

Procedure for Signalling Design

Document ID: W110-600-001

Revision Number: 2.00

This document is controlled within the Livelink Document Management System.

Please refer to the electronic version on Livelink to confirm you have the latest version.

Document Category:	Standard Procedure
Division:	Railway Safety Management
Applicable to:	Brookfield Rail Pty Ltd, Consultants, Contractors and External Parties

	Date	Name	Title	Signature
Owner:	16/09/2015	K Bulger	Signal Manager Projects & Standards	
Reviewer:	16/09/2015	J Ursic	Manager Control & Communications Systems	
Approver:	16/09/2015	P Larsen	Chief Executive Officer	

Document to be reviewed every 3 years

Document History

REV	Date	Amended By	Reviewer	Authoriser	Details of Amendment
1.00	24/12/1999	Signal Systems Manager	Control & Communications Manager	Project Director	Document created
1.01	18/01/2001	Signal Systems Manager	Control & Communications Manager	Project Director	Amended for WestNet Rail
1.02	30/07/2003	Signal Systems Manager	Control & Communications Manager	General Manager	Amended to update for current practice
1.03	15/10/2007	Signal Manager Projects & Standards	Control & Communications Manager	Chief Executive Officer	Updated to reflect current practice & organisation
2.00	16/09/2015	Signal Manager Projects & Standards	Manager Control & Communications Systems	Chief Executive Officer	General review & update to Brookfield Rail standard format. Content from cancelled procedure W110-600-002 (Safeworking System Selection) incorporated as new Appendix B

Table of Contents

1. PURPOSE	5
1.1. Policy.....	5
1.2. Objective	5
2. SCOPE	5
3. DISTRIBUTION LIST	5
4. REFERENCES	6
5. DEFINITIONS	7
6. RESPONSIBILITIES	9
6.1. Introduction.....	9
6.2. Design Engineers	9
6.3. Checking Engineers	9
6.4. Approving Engineers or Managers	9
6.5. Test Engineers	9
6.6. Commissioning Engineers	9
6.7. Witnessing Engineers	9
7. ACTIONS	10
7.1. Introduction.....	10
7.2. Design Methods	11
7.2.1. General.....	11
7.2.2. Correlation.....	11
7.2.3. Stageworks.....	11
7.2.4. Parallel Works	11
7.2.5. Design Version Control	11
7.2.6. Master Prints	12
7.3. Outline Design.....	12
7.3.1. Objective	12
7.3.2. Requirements	12
7.4. Detailed Design	13
7.4.1. Objective	13
7.4.2. Requirements - Design	14
7.4.3. Requirements - Checking.....	14
7.4.4. Requirements - Approval	15
7.4.5. Requirements - Acceptance.....	15
7.5. Construction	16
7.5.1. Objective	16
7.5.2. Requirements	16

7.6.	Testing.....	17
7.6.1.	Objective	17
7.6.2.	Requirements	17
7.7.	Commissioning.....	17
7.7.1.	Objective	17
7.7.2.	Requirements	17
7.8.	Records	18
7.8.1.	Objective	18
7.8.2.	Requirements	18
8.	DOCUMENTATION	18
8.1.	Introduction.....	18
8.2.	Applicable Standards	18
8.3.	Design Drawings	19
	Appendices	21
	Appendix A – System Selection	21
	Appendix B – Design Checklist	22
	Appendix C – Documentation Annotation	23
	Appendix D – Typical Design Review Notice	24

1. PURPOSE

1.1. Policy

Procedures to control, verify and validate signalling design shall be established and maintained for all signalling works undertaken by Brookfield Rail Control and Communications Systems personnel, consultants, contractors and external parties, to ensure that safety and functional requirements are met.

These Procedures set requirements and provide guidance for this phase of the signalling system's lifecycle in order to meet the Brookfield Rail's rail safety management requirements.

1.2. Objective

The objective of this document is to define a signal design procedure, which is to be followed for all signalling design activities relating to Brookfield Rail signalling systems.

Railway signalling systems provide the technical means of controlling train movements safely. Signalling systems consist of a number of specialist items of equipment that must be correctly configured and interfaced in order to deliver the required level of safety.

Signalling design is a critical phase in the lifecycle of signalling systems and must be carefully and formally managed in order that signalling systems are correctly configured and interfaced.

2. SCOPE

This procedure applies to all personnel responsible for design activities for signalling systems on the Brookfield Rail network. This includes all Staff, Contractors and Consultants.

The specified signal design process applies to all new signalling systems and any modifications to existing systems, including active level crossing warning systems. The procedure applies to all design related activities from initial concept design to commissioning.

While specifically applying to signalling systems, this procedure may also be applied to related systems and equipment, including those where functions may not have an affect safety but would nevertheless have impact upon overall system reliability (e.g. signalling control systems).

3. DISTRIBUTION LIST

Copy No.	Copy Holder
1	Signal Manager Projects and Standards
2	Senior Signal Project Engineer
3	Signal Project Engineer
4	Project Manager Level Crossings

4. REFERENCES

Western Australia Rail Safety Act 2010.

Western Australia Rail Safety Regulations 2011.

AS 4300: 1995: Australian Standard: General Conditions of Contract for Design and Construct.

W110-100-017: Procedure for Risk Management.

W110-600-003: Procedure for Alterations to Signalling & Associated Systems.

W110-600-004: Procedure for Type Approval of Signalling Equipment.

W110-600-005: Procedure for Signal Sighting.

W110-600-007: Procedure for Witnessing Externally Performed Signalling Testing & Commissioning.

W110-600-008: Procedure for Signalling System Testing & Commissioning.

W110-600-009: Procedure for Construction of Signalling Installations.

W110-600-010: Procedure for Safeworking Risk Assessments for Signalling Commissionings.

W110-600-011: Procedure for the Preparation of a CAD Drawing for Control & Communication Systems.

W110-600-018: Procedure for the Control of Signal Engineering Competencies.

W110-600-046: Procedure for the Control of Software Installed in Vital Signalling Systems.

W103-600-001: Design Principles for Level Crossing Warning Systems.

W103-600-002: Design Principles for Self Restoring Points in Train Order Territory.

W190-600-001: Code of Practice for Signalling Design Principles for PBI.

W190-600-002: Code of Practice for Signal System Testing & Commissioning.

W190-600-003: Code of Practice for Signal Design Principles Past Practices.

W190-600-005: Code of Practice for Signalling Construction.

W190-600-006: Code of Practice for Signal Bonding.

W190-600-007: Code of Practice for Signal Equipment Software.

5. DEFINITIONS

Where used within this document and all other referenced Brookfield Rail procedures, principles and codes of practice the terms listed here have the following specific meaning.

Acceptance: Denotes that a contractor's or external party's design is approved for construction. Note that the contractor or external party must first approve the design.

Approval: Denotes that a signalling design or other documentation has been produced in accordance with this procedure, is fit for purpose and conforms to contracted requirements, where applicable. For Brookfield Rail designs approval is given by the Signal Manager Projects & Standards. For contractor's designs approval will normally be by the project engineer or project manager responsible for the works, or as otherwise agreed with the Signal Manager Projects & Standards.

Approval for Construction: Denotes that a signalling design is acceptable for construction. Upon receipt of this factory pre-wiring and site construction activities may proceed. For both Brookfield Rail and external designs approval for construction may only be granted by the Signal Manager Projects & Standards, or a nominated representative.

As Built Records: The finalised records of a commissioned signalling design.

Checking: The validation of design details for a new or altered signalling system by a competent person other than the designer.

Checking Engineer: A person responsible for carrying out the checking of all or part of the works associated with a new or altered signalling system.

Commissioning: The bringing into service of a constructed design for a new or altered signalling system.

Commissioning Engineer: A person appointed to lead the commissioning of a new or altered signalling system.

Contractor: A person or organisation contracted to carry out all or part of the works associated with a new or altered signalling system. As such the contractor carries the complete responsibility for the works undertaken.

Correlation: The direct comparison of the current signalling records against the site installation, in order to establish any discrepancies.

Design: The production of design details for a new or altered signalling system.

Design Engineer: A person responsible for carrying out the design of all or part of the works associated with a new or altered signalling system.

External Party: A person or organisation undertaking all work on Brookfield Rail's signalling system on their own behalf, i.e. not as a contractor. As such the external party carries the complete responsibility for the works undertaken.

Factory Acceptance Test (FAT): Off-site testing of new or altered signalling infrastructure. This may be of hardware and/or software and may be carried out on the final equipment prior to installation or on a simulator.

Inspection and Test Plan: A document that details the proposed program and procedures to be used for the inspection and testing of the works associated with a new or altered signalling system.

Major Works: Works that do not qualify as Minor Works.

Document Id:	W110-600-001	Issue Date:	16/09/2015
Rev #:	2.00	Pages:	7 of 25

Manager Control and Communications Systems (C&CS): The Brookfield Rail manager with overall responsibility for its signalling & communications infrastructure.

Master Record: The document that defines the current state of part of the signalling infrastructure. This can be in the form of a plastic film “negative”, a paper print or a CAD file. Brookfield Rail’s preferred form of master record is the Autocad .dwg CAD file.

Minor Works: Works that can be carried out in a single commissioning without the need for any prior stageworks or FAT testing of new hardware.

Parallel Works: Two or more different works requiring alterations to the same drawing or drawings at the same time.

Principal: The term “Principal” is as defined in AS4300. For the purposes of this document the Principal is Brookfield Rail Pty Ltd, 2-10 Adams Drive, Welshpool, WA 6106.

Project Engineer: The person with overall responsibility for the technical aspects of all or part of the works associated with a new or altered signalling system.

Project Manager: The person with overall responsibility for the management of all or part of the works associated with a new or altered signalling system.

Safeworking: The means of manual working applied to protect train operations and the general public during the passage of trains when a signalling system is degraded during alterations or commissioning.

Safeworking Officer in Charge: The person nominated by the Network Operations Manager or his representative as being responsible for safeworking during signalling alterations or commissionings.

Signal Manager Projects & Standards: The Brookfield Rail manager with overall responsibility responsible for signalling project work. This includes design and construction, standards for signalling systems and active level crossing protection, project management, and testing & commissioning.

Significant Modification: A modification that involves a change to the design other than a simple positional change or an error correction, e.g. changing a contact from A1-A2 to B1-B2 is significant whereas moving a relay’s rack position is not.

Superintendent: The person nominated by Brookfield Rail as responsible on their behalf for the supervision of signalling system construction work.

Test Copy: Drawings, plans, schedules and other documentation used for carrying out and recording the testing of a new or altered signalling system.

Test Engineer: A person responsible for carrying out the testing of all or part of the works associated with a new or altered signalling system.

Testing: The verification of a constructed design for a new or altered signalling system.

Up-Issue: A means of identifying that a design has changed by an incremental change in its status, e.g. revision A becomes revision B. An amendment record identifying the reason for the change normally accompanies such changes of status.

WestNet Rules: The operating rule book that applies to all persons working on Brookfield Rail’s infrastructure.

Witness or Witnessing Engineer: The person nominated by Brookfield Rail to witness externally performed signalling system testing & commissioning on its behalf.

Works: All the activities required to plan, design, construct, test and commission a new or altered Brookfield Rail signalling system.

Document Id:	W110-600-001	Issue Date:	16/09/2015
Rev #:	2.00	Pages:	8 of 25

6. RESPONSIBILITIES

6.1. Introduction

The Signal Manager Projects & Standards has overall responsibility for the design and documentation of new or altered signalling systems for Brookfield Rail.

Signalling works may be carried out entirely by Brookfield Rail, by a contractor/external party or by a combination of both. Where the latter applies the responsibilities of each party shall be clearly set out in the contractual documentation.

Brookfield Rail may employ consultants to carry out elements of signalling works. Where this applies the consultant(s) shall comply with these procedures in the same way as Brookfield Rail staff.

6.2. Design Engineers

Design engineers are responsible for the design of new or altered signalling systems, in accordance with this procedure.

6.3. Checking Engineers

Checking engineers are responsible for the independent validation of designs for new or altered signalling systems, in accordance with this procedure.

6.4. Approving Engineers or Managers

Approving engineers or managers are responsible for ensuring that new or altered signalling systems issued for construction have been produced in accordance with this procedure.

6.5. Test Engineers

Test engineers are responsible for verifying that the construction of new or altered signalling systems is in accordance with the approved design and Brookfield Rail's signalling principles, in accordance with procedure W110-600-008. Where necessary, test engineers must ensure that any deviation from the approved design is agreed with the designer and recorded on the testing copy.

6.6. Commissioning Engineers

Commissioning engineers are responsible for bringing new or altered signalling systems into service, having ensured that they have first been fully tested, in accordance with procedure W110-600-008. They are also responsible for ensuring that As Built records are produced and forwarded to the Signal Manager Projects & Standards for records update after commissioning.

6.7. Witnessing Engineers

Witnessing engineers are responsible for witnessing contractor's or external parties' factory acceptance tests (FAT) and commissionings on Brookfield Rail's behalf, in accordance with procedure W110-600-007.

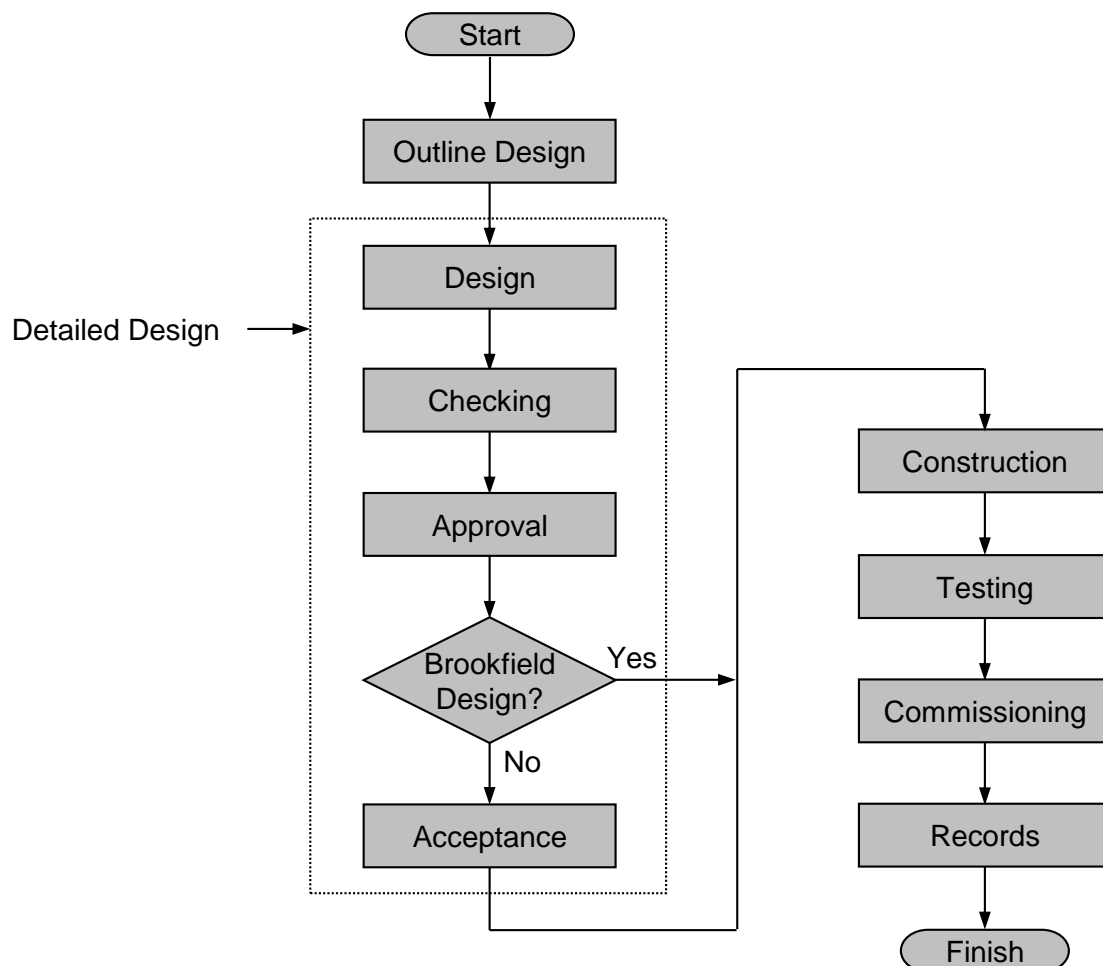
7. ACTIONS

7.1. Introduction

The design process for signalling systems includes all activities from concept design to commissioning. Each activity supports the previous one and adds to the assurance that the design is safe and fit for purpose. The process sets out: -

- a) Specific activities required during each phase of the process, and;
- b) How the activities are to be recorded, and;
- c) The requirements for the identification, control and issue of design documents.

The general process is shown in the following flowchart, and detailed in the sections that follow. Certain activities are interrelated and may require a number of iterations, e.g. design and checking, and others may be divided into several stages, e.g. FAT and site testing.



7.2. Design Methods

7.2.1. General

Design shall be documented by hand drawing or by use of Computer Aided Design (CAD). Where CAD is used drawings shall be produced in accordance with procedure W110-600-011. Designs shall be recorded on: -

- a) Copies of Brookfield Rail's current signalling records, or;
- b) New drawings.

All designs shall be neatly and legibly drawn such that their meaning is clear and unambiguous. To aid understanding the following colours shall be used: -

- c) Red indicates equipment or wiring to be installed, and;
- d) Blue indicates equipment or wiring to be removed, and;
- e) Orange indicates stage work equipment or wiring to be installed, and;
- f) Purple indicates stage work equipment or wiring to be removed, and;
- g) Green indicates an error on an original drawing corrected during the design process.

Other colours may be used provided that they do not create any ambiguity and that a key to their meaning is provided on each drawing on which they are used.

7.2.2. Correlation

Correlation of the current signalling records shall be carried out at the outline design stage if there is any doubt as to the accuracy of the records.

7.2.3. Stageworks

Stageworks may be required for particular projects. Where this applies the stage to which the work applies must be clearly identified on the design drawings. Note that multiple stageworks on the same set of drawings is not permitted, except at the sole discretion of the Signal Manager Projects & Standards.

7.2.4. Parallel Works

Parallel work on the same set of drawings is not permitted, except at the sole discretion of the Signal Manager Projects & Standards.

7.2.5. Design Version Control

A Design that has been formally approved shall only be modified as follows: -

- a) The design status must be up-issued, and;
- b) The change must be fully checked and re-approved.

Designs by a contractor or external party do not require resubmission to Brookfield Rail for acceptance unless there is a significant change in scope, safety integrity or functionality.

7.2.6. Master Prints

Once a design is approved a master print shall be produced and signed by the designer, checking engineer and approver. All copies used in the design process shall use direct copies of this master print. All modifications shall be recorded on the master print by the designer or checking engineer, who shall initial and date the master print. All significant modifications shall be incorporated into an up-issue of the design and re-approved prior to its issue for the next phase of the works.

7.3. Outline Design

7.3.1. Objective

The objective of the outline design phase is to produce a complete and unambiguous scope for the project, for estimating and initial project approvals. The output documentation of the outline design phase provides the input documentation for the detailed design phase.

7.3.2. Requirements

The following requirements apply to the outline design stage: -

- a) Outline design shall normally be carried out by Brookfield Rail's signal projects section, although external consultants may be used for all or part of the design activities as required, and;
- b) Signalling system and/or active level crossing protection system selection shall normally be carried out at this stage, taking into account the factors set out in Appendix A. The system(s) selected shall be agreed with the Network Operations Manager and, if appropriate, other infrastructure engineering areas, and;
- c) Significant changes from previous practice, and all major projects, shall be subject to risk assessment as set out in procedure W110-100-017: Risk Management, and;
- d) Where an outline design document will form part of the final design it must be produced in accordance with the requirements of section 7.4 – Detailed Design.

7.4. Detailed Design

7.4.1. Objective

The objective of the detailed design phase is to produce an error free signalling design approved for construction. It consists of three stages for Brookfield Rail designs, and four for designs by contractors or external parties. The stages are: -

- a) Design – all the surveying, correlation, calculation, design and drafting work required to deliver a complete and fit for purpose design ready for checking, and;
- b) Checking – a detailed check carried out by a checking engineer not involved in the design stage to verify that a design is complete and fit for purpose, and;
- c) Approval – a review by an authorised person that a signalling design or other documentation has been produced in accordance with this procedure, is fit for purpose and, where applicable, conforms to contracted requirements. Where the design is by a contractor or external party a further stage is required;
- d) Acceptance – a review by Brookfield Rail that a design by a contractor or external party is acceptable for construction.

A number of iterations may be required to deliver an approved design, all of which shall be carried out using the same basic process.

Designers and checking engineers need to consider a range of factors when carrying out detailed design; refer to Appendix B as a guide.

7.4.2. Requirements - Design

The following requirements apply to the design stage: -

- a) Designers shall meet the competence requirements set out in procedure W110-600-018, and;
- b) Designs shall be produced in accordance with the scope documentation developed at the outline design phase, and;
- c) Designs shall be produced in accordance with all relevant Brookfield Rail signalling principles, procedures and codes of practice, and;
- d) Designers shall carry out their own check to ensure that designs issued for checking contain minimal errors.

Once complete, the designer shall pass the design on to the checking engineer for the checking stage.

7.4.3. Requirements - Checking

The following requirements apply to the checking stage: -

- a) Checking engineers shall meet the competence requirements set out in procedure W110-600-018, and;
- b) Designs shall be verified to ensure that they are: -
 - i) Safe, and;
 - ii) In accordance with the scope documentation developed at the outline design phase, and;
 - iii) Compliant with all relevant Brookfield Rail signalling principles, procedures and codes of practice, and;
 - iv) Designed to maximise reliability, and;
 - v) Designed to minimise the impact of faults, and;
 - vi) Error free.
- c) Checking shall be documented by the application of tick marks on a copy of the design documents marked as a checking print. Any errors found or comments to be addressed shall be either marked on the drawings or listed in an error report, design review notice (DRN, see Appendix D for typical example) or similar. The checker shall initial or sign the document, denoting whether it is fully accepted or requires correction.

Once checking is complete the checking engineer shall either: -

- d) Return the design to the designer if any errors require correction or comments are to be addressed, or;
- e) Pass the design on for approval.

7.4.4. Requirements - Approval

The following requirements apply to the approval stage: -

- a) Approving engineers or managers shall meet the competence requirements set out in procedure W110-600-018, and;
- b) Designs shall be reviewed by the approving engineer or manager to the degree required to satisfy themselves that the design: -
 - i) Has been produced in accordance with this procedure, and;
 - ii) Is complete and fit for purpose, and;
 - iii) Where carried out by a contractor or external party, conforms to the contracted requirements.

Once the approval review is complete the approving engineer or manager shall either: -

- c) Return the design to the checking engineer if any errors require correction or comments are to be addressed, or;
- d) Approve the design, which shall be denoted by the approving engineer or manager initialling/signing and dating the design.

Once every element of a particular design has been approved the whole design shall be: -

- e) Issued to Brookfield Rail for Acceptance, where the design is carried out by a contractor or external party, or;
- f) Approved for Construction, where the design is carried out by Brookfield Rail.

7.4.5. Requirements - Acceptance

The following requirements apply to the acceptance stage: -

- a) Acceptance reviews shall be carried out by the Signal Manager Projects & Standards or nominated representative for particular projects, and;
- b) Designs shall be reviewed to the degree required to provide a reasonable assurance that the design: -
- c) Has been produced in accordance with this procedure, and;
 - i) Is complete and fit for purpose, and;
 - ii) Conforms to the contracted requirements.

Once the approval review is complete the Signal Manager Projects & Standards or nominated representative engineer or manager shall inform the contractor of the acceptance status. Acceptance status shall be one of the following five categories: -

<u>Category</u>	<u>Denotes</u>
1 - Accepted without comment: -	The design is Approved for Construction.
2 - Accepted with comments: -	The design is Approved for Construction, subject to resolution of the identified comments as set out in the review documentation.
3 - Not Accepted: -	The design is not Approved for Construction. The identified comments should be addressed and the design resubmitted.
4 - Rejected: -	The design is fundamentally flawed and will not be acceptable to Brookfield Rail in its current form.
5 - Noted for Information: -	Formal acceptance is not required.

Note that contractual requirements for particular projects may require a number of design submissions to be made as the design is developed, or alternatively contractors or external parties may choose to provide these at their own volition to assure themselves that the design is developing in the right direction or where early Approval for Construction is required for a particular design element.

7.5. Construction

7.5.1. Objective

The objective of this phase is to construct the approved design ready for testing.

7.5.2. Requirements

The following requirements apply to the construction stage: -

- a) All construction activities shall be carried out in accordance with procedure W110-600-009, and;
- b) Construction copies shall be the same version as the approved design, and;
- c) Any proposed significant modification to the approved design shall first be raised with the designer and recorded on a formal modification sheet.

Any significant modifications to the design shall be incorporated into an up-issue and re-approved prior to issue for testing. Other modifications must be recorded on the master copy prior to issue for testing.

7.6. Testing

7.6.1. Objective

The objective of this phase is to verify the works conforms to the approved design and is safe and fit for purpose.

7.6.2. Requirements

The following requirements apply to the testing stage: -

- a) All testing activities shall be carried out in accordance with procedure W110-600-008, and;
- b) Testing copies shall be the same version as the approved design, and;
- c) Any significant modification required to the approved design shall be raised with the designer and recorded on a formal modification sheet and the testing copies, and;
- d) Other modifications shall be marked on the testing copies.

Any significant modifications to the design shall be incorporated into an up-issue and re-approved prior to issue for commissioning. Other modifications must be recorded on the master copy prior to issue for commissioning.

7.7. Commissioning

7.7.1. Objective

The objective of this phase is to bring a fully tested new or altered signalling installation into service.

7.7.2. Requirements

The following requirements apply to the commissioning stage: -

- a) All commissioning activities shall be carried out in accordance with procedure W110-600-008, and;
- b) Commissioning copies shall be the same version as the approved design, and;
- c) Any significant modification required to the approved design shall be raised with the designer and recorded on a formal modification sheet and the commissioning copies, and;
- d) Other modifications shall be marked on the commissioning copies, and;
- e) All modifications shall be marked on the maintenance copies.

Once commissioned the original or a colour copy of the commissioning copies together with a copy of the commissioning certificate shall be forwarded to the Signal Manager Projects & Standards or nominated representative engineer or manager.

7.8. Records

7.8.1. Objective

The objective of this phase is to provide a true record of the commissioned works for maintenance and subsequent alterations.

7.8.2. Requirements

The design records must be finalised by: -

- a) The removal of all recovered wiring and equipment as coloured in blue, purple or other designated colour, and;
- b) The conversion to black of any new wiring and equipment shown in red, orange or other designated colour, and;
- c) The conversion to black of any errors marked in green, and;
- d) The incorporation of any modifications as marked on the commissioning copies.

The drawings must be checked and approved in a similar manner to the detailed design process, including an acceptance review for designs by contractors and external parties. Note that it is permissible for a draftsman to carry out the design changes in place of a designer, provided that they are provided with clear and complete documentation of the changes required.

Once the designs are finalised the source record files shall be forwarded to Brookfield Rail's C&CS drawing office for the storage and issue of record copies under procedure W110-600-011.

8. DOCUMENTATION

8.1. Introduction

Due to their safety critical nature signalling systems require clear, complete and correct documentation. This section sets out Brookfield Rail's general requirements, although the documentation requirement may vary for specific systems.

The documentation set out in this section shall be produced/amended as required when designing all new or altered signalling works. However, for alterations to existing installations, unless otherwise specified in the project scope the documentation requirement is generally limited to amending what exists for the existing installation, e.g. if there is no existing contact analysis then there is no requirement to produce one, either for new relays or alterations to existing ones.

8.2. Applicable Standards

All current Brookfield Rail standard procedures and codes of practice applicable to the signalling design and related processes are maintained in PDF format on the Brookfield Rail intranet.

Copies of the Brookfield Rail standard procedures and codes of practice applicable at the time of contract or other agreement will be issued to contractors or external parties by the Signal Manager Projects & Standards or nominated representative for particular projects. Subsequent changes to standards will be varied into the contract or other agreement as required.

Document Id:	W110-600-001	Issue Date:	16/09/2015
Rev #:	2.00	Pages:	18 of 25

8.3. Design Drawings

The following design drawings shall be produced for new or altered signalling systems: -

a) A Diagram of Signalling;

This shall show the area covered by the system of safeworking and the signalling equipment provided for that purpose. The diagram of signalling shall show the track layout in a single line diagrammatic form, which is not drawn to scale.

The position of signalling equipment is to be spaced for legibility and positioned correctly relative to each other, the distance between signals being shown on the diagram.

Details shown on the diagram shall include the following:

- i) Road level crossings;
- ii) Pedestrian level crossings;
- iii) Stations;
- iv) Signals;
- v) Points;
- vi) Switch locks and points machines;
- vii) Track circuits including boundaries;
- viii) Location of pilot keys
- ix) Location of crank handles;
- x) Signal clearance points;
- xi) Signage;
- xii) Telephones;
- xiii) Critical Distances
- xiv) Other items considered critical for safeworking.

b) A Scale Signalling Plan;

This shall depict the overall track, signalling and safeworking arrangements. Scale signalling plans shall show the track layout for an interlocking drawn to a longitudinal scale of 1:2,000, or 1:1,000 if required for clarity and legibility.

Scale signalling plans shall be drawn on a single line basis, i.e. with each pair of rails shown as a single line, with the up direction, normally Perth, on the left side of the plan. Tracks are to be drawn straight or curved to scale.

The positions of items laterally are not drawn to scale but shall be spaced for legibility and positioned correctly relative to each other.

Details shown on the plan shall include the following:

- i) Kilometre points;
- ii) Bridges (over and under);
- iii) Viaducts;
- iv) Road level crossings;
- v) Pedestrian level crossings;
- vi) Stations;
- vii) Relay rooms and signal equipment rooms;
- viii) Signals and indicators;
- ix) Signal cable route;
- x) Location cases;
- xi) Pilot keys;
- xii) Crank handles;
- xiii) Signal clearance points;
- xiv) Switch locks and points machines;
- xv) Track circuits including boundaries;
- xvi) Ground frames;
- xvii) Hand points;
- xviii) Catch points;
- xix) Signage;
- xx) Special indicator boards;
- xxi) Other items considered critical for signalling.

c) A Bonding Plan;

This shall depict the arrangement of insulated rail joints (IRJ), track circuit feed and relay end connections, polarities and interconnecting jumper cables. This may be an individual bonding plan or form part of other design drawings, e.g. location drawings.

d) A Control Table;

This shall depict the signalling controls for all the functions required in an interlocking. This shall include actively protected level crossings.

e) Circuit wiring diagrams.

f) Equipment room and rack layout diagrams.

g) Cable layout & termination analysis.

h) Relay layout & contact analysis diagrams.

i) Power supply arrangements, including power supply cubicle designs and distributions schematics.

j) Logic equations, data definitions, and configuration parameters for programmable interlockings, control and indication equipment.

k) A diagram showing train controller's control screen or panel layouts.

Appendices

Appendix A – System Selection

This appendix details factors that should be considered when selecting the signalling system and/or active level crossing protection system for a project at the outline design stage. These factors will not apply to all projects, and are not necessarily comprehensive.

- a) Operational requirements, e.g. section running times, number of crossing movements, headways, loop capacity, line speed;
- b) Signalling system elements proposed, e.g. signal, point and train detection types, and the interlocking, train control system and communications systems required to control and monitor these;
- c) Active level crossing equipment requirements;
- d) Power supply requirements, for normal operations and standby supplies in the event of power failure.
- e) Operational safety requirements, e.g. train separation, gauge detection/selection, signal spacing, point operation, level crossing protection;
- f) Compliance with WestNet Rules and other supporting documents – amendments or new procedures may be required for the selected system.
- g) Degraded mode requirements, e.g. pilot key working, hand crank operation of points;
- h) Personnel safety requirements;
- i) System requirements, e.g. reliability, availability, maintainability;
- j) Engineering support requirements.

Appendix B – Design Checklist

This appendix details factors that should be considered as a guide when carrying out design and checking activities. These factors will not apply to all designs, and are not necessarily comprehensive.

- a) Safety integrity – both for normal operation and failure modes;
- b) Reliability;
- c) Availability;
- d) Maintainability;
- e) Construction – designers should attempt to minimise and simplify construction, testing and commissioning activities.
- f) Interface compatibility;
- g) Completeness;
- h) Correctness of documentation details;
- i) Power supply calculations;
- j) Voltage drop calculations;
- k) Cable sizes;
- l) Timing calculations;
- m) Type and rating of equipment, including whether the equipment is type approved;
- n) Applicable codes of practice, design principles etc.

Appendix C – Documentation Annotation

This appendix details suggested drawing stamps & annotations that may be used at various stages of the design process. These are not mandatory or intended to be comprehensive, but all documentation should be clearly and unambiguously marked to denote its intended purpose.

	DATE	NAME	POSITION	SIGNED
DESIGNED				
DRAWN				
CHECKED				
APPROVED				

The check box above may be used to record each design stage on a drawing.

OFFICE COPY

The above stamp may be applied to the copy of a document that is used in the Design Office for office reference.

WIRING COPY

The above stamp may be applied to the copy of a document that is issued for installing new or altered signalling.

SUPERVISORS COPY

The above stamp may be applied to the copy of a document that is issued to the Regional Signalling Superintendent for reference.

TEST COPY

The above stamp may be applied to the copy of a document that is issued for testing new or altered signalling.

COMMISSIONING COPY


The above stamp may be applied to the copy of a document that is issued for commissioning new or altered signalling.

MAINTENANCE COPY

The above stamp may be applied to the copy of documentation that is supplied for maintenance use following a commissioning.

Appendix D – Typical Design Review Notice

The format of a typical Design Review Notice (DRN) is shown below. The latest version of this form is available on the Brookfield Rail intranet or upon request to the Signal Manager Projects & Standards.

		Design Review Notice <<Project Name>>	
Project:	<<Project Name>>		
Documents For Review:	<<List Drawing Nos., Title and revision status. A separate list may be attached for large submissions>>		
Design Submitted By (Company & Ref):	<<List the transmittal note or other means of document receipt, including the date>>		
Reviewers:	<<Name>>		
Discipline:	<<Discipline>>		
Review Date:	<<Date>>	Review Stage:	85%
Review Reference:	<<Reference>>		
Acceptance Status:	<<1 – 5>> <<Also add any restrictions or qualifications, e.g. acceptance may be up to FAT only>>		
Comments:	<<Comments here if small number, if not list comments in table on page 2>>		
Signed:			

Ref	Diagram/Document	Comment
1.		
2.		
3.		
4.		