

Signalling Documentation and Drawings

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1. Introduction

1.1. General

This Specification sets out CRN's requirements for the preparation, content and presentation of design and design related documentation and drawings for new and altered signalling Works.

Note: Under this Specification, where the term "Contractor" is used and the work is wholly undertaken by UGLRL CRN personnel, the role of the Contractor is undertaken by UGLRL CRN personnel.

1.2. Definitions

1.2.1. Country Regional Network

The NSW Country Regional Network (CRN), the Transport for NSW owned infrastructure.

1.2.2. Maintenance Steward

UGL Regional Linx (UGLRL).

1.2.3. Principal's Representative

The person appointed to manage the contract on behalf of CRN.

1.2.4. Contractor

The person, company, corporation or authority which is contracted to perform the Works. The term "Contractor" shall be taken to include all employees and sub-contractors under the control of the Contractor.

1.2.5. Principal Signal & Communications & Network Control Engineer

The person who holds signalling engineering authority on behalf of UGLRL responsible for the approval and acceptance of signalling designs for installation on the CRN.

1.2.6. Designer

A suitable signalling designer who holds a current Statement of Competency (SoC) with the appropriate competency levels in signal design for the CRN who has the responsibility to ensure design work is carried out to schedule, to provide the required system performance, and to ensure the safety and integrity of the signalling and control system designs.

1.2.7. Reviewer

A suitable signalling designer who holds a current SoC with the appropriate competency levels in signal design for the CRN who reviews a design for safety, functionality and completeness prior to submission for independent verification. The Reviewer may be the designer, or the leader of a team of designers, and need not be independent.

1.2.8. Checker

A person who holds a current SoC with the appropriate competency levels in signal design for the CRN who may perform a design review, or verification.

1.2.9. Independent Verifier

An experienced signalling designer who holds a current SoC with the appropriate competency levels in signal design for the CRN who has responsibility for checking and verifying that the signalling design prepared is safe and reliable and in accordance with standard signalling principles and practices and is operationally functional as specified. The Independent Verifier shall have the necessary level of independence to check safety-related features of signalling designs to a very high degree of certainty whilst not making the same, or similar, mistake(s) as the Designer and who has the necessary level of experience, fitness and competence to ensure the safety-related features are all present and correct.

Unless stated otherwise in the Particular Specification, the Independent Verifier shall be provided by the Contractor.

1.2.10. Design Approver

The CRN Principal Signal & Communications & Network Control Engineer or their appointed delegate.

1.2.11. Engineering Authority

Signal design, review and verification shall only be performed by persons whose qualifications and experience have been submitted and accepted by the Principal Signal & Communications & Network Control Engineer to perform the specified work. Evidence of the competence and experience (Including logbooks with entries certified by a supervisor) of proposed designers, reviewers and verifiers shall be provided prior to a CRN signal design SoC being issued and work commencing.

1.2.12. Drawings

Drawings shall mean layouts, plans, diagrams, tables, schematics and the like that set out the design and/or configuration of signalling infrastructure assets (e.g., physical dimensions and composition, temporal and/or spatial arrangements, physical and/or logical interconnections).

1.2.13. Documents

Documents shall mean technical documents relating to the infrastructure asset and shall not include documents relating to correspondence, administration, finance, marketing, human resource management, project management, contract management and the like.

1.2.14. Approval Terms

Unless otherwise explicit from the context, the terms “for approval”, “for consideration”, “for agreement”, “for acceptance”, “for permission to use”, “for review”, “shall be submitted”, “shall submit”, “as approved”, “as agreed”, “as accepted”, “permitted for use”, shall refer to the requirement to obtain formal acceptance from the Principal Signal & Communications & Network Control Engineer, or other specifically nominated authority, prior to incorporation as part of the Works or use in work under the Contract.

Except where expressly and formally requested as a waiver, deviation or variation to the Contract, the normal process of consideration, review and acceptance for use of submitted documents and drawings shall not provide acceptance of any non-compliance or limited compliance or of any error or deficiency and shall not relieve the Contractor of his responsibilities under the Contract.

1.3. Reference Specifications

This Specification shall be read in conjunction with the Particular Specification, the Signalling Functional Specification, the scope of works and the following CRN publications:

- CRN SC 023 Design of Microlok II Interlockings
- CRD SD 000 Signalling Design Principles - Introduction
- CRN SD 026 Rolling Stock Signalling Interface Requirements
- CRN SQ 001 Signal Engineering Management
- CRN SC 016 Signalling Operator Interface
- CRN SC 007 to CRN SC 013 inclusive - Inspection and Testing of New and Altered Signalling Works, Plans, Programs, Documentation and Packages Specification No
- EP 0491 Detailed Site Survey – Accurate Field Drawing Procedure,
- EP 0492 Detailed Site Survey – Data Capture Procedure,

- EP 0493 Detailed Site Survey – Scope Procedure,
- EP 0494 Detailed Site Survey – Work As Executed Procedure,
- EP 0495 Detailed Site Survey – Infrastructure Services Data Policy, and
- EP 0496 Detailed Site Survey – Specification for Collection of Services Data.

Note: CBI systems must conform to their respective Application Notes or Codes of Practice, and CRN standards.

1.4. Design Personnel

Persons engaged in the design, including the Designer, Reviewer, Checker, Independent Verifier and Design Approver shall have been assessed and accepted for Engineering Authority by the Principal Signal & Communications & Network Control Engineer.

The Contractor's design procedures shall include systems to monitor the competence and fitness of the Designer and Independent Verifier. The system shall record errors and omissions plus corrective actions associated with the various parties involved in the design. The system shall be submitted for review by the Principal Signal & Communications & Network Control Engineer prior to the commencement of the design. CRN may at its discretion, audit the system.

1.5. Signal Design

The Contractor shall:

- Be responsible for the provision and submission of all documents and drawings necessary for the satisfactory completion and performance of the Works under the Contract.
- Provide a safe, reliable and fit-for-purpose signalling design in accordance with the requirements set out in this Specification, the Particular Specification, the Signalling Functional Specification or scope of works, Specified Signalling Plans, Specified Control Tables, CRN's design principles, specifications and procedures.
- Comply with the requirements, practices and procedures set out or referenced in this Specification, except as otherwise expressly approved in writing by the Principal Signal & Communications & Network Control Engineer or their duly appointed Representative.
- Request details of CRN's requirements where there are any vital signalling designs which are not covered by CRN standard practices in the specifications.
- Prepare and submit a proposed drawing practice for review and approval where no standard practices are provided by CRN following a request.
- Prepare and submit proposed designs for a typical application for type approval review at an early stage where CRN advises that no standard design exists. The researching and collation of all current and proposed work in or about the area of the Contract and

determining the status of these works and determining the basis upon which the new or altered design is to be based. This includes the formal incorporation or delay of projects to avoid conflicts in designs and the management of defining this position.

- Produce and present documents and drawings in accordance with CRN's documentation and drawing practices, including templates and formats, title blocks, numbering and naming conventions, symbols and nomenclature, indexing and version control practices, addition and deletion annotation practices, circuit book content arrangements and book binding practices. CRN's standard practices are detailed in this Specification and its Appendices. Obtaining CRN drawing numbers from CRN.
- Provide data in the required format, for changes that affect CRN's train control system data sets.
- Provide configuration control of designs and drawings including the preparation of and delivery of all configuration documents and design drawings such that future corrections, additions, deletions, amendments or presentation changes can be readily made by others and are not dependent on any propriety process that is not an industry standard or on expensive conversion before the change can be made.
- Provide and maintain a register of all drawings and copies of drawings issued for the Works and work under the Contract, showing all identification details of each drawing issued e.g., drawing number and/or title, type of drawing, purpose of copy, version number and date, copy number, copy holder name and receipt acknowledgment, issue date, history and current status.
- Transmit all documents and drawings using standard Transmittal Forms detailing the issue, register the issue details and record and follow up receipt acknowledgments.
- Obtain Job Numbers from the Principal Signal & Communications & Network Control Engineer.
- Provide in the Contract Works Program for 28 days from date of receipt by the Principal Signal & Communications & Network Control Engineer for the consideration of submitted Review Copies/Modification Instruction Forms (including for any and all resubmissions), and inclusion of these periods in the Contract Works Program. An additional 7 days review time for each 25 routes or part thereof in excess of the maximum 75 routes covered by the 28 day review period shall be allowed in the program.
- Provide safe custody, security and control of any alterable replicas of CRN masters of existing design documents and drawings provided to the Contractor for updating with amendments and changes due to the Works, and for integration of the design documentation and drawing work under the Contract with the existing documents and drawings.

- Provide new and altered final drawings so that they fit into CRN's existing series of drawings to form an ordered, comprehensive, consistent and cohesive set in accordance with CRN's standard documentation and drawing practices, including drawing registration numbering practices, without the necessity for any modification to the existing series of drawings that are not affected by the work under the Contract. If it is necessary for other existing drawings not directly affected by the Works to be renumbered or otherwise modified to achieve an ordered, consistent and cohesive set in accordance with CRN's standard drawing practices, then those other drawings shall be considered included in the work under the Contract and shall be modified to comply with the requirements.

1.6. Design Submissions

The Contractor shall:

- Submit three copies when design or design related documents, drawings and software are required to be submitted or supplied, unless otherwise specified or agreed.
- Submit Review Copies of design drawings, and Modification Instruction Forms, for consideration for the Principal Signal & Communications & Network Control Engineer acceptance, after sign-off by the Contractor's Designer, Reviewer, Independent Verifier and Design Approver. Submission of the Review Copies shall include submission of the marked up checking copies that show cross checking of the circuit design and rack details to the contact, cable, fuse and terminal analysis, with all items marked off and each page initialled and dated as complete by the checker. A separate review copy shall also be provided showing the marked up checking copies where the functional elements of the designs have been checked off against control table requirements.
- Refer to Appendix C for the requirements and form of Data Submissions.

1.7. Design Documentation

The Contractor shall:

- Implement corrective action in line with the Principal Signal & Communications & Network Control Engineer's amendment requirements following return of Review Copies submitted for consideration and resubmission of corrected documents and drawings.
- Provide testing copies of all documents and drawings requiring inspection and testing of compliance to the design.
- Hand over to the Commissioning Engineer, each and every Test Copy with inspection and test annotations and Testers' certification signatures and Tester In Charge's endorsement signature, as testing of the particular Test Copy drawing or Test Copy book of drawings is completed.

- Confirm actual site conditions and details for inclusion on Track Insulation Plans, when using CRN Permanent Way layout drawings as an aid.
- Advise the Principal Signal & Communications & Network Control Engineer of any required alterations to Control Tables where these were issued as Specified Control Tables by CRN, arising from detailed design, construction, testing and setting to work of signalling systems. (The Principal Signal & Communications & Network Control Engineer will issue amended sheets of the specified control tables, which will contain the approved alterations.)
- Produce straight line Signalling Plans, utilising the information given on any Specified Signalling Plans.
- Notwithstanding, should any of the documents, drawings or software, or any of the copies thereof provided in accordance with the requirements of the Contract, be revealed at some time to be inaccurate or otherwise not in accordance with the specified Contract requirements the Contractor shall remedy the situation promptly by replacing the incorrect documents, drawings or software and the copies thereof with correct documents etc, with issue and version dates amended where applicable. The Contractor's liability shall include the recovery and updating of controlled copies issued from the deficient documents, drawings or software. The Contractor shall investigate how the error may have occurred and not been picked up by the Contractor's checking, and shall review the possibility that other documents, drawings and software may be in error, and shall attest that any subject to doubt have been rechecked and are correct.

1.8. Design Updating

The Contractor shall:

- Update master design documents and drawings as required,
- Update the drawings during construction and testing phases of the works,
- Ensure that all documents and drawings being used at any time are the latest version, correct, appropriate copies.

1.9. Commissioning

The Contractor shall provide:

- Commissioning documentation as detailed in Specification No CRN SC 008.
- Design closure lists of the total set of approved design documents and drawings, which the installation has been designed to.

1.10. As Built Drawings and Documents

The Contractor shall provide:

- The handover of all final masters and final print copies of documents and drawings correct in accordance with the requirements, within 28 days of commissioning, unless otherwise agreed with the Principal Signal & Communications & Network Control Engineer.
- Provision, within seven days of advice of acceptance of the final documents and drawings, of new or altered drawings with a common related version number and date, reproducibles including all negatives, master and duplicate master software, plus three (3) prints of all documents and drawings including Detailed Site Survey Drawings, Control Tables, Signal Scheme Plans and TFM Allocation Plans (where applicable) and attesting that they have been checked and signed off as checked by suitably competent and responsible members of the Contractor's staff and are in accordance with the relevant Contract requirements; provision of these in accordance with the CRN's standard drawing practices and document management processes, ready for immediate use and ready for immediate integration into CRN's existing documents and drawings without the need for further alteration to the existing documents and drawings. The final as built documents shall be fully incorporated into the existing maintenance documentation, including all Indexes and control sheets and any cross referencing and updating and page numbers consistent throughout the book.
- The documents and drawings must be accompanied by a standard Transmittal Form detailing each and every document and drawing transmitted.
- Any other data and information required for CRN's GIS systems in the format required, as stipulated in the Particular Specification.
- Within 14 days after the Commissioning of each stage of the works, three (3) white prints of all related documents and drawings plus a software copy of all digitised design documents and drawings, amended to final modifications, together with the signed Certified Office Copy (COC).
- The Designer and the Design Approver who carried out the checking of these documents and drawings to verify them as final, shall both sign all sheets of one copy of the final master copy of each document and drawing to certify that the final documents and drawings have been updated and are accurate to the approved designs and to the as-built, tested and commissioned installation, and are in accordance with the contract requirements, including the contract documentation requirements.
- The Signalling Engineer shall review the documents prior to submission and sign the documents confirming the as installed design meets the intent of the design.
- Correction of final documents, drawings and software advised as unacceptable and resubmission of the corrected documents, drawings and software within seven days of the advice.

- The final drawings to be prepared and handed over include:
 - Signalling Plans, (Track Plans, Working Sketches)
 - Control Tables
 - Circuit Drawings and Books
 - Vital data on CD
 - Non-vital data on CD
 - Detailed Site Survey Drawings
 - Signal Sighting Forms
 - Driver's Diagrams
 - Track Insulation Plans (Track Bonding Plans)
 - Level Crossing Layout Plans
 - Installation Drawings
 - Mechanical Drawings
 - Structures Drawings
 - Clearance Diagrams
 - Equipment Housing Layout Plans
- Documents to be prepared and handed over include:
 - System Manuals
 - Equipment Manuals and any other documents required to be provided under the Contract.

2. Documentation and Drawings

2.1. General Requirements

- All documentation and drawings including those submitted for review, shall be laid out in a clear and logical fashion and shall be such as to facilitate understanding, checking, construction and maintenance.
- Typed documents shall be produced using the latest version Microsoft Word for Windows and shall be submitted in both hard and electronic copy. Electronic copy shall be submitted on compact disks.
- Drawings shall be produced in accordance with CRN templates supplied. Final digitised drawings shall be provided on write once Compact Discs.

- Documentation and drawings shall be prepared on A4 or A3 size paper and roll plans shall be divided into manageable and logical lengths and width shall be A4 or A3 length or 412mm wide (max.). A2 and A1 size paper may be allowed for detailed mechanical and structural drawings.
- Original documents, drawings and line work shall be durable and capable of producing clear legible prints.
- Three copies of design or design-related documents, drawings and software shall be submitted for review, unless otherwise specified or agreed.
- Geographically oriented drawings shall have the Sydney direction at the left hand side.
- From each drawing or book of drawings it shall be possible to determine the identity of the persons responsible for the technical content of the drawing including for the amendments, namely the designers, checkers and approvers.
- Where applicable, drawings shall include title blocks in accordance with CRN SQ 001 Signal Engineering Management standards, titled Track Plans/Signalling Plans. Title blocks shall generally be positioned in the bottom right hand corner of drawings. In the case of roll plans, title blocks shall be provided at the right hand end of drawings with an abbreviated title block at the left hand end. For circuit diagrams the version date shall appear within the border in a consistent location. For books of drawings, the current version number and version date of the book and of each of the drawing sheets shall also be individually recorded on documentation control pages and an amendment sheet with a brief description of each amendment for all jobs shall be provided. See CRN SQ 001 standards, titled Control Sheets. Company names and/or logos shall not be prominent.
- Version numbers and dates shall be incorporated on each and every drawing at and from the time they are first signed off as reviewed.
- On master tracing negatives or print masters the signature shall be written onto the tracing. On digitised masters the person's name shall be entered in the respective position when the corresponding signature had been obtained on a paper copy.
- Note: Where drawings are sheets which are to be kept in a book of drawings, the cover sheet shall include the above details (as also shall the individual drawings sheets) and in addition the books shall include control pages inclusive of amendment details.
- The coversheet shall also provide an entry to show the Copy Number and the Copy Holder Name, as shall the control pages for the book.
- Copies of drawings issued for a particular phase of the work shall be identifiable with that phase even where the same drawing is unaltered from the copy for an earlier phase. The version date for the drawing should remain the same unless the drawing has been altered.

Note: The addition of detail to a drawing does not normally constitute a version change.

- New pages for existing circuit books may be numbered with alphabetic suffixes where appropriate e.g., existing altered page N020 replaced by new pages N020A, N020B, to avoid renumbering subsequent pages that are otherwise unaltered.
- The index and table of contents shall be amended for the whole of an existing book which has undergone any alterations, including page number changes, and a new cover sheet and set of control pages inclusive of amendment records, shall be provided for the whole of the book.
- All drawings and documentation applicable to temporary works including stage work, interface work etc. shall be clearly endorsed as such on each drawing sheet. All details necessary for such temporary works should be added to a reproducible copy of the existing arrangements and/or to a reproducible copy of final arrangements as appropriate to facilitate production of the temporary or stage work drawing.
- The practice for showing work comprising alterations shall include the detailing of existing wiring, equipment and structures to be removed, as they exist, but with linework preferably dotted and highlighted with unfilled arrows and crossed out. New work shall be shown in full linework highlighted with filled arrows. The application of arrows shall highlight changeover points. To assist in clarity of the changes, areas may be circled or clouded to highlight.
- Where drawings are prepared for work which is dependent upon completion of other work which has not been completed and certified, then there shall be a means to separately identify on these drawings not only the work to be carried out and the original existing work, but also the other work that will be carried out and completed prior to this work being carried out; for example the latter work could be annotated with asterisks with a note describing what work the asterisk refers to. Before the work for which this latest drawing is prepared is carried out and connected, it must be verified by the constructor that the previous work has been duly installed, inspected and certified to be in accordance with these drawings, and any discrepancies referred to the designer.
- All copies of documents and drawings shall be designated as to their purpose as follows:
 - Correlation Copy (for certification of existing details)
 - Review Copy
 - Office Copy
 - Construction Copy
 - Test Copy
 - Certification Copy

- Commissioning Copy or Commissioning / Interim Maintenance Copy
- Certified Office Copy
- Final/As-Built/ Maintenance Copy
- General Correspondence
- Methods of identifying drawings to all users for the different type of copies shall be obvious and strictly followed. Correlation Copies and Contractor copies for submission (i.e., Review Copies) shall be printed on blue paper, Construction Copy drawings shall be printed on green paper, Test Copies shall be printed on pink paper, Office Copies, Commissioning Copies, and Certified Office Copy drawings shall be printed on yellow copy, and Final/As-Built copies shall be printed on white paper. (For minor works, the Principal Signal & Communications & Network Control Engineer may authorise a design to be issued as yellows, without the coloured stages.)
- Each and every circuit book of drawings shall be provided in a format approved by the Principal Signal & Communications & Network Control Engineer and shall include:
 - A cover sheet. The Cover Sheet shall include the Circuit Book Number in the top right hand side of the cover, Project or Area title, Volume Number and total number of volumes, plus title block,
 - Maintenance Control Sheet nominating the status of the various Circuit Book pages including the Page Number, Medium type, and Version Date or Construction book Control Sheet nominating the status of various circuit book pages including page number and version dates.
 - Correlation Check Instruction Sheet (Construction books only)
 - Amendment Sheet detailing the various amendments to the Circuit Book (final as built only),
 - Index detailing the details on the various sheets.
 - The Book shall include a hard cover and be bound with steel pins on the left hand side of the book. Samples of acceptable covers will be made available to the Contractor upon request.

2.2. Documentation Control Mechanism

To ensure the quality and integrity of the design, designs must be produced such that the status of the design is readily apparent to all persons reliant upon the design. Consistent with this concept, documentation control is intended to:

- Identify the documentation that details the designed configuration of an installation at a specific time,

- Methodically manage authorised alterations to that configuration, and
- Clearly match review, verification and approvals to the design configuration.

To achieve the above:

- Each distinct commissioning configuration (including stagework) must have a different job number. Conversely, all documents associated with works to be concurrently commissioned must have the same job number.
- Circuit Books shall have a unique number and every page of the book shall include the Circuit Book number and page number.
- Additionally, every page of the job number (for a construction job), and version date showing the date the design was last altered.
- A control sheet must be produced for documents including multiple sheets listing all pages of all signalling design documents. The control sheet must be kept up to date and record the version date of each sheet or document and the version date of the control sheet. Where the document is a single sheet (e.g., Signalling Plans) control sheet information may be shown on that single sheet in the amendment boxes provided for that purpose).
- All changes to documents must be highlighted and version dating recorded on the document. Subsequent changes are to be highlighted by the use of clouds with the version date shown. Clouds are only to be used for that version date (i.e., when a further update occurs, previous clouds are to be removed.)
- Rules summarising the process to ensure control of the documentation are included in Appendix A titled Rules of Documentation Control.

2.3. Design Checking, Approval and Engineering Authority Process

2.3.1. Design Checking and Approval Process

Design checking and approval shall be in accordance with CRN SQ 001 Signal Engineering Management standards, titled Design Review Process, Independent Design Verification and Approval of Signalling Designs respectively.

Signalling designs must be prepared by a signal Designer, self-checked, and signed off before being passed to a separate signal design engineer for checking. This will constitute a review.

Where multiple designers have been utilised, the person who signs “reviewed” shall ensure the complete and correct integration of all the designed works, such that it is suitable for independent verification.

Non safety-related aspects of signalling system design may be checked by a competent signal design engineer who need not be totally independent but shall not have designed, or being

closely involved in the design of, any part of the signalling that he/she is checking. (The Independent Verifier must be totally independent). (Note: Signalling system reliability is a safety-related aspect).

The Independent Verifier (independent signalling design checking engineer) is required to sign off safety-related signalling designs as independently verified and correct before passing them on for approval.

The Design Approver must sign off the designs to attest that they have been properly prepared and independently checked by suitably fit, competent and experienced signal designers, working in a suitable controlled environment, applying the approved processes and authorised standards and to attest that the prepared and checked designs are fit for purpose as specified.

Design integrity testing to signalling principles and control table requirements must be carried out and certified after the designs are installed, by an experienced signal design engineer (not the signal designer who prepared the design) appointed by the design

Approver. Design integrity testing is described in specification "Inspection, Testing, Installation and Commissioning Requirements for Safety Assurance of New and Altered Signalling Works" CRN SC 007.

The Designer, Reviewer, Independent Verifier, Design Approver and Design Integrity Tester must be demonstrably fit, competent and qualified to perform the duties required.

The Independent Verifier must be a carefully selected, suitably qualified and experienced signalling design engineer who is not the designer's controlling officer nor anyone else who has participated, or been an involved observer, in working out a design solution of the design requiring checking. The Independent Verifier in marking up deficient designs must highlight the deficiency and not provide the design solution. The same checking engineer must check that all parts of the design that need to be changed in correcting the deficiency pointed out by the checking engineer have been properly changed by the designer and that only those changes and no other changes are made.

Independent Verifiers must not make design corrections or become involved in altering designs or in providing input to design solutions, which they will be required to check.

The Independent Verifier engaged by a contractor should not be accountable to the project signalling Designer or any other designer in the project team, nor to any project person who has a responsibility for project time and cost aspects that could conflict with project quality, safety and reliability, but should be accountable to a person who has safety and quality responsibilities related to the project. At the same time the Independent Verifier is required to be acceptable (as suitably experienced, fit and competent) to the Principal Signal & Communications & Network Control Engineer.

The Independent Verifier must be adequately qualified to be acceptable to the Principal Signal & Communications & Network Control Engineer. Acceptability will be assessed on the degree of

the signal engineer's design competence, knowledge of the equipment to be designed and knowledge of NSW signalling principles.

The Independent Verifier must keep a record of the designers' errors and omissions and pass this record onto the design approver for that officer's information when approving the designs.

Design errors or omissions that are discovered by the Design Integrity Tester or at some later stage shall be recorded on a Design Test Form (DTF) and referred to the Designer/Reviewer/Verifier for rectification.

Error and omission records shall be reviewed for determinations as to the competence of the Designer, Independent Verifier, and Design Integrity Tester.

The design checking procedure shall be consistent with Appendix B titled Checking of Signalling Design for New Works and Alterations, unless otherwise approved by the Principal Signal & Communications & Network Control Engineer.

2.3.2. Engineering Authority

For any project, Engineering Design Authority is to be granted by the Principal Signal & Communications & Network Control Engineer in accordance with CRN procedure CRN ST 002 Signalling and Control Systems Personnel - Process for Authorisations and Licensing.

2.4. Review Copy Documents and Drawings (Blues)

Documents and drawings prepared or modified by a Contractor shall be submitted for consideration as Review copies and each drawing shall carry a version date and job number.

Prior to submission, drawings shall have been internally checked by the Designer, the Reviewer and the Independent Verifier.

All such review copies shall be signed by the Reviewer and Independent Verifier certifying that he/she has assured him/herself that the submission is in accordance with the specified requirements and attesting that have been designed by competent design engineers and then independently checked by competent and independent design checking engineers. The name and signatures of the Designer, Reviewer and the Independent Verifier shall be included on the drawings.

Unless specified otherwise, three Review Copies of all drawings, sketches and other written information shall be submitted for consideration within the specified times and at an orderly rate in accordance with the Works Program.

The foregoing requirements shall also apply to all revisions.

After review, a copy of the document or drawing submitted for review will be returned with:

- a decision as to whether or not they are accepted for use for the purpose of the Contract, or any changes required to reach acceptance level.

OR

- a decision as to whether or not any section or portion of them is accepted for use for the purposes of the Contract, being that section or portion of the documents and drawings clearly identified as such,

OR

- no decision as to whether or not the documents and drawings or any section or portion of them is accepted for use for the purposes of the Contract.

All documents and drawings returned from review will be duly signed and dated by the reviewer.

Those documents and drawings, which are not accepted shall be resubmitted for further consideration once acted upon.

Documents and drawings which require changes consequent upon documents or drawings being returned as not accepted shall be changed accordingly and resubmitted for consideration. Any returned document or drawing within a bound set which is subject to change, but which is not affected should not be resubmitted. In simple, straight forward cases, the Construction Copies cover, and control sheet masters, should also be prepared and issued for that phase where acceptance of the resubmitted change is a formality.

As with all design documents and drawings submitted, all changed documents and drawings resubmitted shall be signed off by the designer, Reviewer, Independent Verifier and approver and shall carry an updated version number and date.

Documents and drawings resubmitted as amended shall have an updated version date. Cover sheets and control pages for books of drawings, some of which have been amended, shall be updated and resubmitted with the amended drawings.

All other returned documents and drawings can be regarded as ready for the preparation of Construction Copies.

Notwithstanding documents and drawings may be returned with no decision as to whether or not the document(s) or drawing(s) is/are accepted, any further revisions of the same document or drawing shall be submitted for review.

2.5. Construction Copy Documents and Drawings (Greens)

Construction Copy documents and drawings shall be based on the returned Review Copy documents and drawings and shall include all amendments nominated on the returned Review Copy documents and drawings.

When Construction Copy documents and drawings have been issued no alteration shall be made to the documents and drawings except by amended drawings issued in accordance with the normal checking, approval and issue process, with amended control pages for books.

2.6. Test Copy Documents and Drawings (Pinks)

Test Copy documents and drawings shall be based on the returned Construction Copy documents and drawings and shall include all clarifications and details nominated on the returned Construction Copy documents and drawings.

Only designated Test Copy drawings shall be used for certification testing. If in emergency any other copy of the drawing is used it shall be treated as a test copy and arrangements shall be made to immediately register it as such and for its original purpose to be cancelled and otherwise accommodated. Details of the change must be documented in the document control system register. Appendix D details the Standard Ways of Showing Alterations to Permit Documentation of Testing.

Following completion of the testing, a Test Copy Master of the documents and drawings shall be produced where required to consolidate multiple test copies.

2.7. Commissioning Copy Documents and Drawings (Yellows)

The Commissioning Copy documents and drawings shall be based upon the returned testing copy drawings.

When the documents and drawings have been updated against the testing documents the Designer responsible for the updating and the Reviewer shall endorse one copy of the commissioning copy drawings with their name, signature and date to certify that the documents and drawings have been correctly updated.

The Certification Copy (or Certified Office Copy) is a yellow copy of the drawings stamped to include signature boxes to allow for the signature of the Project/Commissioning Engineer certifying that the installation has been inspected and tested and verified to be in accordance with the details on that drawing, as marked and signed off.

A sufficient number of copies of commissioning copy documents and drawings, as agreed, shall be supplied for the use of all requiring reference to commissioning copy documents and drawings.

During the Commissioning any modifications shall be submitted for approval using a Modification Instruction Form where use of the normal documentation process is impractical. A copy of each tested and certified Modification Instruction Form shall be attached to the relevant sheets of the Test Copy Master and Test Copy Master - Duplicate for Commissioning Engineer.

Interim Maintenance Copies shall be made available at the commissioning, and photocopies of the certified Modified Instruction Forms generated during the Commissioning shall be attached to the relevant sheets to correct them to be the same as the Test Copy Master.

Sufficient Interim Maintenance Copies, as agreed, shall be left on site for the use of maintenance staff and shall be available to them at the end of the Commissioning Period.

Commissioning Copies and Interim Maintenance Copies may be able to be used to suit both purposes and, in such cases could be issued as Commissioning / Interim Maintenance Copies.

An Interim Maintenance Copy shall be provided for CRN's Plan Room immediately prior to the commissioning and updated within two days of commissioning the respective equipment.

2.8. Document Transmittal Process

Documents shall be issued for construction to the CRN appointed Commissioning Engineer only after acceptance by the Principal Signal & Communications & Network Control Engineer.

3. Signalling Plans

3.1. General

Signalling Plans shall cover the whole of the Works including interface details at the scope of work limits. Plans shall be drawn with the Sydney direction on the left hand side and the country direction on the right hand side and the title/section of the railway line specified e.g., Sydney to Lithgow. Signalling Plans shall be in accordance with CRN SQ 001 Signal Engineering Management titled Track Plans/Signalling Plans.

3.2. Scope of Work

Plans shall extend sufficiently at the interface to detail approach locking track circuits and overlap clearance points for all signals included in the Works.

The plan shall be suited for installation and subsequent testing of the works.

To avoid ambiguities, detailed information shall only be shown on one plan. Unless otherwise specified the work includes the updating of all circuit books affected by the work.

Overlapping of Signalling Plans shall be kept to a minimum.

3.3. Drawing Scales

Metric scales shall be used from the range 1:1,000, 1:2,000 and 1:10,000 and shall be submitted for consideration prior to use. The minimum scale for interlockings shall be 1:2,000 subject to full details being clearly and legibly shown. Unless otherwise approved, the drawing must be a roll plan with a width of 412 mm. Changes of longitudinal scale shall only take place at kilometre points or at one tenth kilometre points.

3.4. Centreline

The centreline of all symbols for equipment and structures shall be longitudinally correct to scale and laterally correct relative to the track centre lines and laterally spaced for legibility.

3.5. Details to be Included

Gradient and curvature details shall be drawn above track layouts. Unless otherwise approved, power system supply and distribution information together with trackside cabling details including number of cables, cable sizes, termination points, joints etc. shall be drawn below track layouts. Other details to be shown on Signalling Plans shall include the following:

- Kilometre Points
- Half Kilometre Points
- Curves and gradients
- Advisory Speed Boards (not permanent speed boards)
- Bridges (Over and Under)
- Viaducts
- Level Crossings including Street Names
- Stations including Platform Nos.
- Signal Boxes
- Signals (including Name Plate in adjacent circle)
- Guards Indicators
- Warning Lights
- Buffer Stop Lights
- Signalled Routes & Route Indicator Display Table
- Signal Clearance Points
- Point Machines & Points Table
- Emergency Switch Machine Locks/EOL
- Track Circuits
- Control Centres
- Equipment Huts
- Equipment Locations
- Relay Rooms

- Power Supply Locations
- Traction Substations
- Traction Section Huts
- Ground Frames
- Hand Points
- Derailers/Crowder
- Releasing Switches
- Notice Boards plus inscription
- Lineside Telephones
- Slip Detectors
- Mechanical Detection Table
- Section Details
- Keys
- Wards
- Ground Frame Locking Diagram and Table

Names and numbers as appropriate associated with each of the details noted above shall be specified on the Signalling Plan.

Signalling Plans shall nominate the areas of equipment fed from each equipment housing together with identification of track circuit types, and frequencies where relevant, location of feed and relay ends, and actual track circuit lengths provided from accurate field measurements.

Actual kilometrages for signals, points, level crossings, signal boxes and control centres specified to the nearest metre shall also be included.

The Points Table shall include:

- Points number/end
- Warding
- Indexing
- Machine type including drive end controller type
- Backdrive.

4. Track Insulation Plans

4.1. Scale

Track Insulation Plans shall be straight line plans drawn to longitudinal and transverse scales of 1:500, unless otherwise approved to be drawn at a larger scale. It is preferred that per-way layouts overlaid with overhead wiring structures and other civil structures are used as a base for the Track Insulation Plan. Track Insulation Plans shall be in accordance with CRN Signal Design Procedure CRN SQ 001 standards, titled Track Insulation Plans. The width of the Track Insulation Plan shall be as detailed for the Signalling Plan.

4.2. Per-way Plans

Prints of CRN's permanent way layout plans, which will be to various scales and may not be fully up to date, shall normally be available as an aid but shall require confirmation of actual site conditions and details for inclusion in the Track Insulation Plans.

Track Insulation Plans shall show the configuration of all track circuits in detail including the track circuit name plus the location of block joints, trackside units, tuning loops, connections, jumpers and bonding cables. Number and sizes of bonding cables, jumpers and connections shall be detailed. The positions of all signals and signal bridges shall also be shown. Where applicable the signalling rail shall be distinguished from the traction rail for single rail track circuits in electrified areas, and the polarity of the rails shall be shown where the polarity reversal between track circuits is important. Traction rails shall be drawn as a solid line.

4.3. Electrified Areas

In electrified areas, Track Insulation Plans shall show, in addition to the above, the following:

- Overhead Traction Structures and Portals and names
- Spark Gap Connections
- Traction Bonds and Bonding Cables
- Impedance Bonds and Bonding Cables
- Substations and Connections
- Section Huts and Connections
- Electrolysis Bonds and Connections
- Rail Connected switch
- Guard rails (over 50 m)
- Bonding cable sizes and

- Kilometrage of all equipment.

4.4. Permanent Trackside Structures

Permanent trackside structures and features such as stations, station buildings, foot and road bridges, relay rooms, level crossings, creeks, viaducts, culverts, transmission and pole line crossings, etc. shall also be shown.

4.5. Non-Electrified Areas

In non-electrified areas and where suitable, Track Insulation Plans may be incorporated in the appropriate book of signalling and associated circuit drawings, subject to approval.

4.6. Dimensioning

Track Insulation Plans shall include the correct relativity of equipment, notwithstanding this may require some inaccuracy in the scaling of the relative kilometrage of the equipment.

5. Signalling Control Tables

5.1. Control Tables

Control tables must be produced from the signalling plan and the applicable signalling principles plus the specified operational requirements. Control Tables shall be in accordance with CRN Signal Design Procedure CRN SQ 001 standards, Control Tables and are subject to design review as for other design drawings.

Where control tables do not exist for current installations, sufficient control table sheets shall be produced during the design of any alteration to permit the proper checking of the design as a document for testing.

The Control Tables shall be produced in approved Microsoft Excel format and include the information requirements as detailed under CRN's Signalling Standard Forms CRN SQ 001 standards.

Books of Control Table sheets shall have control pages including amendment details, similarly to Circuit Books as detailed under CRN's Signalling Standard Form CRN SQ 001 standards.

6. Signalling Circuits

6.1. Information on Circuit Drawings

Drawings of signalling and associated circuits shall be submitted as complete interlockings and complete areas for each location. They shall be comprehensive and fully detailed. Such drawings shall contain all the information and details necessary for checking of design,

construction, setting to work, testing, commissioning and maintenance. Included in such drawings shall be the following:

- All wiring and circuit elements including internal wiring of equipment with each and every circuit drawn separately.
- Identification and numbering of contacts, cable cores, circuit breakers, fuses, terminals, arresters, busbars etc.
- Track circuit adjustment connections.
- Tappings, ratings, capacity etc. and relevant details of items of equipment.
- Internal wiring of control panels, consoles and indication panels, diagrams etc.
- Internal circuits of power supplies and other units, where necessary for maintenance purposes and which are not shown in the equipment manuals. Power supply arrangements, switchboard wiring, power mains distribution and lightning protection details.
- Contact analysis sheets incorporating all relays in appropriate groupings. The contact list shall show the relay name at the right hand side of each page, type, contact arrangement, location and for each relay contact, the circuit name.
- Schematic layouts of all apparatus racks for all equipment locations. Relay rack schematics shall show each relay position, with details of the relay function, relay type and contact arrangement. Schematic layouts shall recognise the physical arrangements of the rack and equipment.
- Layout details for equipment, fuses, busbars, terminals etc. located in cubicles, panels, consoles etc.
- Cable core lists for all external cables, showing the name and size of each cable and the circuit(s) on each core. Spare cores shall be designated 'spare'. Details of each cable detailing all mid-section junction points as well as all termination points.
- Wire sizes for all cables and wiring.
- Table showing for each signal and points turnout, the applicable longest braking distances, line speeds, applicable train braking curve, signal indication sequences and distances, approaching the particular signal or turnout.
- A table showing for each circuit timer, the track circuit length, the line speed, the timing check speed and the time setting.

6.2. Size of Circuit Diagrams

Signalling circuit diagrams shall be set out and drawn on size A3 sheets (Sheet 420 x 297, border 396 x 273). The circuit diagrams shall be prepared in a manner to minimise the amount

of drawing alterations required to update the maintenance circuit books after the project is completed.

Folded pages shall not be used except where specifically allowed by the. Each separate circuit shall be drawn complete within a page. Where a circuit will not fit on an A3 sheet it may be continued on subsequent A3 sheets provided that the break points are logically selected to provide good continuity for ease of reading such circuits. Line break points shall be clearly labelled by drawing a circle at the end of the line, with an alphabetical reference to the continuation of the circuit, also marked with a lettered circle, on the next page.

6.3. Circuit Books

Copies of drawings detailing signalling and associated circuits shall be made up into books on the basis of one or more books per interlocking. In general, the automatic signalling section on the Sydney side of an interlocking shall be included in the book for the interlocking.

Circuit Books shall be in accordance with CRN Signal Design Procedure CRN SQ 001 standards, titled Circuit Books.

Circuit Book Pages shall be controlled in accordance with CRN Signal Design Procedure CRN SQ 001 standards, titled Control of Circuit Book Pages. Each circuit book shall include circuit book control page(s) and circuit book amendment sheets as detailed in CRN Signal Design Procedure Standard Forms CRN SQ 001 standards, plus comprehensive indexes and consecutively numbered pages.

Computer based interlocking designs shall include sheets grouped on a per location basis.

The control sheet shall list all sheets with their last amendment date such that the contents of the book and any missing sheets may be clearly identified. Control sheets shall be numbered to match the circuit book e.g., Book 1 will be CP1 whilst Book 2 will have CP2. Multiple control sheets shall be consecutively numbered e.g., CP1 Part 1 of 2 etc. The control sheet shall reflect the final date of updating. This date shall also appear on the CD label.

The index shall show the circuit group names written out in full, in alphabetical order with the appropriate nomenclature shown in parentheses and with page numbers shown. Spare page numbers shall be listed in the index where continuous numbering sequences are broken. Where more than one book is required for an interlocking, specific reference shall be made in the master index (a copy of which shall be placed in each book) to show in which book each item is contained.

Suitable hard PVC coated covers shall be provided for all signalling circuit books.

Suitable hard PVC coated covers shall be provided for all final books descriptively titled to show contents including, where applicable, the area contained within the book, the book number and the location (and reference number) where the book is to be kept. Cover titles shall be

submitted for acceptance. Books shall be bound such that individual pages may be replaced or added in the future.

6.4. Presentation

Circuits shall be presented in accordance with the CRN Signalling Design Principles and CRN SQ 001.

The number of sheets shall be kept to a minimum. Circuits shall be drawn positive/active fuse to negative/common terminal left to right across the page and no circuit elements shall be drawn in return lines right to left unless the circuit is symmetrically double switched in which case the negative/common leg shall be drawn right to left with the circuit elements shown directly under their counterpart in the positive/active leg. All circuits shall be drawn in a clear, logical and uncluttered manner with adequate vertical spacing between circuit elements. Ease of reading and understanding shall be given first priority in setting out circuits.

6.5. Numbering

Each circuit book sheet shall display a circuit book number (to be allocated upon request) plus page number and version date. Construction Copy drawings that use parts of circuit books shall be sequentially numbered with the page number circled on the right hand side of the page. Further details are provided under the CRN SQ 001.

6.6. Size of the Circuit Books

Books shall be of manageable size and weight, as agreed. Books shall have a maximum thickness of 25 mm. If necessary, books may be divided into volumes of related information to achieve this requirement e.g., a volume containing all circuits and a volume containing rack layout information and contact and termination lists. Division of books shall be at logical points generally at the end of a group of circuits and shall be subject to approval.

6.7. Deletions, Modifications and Alterations

Where deletions, modifications or additions are required to existing circuit sheets or associated drawings, such deletions, modifications or additions shall be carried out using whatever medium is applicable to the existing circuits or drawings e.g., Ink Tracing, CAD. etc.

Wiring and items to be removed shall be indicated by the use of dotted lines and unfilled arrows.

Wiring and items to be added to existing circuits shall be highlighted by filled arrows (particularly at changeover points.)

A sufficient number of unfilled and filled arrows shall be shown to remove any doubt as to which part of the circuit is being referred to.

Changes to drawings and documents shall be performed in accordance with CRN Signal Design Procedure CRN SQ 001 standards titled Process to Amend Issued Controlled Signalling Documentation.

Complete new circuits shall be indicated by a filled arrow pointing to the circuit title and the function.

6.8. Working Circuits

When the work is complete and the redundant wiring and items are removed, the arrows shall be deleted from the drawings. New work shall be transferred to the circuit layer if necessary. The drawings should then represent the working circuits and should be plotted, and copies provided.

7. Modification Record Book

A number of uniquely identified Modification Record Books containing sequentially numbered, multiple copy, Modification Instruction Forms shall be prepared to the CRN's standard format or agreed equivalent to facilitate proposed modification, amendment or revision to drawings, sketches and other written matter to be documented. Modification Record Books shall be in accordance with CRN Signal Design Procedure CRN SQ 001 standards, titled Use of Modification Books.

Proposed modifications shall be submitted in accordance with CRN Signal Design Procedure Standard Form CRN SQ 001 standards, titled Modification Instruction Form.

The books shall be registered and kept in safe custody and issued only to authorised personnel who shall sign for the issue. The details of all issues shall be recorded.

Modification Instruction Forms shall only be used in the Commissioning phase.

Modification Instruction Forms setting out new or altered designs shall be subject to the same review process as the original design.

Only modifications affecting one circuit book sheet shall be shown on any one Modification Instruction Form in order to facilitate the attachment of a copy of the form to the correct circuit sheet.

All circuit modifications shall show at least one clear contact or terminal and all wiring connecting to both sides of that clear contact or terminal. Whenever possible, contacts should not be reused in the same modification. Spare contacts should be wired in wherever possible.

Where a modification is in error but not issued, it shall be cancelled and a new one prepared. Cancelled modification sheets shall have two diagonal lines with the word 'Cancelled' neatly printed between them.

The Modification Record Book shall contain Modification Instruction Forms of different colours. The distribution of the coloured sheets of the Modification Record Book shall be in accordance with CRN SQ 001 standards, titled Use of Modification Books.

In addition to the Certified Office Copy, Office Copy and Test Copy drawings, any other controlled copies of documents or drawings being modified shall also be endorsed with the Modification Instruction Form number.

8. Stageworks

8.1. Submission of Stagework Documents

Where temporary stage works and interface works are required, or where individual items of equipment are to be staged prior to commissioning, review copies of stage/interface circuit drawings, signalling plans, track insulation plans, etc. shall be submitted for review in good and sufficient time to be accepted and then to execute the associated work in an orderly manner in accordance with the Contract Works Program. Allowance shall be made for the magnitude of the work, constraints involved with working on in-service systems and other current activities. Documentation and drawings for temporary stage works shall be subject to the same processes as for a stage to be commissioned, that is with the same process of Review Copies, Construction Copies, Test Copies, Commissioning Copies, Interim Maintenance Copies, except as otherwise agreed with the Principal Signal & Communications & Network Control Engineer because of the minimal size and complexity of the work.

8.2. Stagework Design and Updating when Implemented

Wherever practical, designs for stagework shall generally be separately packaged to facilitate the certification and return of the stagework documents and drawings for prompt updating of the masters and delivery of final documents and drawings covering that stage, unless other arrangements are agreed.

This includes the provision of separate Test Copy Masters for significant stagework.

In all cases stagework must be certified and the Certification Copies (normally Test Copy Masters) of the stagework documents and drawings must be signed by the Tester in Charge at the time the stagework is commissioned.

- Where a subsequent stage or separate work affecting a given signalling design document or drawing is to be commissioned within 4 weeks after the commissioning of a previous stage or separate work, then it may be agreed, if acceptable, that the delivery of final documents and drawings for the previous stage be deferred in order to incorporate the subsequent alterations at the next stage.

9. Detailed Site Survey Drawings

9.1. General

Detailed Site Survey Drawings (DSS Drawings) shall be produced, in accordance with CRN CAD/GIS procedures and practices, for new and altered signalling works. The content of Detailed Site Survey Drawings (DSS Drawings) shall be kept to manageable areas and shall be numbered to form a logical pattern. An overall index shall be provided. Appendix E titled Detailed Site Survey Drawings includes samples illustrating the required layout of DSS Drawings plus the Symbol Legend.

The software version of the detailed site survey drawings shall be drawn at 1:1 scale and plotted to the required scale on A3 paper. All text and symbols must be legible when plotted on A4 paper. In very complex areas, the vertical scale may be abandoned but all vertical dimensions must be shown to the relevant trackside equipment. One hundred metre sections plotted to a scale of 1:250 is preferred in most cases but scales of 1:200 and 1:500 are permissible.

Where mapping files are available these are to be used as a basis for detailed site surveys.

DSS drawings shall be fully dimensioned to show the location of every kilometre and half kilometre post, the final cable routes, underline crossings (ULX's), station buildings, signal boxes, relay rooms, housings, location cases and lineside equipment with reference to the running face of the nearest railway line and, where applicable, existing buildings which are to remain and/or overhead wiring structures.

Detailed Site Survey Drawings shall also show those existing items which affect the construction of the new works, and which are subsequently to be removed. After removal they shall be deleted from the as built drawings.

Lineside equipment shall include but not be limited to signals, trainstops, points, catch points, insulated rail joints, warning lights, guards indicators, notice boards, ground frames, releasing switches, point indicators, level crossing lights and boom posts.

Detailed Site Survey Drawings shall also include the following information:

- The location of all creek, road, rail and river crossings, underbridges, overbridges, tunnels, top of platform ramps, canals, viaducts, drains, culverts, railway cuttings and embankments, retaining walls etc.
- The location of all of the CRN's access roads and public level crossings.
- The location of all telecommunications equipment such as telephones, exchanges, public address systems. This includes equipment from communication providers.
- The location of other services such as water, sewerage, stormwater drains, gas mains, communication cables, power authority underground cables and overhead wires.

- The location of the rails and OHW structures,
- The location of points and crossings,
- All applicable site installation drawing numbers shall be shown at the location to which they apply.

9.2. Cable Routes

The Detailed Site Survey Drawings shall show the following information with respect to cable routes:

- The location of all cable routes with respect to the nearest rail and any other major structures. The maximum distance between reference measurements, even on cable routes which are parallel to the track for long distances, shall be fifty (50) metres. The distances from fences can be shown as an additional reference but these shall not be used as the only reference measurement, as the position of fences may change over the years.
- The distance from each overhead traction wiring structure. Each structure identification number shall be shown
- The type, location, depth, numbers and length of cables, cable ducts or pipes. A cross section of the pipe arrangement shall be shown indicating pipe occupancy and spare ducts or pipes.
- The different types of cable route to be clearly shown i.e., Type 1, Type 2, etc.
- Cable pits and cable turning chambers.
- Underline and under-road crossings.
- The arrangement of cable routes through creeks or waterways.
- The arrangement of cable routes on embankments, viaducts, gantries, railway bridges, etc.
- The location and identification of all relay rooms, equipment cases and trackside signalling and telecommunications equipment.
- The location of cable heads and cable termination points.
- The location of cable joints.
- The location of telecommunications cable loading coils and repeater units.
- The location of cable route markers.
- The location and type, including the conductor sizes and number of cores, of all signalling and telecommunications cables (main and local).
- The location and type of all power supply cables including 2 kV, 11 kV, etc.

- Aerial cable routes, where applicable. The location and identification number of all poles or structures on CRN land must be shown.
- The location of air lines, manifolds, compressors etc.

The As-Built drawings to be supplied include Detailed Site Survey Drawings for the total work, including any Detailed Site Survey Drawings issued by CRN. The Final/As-Built Detailed Site Survey Drawings shall include a schedule with full details of the cable installation and nominate the function of each cable plus the Cable Supplier's Drum Number.

10. Installation Drawings

10.1. Details to be Shown

Installation drawings shall be prepared for use where standard installation drawings issued by CRN are not applicable. Installation drawings shall be produced for standardising installation practices and layout arrangements. The drawings shall show typical arrangements at points, post and gantry signals (including a set out for each type of track circuit / traction arrangement), trainstops, impedance bonds, releasing switches, telephones, wayside and ATP equipment, cabling and airline arrangements.

Installation drawings shall also be prepared for each location cupboard / bungalow arrangement. Minor local variations to the designs may be permitted however drawings for special arrangements shall be prepared for acceptance.

Installation drawings shall be prepared to scale for use where standard installation drawings issued by CRN are not applicable.

10.2. Submission

The installation drawing number system proposed to be used shall be submitted for consideration before being used.

11. Signal Sighting Forms

11.1. Position of Signals

The proposed position of signals will be shown on the Signalling Plan. A field inspection by the signal sighting committee shall be conducted to confirm or otherwise the suitability of the signal positions as shown on the Signalling Plan.

The Signal Sighting Checklist is to be used to assist a Signal Sighting Committee to compile the Signal Sighting Form.

The signal sighting committee shall include the persons as nominated on the Signal Sighting Forms in resolving the actual signal positioning.

The field inspection shall consider:

- Potential signal read through situations,
- Requirements for the provision of sighting screens,
- Special focussing requirements and,
- Compliance to minimum sighting distance requirements,
- Optimum sighting of the new signal,
- Layout and height of the new signal,
- Ground conditions and signal base requirements,
- Safe access to the signal,
- Structure gauge clearances,
- Other factors as set out on the signal sighting form,
- Planned addition or removal of overhead wiring structures,
- Planned changes to physical features e.g., bridges, trackside buildings, station works,

The proposed position of a signal shall be recorded on a Signal Sighting Form. (Signal Sighting Checklist and Forms are included in Standard Forms CRN SC 012).

11.2. Signal Sighting Forms

During the initial site survey with CRN, the Signal Sighting Forms shall be completed. The following information shall, be shown on signal sighting forms:

- Project
- Contract No (where applicable)
- Location
- Signal No
- Design Location (km)
- Actual Location (km)
- Height of (top) red indication from rail level
- Distance, centre line of signal to running face of rail
- Cess depth, rail level to bottom of cess (or ground level at signal)
- Sketch showing signal (include dressing where required)
- Sketch showing location

- Type of lens required (standard or spread)
- Background size (standard or narrow)
- Distance to nearest Km post, OHW structure or bridge
- The sighting distance of the signal (accurate to +/-10 metres)
- Any special requirements e.g., foundations, sighting screens, access

11.3. Pegs

The proposed signal positions shall be pegged as the initial site survey progresses.

11.4. Final Signal Sighting

The final Signal Sighting Forms shall be produced and be neat and accurate in readiness for a final signal sighting survey with all representatives in attendance. Following finalisation of the signal positions the Signalling Plan shall be amended to show the position of the signals.

11.5. Signatures

The Signal Sighting Form shall be signed by all representatives when the signal position is confirmed.

11.6. Revisions

If any signal position is revised on the final sighting survey with all the representatives, the relevant Signal Sighting Form shall be amended accordingly and submitted to CRN who will arrange for the other representatives to sign it.

11.7. Distribution of Approved Signal Sighting Forms

Final signed copies of Signal Sighting Forms shall be provided to the Region Representative, the Design Engineer, and the Commissioning Engineer and all the other signatories. The forms shall be included in the handover package.

12. Drivers Diagrams and Safe Notice Insertions

12.1. General

When it is necessary to carry out engineering work which involves:

- the bringing into use of new signals, train stops, points, level crossing warning equipment or safeworking equipment
- the bringing into use of new lines or sidings

- changes to the location of signals, intermediate train stops, points, level crossing warning equipment, additional lineside signalling equipment or safeworking equipment
- the permanent disconnection or removal of signals, train stops, points, level crossing warning equipment, additional lineside signalling equipment or safeworking equipment
- the removal, closure or alteration of lines or sidings
- or the installation of new points prior to being brought into use,

the work must be advertised in the Safe Notice to ensure that at least one week's notice is given of the work to be carried out.

The Drivers Diagram is used in conjunction with the text in the Safe Notice to describe the operation of the track and signalling arrangements from a drivers' or signallers' perspective. This will include where appropriate the method of operation of the equipment, the new facilities provided, and the existing facilities removed.

Submission of Drivers Diagrams and Safe Notices shall follow the same review and verification process as for other signalling designs.

Both the Safe Notice and Drivers Diagram are published by CRN's Manager Safeworking and are subject to his/her review.

12.2. Drivers Diagrams

Drivers Diagrams shall include the whole of the Works including interlocking areas and automatic signalled sections and are required both for final arrangements and also for all temporary stages of the Works. Separate Drivers Diagrams are required for each stage. Drivers Diagrams shall be produced in accordance with the CRN's Signal Design Procedure CRN SQ 001 standards, titled Drivers Diagram and Safe Notice Instruction. Drivers Diagrams shall be version dated in the format VERDDMMYYY. A typical Drivers Diagram will be made available on request.

The diagrams must be produced using CAD, and provided in CAD tif and pdf formats, suitable for reproduction as A4 size.

The final accepted Drivers Diagram shall be provided in good and sufficient time for advertising the work in CRN's safeworking circulars and/or Safe Notices.

12.3. Safe Notice Insertions

Safe Notices give, for the area concerned, a complete description of the signalling system and its operation, including associated telecommunications facilities.

The following information is included:

- description of any track alterations

- general description of the signalling systems, including type of interlocking and method of operation (if necessary)
- systems of train working
- sections between signal boxes (yard limits)
- numbering and designation of signals and points
- details of the routes available from each signal
- details of releases available
- details of operation of the signaller's control panel
- details of alarms provided and action to be taken when an alarm situation arises
- emergency working in failure conditions
- communications arrangements for safe-working
- any special instructions

Safe Notice insertions shall be produced in accordance with the CRN's Signal Design Procedure CRN SQ 001 standards, titled Drivers Diagram and Safe Notice Instruction.

Copies of previous Safe Notice insertions, indicative of the requirements, can be made available on request.

The Safe Notice shall be version dated and include the version date of the Drivers Diagram that applies plus contact name details of the Commissioning Engineer and the Design Engineer.

The Safe Notice write up shall be provided in good and sufficient time for review, verification, publishing and distribution.

13. Equipment Housing Layout Plans

13.1. Details to be Shown

Layout plans for equipment housings including huts, relay rooms, signal boxes and control centres etc. shall be to scale and shall detail precise floor, wall and ceiling positions for all items including the following:

- Equipment
- Equipment Racks
- Termination Racks
- Cubicles
- Consoles and Diagrams

- Furniture
- Lighting Units and Switches
- Power Points
- Air Conditioning Units
- Fire Protection Units
- Ventilation

14. Level Crossing Layout Plans

14.1. Contents in Layout Plans

Level Crossing Layout Plans shall show, to a scale of 1:50, the physical arrangements at road/rail or controlled pedestrian crossings including the following:

- Railway Track
- Roadway, Pedestrian Path with Pavement, Fence Lines etc.
- Road Traffic Arrangements (e.g., turn restrictions, traffic lights etc)
- Road Markings
- Railway Signalling Arrangements
- Locations for Flashing Light, Boom and Pedestrian Gate Arrangements
- Locations for Equipment Housings and Other Equipment
- Cable Route and Other Services
- Notice Boards and Signs (Road & Rail)
- Any other pertinent features such as buildings, stations, drains, street lighting, CCTV cameras, street lighting and/or power poles
- Guard rails, pedestrian cribs, and walkways.

15. Mechanical Drawings

15.1. Details to be Included

Drawings showing mechanical arrangements for equipment and systems shall be fully detailed scale drawings and shall include all fixtures and fittings and manufacturing, fabrication and finishing details. Equipment shown on mechanical drawings shall include but not be limited to:

- Equipment arrangements

- Signals
- Point mechanisms and points layouts
- Relay racks
- Termination racks
- Cubicles
- Control consoles and diagram cabinets
- Control consoles and diagram faceplate layouts
- Equipment housings
- Releasing switches
- Track circuits
- Signal gantry cages, ladders, walkways and railings
- Signal gantry junction box
- Impedance bond stands
- Cranks and stands
- Rodding and wire runs
- Cable troughing routes, posts and brackets
- Ground frames and foundation arrangements.

16. Structures and Buildings

16.1. Working Drawings

Working drawings for structures and buildings shall be fully detailed and shall include architectural and structural details, specifications, computations, arrangements for services etc. together with assembly, mounting and erection details where appropriate. Details shown on these drawings shall include but not be limited to:

- Services including Power, Water and Sewerage or Septic,
- Drainage
- Air Conditioning
- Natural Ventilation
- Dust & Noise Suppression
- Fire Protection

- Communications services
- Lighting

16.2. Temporary Works

Temporary works such as scaffolding, formwork, sheeting, excavations, launching trusses etc. shall be included, where required, in such working drawings.

16.3. Major Buildings

Drawings and Specifications for major buildings shall be prepared by a Registered Architect and independent Consulting Engineer as applicable.

17. Clearance Diagrams

17.1. Trackside Structures

Trackside structures including signals and signal gantries shall not encroach into the CRN's Standard Structure Gauge, as detailed in Specification CRN SC 021, unless approved by the Principal Signal & Communications & Network Control Engineer. Where it is proposed that a structure be located within the Structure Gauge, a submission for a waiver to the Standard shall be submitted to the Principal Signal & Communications & Network Control Engineer for approval. The waiver submission shall include Clearance Diagrams detailing the precise location of structures, including associated ladders, stays and fittings, in relation to the CRN's Standard Structure Gauge including distances from rail level, running edge and overhead traction wires and equipment. Track curvature and superelevation shall also be shown on these diagrams.

18. Manuals

The format for the manuals shall be in accordance with the CRN Engineering Publications Manual.

18.1. System Manuals

18.1.1. General

System manuals shall include formats, setouts and procedures as used in the CRN's Signalling documentation, which includes the following publications:

- Signalling Design Principles
- Signalling Maintenance Procedures

- Standard Circuit Designs
- Equipment Manuals
- Technical Procedures
- Operators Manuals
- Training Manuals
- Maintenance Manuals

System manuals shall generally be presented in four volumes:

- Installation and Maintenance
- Engineering
- Operations
- Training

Where a particular CRN Equipment or Construction specification prescribes detailed requirements for manuals for a specific item, the requirements of that specification shall take precedence.

18.1.2. Installation and Maintenance Volume

The installation and maintenance volume shall contain all information and data necessary to provide:

- A description of the system and circuitry
- Basic principles of the system
- Methods of installation, adjustment and setting to work
- Recommended periodic maintenance tests, adjustments and tasks
- Fault diagnosis and rectification (Flow diagrams, circuits and diagrams

showing the interrelationship of sub-assemblies and components should be included)

This volume shall also contain a listing and application of recommended test equipment and a listing of sub-assemblies and components, with part numbers, which are required to carry out first level (field) maintenance and repair.

First line maintenance and fault identification and rectification will be carried out by the following personnel:

Electrical signalling equipment	Accredited electrical tradespersons
Mechanical signalling equipment	Accredited skilled non-tradespersons
Communications equipment	Accredited telecommunications technicians

This volume of the manual will be used by first line maintenance and fault rectification personnel and shall be structured accordingly.

18.1.3. Engineering Volume

The engineering volume shall provide all of the information, data and diagrams to provide:

- The theory and principles of the system,
- Detailed system design and circuitry,
- System operation,
- Second line maintenance and fault rectification,
- Design and implementation of system modifications.

This volume will be used by professional and semi-professional personnel and shall be structured accordingly.

18.1.4. Operating Volume

The operating volume will be used by operations personnel and shall provide sufficient information to cover all aspects of the operator / system interface and to allow the operator to use the system in all of its modes.

18.1.5. Training Volume(s)

The training volumes shall include the same information as the maintenance, engineering and operating volumes. This information shall be expanded where advantageous to include examples of fault finding and rectification, details of how to make best use of the information provided and to highlight pitfalls.

Video training aids shall relate to and shall be considered as additional to the training volumes and shall be colour DVD format.

18.1.6. Safety Warnings

Where a potential hazard exists, the manual shall specifically highlight the hazard and the control measures required to eliminate or reduce the risk. Suitable highlighting may take the form of a text box with bold outline, red text or highlighting or similar treatment.

18.2. Equipment Manuals

18.2.1. General

Generally, equipment manuals shall be produced in one volume and shall include sufficient information, data and diagrams to provide:

- Description of the operation of the piece of equipment and its place in the system
- Operating attributes of the piece of equipment
- Method of installation, adjustment and setting to work
- Periodic maintenance tests, adjustments and tasks
- Fault diagnosis and rectification for first level (field) maintenance
- Methods of component replacement and overhaul
- Test equipment and special tools required
- Fault diagnosis and rectification at overhaul
- Spare parts listings with part numbers and drawings/diagrams for every separable part in the piece of equipment.

Where there is a considerable difference in complexity and detail between first and second level maintenance/overhaul tasks, the equipment manual may be produced in maintenance and overhaul volumes.

18.2.2. Safety Warnings

Where a potential hazard exists, the manual shall specifically highlight the hazard and the control measures required to eliminate or reduce the risk. Suitable highlighting may take the form of a text box with bold outline, red text or highlighting or similar treatment.

19. Commissioning Documentation

19.1. Commissioning Notice

The Contractor shall be responsible for the production of the Commissioning Notices.

The Commissioning Notice forms part of the Commissioning Work Package which is defined in Specification CRN SC 007.

Commissioning Notices are for the use of all employees engaged in or associated with the commissioning.

Details shown on the notice shall include the following:

- Location to be Commissioned
- Description of the Work
- Commissioning Dates and Periods
- Commissioning Limits
- Commissioning Programme

- Communications Arrangements
- Rostering of Staff
- List of Equipment and Documents and drawings to be Utilised
- Booking-on Procedures
- Reporting Procedures
- Reporting Centre
- List of Telephone Numbers
- First Aid Arrangements
- Vehicles and Tools

Copies of approved Commissioning Notices shall be issued prior to commencement of commissioning. Sufficient copies, as agreed, shall be issued to provide one copy for each person involved in or with the commissioning who needs to know plus an additional six (6) copies.

20. Asset Register

20.1. Details to be Included

The Asset Register shall include all new equipment and all existing equipment retained within the renewal area of the Contract and shall also include and show separately all new (or renamed) equipment outside the renewal area which was altered consequential to the work. Where existing equipment is renamed, or where new equipment replaces existing equipment, the list shall specifically show the old equipment which has been changed or deleted.

The Asset Register for each stage shall be provided in the format required at least two weeks prior to the Commissioning of the respective equipment.

The format and configuration of the Asset Register is available from the Asset Engineer.

20.2. Asset Register

The Asset Register shall list the following items of equipment:

- Signal Boxes/Consoles
- Signals
- Track Circuits
- Points (ends)
- Level Crossings

- Main Power Supply Locations
- Relay Rooms, Huts and Cupboards
- Releasing Switches
- Safeworking Instruments
- Remote Control Units
- Train Descriptor Units
- Computer Based Interlockings
- Cable Route
- Cable

For each item of equipment, including cable route and cable, the appropriate template from Maximo shall be used to gather the necessary information.

20.3. Layout of Assets Fields

The Equipment Register file is to be produced using a spreadsheet template supplied by CRN's asset engineer. The format of the fields shall be from the Maximo template to allow automated uploading to the database.

A.1. Appendix A: Rules of Documentation Control

Coloured Issues

The use of different colour issues for the various submissions is intended to assist in document control. When updating a design from green to pink to yellow, the sheet version date must not change unless the design has been altered. The adding of detail by field staff to clarify or further detail a design is not a change to the design. Where wiring is physically altered, this is a design change and the alteration must be given a new version date, the control sheet updated, and review, verification and approval signatures obtained.

When updating between different colour issues, the front cover of the circuit book must be signed to indicate the status. The control sheet is not altered unless the design has changed as noted above.

Alterations to the Design

When an issued design is to be altered, the original version date on the sheet is to remain legible, but neatly crossed out. The altered area is to be clouded and the cloud is to receive the new version date. It is often preferable that these changes are neatly drawn by hand as this makes them more obvious. A new control sheet with the changed sheets version dates updated and the control sheet version date also updated shall be provided. Reviewers and Verifiers must check the alterations before approval. It will not be necessary for these checkers to recheck the whole design. They are only signing for the particular change version dated on that control sheet. However, they are responsible for ensuring that all elements of the change are correctly altered to the extent that the change requires.

Amending Documentation with Updated Sheets

Any documents where new sheets are issued together with a new approved control sheet shall be updated by the insertion of the new sheets into the book. Old versions of the updated sheets may remain in the book but must be cancelled by drawing a red line diagonally across the page. Old versions of the control page must also remain in the book as these are the record of the review, verification and approval signatures for the original elements of the design, however these should also be cancelled by drawing a red line diagonally across the page. These signatures are still valid for the unaltered parts of the job.

Version Control Implementation

While ever the design documentation is held within the design office and within the design team, version control need not be in place. However, version control must be in place when:

- The design is compiled for verification. (Checking of the documentation control is one aspect of the work the verifier must ensure is correct. The reviewer need not version

control until the reviewer is satisfied the work is complete and ready to proceed to verification.)

- The design is issued as a proof copy or draft copy (whether reviewed or verified, or not.)

Changes to Previous Designs

Should further alterations be required on a sheet which already contains alterations, the previous changes will be clouded, and version dated. This version date must be crossed out (but remain legible) and the cloud removed. The new changes are made and these clouded and the sheet given a new version date. The control page is updated, and the alteration approved as described before. The previous sheet remains in the book but cancelled, in order to record the previous state of the design.

Changes after Wiring has Commenced

In general, changes to the design do not have to show wires that were to be new, shown as removed, in the update. This is because if the wiring has not commenced, the wires are not in place and hence do not need to be removed. However, once wiring has commenced, it is important that any unnecessary wires run are removed. If these wires are contained fully in new work (e.g. a parallel contact), then they are easily missed. In these circumstances, the usual wires removed and wires to be run new should be shown highlighted by the solid and hollow arrows.

Design Engineers and Construction Engineers to Consult on Changes

When an altered design is to be issued following the commencement of construction, it is important the field Construction Engineer has a clear understanding on the extent of the changes. Design engineers must consult with the Construction Engineer in order to be clear that:

- the modification is being issued, and
- the extent to which wiring changes are required.

Role of Commissioning Engineer

The Commissioning Engineer must ensure that prior to commissioning, the documentation is up to date with the latest control sheet, and all pages are correct to that control sheet. The Commissioning Engineer can check the latest control sheet version date by consulting with the Design Engineer. Closure lists may be issued for this purpose. The Commissioning Engineer must also ensure that all testing on these sheets, including wire counts, bell tests, and null counts are completed before the work is booked into use.

Use of Modification Sheets

Modification sheets are a less well controlled method of documentation control. They should only be used during commissioning, when the preparation of designs in the formal way, and the use of formal control sheets is impractical. Commissioning Engineers must ensure all modification sheets are recorded in the commissioning log and securely stapled into the COC. Design Engineers must ensure that Office Copies of modification sheets are stapled into the Office Copy as soon as they are returned to the Design Office.

A.2. Appendix B: Checking of Signalling Design for New Works and Alterations

Checking Objectives

A signalling project's objective is to effectively implement a safe, reliable signalling installation that meets the functional requirements in accordance with standards and within the approved costs and time scales.

Prior to commissioning signalling work into use for traffic operations, the installation is checked and tested to verify that it is safe, reliable and meets the functional requirements, in accordance with standards.

Prior to issuing the approved design, the design is independently checked to verify it is safe, reliable and meets the functional requirements, in accordance with standard signalling principles and practices, including the circuit design standards.

It is not possible to verify that design is correct to standard solely by field functional testing – rigorous design checking is necessary to ensure that all safety features are included, that there are no unsafe inclusions, and that the design is to the proven standard arrangements for safe operation.

The primary focus of independent checking of design is therefore to ensure:

- The design is safe.

For reasons of efficiency the design is also independently checked to ensure:

- The design meets the functional requirements.
- The design contains no deficiencies that could result in an operationally unreliable or restrictive installation.
- The design contains no errors that could result in significant rework.

Rework increases risk exposure and needs to be minimized; signalling rework in safety related areas must be rigorously controlled.

All design modifications to provide added functionality, remove deficiencies, remedy errors (or for any other reason) are subject to the same checking process and, as a general rule, are carried out by the original designer and Independent Verifier.

Checking Process

The checking process for signalling design involves:

- The signal Designer who is required to fully check his/her own work.
- The signal designer's immediate signalling design supervisor, where that signalling design supervisor has provided any technical guidance, direction or input to the design, or a

nominated suitably fit and competent signalling design checking engineer. This person may be the project signal Design Engineer in Charge. This is the Review.

- An independent signalling design checking engineer (Independent Verifier), appropriately experienced and suitably fit and competent. This is verification.
- The Principal Signal & Communications & Network Control Engineer, or a nominated suitably fit and competent signalling Design Approval Authority (Design Approver), who examines the designs and satisfies him/herself that they have been comprehensively and properly checked by competent and Independent Verifiers. This is approval.

The signalling design checking process covers a full check of designs for soundness, safety, reliability, functionality and compliance with standards. The checking may be considered as two aspects.

- Checking for any errors or deficiencies in designs relating to sound engineering design practice, interface compatibility, completeness, correctness of documentation detail, power supply calculations, voltage drop calculations, cable sizes, timing calculations, typing and ratings of equipment, and the like. This may be performed by a suitably fit and competent signalling design engineer who is not the designer but may not be fully independent (Checker).
- Checking for any errors or deficiencies in the design relating to signalling safety, reliability, compliance with design standards and signalling principles and practices, and operational functionality. This shall be performed by a suitably experienced, fit and competent signalling design checking engineer who is independent (Independent Verifier).

Both aspects could be checked by the Independent Verifier or the first aspect could be checked by a separate checking engineer who is not the designer but who may not be fully independent.

Design Integrity Testing

A design integrity test by a suitably experienced senior design engineer is generally carried out for all signalling works especially those with complex designs such as designs incorporating multiple overlap sequencing where it is difficult for designers and checking engineers to visualise indirect locking and timing implications in all the operational circumstances that might cause operational problems.

The design integrity test is complementary to, and not a substitute for, in-depth design checking. Design integrity testing is described in Specification "Inspection and Testing of New and Altered Signalling Works" CRN SC 007.

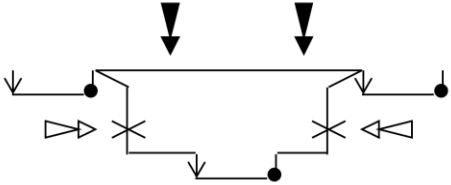
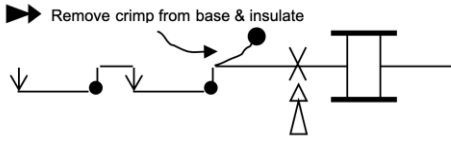
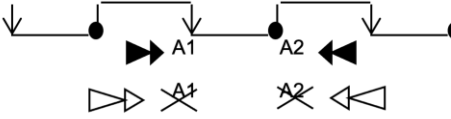
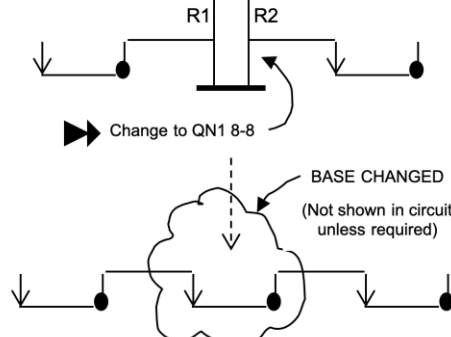
A.3. Appendix C: Data Submissions by Contractors

This Appendix describes how and when Microlok data should be submitted for checking and approval, by contractors, to CRN.

The Microlok Data must be "set to work" and proved by the contractor's verifier's Design Integrity Test as correct on a Microlok Interlocking Simulator System (MISS) workstation prior to submission.

- The Microlok data shall be submitted formally in both hard and soft copy. (This allows CRN to look at the .mll file for relevant information and confirm the data submitted actually compiles. It also allows CRN to produce difference files where there are multiple submissions)
- The Microlok data shall include the Microlok Interlocking Simulator System (MISS) testing data component commented out. (This should be the case rather than the "local" data commented out, considering that any commented out data is not looked at by the compiler and errors may exist in that commented out data. The Contractor should provide two versions of the data. One version should have the MISS data commented out and the other version should include the MISS configuration. This arrangement allows CRN to use the MISS data for testing)
- The contractor shall provide soft copies of all MISS simulation files for CRN testing purposes.
- The contractor shall provide Microlok data compiled using a type approved version only. The contractor shall request CRN for the latest type approval version, if this is not detailed in the contract documents.
- The Contractor shall follow CRN data design practices and not omit data that may be deemed unnecessary by the Contractor. (For example, data bits that are created or sent to, but not used in the Master Interlocking - VRR and DR etc)
- Data shall be submitted on CD.

A.4. Appendix D: Standard Ways of Showing Alterations to Permit Documentation of Testing

<p>Insertion of Wire Removal of Wire (Tests as per Specification CRN SC 010)</p>	
<p>Temporary Disconnection of Circuit Wire by removal of crimp from base (for later reconnection)¹</p>	
<p>Change of Contact Number²</p>	
<p>Change of Relay Base and Relay (e.g., QN1 12-4 to QN1 8-8). Wire transfer directly across - no rebeading or recrimping³ When Bell testing of a changed base is required, all contacts to be highlighted in the circuits to permit bell test to be marked off, only when the base is not changed out on a wire for wire basis.</p>	

Note 1: On reconnection, the circuit doesn't need to be bell tested, but the circuit must be proved to be functioning

Note 2: On Alteration, circuit to be 'belled' back to the adjacent relay contact (wires are rebeaded and crimped)

Note 3:

- If all wires are removed from base and then inserted in new base, each wire is to be bell tested. Null count and wire count will not be required.
- If wires transferred across one at a time, bell test, null count, wire count not required.
- For either process, each circuit must be proved to be functioning.

Basic Rules:

- If wires are cut, rebeaded or crimped, the bell testing is always required, as is a wire count.

If more than one wire removed at a time (whether crimp cut off or not), bell testing is always required.

A.5. Appendix E: Detailed Site Survey Drawings

Sample layouts follow on subsequent pages.

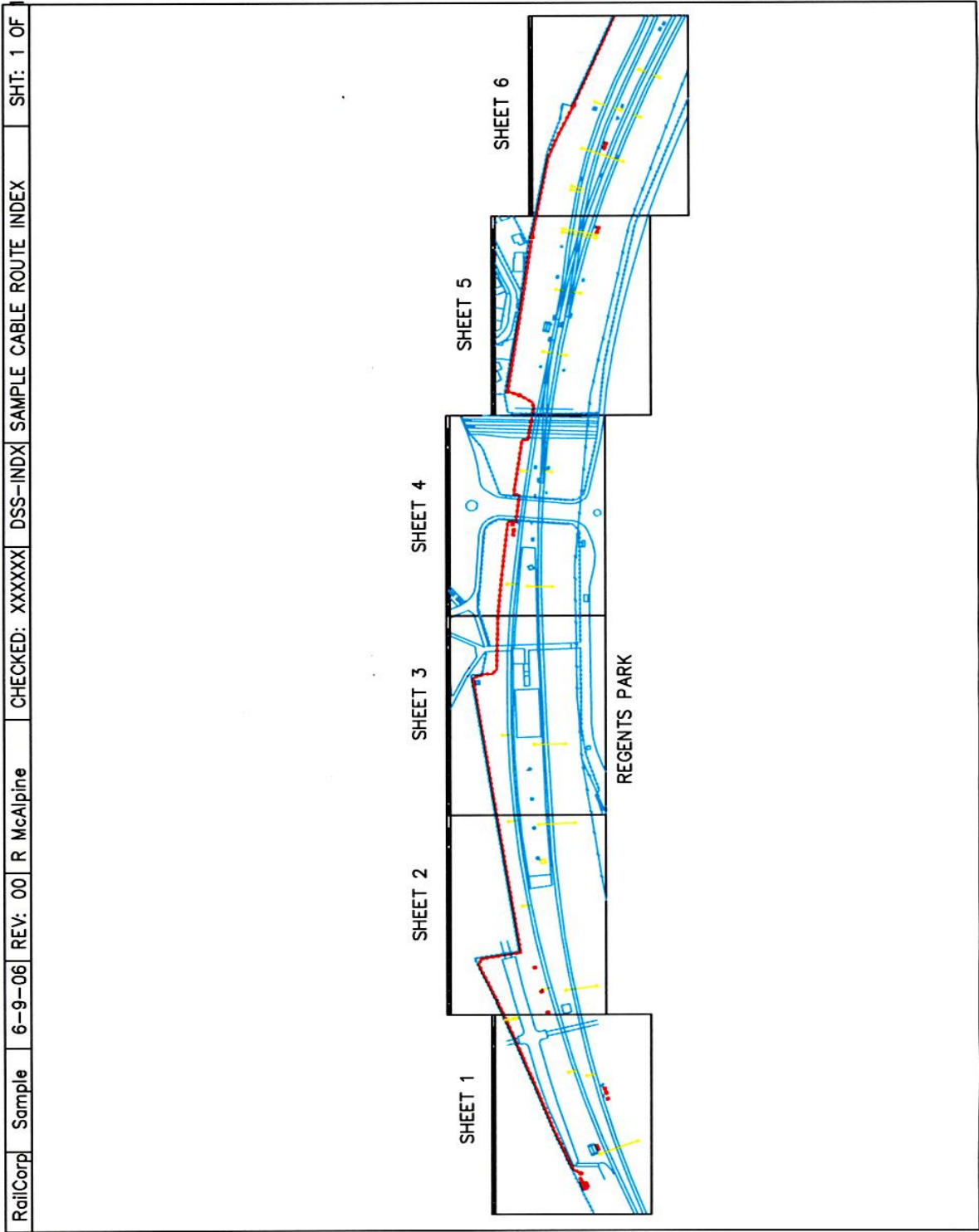


Figure 1 – Sample Cable Route Index



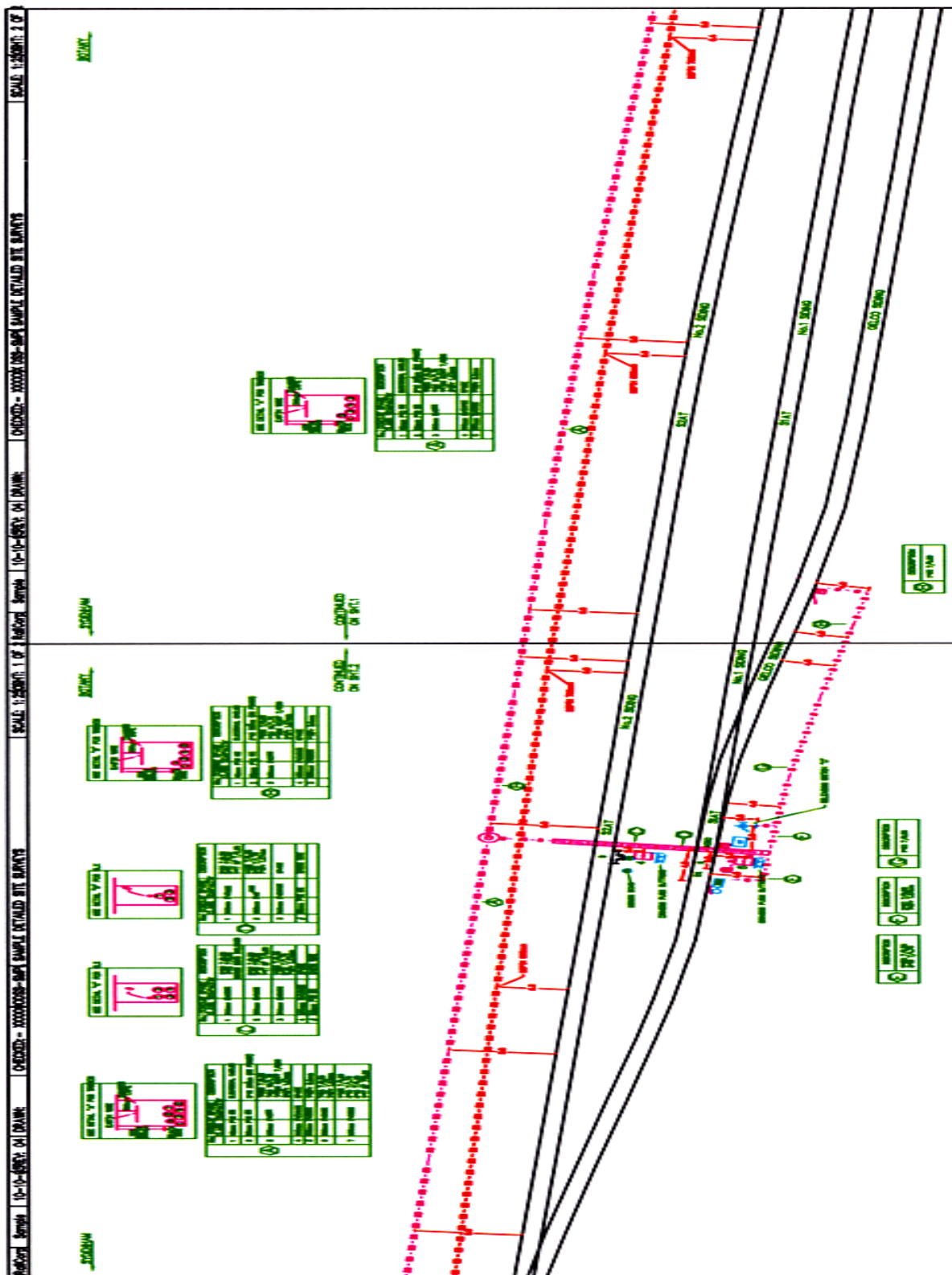


Figure 3 – Detailed Site Survey: Sample Sheet 2

RailCorp	Sample	DRAWN	APPROVED	DETAILED SITE SURVEY SYMBOLS	DWG- DSS-SYMB	REV: 03	6-9-06	SHT: 1 OF 2
LAYER COLOUR L0 WHITE L1 YELLOW L2 CYAN L3 BLUE L4 GREEN L5 BROWN L6 MAGENTA L7 EXISTING CABLE ROUTES ETC THAT BECOME OBSOLETE	— TP — TP — TP — TP —			KILOMETRE POST 	CABLE JUNCTION BOX 	V.B.S. 2000P BOND SHOWING RELATIONSHIP TO POST	100.000000B	
	— TP — TP — TP — TP —			HALF KILOMETRE POST 	CABLE ROUTE MARKER 	V.B.S. 2000R BOND SHOWING RELATIONSHIP TO POST	100.000000B	
	— 0.1 — 0.1 — 0.1 —			KILOMETRE MEASUREMENT 	CABLE ROUTE G.S.T. EXPANSION JOINT 	ELECTROLYSIS BOND BOX AND TRACK CONNECTIONS	100.000000B	
	— 3 — 3 — 3 — 3 —			OVERHEAD WIRING STRUCTURE 	CABLE ROUTE G.S.T. INSULATION JOINT 	EXISTING Z BOND TO REMAIN	100.000000B	
	— 10 — 10 — 10 — 10 —			BURIED DUCT (PIPES) 	CABLE JOINT 	BOOT LEG RISER	100.000000B	
	— L13 — L13 — L13 —			LADDER RACK ON BRACKETS 	AIRLINE ANCHOR 	AC TRACK CIRCUIT FEED END	100.000000B	
	— CP — CP — CP — CP —			GALVANISED PIPE 	AIR VETLAG TRAIN 	JUNCTION TRACK CIRCUIT FEED END	100.000000B	
	— AP — AP — AP — AP —			AIRLINE ON POSTS 	AIRLINE EXPANSION JOINT 	TRACK CIRCUIT RELAY END	100.000000B	
	— CTP — CTP — CTP —			EXISTING ROUTES ARE PREEXISTED BY THE LETTER 'C' EG. EXISTING TROUGH ON POSTS	AIRLINE INSULATION JOINT 	TRACK CIRCUIT(C) FEED END	100.000000B	
	— 0 — 0 — 0 — 0 —			FENCE/BOUNDARY 	AIR CONTROL MANIFOLD 	FREQUENCY TRACK TRANSMITTER END	100.000000B	
				GATE 	PNEUMATIC POINTS CONTROL VALVE 	FREQUENCY TRACK RELAY END	100.000000B	
				ULX OR URX 	PNEUMATIC POINTS PLUNGER VALVE 	DATA PICKUP UNIT	100.000000B	
				FLASHING LIGHT FOUNDATION 	JUNCTION TRACK BOX SHOWING RELATIONSHIP TO POST	BOND OUT EXISTING BLOCK JOINT	100.000000B	
				PEDESTRIAN BOMB FOUNDATION 	JUNCTION BOND CIT 1408 SHOWING RELATIONSHIP TO POST	GROUND FRAME INDICATES NO. OF LEVERS	100.000000B	
				CABLE PIT (GROUND) 	TUNING UNIT SHOWING RELATIONSHIP TO POST	GUARDS INDICATOR	100.000000B	
				CABLE PIT (SQUARED) 	END TUNING UNIT SHOWING RELATIONSHIP TO POST	WARNING LIGHT	100.000000B	
				TURNING CHAMBER 	V.B.S. 2000(RAF) BOND SHOWING RELATIONSHIP TO POST	BUFFER STOP LIGHT (WHITE OVER RED)	100.000000B	

Figure 4 – Detailed Site Survey Symbols: Sample Sheet 1

































RailCorp Sample	DRAWN	APPROVED	DETAILED SITE SURVEY SYMBOLS	DWG-DSS-SYMB	REV: 03	6-9-06	SHT: 2 OF 2
	TRAIN STOP						
	POINT MACHINE						
	CLAMP LOCK						
	POINT INDICATOR						
	POINTS DETECTOR						
	NOTICE BOARD						
	POST MOUNTED TELEPHONE						
	WALL MOUNTED TELEPHONE						
	ELECTRIC RELEASING SWITCH OR ESRL						
	ELECTRIC RELEASING SWITCH WITH TELEPHONE						
	LEVEL CROSSING SIGNAL						
	POST MOUNTED SIGNAL SHOWING LOCATION OF CABLE ENTRY TO BASE						
	SHUNT SIGNAL SHOWING LOCATION OF CABLE ENTRY TO BASE						
	SHUNT SIGNAL SHOWING LOCATION OF CABLE ENTRY TO BASE						
	GANTRY MOUNTED SIGNAL						
	BLOCK JOINTS						

Figure 5 – Detailed Site Survey Symbols: Sample Sheet 2