

COST-EFFICIENT ELECTRIFICATION OPTIMISED SECTIONING AND SWITCHING

PWI West of England Section Meeting
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Presenters:

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OPTIMISED SECTIONING AND SWITCHING DRIVERS FOR CHANGE

- Current sectioning and switching practice essentially unchanged since at least 1960s
- Not codified in standards
- Different projects take differing approaches
- Potentially excessive sectioning = higher capex, more assets to maintain
- Potentially over-complex switching = higher capex, more assets to maintain

OPTIMISED SECTIONING AND SWITCHING

ATKINSRÉALIS REMIT

- AtkinsRéalis commissioned to undertake study for Network Rail Technical Authority to review current practices in designing the sectioning and switching for OCS systems
- Focus on electrical, operational and maintenance needs
- Develop proposals for new electrification of two track railways

OPTIMISED SECTIONING AND SWITCHING METHODOLOGY

- Assessment of existing sectioning logic on:
 - Great Western Mainline
 - Glasgow to Edinburgh via Falkirk High
 - Great Eastern Mainline
- Requirements separately identified for:
 - Maintenance
 - Operations
 - Electrical Power and Distribution
- Rationale for new electrification developed
- Tested by applying to Bromsgrove to Gloucester and Westerleigh Junction crosscountry route

OPTIMISED SECTIONING AND SWITCHING

SUMMARY OF FINDINGS FOR GW FOUR TRACK SECTION

- Maidenhead MPATS to Foxhall Junction ATFS (Didcot)
 - 195 sectioning locations, ~130 assessed
 - 21 considered unnecessary or “nice to have”, 43 desirable
- Mostly relate to loops, Reading Station and ATF sectioning

OPTIMISED SECTIONING AND SWITCHING

SUMMARY OF FINDINGS FOR GW TWO TRACK SECTION

- Wootton Bassett Junction to Stoke Gifford West Junction
 - 58 sectioning locations assessed
 - 19 considered unnecessary, 16 not essential
- 15 isolators (14 motorised, 1 manual) unnecessary, 15 not essential (13 motorised, 2 manual).
- Mostly relate to loops, Bristol Parkway and ATF sectioning
- NR Western Route - most switching at Bristol Parkway would never be used, challenges with isolations / access points at Chipping Sodbury Tunnel

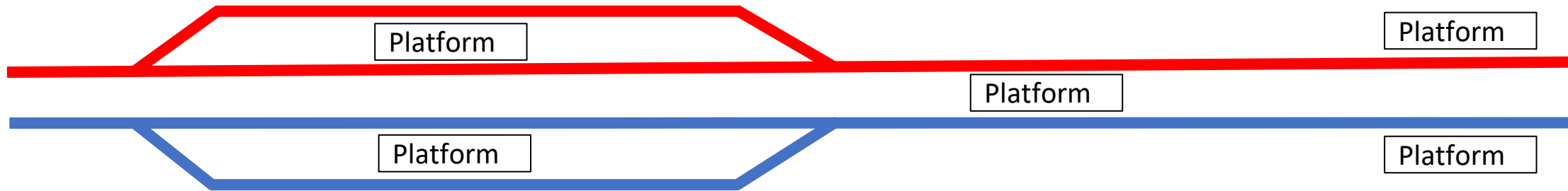
OPTIMISED SECTIONING AND SWITCHING

PROPOSED PRINCIPLES FOR SECTIONING

- Principles based on Minimum Viable Product requirements for:
 - Maintenance
 - Operations
 - Electrical Power and Distribution

OPTIMISED SECTIONING AND SWITCHING KEY PROPOSALS

- Define “Fault Isolation” and “Possession Isolation”
- Degraded modes to be identified at design stage
- No need for loops to be separately isolated unless justified
- No need for platforms to be separately isolated unless justified



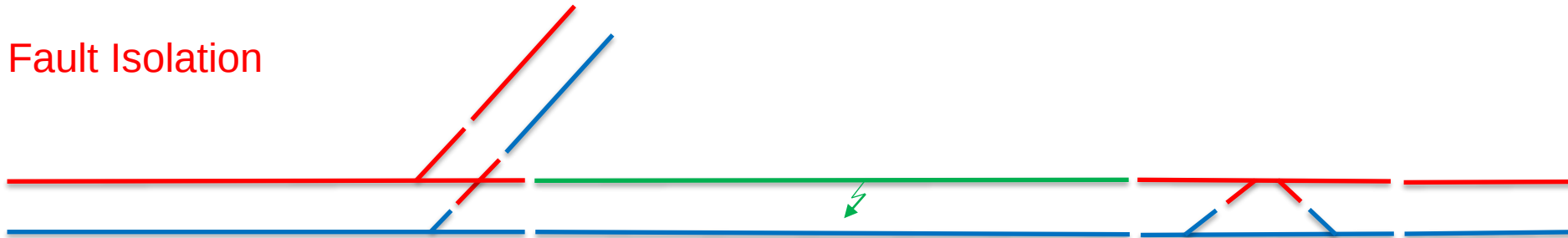
- No need for ATF to be isolated at auto-transformer sites
- Additional sectioning requested by O&M to be justified
- Principles in line with NR/L1/ELP/27000, with exceptions which will be noted in slides

OPTIMISED SECTIONING AND SWITCHING CONCEPT OF FAULT AND POSSESSION ISOLATIONS

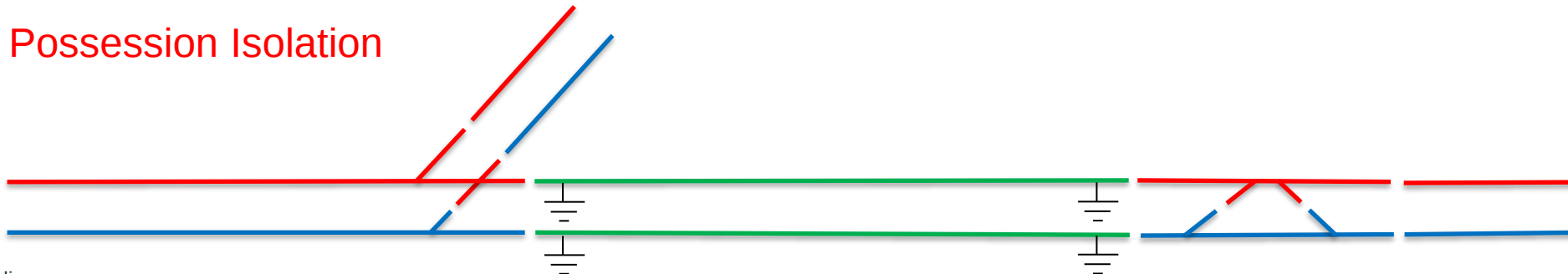
Normal Feeding



Fault Isolation



Possession Isolation



Electrical Power and Distribution

Electrical sectioning required to separate different phases and different electrical sections.

Up and Down lines to be separate electrical sections (no change to current practice)

UP



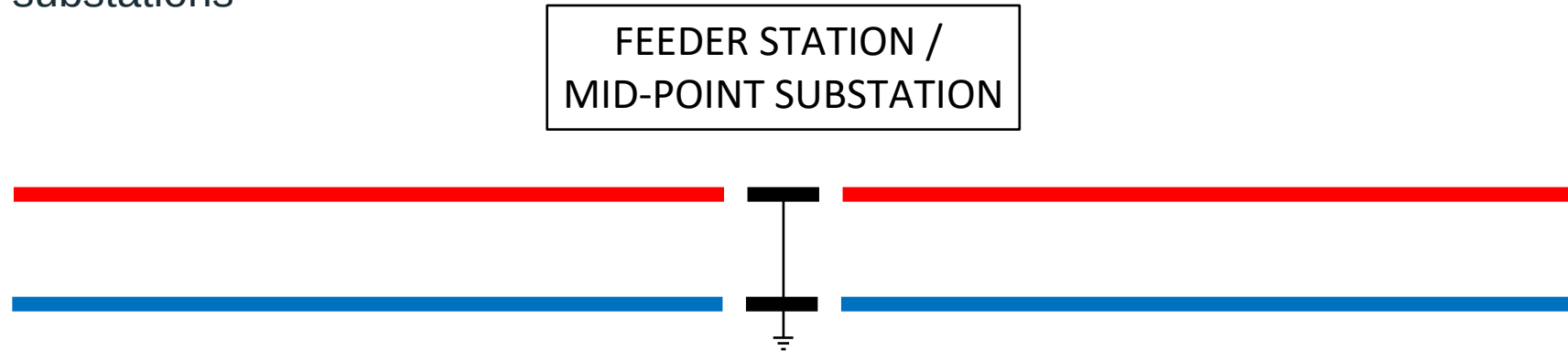
DOWN



Substations - Electrical

Where practicable, substation sectioning should be provided at same location as operations and maintenance sectioning.

Neutral sections shall be provided at phase separations, generally feeder stations and mid-point substations

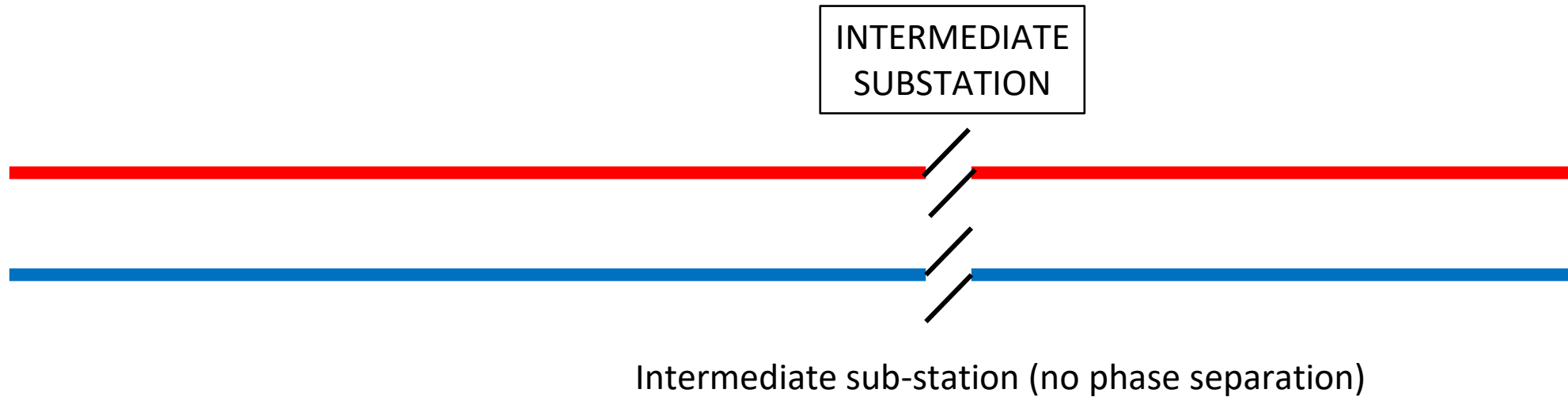


Neutral Sections:

- Either carrier wire type or the short in-line type (such as Arthur Flury)
- Located to ensure that trains starting from a standstill have enough momentum to not become stranded
- Where located near stations, the impact on sectional running times for stopping trains assessed and agreed before the location is confirmed

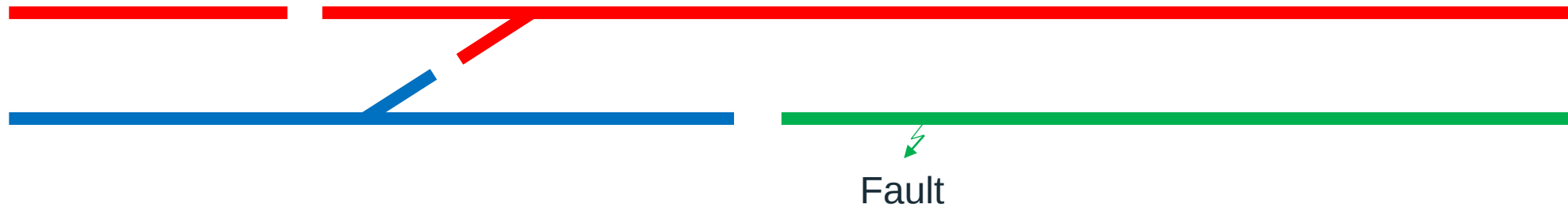
Substations - Electrical

Overlaps shall only be provided at intermediate substations if required to support protection system (see also rationalised switching proposals)



Single Crossovers – No Turnback Facility

If bi-directional working is possible then sectioning should be provided at crossover locations to enable trains to by-pass a section of OCS that is isolated due to a fault (Fault Isolation). The minimum number of sectioning points should be provided.



NR/L1/ELP/27000 Clause 4.7.9

Single Crossovers – with Turnback Facility

Sectioning should be provided at crossover locations to enable trains to reverse in live section of OCS. The minimum number of sectioning points should be provided.

Turnback from left, both lines to right isolated – Possession Isolation

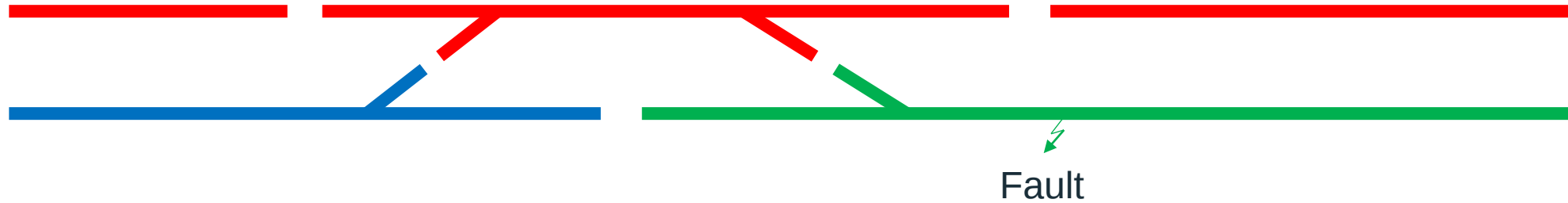


Sectioning beyond limit of shunt

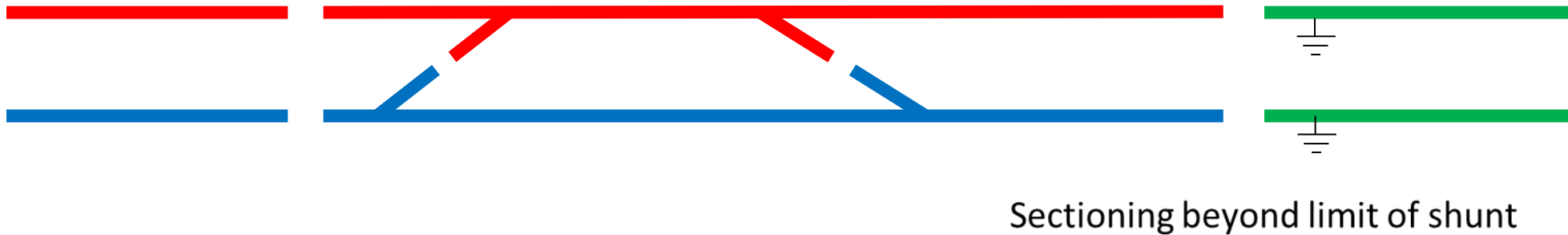
NR/L1/ELP/27000 Clause 4.7.9

Two Crossovers – Facing and Trailing

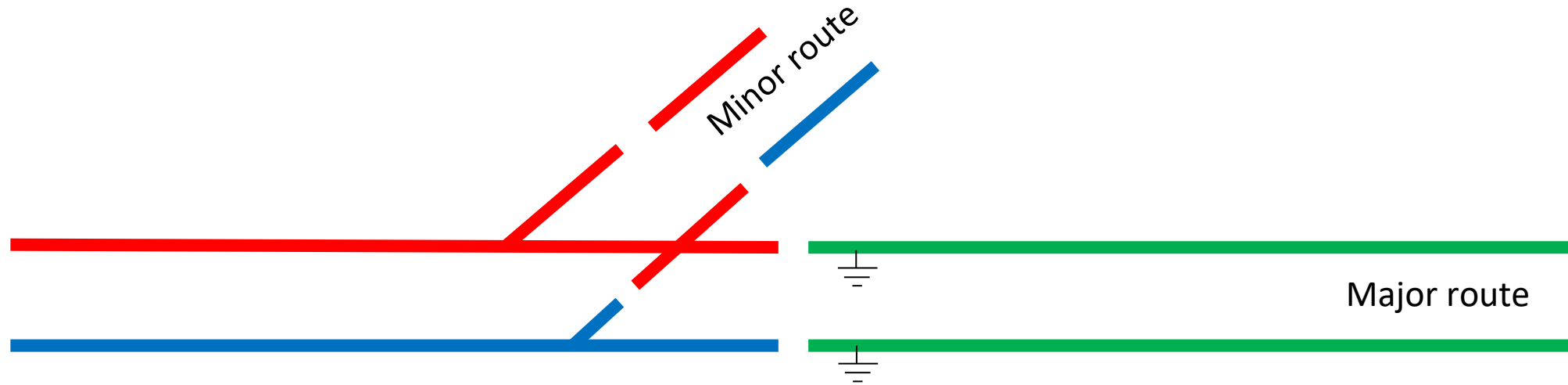
No turnback facility (fault isolation only)



With turnback facility (turnback from left, both lines to right isolated – possession isolation)

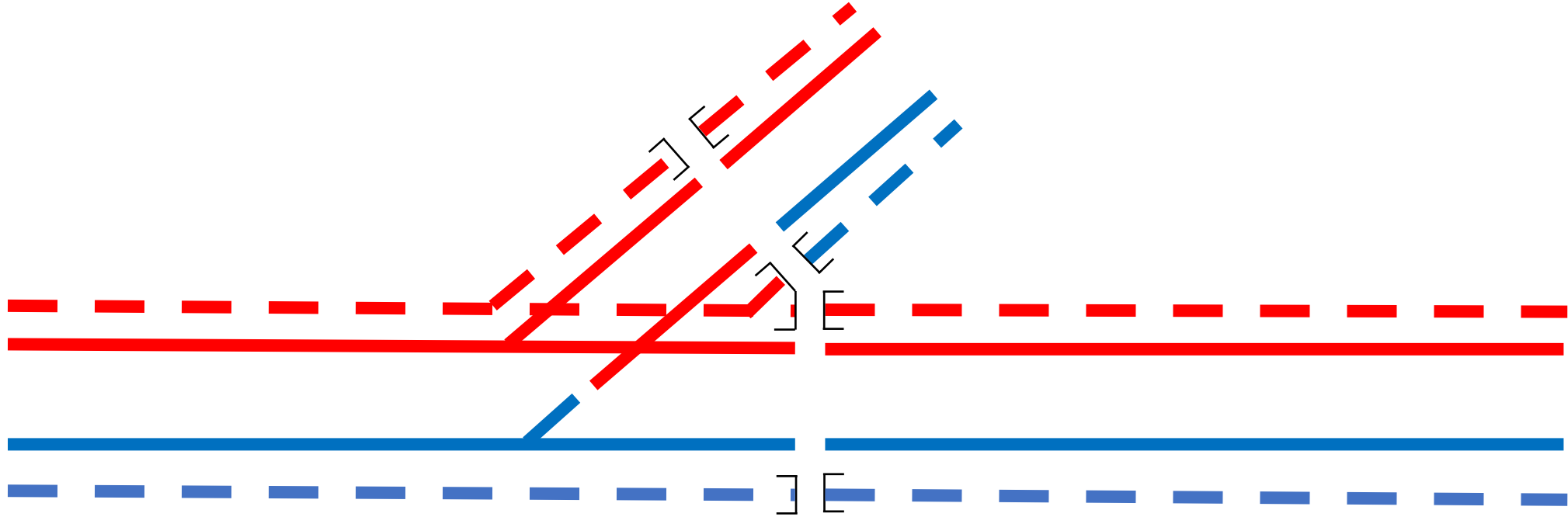


Diverging Junction



- Sectioning provided on both divergent legs
- Enables faults to be isolated, railway to remain open on electrical sections not isolated (Fault Isolation)
- Enables railway to remain open on route not isolated for maintenance (Possession Isolation). Major route shown isolated above
- Sectioning location should be within the limits of associated possessions
- Sectioning should be provided between the electrical sections on the major route

Auto Transformer Feeders - Junctions

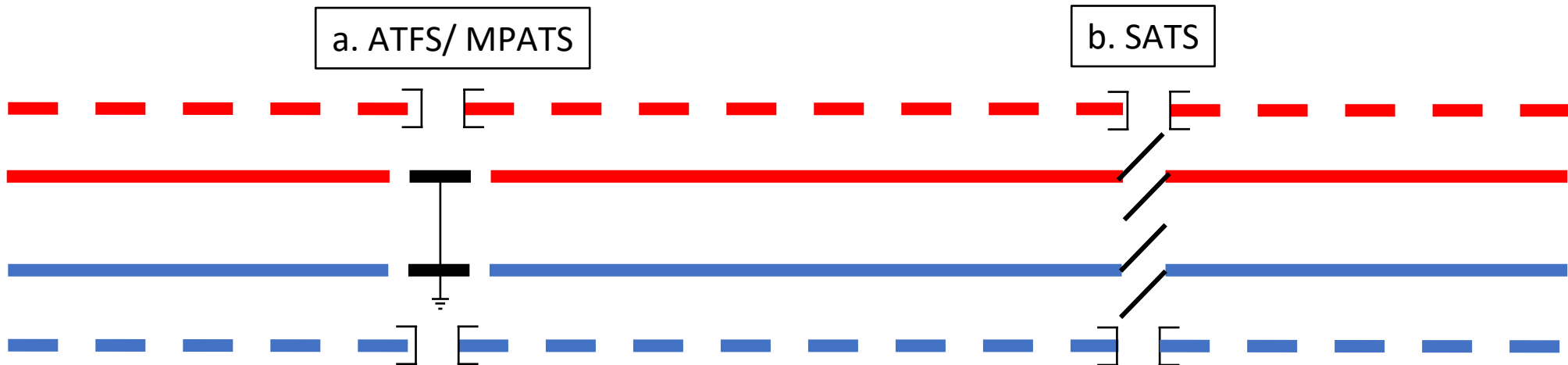


- Sectioned at diverging junctions where both divergent legs have ATF installed for both Fault and Possession Isolations
- Sectioning should be parallel to sectioning points on each divergent leg
- Where only one leg has ATF installed, no sectioning is required
- Where required, ATF isolated from feeder station to mid-point substation

Auto Transformer Feeders - Substations

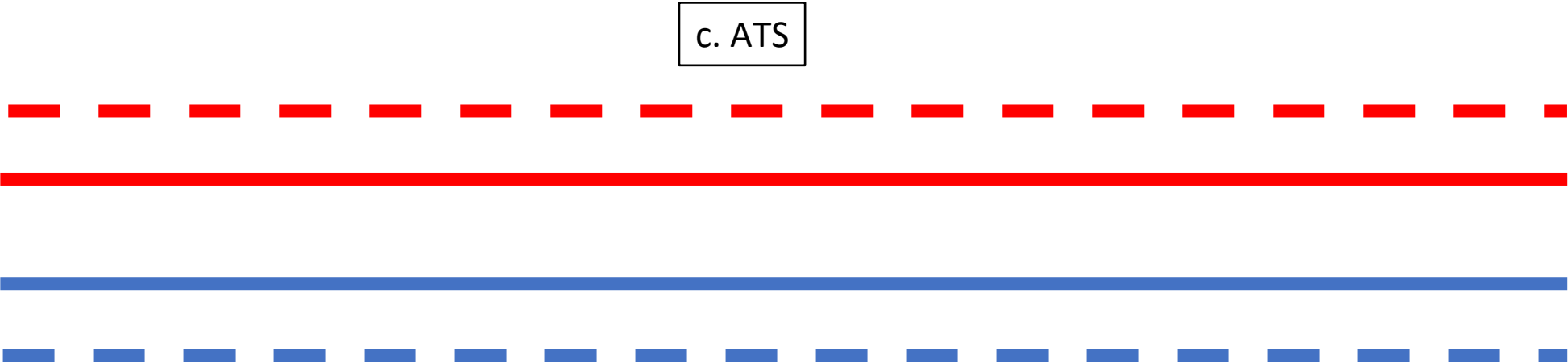
In addition to operations and maintenance requirements at diverging junctions:

- AT feeders should be sectioned at feeder stations (ATFS) and mid-point substations (MPATS), parallel to the neutral sections
- AT feeders should be sectioned at sectioning substations (SATS) parallel to the overlaps
- No sectioning required at AT sites (ATS).



Auto Transformer Feeders - ATS

No ATF sectioning at auto-transformer sites (ATS)



Propose requirement in NR/L1/ELP/27000 clause 4.7.14 deleted



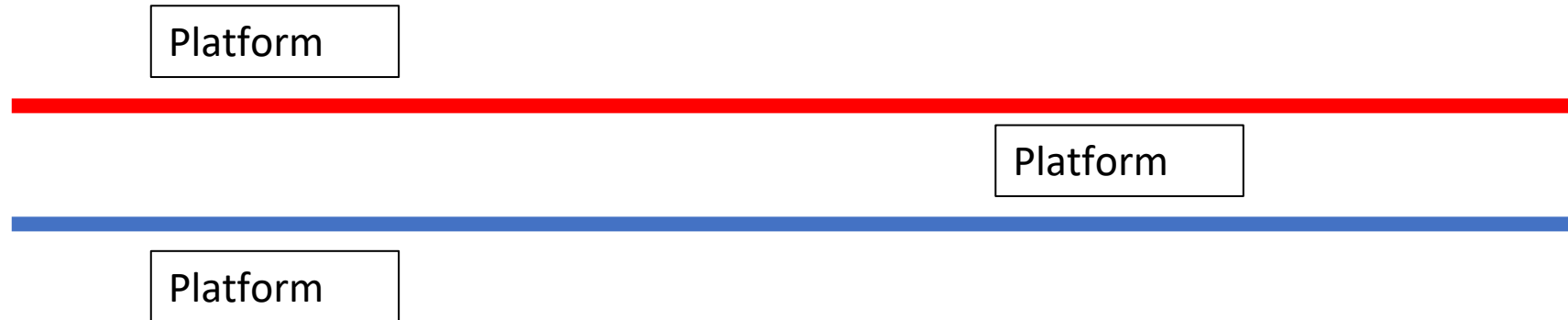
Loop Lines

- No electrical sectioning required unless specifically identified as a need with clear rationale and justification
- NR/L1/ELP/27000 4.7.3 subject to standards challenge



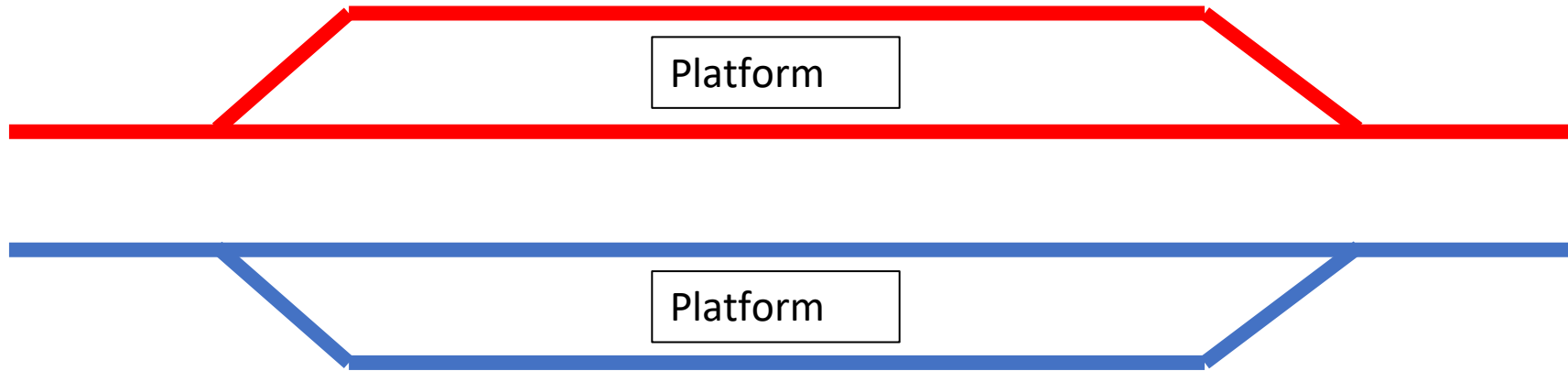
Stations

Simple two track stations require no additional sectioning:



Stations

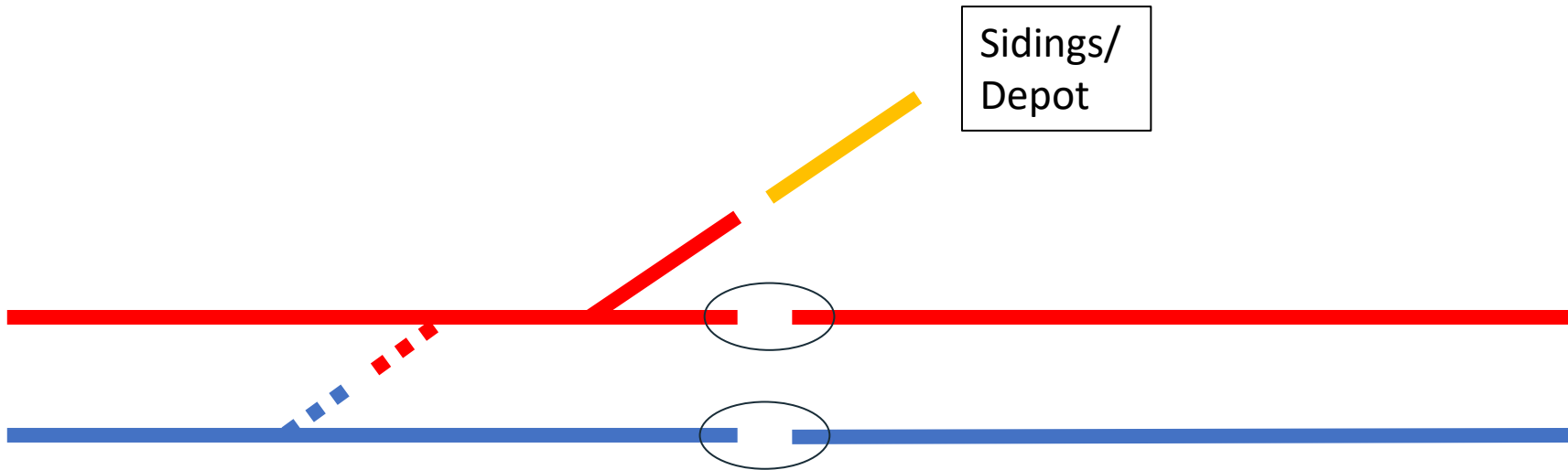
- Loop lines only require additional sectioning if required for maintenance



- At more complex stations minimum sectioning should be provided to meet operational requirements
- Platforms only to be separately sectioned (individually, in pairs or in appropriate groups) where possession arrangements enable maintenance access when other platforms/lines in same electrical section are required to remain live

Sidings and Depots

Electrical sectioning within depots shall be provided to meet the operational requirements of the depot.



- Enables sidings and depots to be isolated whilst the main line remains
- **Where justified**, additional sectioning may be required in main line (circled) to enable access to the sidings/depot to be maintained if there is a fault or possession on the main line beyond the turnout (likely this will be supplemented by crossover)

O&M requirements for electrification design

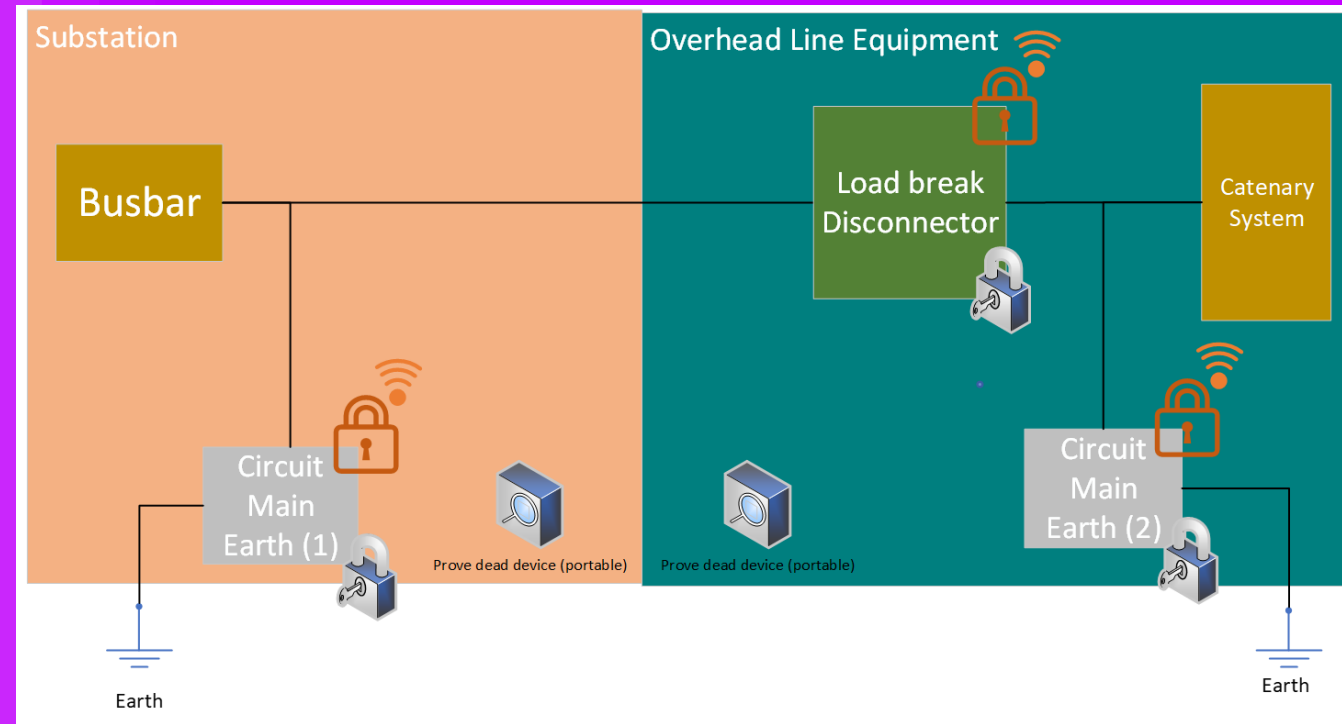
Requirement	Issues to consider
Isolation strategy	2 or 4 track, adjacent lines live, isolated, isolated and earthed method of earthing (i.e. remote, local) access points
Possession limits	Location of sectioning point relative to possession limit
Mitigation against inadvertent energisation	Any specific requirements
Emergency isolation requirements	Neutral section to neutral section or intermediate points
CME/FED strategy	When should FEDs be provided (instead of portable earths)? Related to remote securing of isolations, frequency of use, access etc
Method of securing points of isolation	Remote/local Locks/keys
Standard degraded mode operations	ROTP/ROTR Emergency operations/non-planned disruption Alternate feeding diagrams

O&M requirements for electrification design

Requirement	Issues to consider
OLE maintenance strategies	Frequency Access Specific items (neutral sections, SIs, switches)
Infrastructure maintenance depots	
Train configuration/pantograph combinations	Critical in considering position of pantographs relative to key OLE features when trains stopped at signals
Drivers for electrical capability/capacity requirements	timetable, train types, frequency, headway etc.
Station operations	How is maintenance undertaken within the stations along the route What degraded operating arrangements need to be catered for?
Sidings/depot access	
Interface with existing equipment and provision for future electrification	SCADA/control room

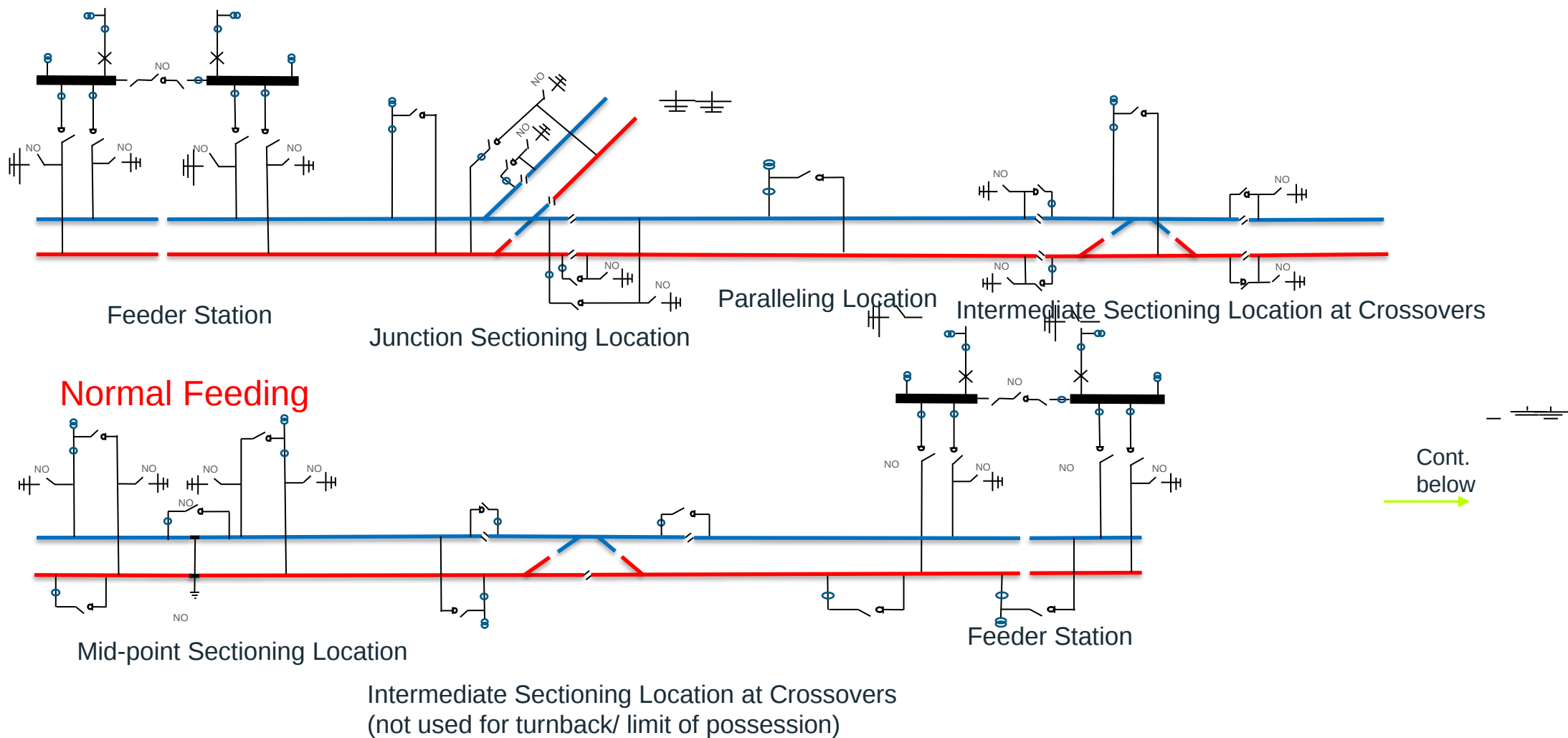
Simplified substations

- Review of substation functional requirements and associated devices
 - Disconnect (from source of supply)
 - Isolate
 - Secure
 - Earth
 - Prove Dead



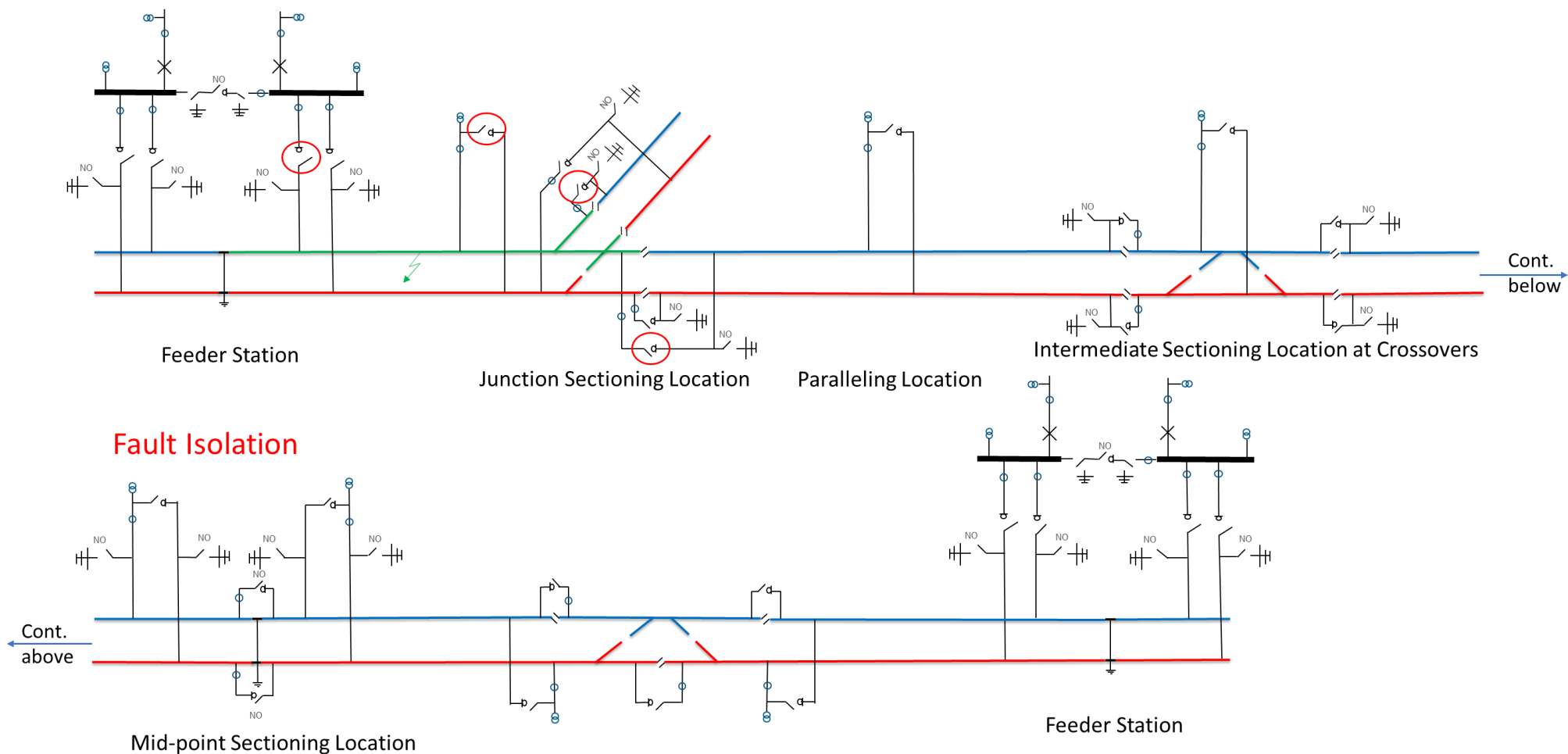
OPTIMISED SECTIONING AND SWITCHING

NORMAL FEEDING

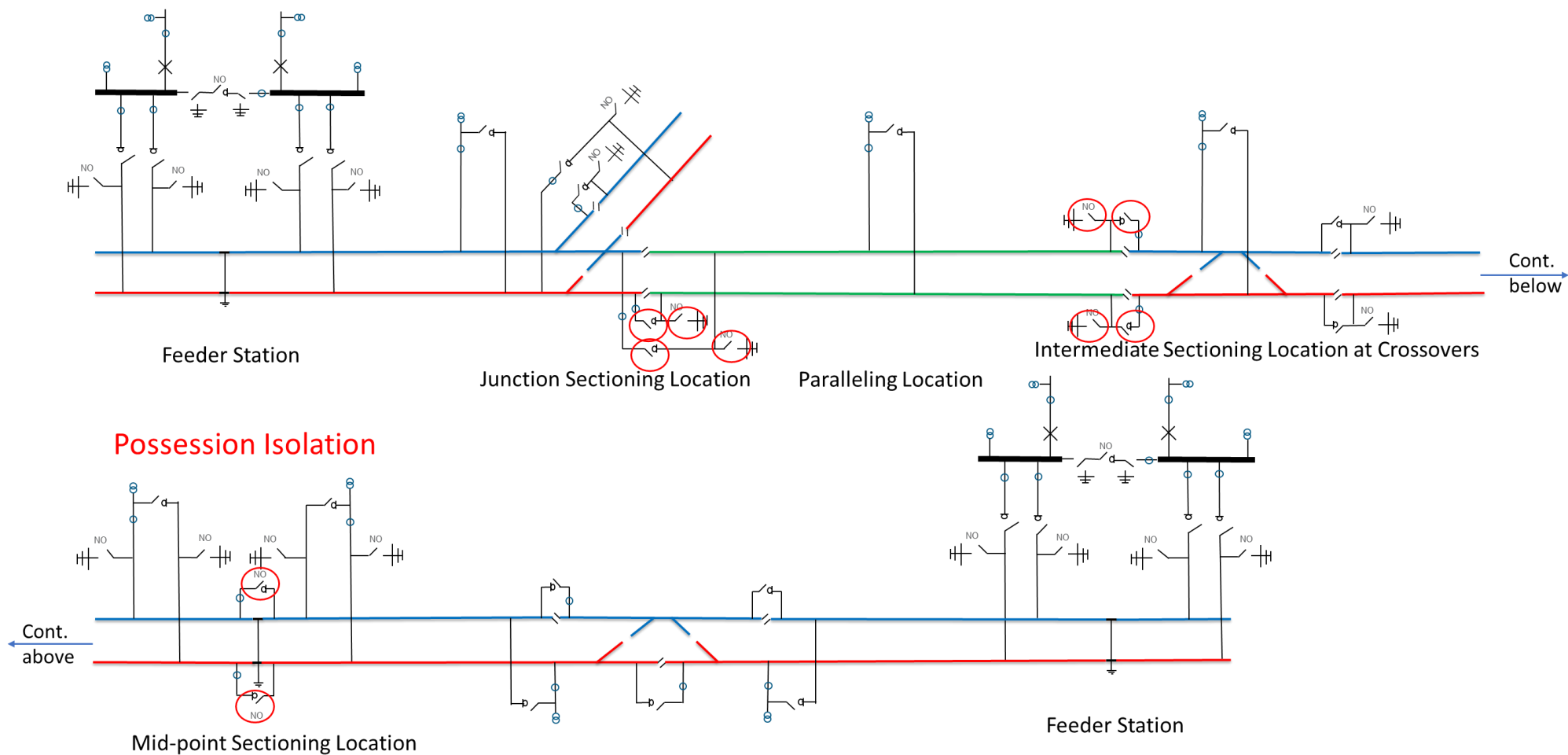


OPTIMISED SECTIONING AND SWITCHING

FAULT ISOLATION

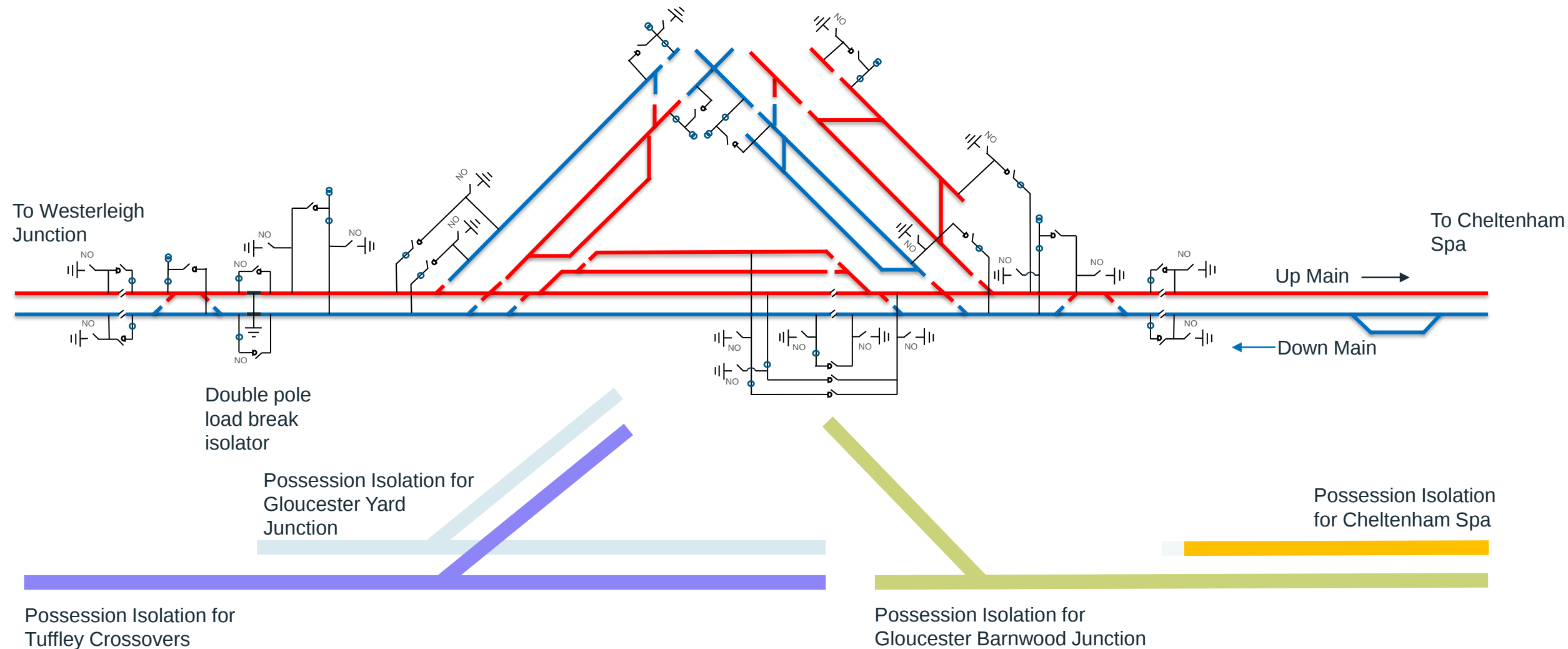


OPTIMISED SECTIONING AND SWITCHING POSSESSION ISOLATION



Intermediate Sectioning Location at Crossovers
(not used for turnback/ limit of possession)

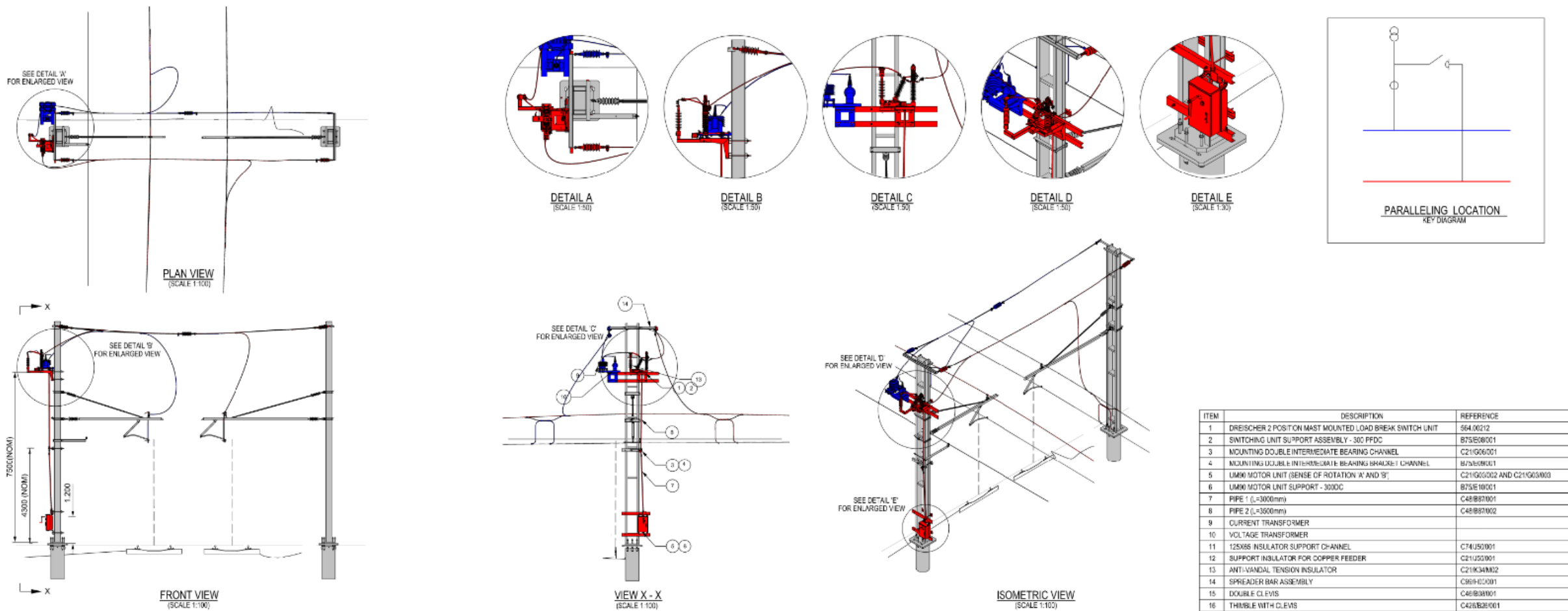
OPTIMISED SECTIONING AND SWITCHING POTENTIAL APPLICATION AT GLOUCESTER



COST-EFFICIENT ELECTRIFICATION

OPTIMISED SECTIONING AND SWITCHING

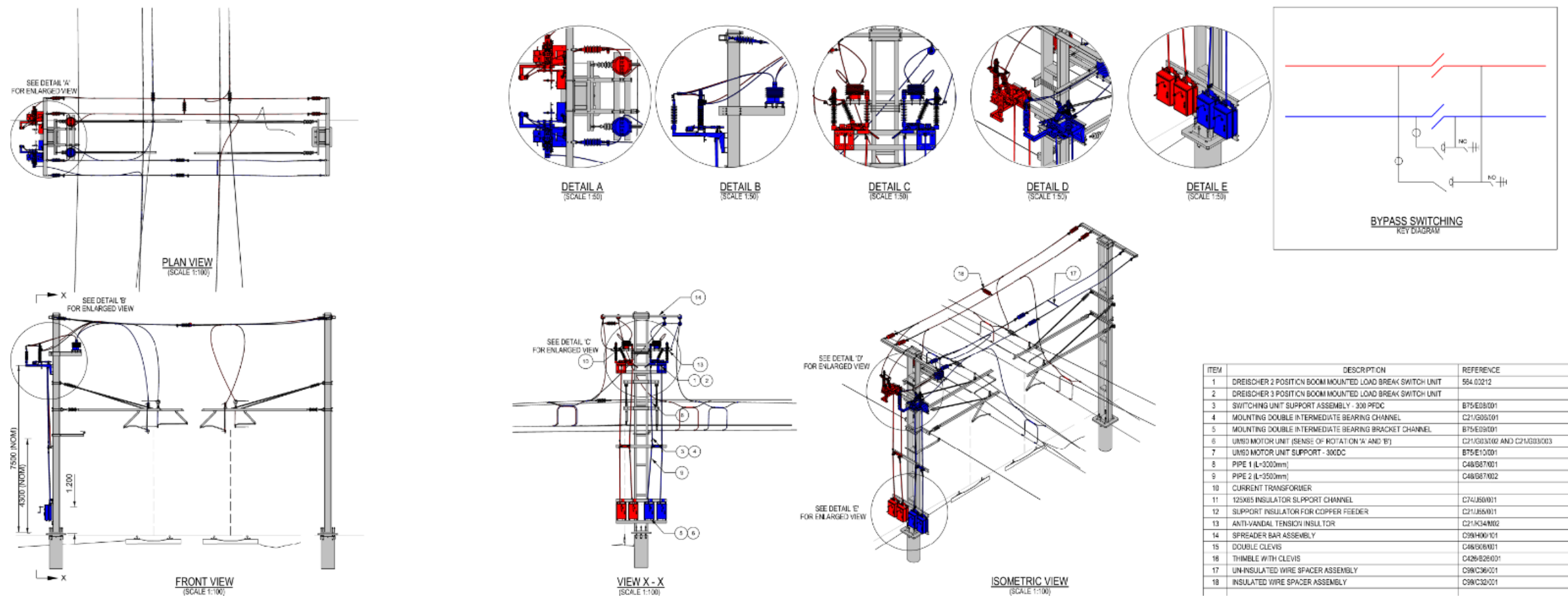
GENERAL SWITCHING ARRANGEMENT – PARALLELING LOCATION



COST-EFFICIENT ELECTRIFICATION

OPTIMISED SECTIONING AND SWITCHING

GENERAL SWITCHING ARRANGEMENT – BYPASS LOCATION



COST-EFFICIENT ELECTRIFICATION OPTIMISED SECTIONING AND SWITCHING

- Recommendations:
 - Sectioning rationale to be developed into a Network Rail Standard
 - Switching General Arrangements to be included in UKMS (and existing arrangements withdrawn)
 - Further work proposed:
 - Consider AT systems in more detail
 - Review protection and control arrangements associated with simplified switching

OPTIMISED SECTIONING AND SWITCHING CHALLENGES FOR W&W

- Filton Bank/Bristol Parkway:
 - Four track railway – consider treating a 2x2 track
 - Focus on degraded mode operations and possession patterns/ Rules of the Route
 - Define Fault Isolation and Possession Isolation limits
 - Safety consideration with working ALO
 - Working of Through Lines and bay platforms in BTM
 - Sectioning on triangle (Dr Days, Feeder Bridge and Gloucester Line Junction)
 - Depot connections
 - Future Electrification

OPTIMISED SECTIONING AND SWITCHING CHALLENGES FOR W&W

- Didcot – Oxford and Cardiff - Swansea:
 - Follow proposed rationale
 - Focus on degraded mode operations and possession patterns/ crossovers/ di-directional working/ Rules of the Route
 - Define Fault Isolation and Possession Isolation limits
 - Safety consideration with working ALO – agree that for possession isolations both lines will be isolated
 - Depot connections
 - Future Electrification/ Landore triangle
 - Challenge all sectioning requests that don't align with rationale

thank you