130	5	BRG	532	S28	3	Existing Services	For Tender Purposes Only	
ULE90130	5	BRG	533	S28	1	South Portal GA	For Tender Purposes Only	
ULE90130	5	BRG	580	S32	5	Depot Access GA 1 of 2	For Tender Purposes Only	
ULE90130	5	BRG	581	S32	5	Depot Access GA 2 of 2	For Tender Purposes Only	
ULE90130	5	BRG	601	S21C		Murrayfield Stadium Underpass	For Tender Purposes Only	
ULE90130	5	BRG	602	S21C	1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	BRG	603	S21C	2	Murrayfield Stadium Underpass	Issued for External Approval	
ULE90130	5	BRG	604	S21C	3	Murrayfield Stadium Underpass	Issued for External Approval	
ULE90130	5	BRG	605	S21C	1	Murrayfield Stadium Underpass	Issued for External Approval	
ULE90130	5	BRG	606	S21C	2	Murrayfield Stadium Underpass	Issued for External Approval	
ULE90130	5	BRG	608	S21C	1	Murrayfield Stadium Underpass	Issued for External Approval	
ULE90130	5	BRG	741	S21E	4	Water of Leith	For Comment	
ULE90130	5	BRG	751	S21E	1	Structure S21E Water of Leith Bridge General Arrangement	For Tender Purposes Only	
ULE90130	5	BRG	755	S21E	1	Water of Leith	For Tender Purposes Only	
ULE90130	5	BRG	760	S21E	2	Structure S21E - Water of Leith Bridge Steelwork Details Sheet 2 of 2	Issued for External Approval	
ULE90130	5	BRG	760	S21E	2	Structure S21E - Water of Leith Bridge Steelwork Details Sheet 2 of 2	Issued for External Approval	
ULE90130	5	BRG	761	S21E	2	Structure S21E - Water of Leith Bridge Deck Concrete Outline Sheet 1 of 2	Issued for External Approval	
ULE90130	5	BRG	762	S21E	2	Structure S21E - Water of Leith Bridge Deck Concrete Outline Sheet 2 of 2	Issued for External Approval	
ULE90130	5	BRG	763	S21E	1	Structure S21E - Water of Leith Bridge Deck RC Details Sheet 1 of 2	Issued for External Approval	
ULE90130	5	BRG	764	S21E	1	Structure S21E - Water of Leith Bridge Deck RC Details Sheet 2 of 2	Issued for External Approval	
ULE90130	7	BRG	20	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Drawing Schedule	For Tender Purposes Only	
ULE90130	7	BRG	21	S29	2B	Gogarburn to Edinburgh Airport Gogar Burn Bridge Structure S29 General Arrangement 1 of 2	Issued for External Approval	
ULE90130	7	BRG	22	S29	2B	Gogarburn to Edinburgh Airport Gogar Burn Bridge Structure S29 General Arrangement 2 of	Issued for External Approval	
ULE90130	7	BRG	23	S29	1A	Gogarburn to Edinburgh Airport Gogar Burn Bridge Structure S29 Setting Out Details	For Tender Purposes Only	
ULE90130	7	BRG	24	S29	2A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Substructure General Arrangement	For Tender Purposes Only	
ULE90130	7	BRG	25	S29	[illegible]	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Piles Details	Draft	
ULE90130	7	BRG	26	S29	A1	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Pile cap reinforcement	Draft	
ULE90130	7	BRG	27	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Column and Capping Beam Reinforcement	Draft	
ULE90130	7	BRG	28	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 West Abutment Reinforced Earth GA Sheet 1 of 2	Issued for External Approval	
ULE90130	7	BRG	29	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 West Abutment Reinforced Earth GA Sheet 2 of 2	Issued for External Approval	Drawings received but not in Drawing List
ULE90130	7	BRG	30	S29	2A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Deck General Arrangement	For Tender Purposes Only	
ULE90130	7	BRG	31	S29	2A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Precast Pre-stressed TY Beams	For Tender Purposes Only	
ULE90130	7	BRG	32	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Structure S29 Precast Prestressed TYE Beams	For Tender Purposes Only	
ULE90130	7	BRG	33	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Diaphragm Reinforcement	Draft	
ULE90130	7	BRG	34	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Deck Slab Reinforcement	Draft	
ULE90130	7	BRG	35	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Run on Slab General Arrangement	Draft	
ULE90130	7	BRG	36	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Parapet and Fencing Details	Draft	
ULE90130	7	BRG	37	S29	2A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Parapet Ground Beam Outline	For Tender Purposes Only	
ULE90130	7	BRG	38	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Parapet Ground Beam Reinforcement	Draft	
ULE90130	7	BRG	39	S29	1	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Watercourse Protection Works	For Tender Purposes Only	
ULE90130	7	BRG	40	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 East Abutment Reinforced Earth GA	Issued for External Approval	
ULE90130	7	BRG	41	S29	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge Structure S29 Run on Slabs Reinforcement	Draft	

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ULE 90130	7	BRG	42	S20	1A	Gogarburn to Edinburgh Airport Gogarburn Bridge	Issued for External Approval	
ULE 90130	7	BRG	43	S2?	1	Gogarburn to Edinburgh Airport Reinforced Earth Details		
ULE 90130	7	BRG	64	S30 31 34	1	S30, S31 & S34 Culverts	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	65	S30 31 34		Gogarburn Culverts General Arrangements	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	66	S30 31 34		Gogarburn Culverts General Arrangements	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	67	S30 31 34		Gogarburn Culverts General Arrangements	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	68	S30 31 34		Gogarburn Culverts General Arrangements	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	69	S30 31 34		Gogarburn Culverts Culvert No. 1 Concrete Outlines	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	70	S30 31 34		Gogarburn Culverts Culvert No. 1 Concrete Outlines	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	71	S30 31 34	2	Gogarburn Culverts Culvert No. 3 Concrete Outlines	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	72	S30 31 34	1	Gogarburn Culverts Culvert No. 1 RC Details - Box Culvert Sections Sheet 1	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	73	S30 31 34	1	Gogarburn Culverts Culvert No. 1 RC Details - Box Culvert Sections Sheet 2	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	74	S30 31 34	1	Gogarburn Culverts Culvert No. 2 RC Details - Box Culvert Sections Sheet 1	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	75	S30 31 34	1	Gogarburn Culverts Culvert No. 2 RC Details - Box Culvert Sections Sheet 2	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	76	S30 31 34	1	Gogarburn Culverts Culvert No. 3 RC Details - Box Culvert Sections Sheet 1	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	77	S30 31 34	1	Gogarburn Culverts Culvert No. 3 RC Details - Box Culvert Sections Sheet 2	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	78	S30 31 34	1	Gogarburn Culverts Culvert No. 1 Headwalls RC Details	Issued for External Approval	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	79	S30 31 34	1	Gogarburn Culverts Culvert No. 2 Headwalls RC Details	Missing Drawing	Sent TQ for revisions and clarifications...
ULE 90130	7	BRG	80	S30 31 34	1	Gogarburn Culverts Culverts No 3 Headwalls RC Details	Issued for External Approval	
ULE 90130	SW	CND	2		6	Kerbing Details	Issued for External Approval	
ULE 90130	SW	CND	3		2	Signal Head Types	Issued for External Approval	
ULE 90130	SW	CND	4		2	Kerbing Details	Issued for External Approval	
ULE 90130	SW	CND	5		1	Step Details	External Approval	No drawing status stamped
ULE 90130	SW	CND	7		1	Timber Kick Detail	Issued for External Approval	
ULE 90130	SW	CND	8		1	Pedestrian Handrail Details	Issued for External Approval	
ULE 90130	SW	CND	9		1	Pedestrian Handrail Details Section 3A	Issued for External Approval	
ULE 90130	SW	CND	10			Construction Detail Typical Substation Access Details	Issued for Internal Review	
ULE 90130	6	DEP	1		7	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	2		7	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	3		7	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	4		7	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	5		7	Gogar - First Floor Layout	For External Approval	
ULE 90130	6	DEP	6		6	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	7		6	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	8		8	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	9		7	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	10		7	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	12		7	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	13		00	Standard Electrical Services Details	For Internal Review	
ULE 90130	6	DEP	14		7	Gogar Depot Proposed Maintenance & Stabling Layout Site Plan	For External Approval	
ULE 90130	6	DEP	17		8	Gogar Depot Depot & Office Building Roof Plan Layout	For External Approval	
ULE 90130	6	DEP	18		1	Gogar Depot Depot & Office Building Ground Floor Layout Plan Ceiling Layout	For External Approval	
ULE 90130	6	DEP	19		1	Gogar Depot Depot & Office Building First Floor Layout Plan Ceiling Layout	For External Approval	
ULE 90130	6	DEP	21		1	Gogar Depot Depot & Office Building Wall & Column Casing Plan Details	For External Approval	
ULE 90130	6	DEP	23		1	Gogar Depot Depot & Office Building Wall Elevation & Sections Internal & External Details	For External Approval	
ULE 90130	6	DEP	27		1	Gogar Depot Office Building Male WC, Showers & Locker Room Ground Floor Details	For External Approval	
ULE 90130	6	DEP	28		1	Gogar Depot Office Building Female & Accessible Toilet First Floor Details	For External Approval	
ULE 90130	6	DEP	30		1	Gogar Depot Office Building Public & Staff Entrance Canopy Details	For External Approval	
ULE 90130	6	DEP	32		1	Gogar Depot Depot & Office Building Ground Floor Fire Strategy Plan	For External Approval	
ULE 90130	6	DEP	33		1	Gogar Depot Depot & Office Building First Floor Fire Strategy Plan	For External Approval	
ULE 90130	6	DEP	34		1	Gogar Depot Depot & Office Building General Arrangement Layout Fire Strategy Plan	For External Approval	
ULE 90130	6	DEP	35		1	Gogar Depot Depot & Office Building Ground Floor Layout Plan Schedule of Finishes	For External Approval	
ULE 90130	6	DEP	36		1	Gogar Depot Depot & Office Building First Floor Layout Plan Schedule of Finishes	For External Approval	
ULE 90130	6	DEP	37		1	Gogar Depot Office Building Ground Floor Plan Door & Window Layout	For External Approval	
ULE 90130	6	DEP	38		1	Gogar Depot Office Building First Floor Plan Door & Window Layout	For External Approval	
ULE 90130	6	DEP	39		1	Gogar Depot Depot Building Workshop Area Floor Plan Door Layout	For External Approval	
ULE 90130	6	DEP	40		1	Gogar Depot Depot & Office Building Door Schedule Ground Floor	For External Approval	
ULE 90130	6	DEP	41		1	Gogar Depot Office Building Door Schedule First Floor	For External Approval	
ULE 90130	6	DEP	60		1	Gogar Depot Depot & Office Building Power Energy Centre Building Ground Floor Layout Plan	For External Approval	
ULE 90130	6	DEP	61		1	Gogar Depot Depot & Office Building Power Energy Centre Building Reflected Ceiling & Roof Layout Plans	For External Approval	
ULE 90130	6	DEP	62		1	Gogar Depot Depot & Office Building Power Energy Centre Elevations	For External Approval	

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ULE-90130	6	DEP	63		1	Gogar Depot Depot & Office Building Power Energy Centre Building Section A-A & Details	For External Approval	
ULE-90130	6	DEP	67		1	Gogar Depot Depot & Office Building Sub-Station Building Ground Floor Layout Plans	For External Approval	
ULE-90130	6	DEP	69		1	Gogar Depot Depot & Office Building Sub Station Building Reflected Ceiling & Roof Layout Plans	For External Approval	
ULE-90130	6	DEP	70		1	Gogar Depot Depot & Office Building Sub Station Building Section A-A & Details	For External Approval	
ULE-90130	6	DEP	75		2	Gogar Depot Depot Equipment & Communications Room Arrangement Ground Floor Layout Plan	For External Approval	
ULE-90130	6	DEP	83		2	Gogar Depot Control Room Arrangement First Floor Layout Plan	For External Approval	
ULE-90130	6	DEP	101		4	Section 6 Depot Foundation Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	102		4	Section 6 Depot Foundation Layout Sheet 2 of 2	For External Approval	
ULE-90130	6	DEP	103		4	Section 6 Depot Ground Floor Slab Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	104		4	Section 6 Depot Ground Floor Slab Layout Sheet 2 of 2	For External Approval	
ULE-90130	6	DEP	106		4	Gogar - Ground Floor Steel Layout	For Tender Purposes Only	
ULE-90130	6	DEP	107		4	Section 6 Depot First Floor Steel Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	108		4	Gogar - First Floor Steel Layout	For External Approval	
ULE-90130	6	DEP	110		4	Section 6 Depot Roof Level Steel Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	111		4	Section 6 Depot Roof Level Steel Layout Sheet 2 of 2	For External Approval	
ULE-90130	6	DEP	115		2	Section 6 Depot Steel Frame Sections Sheet 1	For External Approval	
ULE-90130	6	DEP	118		1	Section 6 Depot Steel Frame Sections Sheet 2	For External Approval	
ULE-90130	6	DEP	122		1	Depot & Office Building Base Plate Details	For External Approval	
ULE-90130	6	DEP	160		1	Gogar Depot Depot & Office Building Power Energy Centre Foundation Layout	For External Approval	
ULE-90130	6	DEP	161		1	Gogar Depot Depot & Office Building Power Energy Centre Lower Roof Layout	For External Approval	
ULE-90130	6	DEP	162		1	Gogar Depot Depot & Office Building Power Energy Centre Upper Roof Layout	For External Approval	
ULE-90130	6	DEP	165		1	Gogar Depot Depot & Office Building Power Energy Centre Upper Roof Layout	For External Approval	
ULE-90130	6	DEP	170		1	Gogar Depot Depot & Office Building Power Energy Centre Sections	For External Approval	
ULE-90130	6	DEP	171		1	Gogar Depot Depot & Office Building Sub-Station Building Foundation Layout	For External Approval	
ULE-90130	6	DEP	175		1	Gogar Depot Depot & Office Building Sub Station Sections	For External Approval	
ULE-90130	6	DEP	201		4	Gogar - Electrical Symbols	For External Approval	
ULE-90130	6	DEP	202		4	Gogar - External Lighting	For External Approval	
ULE-90130	6	DEP	203		4	Gogar - External Lighting	For External Approval	
ULE-90130	6	DEP	204		4	Gogar - Electrical Lighting Layout	For External Approval	
ULE-90130	6	DEP	205		4	Gogar - Electrical Small Power	For External Approval	
ULE-90130	6	DEP	206		4	Gogar - Electrical Small Power	For External Approval	
ULE-90130	6	DEP	207		4	Gogar - Fire Alarm & Security	For External Approval	
ULE-90130	6	DEP	208		4	Gogar - Fire Alarm & Security	For External Approval	
ULE-90130	6	DEP	209		4	Gogar - Electrical Containment	For External Approval	
ULE-90130	6	DEP	210		4	Gogar - Electrical Containment	For External Approval	
ULE-90130	6	DEP	231		4	Gogar - Electrical LV Power	For External Approval	
ULE-90130	6	DEP	232		4	Gogar - Electrical Fire Alarm	For External Approval	
ULE-90130	6	DEP	233		4	Gogar - Electrical Earthing System	For External Approval	
ULE-90130	6	DEP	234		1	Gogar Depot Lightning Protection System	For External Approval	
ULE-90130	6	DEP	239		1	Gogar Depot External Electrical Services Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	240		-	Gogar Depot External Electrical Services Layout Sheet 2 of 2	For External Approval	
ULE-90130	6	DEP	242		1	Gogar Depot Depot & Office Building Ground Floor Level Lighting Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	243		1	Gogar Depot Depot & Office Building Ground Floor Level Lighting Layout Sheet 2 of 2	For External Approval	
ULE-90130	6	DEP	244		1	Gogar Depot Depot & Office Building First Floor Level Lighting Layout	For External Approval	
ULE-90130	6	DEP	245		1	Gogar Depot Depot & Office Building Ground Floor Level Small Power & Data Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	246		1	Gogar Depot Depot & Office Building Ground Floor Level Small Power & Data Layout Sheet 2 of 2	For External Approval	
ULE-90130	6	DEP	247		1	Gogar Depot Depot & Office Building Sub Station Sections	For External Approval	
ULE-90130	6	DEP	248		1	Gogar Depot Depot & Office Building Ground Floor Fire Alarm & Security Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	249		1	Gogar Depot Depot & Office Building Ground Floor Fire Alarm & Security Layout Sheet 2 of 2	For External Approval	
ULE-90130	6	DEP	250		1	Gogar Depot Depot & Office Building First Floor Fire Alarm & Security Layout	For External Approval	
ULE-90130	6	DEP	251		1	Gogar Depot Depot & Office Building First Floor Level Containment Layout	For External Approval	
ULE-90130	6	DEP	252		1	Gogar Depot Depot & Office Building Ground Floor Level Containment Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	253		1	Gogar Depot Depot & Office Building Ground Floor Level Containment Layout Sheet 2 of 2	For External Approval	
ULE-90130	6	DEP	254		1	Gogar Depot Depot Substation Building Electrical Services Layout	For External Approval	
ULE-90130	6	DEP	255		1	Gogar Depot Power Energy Centre Building Electrical Services Layout	For External Approval	
ULE-90130	6	DEP	256		1	Gogar Depot Depot Equipment & Communications Room Arrangement Electrical Services Layout	For External Approval	
ULE-90130	6	DEP	257		1	Gogar Depot Supervisory Control Centre First Floor Electrical Services Layout	For External Approval	
ULE-90130	6	DEP	258		1	Gogar Depot Workshop Electrical Services & Sections Layout	For External Approval	
ULE-90130	6	DEP	260		1	Gogar Depot External Lighting Electrical & Services Layout Sheet 1 of 2	For External Approval	
ULE-90130	6	DEP	261		1	Gogar Depot External Lighting Electrical & Services Layout Sheet 2 of 2	For External Approval	
ULE-90130	6	DEP	301		4	Gogar Depot Depot & Office Building Ventilation & Air Cooling Ground Floor	For External Approval	

PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE90130	6	DEP	302		4	Gogar Depot Depot & Office Building Ventilation & Air Cooling First Floor	For External Approval	
ULE90130	6	DEP	303		4	Gogar Depot Depot & Office Building LPHW Radiator & Radiant Heating Layout Ground Floor	For External Approval	
ULE90130	6	DEP	304		4	Gogar Depot Depot & Office Building LPHW Radiator Heating First Floor	For External Approval	
ULE90130	6	DEP	305		4	Gogar	For Tender Purposes Only	
ULE90130	6	DEP	306		3	Gogar	For Tender Purposes Only	
ULE90130	6	DEP	307		1	Gogar Depot Depot & Office Building Power Energy Centre	For External Approval	
ULE90130	6	DEP	330		3	Gogar	For Tender Purposes Only	
ULE90130	6	DEP	331		3	Gogar	For Tender Purposes Only	
ULE90130	6	DEP	332		3	Gogar	For Tender Purposes Only	
ULE90130	6	DEP	401		4	Gogar Depot Depot & Office Building	For External Approval	
ULE90130	6	DEP	402		4	Gogar Depot Depot & Office Building	For External Approval	
ULE90130	6	DEP	403		4	Gogar Depot Depot & Office Building	For External Approval	
ULE90130	6	DEP	430		4	Gogar Depot Depot & Office Building	For External Approval	
ULE90130	6	DEP	450		4	Gogar Depot Depot & Office Building	For External Approval	
ULE90130	1	CIVL	10		2	Newhaven to Haymarket Drainage Plan Section 1B	Issued for External Review	
ULE90130	1	CIVL	11		2	Newhaven to Haymarket Drainage Plan Section 1B	Issued for External Review	
ULE90130	1	CIVL	12		2	Newhaven to Haymarket Drainage Plan Section 1B	Issued for External Review	
ULE90130	1	CIVL	13		2	Newhaven to Haymarket Drainage Plan Section 1B	Issued for External Review	
ULE90130	1	CIVL	21		1	Newhaven to Haymarket Section 1D	Issued for External Review	
ULE90130	1	CIVL	22		1	Newhaven to Haymarket Section 1D	Issued for External Review	
ULE90130	1	CIVL	23		1	Newhaven Road to Haymarket	Issued for External Review	
ULE90130	1	CIVL	24		1	Newhaven Road to Haymarket	Issued for External Review	
ULE90130	1	CIVL	25		1	Newhaven to Haymarket Section 1D	For External Approval	
ULE90130	2	CIVL	1		2	Haymarket to Roseburn Junction	Issued for External Review	
ULE90130	2	CIVL	2		3	Haymarket to Roseburn Junction	Issued for External Review	
ULE90130	2	CIVL	3		3	Haymarket to Roseburn Junction	Issued for External Review	
ULE90130	5	CIVL	1		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5A	Issued for External Review	
ULE90130	5	CIVL	2		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5A	Issued for External Review	
ULE90130	5	CIVL	3		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5A	Issued for External Review	
ULE90130	5	CIVL	4		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5A	Issued for External Review	
ULE90130	5	CIVL	5		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5A	Issued for External Review	
ULE90130	5	CIVL	6		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	7		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	8		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	9		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	10		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	11		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	12		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	13		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	14		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	15		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	16		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	17		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	18		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	19		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	20		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5B	Issued for External Review	
ULE90130	5	CIVL	21		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5C	Issued for External Review	
ULE90130	5	CIVL	22		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5C	Issued for External Review	
ULE90130	5	CIVL	23		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5C	Issued for External Review	
ULE90130	5	CIVL	24		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5C	Issued for External Review	
ULE90130	5	CIVL	25		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5C	Issued for External Review	
ULE90130	5	CIVL	26		2	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 5C	Issued for External Review	
ULE90130	6	CIVL	1		1	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 6	Issued for External Review	
ULE90130	6	CIVL	2		1	Roseburn Junction to Gogarburn Drainage Plan - Sub-section 6	Issued for External Review	
ULE90130	7	CIVL	1		2	Gogarburn to Edinburgh Airport Drainage Plan - Sub-section 7A	Issued for External Review	
ULE90130	7	CIVL	2		-	Gogarburn to Edinburgh Airport Drainage Plan - Sub-section 7A	NO STATUS	
ULE90130	7	CIVL	3		-	Gogarburn to Edinburgh Airport Drainage Plan - Sub-section 7A	NO STATUS	
ULE90130	7	CIVL	4		-	Gogarburn to Edinburgh Airport Drainage Plan - Sub-section 7A	NO STATUS	
ULE90130	7	CIVL	5		-	Gogarburn to Edinburgh Airport Drainage Plan - Sub-section 7A	NO STATUS	
ULE90130	7	CIVL	6		-	Gogarburn to Edinburgh Airport Drainage Plan - Sub-section 7A	NO STATUS	
ULE90130	7	CIVL	7		-	Gogarburn to Edinburgh Airport Drainage Plan - Sub-section 7A	NO STATUS	

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ULE90130	7	CIVL	8		-	Gogarburn to Edinburgh Airport Drainage Plan - Sub-section 7A	NO STATUS	
ULE90130	7	CIVL	9		-	Gogarburn to Edinburgh Airport Drainage Plan - Sub-section 7A	NO STATUS	
ULE90130	7	CIVL	10		A	Gogarburn to Edinburgh Airport Drainage Plan and Long Section Sheet 1 of 9 Minimum drainage inverts	For Information Only	
ULE90130	7	CIVL	11		A	Gogarburn to Edinburgh Airport Drainage Plan and Long Section Sheet 2 of 9 Minimum drainage inverts	For Information Only	
ULE90130	7	CIVL	12		A	Gogarburn to Edinburgh Airport Drainage Plan and Long Section Sheet 3 of 9 Minimum drainage inverts	For Information Only	
ULE90130	7	CIVL	13		A	Gogarburn to Edinburgh Airport Drainage Plan and Long Section Sheet 4 of 9 Minimum drainage inverts	For Information Only	
ULE90130	7	CIVL	14		A	Gogarburn to Edinburgh Airport Drainage Plan and Long Section Sheet 5 of 9 Minimum drainage inverts	For Information Only	
ULE90130	7	CIVL	15		A	Gogarburn to Edinburgh Airport Drainage Plan and Long Section Sheet 6 of 9 Minimum drainage inverts	For Information Only	
ULE90130	7	CIVL	16		A	Gogarburn to Edinburgh Airport Drainage Plan and Long Section Sheet 7 of 9 Minimum drainage inverts	For Information Only	
ULE90130	7	CIVL	17		A	Gogarburn to Edinburgh Airport Drainage Plan and Long Section Sheet 8 of 9 Minimum drainage inverts	For Information Only	
ULE90130	7	CIVL	18		A	Gogarburn to Edinburgh Airport Drainage Plan and Long Section Sheet 9 of 9 Minimum drainage inverts	For Information Only	
ULE90130	SW	CIVL	53		2	Brick and Precast Concrete Catchpits Sheet 1 of 3	Issued for External Review	
ULE90130	SW	CIVL	54		2	Brick and Precast Concrete Manholes Sheet 2 of 3	Issued for External Review	
ULE90130	SW	CIVL	55		2	Manhole and Catchpit standard Details Sheet 3 of 3	Issued for External Review	
ULE90130	SW	CIVL	56		2	Concrete Headwalls	Issued for External Review	
ULE90130	SW	CIVL	57		2	Rodding Eye & Street Gully Standard Details	Issued for External Review	
ULE90130	SW	CIVL	59		2	Typical Hydro-Brake chamber with integral weir wall	Issued for External Review	
ULE90130	SW	CIVL	58		2	Typical pipe and french drain construction details	Issued for External Review	
ULE90130	1	DRG	9		1	Newhaven Road to Haymarket Leith Walk	For Information Only	
ULE90130	1	DRG	10		1	Newhaven Road to Haymarket Leith Walk	For Information Only	
ULE90130	1	DRG	11		1	Newhaven Road to Haymarket Leith Walk	For Information Only	
ULE90130	1	DRG	12		1	Newhaven Road to Haymarket Leith Walk	For Information Only	
ULE90130	1	DRG	13		1	Newhaven Road to Haymarket Leith Walk	For Information Only	
ULE90130	1	DRG	14		1	Newhaven Road to Haymarket Leith Walk	For Information Only	
ULE90130	1	DRG	40		1	Newhaven Road to Haymarket	For Information Only	
ULE90130	1	DRG	179		1	Newhaven to Haymarket Subsection 1A/b	Issued for External Approval	
ULE90130	1	DRG	183		1	Newhaven to Haymarket Subsection 1A/b	Issued for External Approval	
ULE90130	1	DRG	184		1	Newhaven to Haymarket Subsection 1C/1D	Issued for External Approval	
ULE90130	1	DRG	185		1	Newhaven to Haymarket Subsection 1A/b	Issued for External Approval	
ULE90130	1	DRG	186		1	Newhaven to Haymarket Subsection 1A/b	Issued for External Approval	
ULE90130	1	DRG	216		1	Due Diligence Update	Draft - Design in Progress	
ULE90130	1	DRG	217		1	Due Diligence Update	Draft - Design in Progress	
ULE90130	1	DRG	219		1	Roads Design Status Section 1C	For Information Only	
ULE90130	1	DRG	220		1	Roads Design Status Section 1D	For Information Only	
ULE90130	1	DRG	221		1	Roads Design Status Section 1C	For Information Only	
ULE90130	2	DRG	5		1	Haymarket to Roseburn Junction Integrated Cross Sections Sub-Section 2A Sheet 1 of 2	Issued for External Approval	
ULE90130	2	DRG	6		1	Haymarket to Roseburn Junction Integrated Cross Sections Sub-Section 2A Sheet 2 of 2	Issued for External Approval	
ULE90130	5	DRG	197		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	198		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	199		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	200		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	201		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	202		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	203		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	204		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	205		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	206		2	Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	207			Roseburn Junction to Gogarburn	Issued for External Review	
ULE90130	5	DRG	214		1	Roseburn Junction to Gogarburn	For Information Only	
ULE90130	5	DRG	217		1	Roseburn Junction to Gogarburn	For Information Only	
ULE90130	5	DRG	218		1	Roseburn Junction to Gogarburn	For Information Only	
ULE90130	5	DRG	224		1	Roseburn to Gogarburn Unmaybed Training Pitches	For Information Only	
ULE90130	5	DRG	227		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5C Sheet 1 of 5	Issued for External Approval	
ULE90130	5	DRG	228		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5C	Issued for External Approval	
ULE90130	5	DRG	545		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5C (Sheet 3 of 5)	Issued for External Approval	
ULE90130	5	DRG	546		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5C (Sheet 4 of 5)	Issued for External Approval	
ULE90130	5	DRG	547		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5C (Sheet 5 of 5)	Issued for External Approval	
ULE90130	5	DRG	548		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5B Sheet 1 of 6	Issued for External Approval	
ULE90130	5	DRG	549		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5B Sheet 2 of 6	Issued for External Approval	
ULE90130	5	DRG	550		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5B Sheet 3 of 6	Issued for External Approval	
ULE90130	5	DRG	551		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5B Sheet 4 of 6	Issued for External Approval	

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ULE 90130	5	DRG	552		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5B	Issued for External Approval	
ULE 90130	5	DRG	553		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5B	Issued for External Approval	
ULE 90130	5	DRG	554		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5B	Issued for External Approval	
ULE 90130	5	DRG	555		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5B	Issued for External Approval	
ULE 90130	5	DRG	556		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5A	Issued for External Approval	
ULE 90130	5	DRG	557		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5A	Issued for External Approval	
ULE 90130	5	DRG	558		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5A	Issued for External Approval	
ULE 90130	5	DRG	559		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5A	Issued for External Approval	
ULE 90130	5	DRG	560		1	Roseburn Junction to Gogarburn Integrated Cross Sections Sub-Section 5A	Issued for External Approval	
ULE 90130	5	DRG	1		1	Gogar Circuit	For Information Only	
ULE 90130	7	DRG	69		1	Gogarburn to Edinburgh Airport	Issued for External Review	
ULE 90130	7	DRG	73		2	Gogarburn to Edinburgh Airport Future Provision for NL Stop Location	For Information Only	
ULE 90130	7	DRG	132		1	Gogarburn to Edinburgh Airport Integrated Cross Section Sub-Section 7A Sheet 1 of 5	Issued for External Approval	
ULE 90130	7	DRG	133		1	Gogarburn to Edinburgh Airport Integrated Cross Section Sub-Section 7A Sheet 2 of 5	Issued for External Approval	
ULE 90130	7	DRG	134		1	Gogarburn to Edinburgh Airport Integrated Cross Section Sub-Section 7A Sheet 3 of 5	Issued for External Approval	
ULE 90130	SW	DRG	31		7	Typical Tramway Cross Sections	Issued for External Approval	
ULE 90130	SW	DRG	32		7	Typical Tramway Cross Sections	Issued for External Approval	
ULE 90130	SW	DRG	33		7	Typical Tramway Cross Sections	Issued for External Approval	
ULE 90130	SW	DRG	34		7	Typical Tramway Cross Sections	Issued for External Approval	
ULE 90130	SW	DRG	56		3	System Wide Structure Gauge	Issued for External Approval	
ULE 90130	SW	DRG	57		2	Structure Gauge	Issued for External Approval	
ULE 90130	SW	DRG	58		3	Typical Tramway Cross Sections	Issued for External Approval	
ULE 90130	SW	DRG	69		3	Surface Finishes	Issued for External Approval	
ULE 90130	SW	DRG	70		3	Surface Finishes	Issued for External Approval	
ULE 90130	SW	DRG	71		3	Surface Finishes	Issued for External Approval	
ULE 90130	SW	DRG	72		3	Typical Tramway Cross Sections	Issued for External Approval	
ULE 90130	SW	DRG	73		3	Typical Tramway Cross Sections	Issued for External Approval	
ULE 90130	SW	DRG	74		3	Typical Tramway Cross Sections	Issued for External Approval	
ULE 90130	SW	DRG	75		4	Section 6 & 7 Route Plan	Issued for External Approval	
ULE 90130	SW	DRG	77		1	System Wide Standard Turnout Geometry	For Information Only	
ULE 90130	SW	DRG	454		13	System Wide Line 1 Project Status	For Information Only	
ULE 90130	SW	DRG	455		13	System Wide Line 1 Project Status	For Information Only	
ULE 90130	SW	DRG	451		3	System Wide Guard Rail Installation of Ballasted Track	Issued for External Approval	
ULE 90130	SW	DRG	476		1	South Gyle Tram Stop	Issued for External Review	
ULE 90130	SW	DRG	540		1	Line 1 Integrated Cross Section Location Overview	Issued for External Approval	
ULE 90130	SW	DRG	549		1	Line 2 Integrated Cross Section Location Overview	Issued for External Approval	
ULE 90130	SW	DRG	572		1	System Wide S & C Layout Plans (Drawing 1 of 4)	Issued for External Approval	
ULE 90130	SW	DRG	573		1	System Wide S & C Layout Plans (Drawing 2 of 4)	Issued for External Approval	
ULE 90130	SW	DRG	574		1	System Wide S & C Layout Plans (Drawing 3 of 4)	Issued for External Approval	
ULE 90130	SW	DRG	575		1	System Wide S & C Layout Plans (Drawing 4 of 4)	Issued for External Approval	
ULE 90130	SW	DRG	583		1	Trackform Reference Design Grass Track In-Situ Concrete In-Situ Rail Beam	Issued for External Approval	
ULE 90130	SW SW	TRK DRG	23		5	Route Plan Proposed Tramway	Issued for External Approval	
ULE 90130	SW-SW	TRK-DRG	27		5	System Wide Section/Sub-Section Overview (Sheet 1 of 2)	For Information Only	
ULE 90130	SW-SW	TRK-DRG	28		6	System Wide Section/Sub-Section Overview (Sheet 2 of 2)	For Information Only	
ULE 90130	1	HRL	1		8	Section 1A	Issued for External Approval	
ULE 90130	1	HRL	2		8	Section 1A	Issued for External Approval	
ULE 90130	1	HRL	3		8	Section 1A	Issued for External Approval	
ULE 90130	1	HRL	4		8	Section 1A	Issued for External Approval	
ULE 90130	1	HRL	5		8	Roads Design Section 1A Sheet 5 of 24	Issued for External Approval	
ULE 90130	1	HRL	6		8	Roads Design Section 1A Sheet 6 of 24	Issued for External Approval	
ULE 90130	1	HRL	7		8	Roads Design Section 1A Sheet 7 of 24	Issued for External Approval	
ULE 90130	1	HRL	8		8	Roads Design Section 1A Sheet 8 of 24	Issued for External Approval	
ULE 90130	1	HRL	9		8	Roads Design Section 1A Sheet 9 of 24	Issued for External Approval	
ULE 90130	1	HRL	10		4	Section 1B	Issued for External Approval	
ULE 90130	1	HRL	11		4	Section 1B	Issued for External Approval	
ULE 90130	1	HRL	12		4	Section 1B	Issued for External Approval	
ULE 90130	1	HRL	13		4	Roads Design Section 1B	Issued for External Approval	
ULE 90130	1	HRL	14		4	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE 90130	1	HRL	15		3	Section 1C	Issued for External Approval	
ULE 90130	1	HRL	16		3	Section 1C	Issued for External Approval	
ULE 90130	1	HRL	17		3	Section 1C	Issued for External Approval	

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ULE-90130	1	HRL	18		3	Section 1C	Issued for External Approval	
ULE-90130	1	HRL	19		3	Section 1C	Issued for External Approval	
ULE-90130	1	HRL	20		3	Roads Design Section 1C	Issued for External Approval	
ULE-90130	1	HRL	21		4	Newhaven to Haymarket,Section 1D	Issued for External Approval	
ULE-90130	1	HRL	22		4	Roads Design Section 1D	Issued for External Approval	
ULE-90130	1	HRL	23		4	Roads Design Section 1D	Issued for External Approval	
ULE-90130	1	HRL	24		4	Roads Design Section 1D	Issued for External Approval	
ULE-90130	1	HRL	74		1	Parking Layby Section 1B	For Approval	
ULE-90130	1	HRL	75		1	Parking Layby and Cycle Lane	For Approval	
ULE-90130	1	HRL	76		1	Typical Cross Section ,Section 1B	For Approval	
ULE-90130	1	HRL	77		1	Foot of the Walk Section 1B	For Approval	
ULE-90130	1	HRL	78		1	Typical Cross Section,Section1D	For Approval	
ULE-90130	1	HRL	79		1	Typical Cross Section,Section1D	For Approval	
ULE-90130	1	HRL	79		1	Typical Cross Section,Section 1D	For Approval	
ULE-90130	1	HRL	80		1	Newhaven Road to Haymarket Lighting Layout Plans Sheet 10 of 24	For Approval	
ULE-90130	1	HRL	81		1	Newhaven Road to Haymarket Lighting Layout Plans Sheet 10 of 24	For External Approval	
ULE-90130	1	HRL	82		1	Newhaven Road to Haymarket Lighting Layout Plans Sheet 10 of 24	For External Approval	
ULE-90130	1	HRL	83		1	Newhaven Road to Haymarket Lighting Layout Plans Sheet 10 of 24	For External Approval	
ULE-90130	1	HRL	151		6	St Andrew Square Road Design	For External Approval	
ULE-90130	1	HRL	152		1	St Andrew Square Road Design	For Information Only	
ULE-90130	1	HRL	153		1	St Andrew Square Road Design	For Information Only	
ULE-90130	1	HRL	154		1	St Andrew Square Road Design	For Information Only	
ULE-90130	1	HRL	155		1	St Andrew Square Road Design	For Information Only	
ULE-90130	1	HRL	210		1	New Haven Road to Haymarket	Issued for External Approval	
ULE-90130	1	HRL	211		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	212		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	213		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	214		1	Newhaven Road to Haymarket Site Clearance Section 1B Sheet 14 of 24	Issued for External Approval	
ULE-90130	1	HRL	221		1	Newhaven to Haymarket,Section 1D	Issued for External Approval	
ULE-90130	1	HRL	222		1	Newhaven to Haymarket,Section 1D	Issued for External Approval	
ULE-90130	1	HRL	223		1	Newhaven to Haymarket,Section 1D	Issued for External Approval	
ULE-90130	1	HRL	224		1	Newhaven to Haymarket,Section 1D	Issued for External Approval	
ULE-90130	1	HRL	225		1	Road Design & Site Clearance,St Andrew Sq	Issued for External Approval	
ULE-90130	1	HRL	410		1	New Haven Road to Haymarket,Section 1B	Issued for External Approval	
ULE-90130	1	HRL	411		1	New Haven Road to Haymarket,Section 1B	Issued for External Approval	
ULE-90130	1	HRL	412		1	New Haven Road to Haymarket,Section 1B	Issued for External Approval	
ULE-90130	1	HRL	413		1	New Haven Road to Haymarket,Section 1B	Issued for External Approval	
ULE-90130	1	HRL	414		1	New Haven Road to Haymarket,Section 1B	Issued for External Approval	
ULE-90130	1	HRL	421		1	Newhaven to Haymarket,Section 1D	Issued for External Approval	
ULE-90130	1	HRL	422		1	Newhaven to Haymarket,Section 1D	Issued for External Approval	
ULE-90130	1	HRL	423		1	Newhaven to Haymarket,Section 1D	Issued for External Approval	
ULE-90130	1	HRL	424		1	Newhaven to Haymarket,Section 1D	Issued for External Approval	
ULE-90130	1	HRL	544		2	St Andrews Sqaure	For Information Only	*Infraco Proposals are based on the 21 No Drawings highlighted below
ULE-90130	1	HRL	545		*	St Andrews Square Road Design Traffic Signals Ducting Dwg St. David's St Sheet 17 & 18 of 24*	Sketch	Marked Up Drawing Received on 24.07.2007 as dwg ULE90130-01-HRL-000148, PB Internal Version no. -
ULE-90130	1	HRL	701		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1A Sheet 1 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. 4A
ULE-90130	1	HRL	702		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1A Sheet 2 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. 3
ULE-90130	1	HRL	705		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1A Sheet 5 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. 3
ULE-90130	1	HRL	706		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1A Sheet 6 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. 3
ULE-90130	1	HRL	707		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1A Sheet 7 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. 3
ULE-90130	1	HRL	708		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1A Sheet 8 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. -
ULE-90130	1	HRL	709		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1A Sheet 9 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. 6
ULE-90130	1	HRL	710		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1B Sheet 10 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. -
ULE-90130	1	HRL	711		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1B Sheet 11 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. -
ULE-90130	1	HRL	712		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1B Sheet 12 of 24*	Issued for External Approval	Marked Up Drawing Received on 24.07.2007 as dwg ULE90130-01-TAL-00012, PB Internal Version no. 4
ULE-90130	1	HRL	713		4	Newhaven to Haymarket Pavement Design Dwgs Sec 1B Sheet 13 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. 3
ULE-90130	1	HRL	714		2	Newhaven to Haymarket Pavement Design Dwgs Sec 1C Sheet 14 of 24*	For Tender Purposes Only	Marked Up Drawing Received on 24.07.2007 as dwg ULE90130-01-HRL-00014, PB Internal Version no. -
ULE-90130	1	HRL	715		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1C Sheet 15 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. 4
ULE-90130	1	HRL	716		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1C Sheet 16 of 24*	For Public Meeting	Marked Up Drawing Received on 24.07.2007, PB Internal Version no. 4
ULE-90130	1	HRL	719		2	Newhaven to Haymarket Pavement Design Dwgs Sec 1C Sheet 19 of 24*	For Tender Purposes Only	Marked Up Drawing Received on 24.07.2007 as dwg ULE90130-01-HRL-00019, PB Internal Version no. -
ULE-90130	1	HRL	720		2	Newhaven to Haymarket Pavement Design Dwgs Sec 1C Sheet 20 of 24*	For Tender Purposes Only	Marked Up Drawing Received on 24.07.2007 as dwg ULE90130-01-HRL-00020, PB Internal Version no. -
ULE-90130	1	HRL	721		2	Newhaven to Haymarket Pavement Design Dwgs Sec 1D Sheet 21 of 24*	For Tender Purposes Only	Marked Up Drawing Received on 24.07.2007 as dwg ULE90130-01-HRL-00021, PB Internal Version no. -

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ULE-90130	1	HRL	722		2	Newhaven to Haymarket Pavement Design Dwgs Sec 1D Sheet 22 of 24"	For Tender Purposes Only	Marked Up Drawing Received on 24.07.2007 as dwg ULE90130-01-HRL-00022. PB Internal Version no. -
ULE-90130	1	HRL	723		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1D Sheet 23 of 24"	For Public Meeting	Marked Up Drawing Received on 24.07.2007. PB Internal Version no. 1
ULE-90130	1	HRL	724		*	Newhaven to Haymarket Pavement Design Dwgs Sec 1D Sheet 24 of 24"	For Public Meeting	Marked Up Drawing Received on 24.07.2007. PB Internal Version no. 1
ULE-90130	1	HRL	725		2	Road Design Kerbs Footways and Paved Areas Section 1D	For External Approval	
ULE-90130	1	HRL	1110		1	Road Design Footways and Paved Areas	External Approval	
ULE-90130	1	HRL	1111		1	Road Design Footways and Paved Areas	External Approval	
ULE-90130	1	HRL	1112		1	Road Design Footways and Paved Areas	External Approval	
ULE-90130	1	HRL	1113		1	Road Design Footways and Paved Areas	External Approval	
ULE-90130	1	HRL	1114		1	Road Design Footways and Paved Areas Section 1D	External Approval	
ULE-90130	1	HRL	1121		1	Road Design Kerbs Footways and Paved Areas Section 1D	External Approval	
ULE-90130	1	HRL	1122		1	Road Design Kerbs Footways and Paved Areas Section 1D	External Approval	
ULE-90130	1	HRL	1123		1	Road Design Kerbs Footways and Paved Areas Section 1D	External Approval	
ULE-90130	1	HRL	1125		1	Road Design Kerbs Footways and Paved Areas Section 1D	For External Approval	
ULE-90130	1	HRL	1130		1	Road Design Kerbs Footways and Paved Areas Section 1D	External Approval	
ULE-90130	1	HRL	1131		3	Road Design Kerbs Footways and Paved Areas Section 1D	External Approval	
ULE-90130	1	HRL	1132		1	Road Design Raised Table Construction Standard Details	External Approval	
ULE-90130	1	HRL	1133		1	Road Design Raised Table Construction Standard Details	External Approval	
ULE-90130	1	HRL	1210		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	1211		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	1212		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	1213		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	1214		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	1221		1	Newhaven to Haymarket Section 1D	Issued for External Approval	
ULE-90130	1	HRL	1222		1	Newhaven to Haymarket Section 1D	Issued for External Approval	
ULE-90130	1	HRL	1223		1	Newhaven to Haymarket Section 1D	Issued for External Approval	
ULE-90130	1	HRL	1224		1	Newhaven to Haymarket Section 1D	Issued for External Approval	
ULE-90130	1	HRL	1225		4	St Andrew Square Road Design	For External Approval	
ULE-90130	1	HRL	1250		8	St Andrew Square Road Design	For External Approval	
ULE-90130	1	HRL	1253		6	St Andrews Square Road Design Road Marking	For Information Only	
ULE-90130	1	HRL	1251		1	St Andrew Square Road Design Road Markings St David Street	For Information Only	
ULE-90130	1	HRL	1252		1	St Andrew Square Road Design Traffic Signs St David Street	For Information Only	
ULE-90130	1	HRL	1270		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	1271		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	1272		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	1273		1	Newhaven Road to Haymarket Section 1B	Issued for External Approval	
ULE-90130	1	HRL	1274		1	Newhaven Road To Haymarket Pavement Surface Colour 1B Sheet 14 of 24	Issued for External Approval	
ULE-90130	1	HRL	1281		1	Pavement Surface Colour Section 1D	Issued for External Approval	
ULE-90130	1	HRL	1282		1	Pavement Surface Colour Section 1D	Issued for External Approval	
ULE-90130	1	HRL	1283		1	Newhaven Road to Haymarket	Issued for External Approval	
ULE-90130	1	HRL	1284		1	Newhaven Road to Haymarket Section 1D	Issued for External Approval	
ULE-90130	1	HRL	1285		1	Newhaven Road to Haymarket Pavement Surface Colour St Andrew Square	For External Approval	
ULE-90130	2	HRL	1		3	Roseburn Junction to Granton Square - Section 3A	Draft	
ULE-90130	2	HRL	2			Haymarket to Roseburn Junction - Section 2A	Draft	
ULE-90130	2	HRL	3		4	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	130		2	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	131		3	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	200		3	Typical Cross Section Subsection 2A	Issued for External Approval	
ULE-90130	2	HRL	531		2	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	532		2	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	533		2	Haymarket to Roseburn Junction Traffic Signs and Road Marking Section 2A	Issued for External Approval	
ULE-90130	2	HRL	630		1	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	631		1	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	801		1	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	932		1	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	933		3	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE-90130	2	HRL	1001		1	Construction Details Kerbing Details	Issued for External Approval	
ULE-90130	2	HRL	1002		1	Construction Details Signal Head Types	Issued for External Approval	
ULE-90130	5	HRL	1		3	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5A	Issued for External Approval	
ULE-90130	5	HRL	2		2	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE-90130	5	HRL	3		2	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE-90130	5	HRL	4		2	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5A	Issued for External Approval	

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ULE-90130	5	HRL	5		3	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE-90130	5	HRL	6		3	Roseburn Junction to Gogarburn - Section 5B	Issued for External Approval	
ULE-90130	5	HRL	7		3	Roseburn Junction to Gogarburn - Section 5B	Issued for External Approval	
ULE-90130	5	HRL	8		2	Roseburn Junction to Gogarburn - Section 5B	Issued for External Approval	
ULE-90130	5	HRL	9		3	Roseburn Junction to Gogarburn - Section 5B	Issued for External Approval	
ULE-90130	5	HRL	10		2	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	11		1	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	12		1	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	13		1	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	14		2	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	15		2	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	16		1	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	17		2	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	18		4	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	19		1	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	20		1	Roseburn Junction to Gogarburn Road Scheme Layout Plans Section 5B	Issued for External Approval	
ULE-90130	5	HRL	21		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	22		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	23		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	24		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	25		3	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	26		3	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	100		2	Roseburn Junction to Gogarburn Road Junction and Crossing Layouts Section 5A	Issued for External Approval	
ULE-90130	5	HRL	102		2	Roseburn Junction to Gogarburn Road Junction and Crossing Layouts Section 5A	Issued for External Approval	
ULE-90130	5	HRL	150		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	151		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	201		2	Roseburn Junction to Gogarburn Road Junction and Crossing Layouts Section 5A	Issued for External Approval	
ULE-90130	5	HRL	203		2	Roseburn Junction to Gogarburn Road Junction and Crossing Layouts Section 5A	Issued for External Approval	
ULE-90130	5	HRL	250		1	Typical Cross Section Subsection 5B	Issued for External Approval	
ULE-90130	5	HRL	260		2	Typical Cross Section Subsection 5C	Issued for External Approval	
ULE-90130	5	HRL	261		2	Typical Cross Section Subsection 5C	Issued for External Approval	
ULE-90130	5	HRL	262		2	Typical Cross Section Subsection 5C	Issued for External Approval	
ULE-90130	5	HRL	263		2	Typical Cross Section Subsection 5C	Issued for External Approval	
ULE-90130	5	HRL	264		2	Typical Cross Section Subsection 5C	Issued for External Approval	
ULE-90130	5	HRL	501		2	Roseburn Junction to Gogarburn Traffic Signs and Road Markings Section 5A	Issued for External Approval	
ULE-90130	5	HRL	502		2	Roseburn Junction to Gogarburn Traffic Signs and Road Markings Section 5A	Issued for External Approval	
ULE-90130	5	HRL	551		2	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE-90130	5	HRL	552		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	553		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	554		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	800		2	Roseburn Junction to Gogarburn Traffic Signal Ducting Section 5A	Issued for External Approval	
ULE-90130	5	HRL	802		2	Roseburn Junction to Gogarburn Traffic Signal Ducting Section 5A	Issued for External Approval	
ULE-90130	5	HRL	850		2	Roseburn Junction to Gogarburn Traffic Signal Ducting Section 5C	Issued for External Approval	
ULE-90130	5	HRL	851		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	901		2	Roseburn Junction to Gogarburn Kerbs, Footways and Paved Areas Section 5A	Issued for External Approval	
ULE-90130	5	HRL	902		2	Roseburn Junction to Gogarburn Kerbs, Footways and Paved Areas Section 5A	Issued for External Approval	
ULE-90130	5	HRL	951		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	952		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	953		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	5	HRL	959		2	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE-90130	6	HRL	1		3	Gogar Depot Road Scheme Layout Plans Section 6	Issued for External Approval	
ULE-90130	6	HRL	2		3	Gogar Depot Road Scheme Layout Plans Section 6	Issued for External Approval	
ULE-90130	6	HRL	100		2	Gogar Depot Road Junction & Crossing layout	Issued for External Approval	
ULE-90130	6	HRL	201		2	Typical Cross Section	Issued for External Approval	
ULE-90130	6	HRL	202		2	Typical Cross Section A Gogar Depot	Issued for External Approval	
ULE-90130	6	HRL	501		2	Gogar Depot Traffic Signs and Road Markings Section 6	Issued for External Approval	
ULE-90130	6	HRL	502		2	Gogar Depot Traffic Signs and Road Markings Section 6	Issued for External Approval	
ULE-90130	6	HRL	503		1	Gogar Depot Traffic Signs and Road Markings Section 6	Issued for External Approval	
ULE-90130	6	HRL	601		1	Road Long Section Section 6 Depot Access Road	Issued for External Approval	
ULE-90130	6	HRL	800		2	Gogar Depot Traffic Signal Ducting Section Subsection 6	Issued for External Approval	
ULE-90130	6	HRL	901		2	Gogar Depot Kerbs Footways and paved areas Section 6	Issued for External Approval	

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ULE90130	6	HRL	902		2	Gogar Circle Kerbs, Footways and paved areas Section 6	Issued for External Approval	
ULE90130	7	HRL	1		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	2		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	3		3	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	4		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	5		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	6		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	7		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	8		3	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	9		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	201		2	Typical Cross Section - Section 7A	Issued for External Approval	
ULE90130	7	HRL	503		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	507		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	508		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	600		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	603		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	HRL	607		2	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	2	LDS	1		2	Section 2A	Issued for External Approval	
ULE90130	2	LDS	2		1	Section 2A	Issued for External Approval	
ULE90130	2	LDS	3		2	Section 2A	Issued for External Approval	
ULE90130	5	LDS	6		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	7		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	8		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	9		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	10		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	11		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	12		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	13		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	14		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	15		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	16		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	17		1	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	18		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	19		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	20		2	Soft Landscape Plan Section 5B	Issued for External Approval	
ULE90130	5	LDS	21		4	Soft Landscape Plan Section 5B	Draft	
ULE90130	5	LDS	22		3	Soft Landscape Plan Section 5B	Draft	
ULE90130	5	LDS	23		3	Soft Landscape Plan Section 5B	Draft	
ULE90130	5	LDS	24		2	Soft Landscape Plan Section 5B	Draft	
ULE90130	5	LDS	25		2	Soft Landscape Plan Section 5B	Draft	
ULE90130	5	LDS	26		2	Soft Landscape Plan Section 5B	Draft	
ULE90130	1	LTG	10		2	Newhaven Road to Haymarket Lighting Layout Plans Sheet 10 of 24	Issued for External Approval	
ULE90130	1	LTG	11		2	Newhaven Road to Haymarket Lighting Layout Plans Sheet 10 of 24	Issued for External Approval	
ULE90130	1	LTG	12		2	Newhaven Road to Haymarket Lighting Layout Plans Sheet 10 of 24	Issued for External Approval	
ULE90130	1	LTG	13		2	Newhaven Road to Haymarket Lighting Layout Plans Sheet 10 of 24	Issued for External Approval	
ULE90130	1	LTG	17		1	Newhaven road to Haymarket Lighting Layout Plans	Issued for Internal Review	
ULE90130	1	LTG	18		1	Newhaven road to Haymarket Lighting Layout Plans	Issued for Internal Review	
ULE90130	1	LTG	21		2	Newhaven Road to Haymarket Lighting Layout Plans Sheet 21 of 24	Issued for External Approval	
ULE90130	1	LTG	22		2	Newhaven Road to Haymarket Lighting Layout Plans Sheet 22 of 24	Issued for External Approval	
ULE90130	1	LTG	23		2	Newhaven Road to Haymarket Lighting Layout Plans Sheet 23 of 24	Issued for External Approval	
ULE90130	1	LTG	24		2	Newhaven Road to Haymarket Lighting Layout Plans Sheet 24 of 24	Issued for External Approval	
ULE90130	2	LTG	1		2	Haymarket to Roseburn Junction	Issued for External Approval	
ULE90130	2	LTG	2		2	Haymarket to Roseburn Junction	Issued for External Approval	
ULE90130	2	LTG	3		2	Haymarket to Roseburn Junction	Issued for External Approval	
ULE90130	5	LTG	1		2	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	LTG	2		2	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	LTG	3		2	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	LTG	4		2	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	LTG	5		2	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	LTG	6		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE90130	5	LTG	7		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	

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PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE-90130	5	LTG	8		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	9		2	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE-90130	5	LTG	10		2	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE-90130	5	LTG	11		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	12		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	13		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	14		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	15		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	16		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	17		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	18		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	19		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	20		2	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	5	LTG	21		2	Roseburn Junction to Gogarburn	External Approval	
ULE-90130	5	LTG	22		2	Roseburn Junction to Gogarburn	External Approval	
ULE-90130	5	LTG	23		2	Roseburn Junction to Gogarburn	External Approval	
ULE-90130	5	LTG	24		2	Roseburn Junction to Gogarburn	External Approval	
ULE-90130	5	LTG	25		2	Roseburn Junction to Gogarburn	External Approval	
ULE-90130	5	LTG	26		2	Roseburn Junction to Gogarburn	External Approval	
ULE-90130	6	LTG	1		2	Gogar Depot Lighting Layout Plans Section 6A Sheet 1 of 2	Issued for External Approval	
ULE-90130	6	LTG	2		2	Gogar Depot Lighting Layout Plans Section 6A Sheet 2 of 2	Issued for External Approval	
ULE-90130	7	LTG	7		1	Gogarburn to Edinburgh Airport Lighting Layout Plans Section 7A	Issued for External Approval	
ULE-90130	7	LTG	8		1	Gogarburn to Edinburgh Airport Lighting Layout Plans Section 7A	Issued for External Approval	
ULE-90130	7	LTG	9		1	Roseburn Junction to Gogarburn Lighting Layout plans	Issued for External Approval	
ULE-90130	1	OLE	5		3	Haymarket to Newhaven Outline OLE Layout Plan Chainage [illegible] to [illegible] Sheet 5 of 13	Issued for External Approval	
ULE-90130	1	OLE	6		3	Haymarket to Newhaven Outline OLE Layout Plan Chainage 110300 to 110950 Sheet 6 of 13	Issued for External Approval	
ULE-90130	1	OLE	7		3	Haymarket to Newhaven Outline OLE Layout Plan Chainage 110950 to 120300 Sheet 7 of 13	Issued for External Approval	
ULE-90130	1	OLE	8		3	Haymarket to Newhaven Outline OLE Layout Plan Chainage [illegible] to [illegible] Sheet 8 of 13	Issued for External Approval	
ULE-90130	1	OLE	9		3	Haymarket to Newhaven Outline OLE Layout Plan Chainage 120900 to 121200 Sheet 9 of 13	Issued for External Approval	
ULE-90130	1	OLE	10		3	Haymarket to Newhaven Outline OLE Layout Plan Chainage 121200 to 121500 Sheet 10 of 13	Issued for External Approval	
ULE-90130	1	OLE	11		3	Haymarket to Newhaven Outline OLE Layout Plan Chainage 121500 to 130000 Sheet 11 of 13	Issued for External Approval	
ULE-90130	1	OLE	12		2	Haymarket to Newhaven Outline OLE Layout Plan Chainage [illegible] to [illegible] Sheet 12 of 13	For Tender Purposes Only	
ULE-90130	1	OLE	13		3	Haymarket to Newhaven Outline OLE Layout Plan Chainage 130030 to 200000 Sheet 13 of 13	Issued for External Approval	
ULE-90130	2	OLE	1		3	Haymarket to Roseburn Junction Outline OLE	Issued for External Approval	
ULE-90130	2	OLE	2		3	Haymarket to Roseburn Junction Outline OLE	Issued for External Approval	
ULE-90130	5	OLE	1		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	2		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	3		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	4		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	5		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	6		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	7		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	8		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	9		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	10		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	11		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	12		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	5	OLE	13		4	Roseburn Junction to Gogarburn Outline OLE Layout Plan Change	Issued for External Approval	
ULE-90130	6	OLE	1		4	Gogar Depot Outline OLE Layout Plan Sheet 1 of 3	Issued for External Approval	
ULE-90130	6	OLE	2		2	Gogar Depot Outline OLE Layout Plan Sheet 2 of 3	Issued for External Approval	
ULE-90130	6	OLE	3		2	Gogar Depot Outline OLE Layout Plan Sheet 3 of 3	Issued for External Approval	
ULE-90130	7	OLE	1		4	Roseburn to Edinburgh Airport Outline	Issued for External Approval	
ULE-90130	7	OLE	2		4	Roseburn to Edinburgh Airport Outline	Issued for External Approval	
ULE-90130	7	OLE	3		4	Roseburn to Edinburgh Airport Outline	Issued for External Approval	
ULE-90130	7	OLE	4		4	Roseburn to Edinburgh Airport Outline	Issued for External Approval	
ULE-90130	7	OLE	5		4	Roseburn to Edinburgh Airport Outline	Issued for External Approval	
ULE-90130	SW	OLE	7		6	System Wide - Section 1, 2 and 3	Issued for External Approval	
ULE-90130	SW	OLE	8		5	System Wide - Sections 5 and 7	Issued for External Approval	
ULE-90130	SW	OLE	9		6	Gogar Depot - Section 6	Issued for External Approval	
ULE-90130	1	RTW	1	W1	A	Lindsay Road	For Tender Purposes Only	
ULE-90130	1	RTW	2	W1	A	Lindsay Road	For Tender Purposes Only	

PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE-90130	5	RTW	1	W3&W4	-	W3 & 4 Russell Road	Preliminary Design	
ULE-90130	5	RTW	2	W3&W4	-	W3 & 4 Russell Road	Preliminary Design	
ULE-90130	5	RTW	3	W3&W4	B	W3 & 4 Russell Road	For Tender Purposes Only	
ULE-90130	5	RTW	4	W3&W4	C	W3 & 4 Russell Road	For Tender Purposes Only	
ULE-90130	5	RTW	5	W3&W4	-	W3 & 4 Russell Road	For Tender Purposes Only	
ULE-90130	5	RTW	11	W3&W4	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	12	W3&W4	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	13	W3&W4	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	14	W3	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	15	W3	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	16	W3A	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	17	W3A	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	18	W3	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	19	W3B	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	20	W3B	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	21	W3B	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	22	W3B	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	23	W3B	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	24	W3B	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	25	W3C	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	26	W3C	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	27	W3C	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	28	W3	1	Russell Road Retaining Wall One	Issued for External Approval	
ULE-90130	5	RTW	29	W4A	1	Russell Road Retaining Wall Two Structure W4 Drawing Schedule	Issued for External Approval	
ULE-90130	5	RTW	30	W4A	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	31	W4A	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	32	W4A	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	33	W4A	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	34	W4A	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	35	W4A	1	Russell Road Retaining Wall Two Structure W4A Setting Out Details	Issued for External Approval	
ULE-90130	5	RTW	36	W4A	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	37	W4A	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	38	W4A	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	39	W4A	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	40	W4B	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	41	W4B	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	42	W4B	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	43	W4B	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	45	W4C	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	46	W4C	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	47	W4C	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	48	W4C	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	49	W4C	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	50	W4D	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	51	W4D	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	52	W4D	1	Russell Road Retaining Wall Two Structure W4D Concrete Outlines and Setting out Sheet 2 of 3	Issued for External Approval	
ULE-90130	5	RTW	53	W4D	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	54	W4D	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	55	W4D	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	56	W3&W4	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	57	W3	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	58	W4	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	59	W4	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	60	W3&W4	1	Russell Road Retaining Wall Two	Issued for External Approval	
ULE-90130	5	RTW	101	W3&W4	1	Russell Road Retaining Wall Two	Draft	Drawing taken from Disc 2. Not found in Network
ULE-90130	5	RTW	201	W8	1	W8 Balgreen to Water of Leith / Baird Drive	Issued for Tender Purposes Only	
ULE-90130	5	RTW	202	W8	1	W8 Balgreen to Water of Leith / Baird Drive	For Tender Purposes Only	
ULE-90130	5	RTW	241	W6	-	W6 Balgreen Road (West of Balgreen Rd)	Draft	
ULE-90130	5	RTW	242	W5	-	W5 Balgreen Road (West of Balgreen Rd)	Draft	
ULE-90130	5	RTW	321	W11	1	Roseburn Junction to Gogarburn	Issued for Tender Purposes Only	
ULE-90130	5	RTW	322	W11	2	Roseburn Junction to Gogarburn	Issued for Tender Purposes Only	

PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE90130	5	RTW	362	W15	1	GA 1 of 3	For Tender Purposes Only	
ULE90130	5	RTW	363	W15	1	2 of 3	For Tender Purposes Only	
ULE90130	5	RTW	364	W15	1	3 of 3	For Tender Purposes Only	
ULE90130	5	RTW	399	W15	1	Roseburn Junction to Gogarburn	Draft	
ULE90130	5	RTW	400	W15		Gyle Tram Stop	For Tender Purposes Only	
ULE90130	5	RTW	445	S21B	1	Roseburn Junction to Gogarburn Structure S21B Murrayfield Stadium Retaining Wall Murrayfield Stadium Underpass GA	For Tender Purposes Only	
ULE90130	5	RTW	446	S21B	1	Roseburn Junction to Gogarburn Structure S21B Murrayfield Stadium Retaining Wall	For Tender Purposes Only	
ULE90130	5	RTW	447	S21B	1	Roseburn Junction to Gogarburn Structure S21B Cross Section Sheet 2 of 2	For Tender Purposes Only	
ULE90130	5	RTW	448	S21B	1	Roseburn Junction to Gogarburn	Draft	
ULE90130	5	RTW	449	S21B	1	Roseburn Junction to Gogarburn Structure S21B Murrayfield Stadium Retaining Wall Reinforced Earthwork Details	Issued for External Approval	
ULE90130	5	RTW	491	S21D	3	S21D Murrayfield Training Pitches	For Tender Purposes Only	
ULE90130	5	RTW	521	W16	2	W16 A8 Retaining Wall	Issued for External Approval	
ULE90130	5	RTW	522	W16	2	W16 A8 Retaining Wall	Issued for External Approval	
ULE90130	5	RTW	561	W12	1	W12 Murrayfield Tramstop	For Tender Purposes Only	
ULE90130	5	RTW	562	W18	2	W18 Murrayfield Tramstop	Issued for External Approval	
ULE90130	5	RTW	563	W18		Roseburn Junction to Gogarburn Murrayfield Tramstop Retaining Wall Sheet 22 of 40	Draft	
ULE90130	5	RTW	564	W12		Roseburn Junction to Gogarburn Murrayfield Tramstop Retaining Wall Sheet 03 of 40	Draft	
ULE90130	5	RTW	565	W18		Roseburn Junction to Gogarburn Murrayfield Tramstop Retaining Wall Bank Seat General Arrangement 1 of 2	Draft	
ULE90130	5	RTW	566	W18		Roseburn Junction to Gogarburn Murrayfield Tramstop Retaining Wall Bank Seat General Arrangement 2 of 2	Draft	
ULE90130	5	RTW	567	W12		Roseburn Junction to Gogarburn Murrayfield Tramstop Retaining Wall South West Access Steps Wall	Draft	
ULE90130	5	RTW	568	W18		Roseburn Junction to Gogarburn Murrayfield Tramstop Retaining Wall South Main Stairs Wall	Draft	
ULE90130	5	RTW	569	W18		Roseburn Junction to Gogarburn Murrayfield Tramstop Retaining Wall North Main Stairs Wall	Draft	
ULE90130	7	RTW	1	S14	3	Gogarburn Retaining Walls	For Tender Purposes Only	
ULE90130	7	RTW	2	S14	3	Gogarburn Retaining Walls	For Tender Purposes Only	
ULE90130	7	RTW	3	W14	3	W14 Gogarburn	For Tender Purposes Only	
ULE90130	7	RTW	4	W14	3	W14 Gogarburn	For Tender Purposes Only	
ULE90130	7	RTW	5	W14	8	W14 Gogarburn	For Tender Purposes Only	
ULE90130	7	RTW	6	W14	2	W14 Gogarburn	For Tender Purposes Only	
ULE90130	7	RTW	7	W14	2	W14 Gogarburn	For Tender Purposes Only	
ULE90130	7	RTW	8	W14	2	W14 Gogarburn	For Tender Purposes Only	
ULE90130	7	RTW	9	W14	2	W14 Gogarburn	For Tender Purposes Only	
ULE90130	5	RTW	11	W3	1	Russell Road Retaining Wall One Structure W3 Drawing Schedule	Issued for External Approval	
ULE90130	5	SCH	8		2	Drainage Schedule Section 5A	Issue for External Approval	Drawings received but not in Drawing List
ULE90130	5	SCH	9		2	Drainage Schedule Section 5B	Issue for External Approval	Drawings received but not in Drawing List
ULE90130	5	SCH	10		2	Drainage Schedule Section 5C	Issue for External Approval	Drawings received but not in Drawing List
ULE90130	2	SCL	1		1	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE90130	2	SCL	2		1	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE90130	2	SCL	3		1	Haymarket to Roseburn Junction - Section 2A	Issued for External Approval	
ULE90130	5	SCL	1		1	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	SCL	2		1	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	SCL	3		1	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	SCL	4		1	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	SCL	5		1	Roseburn Junction to Gogarburn - Section 5A	Issued for External Approval	
ULE90130	5	SCL	21		1	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE90130	5	SCL	22		1	Roseburn Junction to Gogarburn - Section 5C	Issued for Internal Review	
ULE90130	5	SCL	23		1	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE90130	5	SCL	24		1	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE90130	5	SCL	25		1	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE90130	5	SCL	26		1	Roseburn Junction to Gogarburn - Section 5C	Issued for External Approval	
ULE90130	7	SCL	1		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	SCL	2		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	SCL	3		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	SCL	4		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	SCL	5		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	SCL	6		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	SCL	7		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	SCL	8		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	7	SCL	9		1	Gogarburn to Edinburgh Airport - Section 7A	Issued for External Approval	
ULE90130	1	STP	2		4	Newhaven Road to Haymarket - Newhaven	For Tender Purposes Only	
ULE90130	1	STP	12		2	Newhaven Road to Haymarket - Ocean Terminal	For Tender Purposes Only	
ULE90130	1	STP	22		2	Newhaven Road to Haymarket - Ocean Drive	For Tender Purposes Only	

PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE90130	1	STP	32		2	Newhaven Road to Haymarket - Constitution Street	For Tender Purposes Only	
ULE90130	1	STP	33		2	Newhaven Road to Haymarket - Constitution Street	For Tender Purposes Only	
ULE90130	1	STP	42		4	Newhaven Road to Haymarket - Foot of the Walk	Issued for External Approval	
ULE90130	1	STP	52		4	Newhaven Road to Haymarket - Balfour Street	Issued for External Approval	
ULE90130	1	STP	53		1	Newhaven Road to Haymarket Balfour Street Location Plan	Issued for External Approval	
ULE90130	1	STP	62		4	Newhaven Road to Haymarket - Macdonald Road	Issued for External Approval	
ULE90130	1	STP	63		1	Newhaven Road to Haymarket McDonald Rd Tramstop	Issued for External Approval	
ULE90130	1	STP	72		3	Newhaven Road to Haymarket - Picardy Place	Issued for External Approval	
ULE90130	1	STP	82		2	Newhaven Road to Haymarket - St Andrews Square	For Tender Purposes Only	
ULE90130	1	STP	92		3	Newhaven Road to Haymarket - St Andrews Square	Issued for External Approval	
ULE90130	1	STP	93		1	Newhaven Road to Haymarket - St Andrews Square	Issues for Tender Purposes Only	
ULE90130	1	STP	102		3	Newhaven Road to Haymarket - Princes Street	Issued for External Approval	
ULE90130	1	STP	112		3	Newhaven Road to Haymarket - Shandwick Place	Issued for External Approval	
ULE90130	1	STP	124		1	Newhaven Road to Haymarket - Haymarket	Issued for External Approval	
ULE90130	1	STP	125		1	Newhaven Road to Haymarket - Haymarket	Issued for External Approval	
ULE90130	1	STP	126		1	Newhaven Road to Haymarket - Exemplar Tram Stop	Issued for External Approval	
ULE90130	1	STP	127		1	Newhaven Road to Haymarket - Haymarket	Issued for External Approval	
ULE90130	1	STP	128		1	Newhaven Road to Haymarket - Haymarket	Issued for External Approval	
ULE90130	1	STP	129		1	Newhaven Road to Haymarket - Haymarket	Issued for External Approval	
ULE90130	5	STP	2		1	Roseburn Junction to Gogarburn - Murrayfield	Issued for External Approval	
ULE90130	5	STP	3		1	Roseburn Junction to Gogarburn - Murrayfield	Issued for External Approval	
ULE90130	5	STP	4		1	Roseburn Junction to Gogarburn - Murrayfield	Issued for External Approval	
ULE90130	5	STP	5		1	Roseburn Junction to Gogarburn - Murrayfield	Issued for External Approval	
ULE90130	5	STP	6		1	Roseburn Junction to Gogarburn - Exemplar Tram Stop	Issued for External Approval	
ULE90130	5	STP	7		1	Roseburn Junction to Gogarburn - Murrayfield	Issued for External Approval	
ULE90130	5	STP	27		1	Roseburn Junction to Gogarburn Section 03	Issued for External Approval	
ULE90130	5	STP	30		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	31		2	South Gyle	Issued for External Approval	
ULE90130	5	STP	38		1	Roseburn Junction to Gogarburn Section 03	Issued for External Approval	
ULE90130	5	STP	39		1	Roseburn Junction to Gogarburn Section 03	Issued for External Approval	
ULE90130	5	STP	48		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	49		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	53		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	54		1	Roseburn Junction to Gogarburn Edinburgh Park Tramstop	Draft	Drawings received but not in Drawing List
ULE90130	5	STP	56		2	Roseburn Junction to Gogarburn Edinburgh Park Tramstop	Issued for External Approval	Drawings received but not in Drawing List
ULE90130	5	STP	59		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	60		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	62		1	Roseburn Junction to Gogarburn - Gyle	Issued for External Approval	
ULE90130	5	STP	63		1	Roseburn Junction to Gogarburn - Gyle	Issued for External Approval	
ULE90130	5	STP	64		1	Roseburn Junction to Gogarburn - Gyle	Issued for External Approval	
ULE90130	5	STP	65		1	Roseburn Junction to Gogarburn - Gyle	Issued for External Approval	
ULE90130	5	STP	72		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	73		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	74		1	Roseburn Junction to Gogarburn Murrayfield Tramstop Engineering Detailed Design Around Platform West	Issued for External Approval	
ULE90130	5	STP	75		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	76		1	Roseburn Junction to Gogarburn Murrayfield Tramstop Engineering Detailed Design South West Access Steps	Issued for External Approval	
ULE90130	5	STP	77		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	78		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	79		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	80		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	81		1		Issued for External Approval	
ULE90130	5	STP	83		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	5	STP	85		1	Roseburn Junction to Gogarburn	Issued for External Approval	Drawings received but not in Drawing List
ULE90130	7	STP	1		2	Gogarburn	For Tender Purposes Only	
ULE90130	7	STP	7		1	Gogarburn to Edinburgh Airport	Issued for External Approval	
ULE90130	7	STP	8		1	Gogarburn to Edinburgh Airport	Issued for External Approval	
ULE90130	7	STP	9		1	Roseburn Junction to Gogarburn	Issued for External Approval	
ULE90130	7	STP	11		2	Ingliston	For Tender Purposes Only	
ULE90130	7	STP	21		2	Edinburgh Airport	For Tender Purposes Only	
ULE90130	SW	STP	1		6	Exemplar Stop - Central Platform Arrangement	For Information Only	
ULE90130	SW	STP	2		6	Exemplar Stop - Side Platform Arrangement	Issued for External Approval	

PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE90130	SW	STP	9		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	8		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	10		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	11		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	13		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	14		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	15		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	16		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	17		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	19		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	18		1	System Wide Exemplar Tram Stop	Issued for External Approval	
ULE90130	SW	STP	20		1	System Wide Exemplar Tram Stop	Issued for External Approval	Drawings received but not in Drawing List
ULE90130	1	SUB	1		3	Newhaven Road to Haymarket - Leith Sands	For Tender Purposes Only	
ULE90130	1	SUB	2		4	Newhaven Road to Haymarket - Leith Sands	For Tender Purposes Only	
ULE90130	1	SUB	4		1	Newhaven Road to Haymarket Tram North Leith Sands (NLE) Substation General Arrangement	Issued for External Review	
ULE90130	1	SUB	5		1	Newhaven Road to Haymarket Tram North Leith Sands (NLE) Substation Elevations and Sections	Issued for External Review	
ULE90130	1	SUB	15		4	Newhaven Road to Haymarket - Leith Walk	For Tender Purposes Only	
ULE90130	1	SUB	17		4	Newhaven Road to Haymarket - Leith Walk	For Tender Purposes Only	
ULE90130	1	SUB	31		3	Newhaven Road to Haymarket - Cathedral	For Tender Purposes Only	
ULE90130	1	SUB	32		3	Newhaven Road to Haymarket - Cathedral	For Tender Purposes Only	
ULE90130	2	SUB	1		5	Haymarket to Roseburn Junction - Haymarket	For Tender Purposes Only	
ULE90130	2	SUB	2		4	Haymarket to Roseburn Junction - Haymarket	For Tender Purposes Only	
ULE90130	2	SUB	3		4	Haymarket to Roseburn Junction - Haymarket	For Tender Purposes Only	
ULE90130	2	SUB	4		7	Haymarket to Roseburn Junction - Russell Road	Issued for External Approval	
ULE90130	2	SUB	5		7	Haymarket to Roseburn Junction - Russell Road	Issued for External Approval	
ULE90130	2	SUB	15		4	Haymarket to Roseburn Junction - Russell Road	For Tender Purposes Only	
ULE90130	2	SUB	17		4	Haymarket to Roseburn Junction - Roseburn Delta	For Tender Purposes Only	
ULE90130	2	SUB	18		7	Haymarket to Roseburn Junction	Issued for External Approval	
ULE90130	2	SUB	19		7	Haymarket to Roseburn Junction	Issued for External Approval	
ULE90130	2	SUB	20		7	Haymarket to Roseburn Junction	Issued for External Approval	
ULE90130	2	SUB	21		7	Haymarket to Roseburn Junction	Issued for External Approval	
ULE90130	5	SUB	3		4	Roseburn Junction to Gogarburn - Jenners Depository	For Tender Purposes Only	
ULE90130	5	SUB	4		4	Roseburn Junction to Gogarburn - Jenners Depository	For Tender Purposes Only	
ULE90130	5	SUB	18		4	Roseburn Junction to Gogarburn - Bankhead Drive	For Tender Purposes Only	
ULE90130	5	SUB	10		4	Roseburn Junction to Gogarburn - Bankhead Drive	For Tender Purposes Only	
ULE90130	7	SUB	1		4	Ingliston P & R	For Tender Purposes Only	
ULE90130	7	SUB	2		4	Ingliston P & R	For Tender Purposes Only	
ULE90130	1	TAL	1		4	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE90130	1	TAL	2		3	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE90130	1	TAL	3		3	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE90130	1	TAL	4		3	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE90130	1	TAL	5		4	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE90130	1	TAL	6		4	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE90130	1	TAL	7		4	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE90130	1	TAL	8		4	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE90130	1	TAL	9		6	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE90130	1	TAL	10		5	Newhaven Road to Haymarket Subsection 1B	Issued for External Approval	
ULE90130	1	TAL	11		5	Newhaven Road to Haymarket Subsection 1B	Issued for External Approval	
ULE90130	1	TAL	12		5	Newhaven Road to Haymarket Subsection 1B	Issued for External Approval	
ULE90130	1	TAL	13		4	Newhaven Road to Haymarket Subsection 1B	Issued for External Approval	
ULE90130	1	TAL	14		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE90130	1	TAL	15		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE90130	1	TAL	16		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE90130	1	TAL	17		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE90130	1	TAL	18		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE90130	1	TAL	19		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE90130	1	TAL	20		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE90130	1	TAL	21		5	Newhaven Road to Haymarket Subsection 1D	Issued for External Approval	
ULE90130	1	TAL	22		3	Newhaven Road to Haymarket Subsection 1D	Issued for External Approval	
ULE90130	1	TAL	23		5	Newhaven Road to Haymarket Subsection 1D	Issued for External Approval	
ULE90130	1	TAL	24		5	Newhaven Road to Haymarket Subsection 1D	Issued for External Approval	

PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE 90130	2	TAL	1		3	Haymarket to Roseburn Junction Subsection 2A	Issued for External Approval	
ULE 90130	2	TAL	2		3	Haymarket to Roseburn Junction Subsection 2A	Issued for External Approval	
ULE 90130	2	TAL	3		3	Haymarket to Roseburn Junction Subsection 2A	Issued for External Approval	
ULE 90130	5	TAL	1		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TAL	2		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TAL	3		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TAL	4		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TAL	5		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TAL	6		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	7		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	8		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	9		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	10		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	11		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	12		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	13		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	14		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	15		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	16		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	17		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	18		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	19		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	20		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TAL	21		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TAL	22		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TAL	23		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TAL	24		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TAL	25		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TAL	26		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	6	TAL	1		3	Gogar Depot	Issued for External Approval	
ULE 90130	6	TAL	2		2	Gogar Depot	Issued for External Approval	
ULE 90130	7	TAL	1		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TAL	2		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TAL	3		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TAL	4		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TAL	5		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TAL	6		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TAL	7		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TAL	8		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TAL	9		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	1	TMG	27		1	Leith Walk/Great Junction Street	Issued for External Approval	
ULE 90130	1	TMG	28		1	Leith Walk/Manderston Street Section 1B	Issued for External Approval	
ULE 90130	1	TMG	29		1	Leith Walk/Springfield Street	Issued for External Approval	
ULE 90130	1	TMG	30		1	Leith Walk/Balfour Stop North Junction Section 1B	Issued for External Approval	
ULE 90130	1	TMG	31		1	Leith Walk/Dalmeny Street Section 1B	Issued for External Approval	
ULE 90130	1	TMG	32		1	Leith Walk/Pilrig Street Junction and Crossing Section 1B Junction 20	Issued for External Approval	
ULE 90130	1	TMG	33		1	Leith Walk/Macdonald Road Junction and Crossing Section 1B Junction 21	Issued for External Approval	
ULE 90130	1	TMG	34		1	Leith Walk/Macdonald Road Junction and Crossing Section 1B Junction 21	Issued for External Approval	
ULE 90130	1	TMG	35		1	Leith Walk/Macdonald Stop South Junction and Crossing Section 1B Junction 22	Issued for External Approval	
ULE 90130	1	TMG	36		1	Leith Walk/Manderston Street Traffic Signal Ducting Section 1B Junction 16	Issued for External Approval	
ULE 90130	1	TMG	37		1	Leith Walk/Springfield Street Traffic Signal Ducting Section 1B Junction 17	Issued for External Approval	
ULE 90130	1	TMG	38		1	Leith Walk/Balfour Stop North Traffic Signal Ducting Section 1B Junction 18	Issued for External Approval	
ULE 90130	1	TMG	39		1	Leith Walk/Dalmeny Street Traffic Signal Ducting Section 1B	Issued for External Approval	
ULE 90130	1	TMG	40		1	Leith Walk/Pilrig Street Traffic Signal Ducting Section 1B	Issued for External Approval	
ULE 90130	1	TMG	41		1	Leith Walk/MacDonald Road Traffic Signal Ducting	Issued for External Approval	
ULE 90130	1	TMG	42		1	Leith Walk/MacDonald Stop South Section 1B	Issued for External Approval	
ULE 90130	1	TMG	43		1	Shandwick Place Tram Stops	Issued for External Approval	
ULE 90130	1	TMG	44		1	Manor Place/Shandwick Place Junction and Crossing Section 1D Junction 45	Issued for External Approval	
ULE 90130	1	TMG	45		1	Palmerston Place/[illegible] Street Junction and Crossing Section 1D Junction 46	Issued for External Approval	
ULE 90130	1	TMG	46		1	Morrison Street/Torphichen Place Junction and Crossing Section 1D Junction 47	Issued for External Approval	
ULE 90130	1	TMG	47		1	Haymarket Junction Junction and Crossing Section 1D Junction 48	Issued for External Approval	

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PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE 90130	1	TMG	50		1	North St Andrew St/St Andrew Square Traffic Signal Ducting Section 1C Junction 29	Issued for External Approval	
ULE 90130	1	TMG	51		1	South St Andrew St/St Andrew Square Traffic Signal Ducting Section 1C Junction 30	Issued for External Approval	
ULE 90130	1	TMG	52		1	South St Andrew ST/Princes St Traffic Signal Ducting Section 1C Junction 31	Issued for External Approval	
ULE 90130	1	TMG	53		1	South St David St/Princes Street Traffic Signal Ducting Section 1C Junction 32	Issued for External Approval	
ULE 90130	1	TMG	54		1	South St David St/St Andrew Square Traffic Signal Ducting Section 1C Junction 33	Issued for External Approval	
ULE 90130	1	TMG	55		1	St David St/George St Traffic Signal Ducting Section 1C Junction 34	Issued for External Approval	
ULE 90130	1	TMG	56		1	North St David St/St Andrew Square Traffic Signal Ducting Section 1C Junction 35	Issued for External Approval	
ULE 90130	1	TMG	57		1	North St David St/Queen St Traffic Signal Ducting Section 1C Junction 39	Issued for External Approval	
ULE 90130	1	TMG	60		1	Lothian Road/Princes Street Traffic Signal Ducting Section 1D Junction 41	Issued for External Approval	
ULE 90130	1	TMG	61		1	Queensferry Street/Princes Street Section 1D	Issued for External Approval	
ULE 90130	1	TMG	62		1	Shandwick Place Puffin Crossing Section 1D	Issued for External Approval	
ULE 90130	1	TMG	63		1	Shandwick Place Traffic Tramstop	Issued for External Approval	
ULE 90130	1	TMG	64		1	Manor Place/Shandwick Place	Issued for External Approval	
ULE 90130	1	TMG	65		1	Palmerston Place/Torphichen Street Section 1D	Issued for External Approval	
ULE 90130	1	TMG	66		1	Morrison Street/Torphichen Place Section 1D	Issued for External Approval	
ULE 90130	1	TMG	67		1	Haymarket Junction Traffic Signal Ducting Section 1D	Issued for External Approval	
ULE 90130	1	TVA	1		4	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE 90130	1	TVA	2		3	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE 90130	1	TVA	3		3	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE 90130	1	TVA	4		3	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE 90130	1	TVA	5		4	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE 90130	1	TVA	6		4	Newhaven Road to Haymarket Subsection 1A	Issued for External Approval	
ULE 90130	1	TVA	7		4	Track Vertical Alignment Sheet 7 of 24	Issued for External Approval	
ULE 90130	1	TVA	8		4	Track Vertical Alignment Sheet 8 of 24	Issued for External Approval	
ULE 90130	1	TVA	9		5	Track Vertical Alignment Sheet 9 of 24	Issued for External Approval	
ULE 90130	1	TVA	10		5	Newhaven Road to Haymarket Subsection 1B	Issued for External Approval	
ULE 90130	1	TVA	11		5	Newhaven Road to Haymarket Subsection 1B	Issued for External Approval	
ULE 90130	1	TVA	12		5	Newhaven Road to Haymarket Subsection 1B	Issued for External Approval	
ULE 90130	1	TVA	13		4	Newhaven Road to Haymarket Subsection 1B	Issued for External Approval	
ULE 90130	1	TVA	14		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE 90130	1	TVA	15		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE 90130	1	TVA	16		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE 90130	1	TVA	17		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE 90130	1	TVA	18		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE 90130	1	TVA	19		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE 90130	1	TVA	20		5	Newhaven Road to Haymarket Subsection 1C	Issued for External Approval	
ULE 90130	1	TVA	21		5	Newhaven Road to Haymarket Subsection 1D	Issued for External Approval	
ULE 90130	1	TVA	22		3	Newhaven Road to Haymarket Subsection 1D	Issued for External Approval	
ULE 90130	1	TVA	23		5	Newhaven Road to Haymarket Subsection 1D	Issued for External Approval	
ULE 90130	1	TVA	24		5	Newhaven Road to Haymarket Subsection 1D	Issued for External Approval	
ULE 90130	2	TVA	1		3	Haymarket to Roseburn Junction Subsection 2A	Issued for External Approval	
ULE 90130	2	TVA	2		3	Haymarket to Roseburn Junction Subsection 2A	Issued for External Approval	
ULE 90130	2	TVA	3		3	Haymarket to Roseburn Junction Subsection 2A	Issued for External Approval	
ULE 90130	2	TVA	4		3	Haymarket to Roseburn Junction Subsection 2A	Issued for External Approval	
ULE 90130	2	TVA	5		1	Haymarket to Roseburn Junction Subsection 2A	Issued for External Approval	
ULE 90130	5	TVA	1		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TVA	2		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TVA	3		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TVA	4		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TVA	5		3	Roseburn Junction to Gogarburn Subsection 5A	Issued for External Approval	
ULE 90130	5	TVA	6		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	7		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	8		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	9		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	10		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	11		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	12		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	13		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	14		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	15		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	16		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	

PROJECT	SECTION	FOLDER	DWG NO	STR ID	REV NO	DRAWING NAME	STATUS	COMMENTS
ULE 90130	5	TVA	17		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	18		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	19		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	20		3	Roseburn Junction to Gogarburn Subsection 5B	Issued for External Approval	
ULE 90130	5	TVA	21		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TVA	22		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TVA	23		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TVA	24		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TVA	25		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	5	TVA	26		3	Roseburn Junction to Gogarburn Subsection 5C	Issued for External Approval	
ULE 90130	6	TVA	1		3	Gogar Depot Track Vertical Alignment Sheet 1 of 4 Section 6	Issued for External Approval	
ULE 90130	6	TVA	2		3	Gogar Depot Track Vertical Alignment Sheet 2 of 4 Section 6	Issued for External Approval	
ULE 90130	6	TVA	3		1	Gogar Depot Track Vertical Alignment Sheet 3 of 4 Section 6	Issued for External Approval	
ULE 90130	6	TVA	4		1	Gogar Depot Track Vertical Alignment Sheet 4 of 4 Section 6	Issued for External Approval	
ULE 90130	7	TVA	1		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TVA	2		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TVA	3		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TVA	4		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TVA	5		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TVA	6		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TVA	7		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	
ULE 90130	7	TVA	8		3	Gogarburn to Edinburgh Airport Subsection 7A	Issued for External Approval	