

A.25 Signal KM3951 – LR71 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		119855
Line speed at stop signal under review (<i>mph</i>)		90
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		400(350)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	LR71	1715
Line speed at first caution (<i>mph</i>)		90
Average gradient from first caution to stop signal (<i>xxx F or R</i>)		137 R
Excess spacing from first caution to stop signal (%)		52(F)/23(P)/66(E)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3953	1715
Excess spacing of next stop signal (%)		36(F)/11(P)/56(E)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information: New auto signal on the Down Corby.		

Table 2 – Route Assessment Questions: Stop Signal No. KM3951	
Constraints on position of stop signal:	New 3-aspect LED auto signal on the Down Corby.
Constraints on position of caution signal:	New 3-aspect LED signal on a shared gantry.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	The reduction of signal spacing with the preceding section, although greater than 34% is not considered an issue with driver training. There is no SPAD history on this signal.

A.26 Signal KM3951 – LR93 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		120379
Line speed at stop signal under review (<i>mph</i>)		90
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		400(350)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	LR93	1715
Line speed at first caution (<i>mph</i>)		50
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	157 R
Excess spacing from first caution to stop signal (%)		112(F)/342(P)/399(E)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3953	1715
Excess spacing of next stop signal (%)		36(F)/11(P)/55(E)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information:	New auto signal on the Down Corby.	

Table 2 – Route Assessment Questions: Stop Signal No. KM3951	
Constraints on position of stop signal:	New 3-aspect LED auto signal on the Down Corby.
Constraints on position of caution signal:	New 3-aspect LED signal on a shared gantry.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	The reduction of signal spacing with the preceding section, although greater than 34% is not considered an issue with driver training. There is no SPAD history on this signal.

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3951
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Gradient is generally rising between the caution and stop signal with a steep falling gradient of 1:200 for the final 87m on approach.
Changes in speed – particularly increases in speed.	Speed across the route changes from 50 to 40 to 90.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	Route curves to the right after the junction.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	N/A
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	Speed across the route changes from 50 to 40 to 90.
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	2239m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Speed across the route changes from 50 to 40 to 90.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal is most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	3-aspect sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	3-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3951
(TI 085: Excess Signal Spacing over 100% and over 1000m)

4. Spacing and Location

4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A
Speed reduction – a significant drop in speed often means the new speed is hard to judge.	N/A
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient is generally rising between the caution and stop signal with a steep falling gradient of 1:200 for the final 87m on approach.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A

5. Junction controls

Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A
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A.27 Signal KM3954 – KM3958 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		123703
Line speed at stop signal under review (<i>mph</i>)		90
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		350(350)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3958	1952
Line speed at first caution (<i>mph</i>)		90
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	253 F
Excess spacing from first caution to stop signal (%)		43(F)/18(P)/69(E)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3952	2162
Excess spacing of next stop signal (%)		71(F)/40(P)/96(E)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information:	New auto signal on the Up Corby.	

Table 2 – Route Assessment Questions: Stop Signal No. KM3954	
Constraints on position of stop signal:	New 3-aspect auto signal.
Constraints on position of caution signal:	New 3-aspect auto signal.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	The reduction of signal spacing with the preceding section, although greater than 34% is not considered an issue with driver training. There is no SPAD history on this signal.

A.28 Signal KM3962 – KM3974 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		127817
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		380(250)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		2
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3974	1147
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	208 R
Excess spacing from first caution to stop signal (%)		92(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3958	2162
Excess spacing of next stop signal (%)		233(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information:	New signal at Corby Station on the Up Corby.	

Table 2 – Route Assessment Questions: Stop Signal No. KM3962	
Constraints on position of stop signal:	New 3-aspect LED platform starter signal on the Up Corby. Constrained by BSC/Automotive Branch line turn-out.
Constraints on position of caution signal:	Existing 3-aspect signal.
Record any Protection and Mitigation measures in the design for this signal.	Signal is fitted with TPWS, both TSS and OSS loops.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

A.29 Signal KM3974 – KM3976 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		128964
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		250(250)
SORAT risk level of signal under review, if available		I2
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		2
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3976	1093
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	200 R
Excess spacing from first caution to stop signal (%)		83(P)/123(E)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3962	1147
Excess spacing of next stop signal (%)		92(P)/133(E)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information:	Existing 3-aspect LED signal on the Up Corby.	

Table 2 – Route Assessment Questions: Stop Signal No. KM3974	
Constraints on position of stop signal:	Existing 3-aspect LED signal.
Constraints on position of caution signal:	Existing 2-aspect LED distant signal.
Record any Protection and Mitigation measures in the design for this signal.	Signal is fitted with TPWS, existing TSS and new OSS loops.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3974
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Rising gradient of 1:200 between caution and stop signal.
Changes in speed – particularly increases in speed.	60mph line speed.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	2 small over-bridges on approach to the stop signal.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1093m from caution to stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	60mph line speed.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	2-aspect sequence on approach to 3-aspect.
Number of warnings – three aspect only gives one caution, four aspect gives two.	2-aspect sequence on approach to 3-aspect giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	Transition from 2 to 3-aspect occurs at this point.
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	
4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3974
(TI 085: Excess Signal Spacing over 100% and over 1000m)

Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Rising gradient of 1:200 between caution and stop signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.30 Signal KM3975 – KM3959 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		128091
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		300(250)
SORAT risk level of signal under review, if available		I1
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3959	1367
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	460 F
Excess spacing from first caution to stop signal (%)		108(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3977	1833
Excess spacing of next stop signal (%)		169(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information:	New 3-aspect LED signal on the Down Corby at Corby Station.	

Table 2 – Route Assessment Questions: Stop Signal No. KM3975	
Constraints on position of stop signal:	New 3-aspect LED signal on the Down Corby to be parallel positioned with Platform starter on Up Corby.
Constraints on position of caution signal:	New 3-aspect LED signal on the Down Corby protecting 651 points
Record any Protection and Mitigation measures in the design for this signal.	New TPWS TSS and OSS provided.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3975
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Falling gradient, an average of 1:460 between caution and stop signal but there is a steep change from 1:264F to 1:200F on approach to the signal.
Changes in speed – particularly increases in speed.	N/A
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	N/A
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1367m from caution to stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	60mph line speed.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	3-aspect signal sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	3-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3975
(TI 085: Excess Signal Spacing over 100% and over 1000m)

4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A
Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Falling gradient, an average of 1:460 between caution and stop signal but there is a steep change from 1:264F to 1:200F on approach to the signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.31 Signal KM3977 – KM3975 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		129924
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		250(250)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3975	1833
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	200 F
Excess spacing from first caution to stop signal (%)		169(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3981	3666
Excess spacing of next stop signal (%)		106(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information: Auto section on the Down Corby. Signal is a non-plated auto, Co-actor signal right hand mounted in the Up Corby cess also provided.		

Table 2 – Route Assessment Questions: Stop Signal No. KM3977	
Constraints on position of stop signal:	New 2-aspect non-plated LED auto signal on the Down Corby.
Constraints on position of caution signal:	New 2-aspect distant LED signal on the Down Corby.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3977
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Falling gradient of 1:200 between caution and stop signal.
Changes in speed – particularly increases in speed.	N/A
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	2 small over-bridges on approach to the stop signal.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1400m from caution to stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	60mph line speed.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	New 2-aspect signal sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	2-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	Transition from 3 to 2 aspect occurs at this point.
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	
4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3977
(TI 085: Excess Signal Spacing over 100% and over 1000m)

Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Falling gradient of 1:200 between caution and stop signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.32 Signal KM3978 – KM3980 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		132493
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		250(250)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3980	1222
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	207 R
Excess spacing from first caution to stop signal (%)		104(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3974	3529
Excess spacing of next stop signal (%)		83(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information: Auto section on the Up Corby. Signal is a non-plated auto.		

Table 2 – Route Assessment Questions: Stop Signal No. KM3978	
Constraints on position of stop signal:	New 2-aspect LED auto signal with foot crossing and tunnel ahead.
Constraints on position of caution signal:	New 2-aspect LED distant signal.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3978
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Rising gradient of 1:200 on approach.
Changes in speed – particularly increases in speed.	Line speed 60mph.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	No tunnels or bridges between caution and stop signal.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1222m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Line speed 60mph.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	New 2-aspect sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	2-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	
4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3978
(TI 085: Excess Signal Spacing over 100% and over 1000m)

Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient rising at 1:200 on approach.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	No, Corby tunnel ahead.
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.33 Signal KM3981 – KM3979 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		133590
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		240(240)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3979	1400
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	204 F
Excess spacing from first caution to stop signal (%)		106(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3985	3361
Excess spacing of next stop signal (%)		115(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information: New auto section on the Down Corby. Plated auto signal.		

Table 2 – Route Assessment Questions: Stop Signal No. KM3981	
Constraints on position of stop signal:	New 2-aspect LED auto signal on the Down Corby.
Constraints on position of caution signal:	New 2-aspect distant LED signal on the Down Corby.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3981
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Gradient is falling at 1:200 on approach.
Changes in speed – particularly increases in speed.	Line speed is 60mph.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	No tunnels or bridges between caution and stop signal.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1400m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Line speed is 60mph.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal is most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	New 2-aspect sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	2-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	
4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3981
(TI 085: Excess Signal Spacing over 100% and over 1000m)

Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient is falling between caution and stop signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.34 Signal KM3982 – KM3984 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		135813
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		300(300)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3984	1086
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	209 R
Excess spacing from first caution to stop signal (%)		11(F)/82(P)/121(E)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3978	3570
Excess spacing of next stop signal (%)		33(F)/117(P)/164(E)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information:	New auto section on the Up Corby. Plated auto signal.	

Table 2 – Route Assessment Questions: Stop Signal No. KM3982	
Constraints on position of stop signal:	New 2-aspect LED auto signal.
Constraints on position of caution signal:	New 2-aspect LED distant signal placed beyond Welland viaduct.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	The reduction of signal spacing with the preceding section, although greater than 34% is not considered an issue with driver training. There is no SPAD history on this signal.

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3982
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Rising gradients of 1:264 and 1:200 on approach.
Changes in speed – particularly increases in speed.	Line speed is 60mph.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	No bridges or tunnels between caution and stop signal.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1086m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Line speed is 60mph.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal is most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	New 2-aspect sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	2-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	
4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3982
(TI 085: Excess Signal Spacing over 100% and over 1000m)

Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient is rising between caution and stop signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.35 Signal KM3985 – KM3983 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		136951
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		250(250)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3983	1521
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	206 F
Excess spacing from first caution to stop signal (%)		124(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3991	3456
Excess spacing of next stop signal (%)		1441(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information: New auto section on the Down Corby. Signal is a non-plated auto.		

Table 2 – Route Assessment Questions: Stop Signal No. KM3985	
Constraints on position of stop signal:	New 2-aspect LED auto signal on the Down Corby.
Constraints on position of caution signal:	New 2-aspect distant LED signal on the Down Corby.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3985
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Falling gradients of 1:200 and 1:264 on approach.
Changes in speed – particularly increases in speed.	Line speed is 60mph.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	No bridges or tunnels between caution and stop signal.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1521m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Line speed is 60mph.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal is most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	New 2-aspect sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	2-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	
4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3985
(TI 085: Excess Signal Spacing over 100% and over 1000m)

Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient is falling between caution and stop signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.36 Signal KM3988 – KM3990 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		139232
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		300(250)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3990	1156
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	190 F
Excess spacing from first caution to stop signal (%)		316(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3982	3419
Excess spacing of next stop signal (%)		82(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information: New auto section on the UP Corby. Signal is a non-plated auto.		

Table 2 – Route Assessment Questions: Stop Signal No. KM3988	
Constraints on position of stop signal:	New 2-aspect LED signal with Seaton tunnel and Welland viaduct ahead.
Constraints on position of caution signal:	New 2-aspect LED distant beyond Glaston tunnel.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3988
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Steep average falling gradient of 1:190 between caution and stop signal.
Changes in speed – particularly increases in speed.	Reduction of speed from 60 to 20/40mph.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	No tunnels or bridges between caution and stop.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1156m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Line speed changes from 60 to 20/40mph between caution and stop.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	2-aspect sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	2-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3988
(TI 085: Excess Signal Spacing over 100% and over 1000m)

4. Spacing and Location

4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A
Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed changes from 60 to 20/40mph between caution and stop.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Steep falling gradient between caution and stop signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	No, Seaton tunnel ahead.

5. Junction controls

Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A
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A.37 Signal KM3991 – KM3989 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		140407
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		300(300)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3989	1169
Line speed at first caution (<i>mph</i>)		20
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	189 R
Excess spacing from first caution to stop signal (%)		1441(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3995	2526
Excess spacing of next stop signal (%)		329(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information: New auto section on the Down Corby. Signal is a non-plated auto.		

Table 2 – Route Assessment Questions: Stop Signal No. KM3991	
Constraints on position of stop signal:	New 3-aspect LED auto signal on the Down Corby.
Constraints on position of caution signal:	New 2-aspect distant LED signal on the Down Corby.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3991
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Rising gradient of 1:167 on the approach.
Changes in speed – particularly increases in speed.	Speed increases from 20mph to 60mph on approach.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	No bridges or tunnels between caution and stop signal.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1169m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Speed increases from 20mph to 60mph on approach.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal is most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	3-aspect stop signal with a two aspect distant.
Number of warnings – three aspect only gives one caution, four aspect gives two.	3-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	Transition from 2 to 3 aspect occurs at this point.
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	
4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3991
(TI 085: Excess Signal Spacing over 100% and over 1000m)

Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed increases from 20mph to 60mph on approach.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient is rising between caution and stop signal at an average of 1:189.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.38 Signal KM3992 – MJ6 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		142493
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		220(220)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	MJ6	1722
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	1179 F
Excess spacing from first caution to stop signal (%)		168(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3988	3261
Excess spacing of next stop signal (%)		316(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information: Auto section on the Up Corby. Signal is a non-plated auto.		

Table 2 – Route Assessment Questions: Stop Signal No. KM3992	
Constraints on position of stop signal:	New 2-aspect LED auto signal with Glaston tunnel and AWS for 20/40mph AWI ahead.
Constraints on position of caution signal:	Existing signal position with new 3-aspect LED signal head. Wing tunnel situated ahead of signal.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	The reduction of signal spacing with the preceding section, although greater than 34% is not considered an issue with driver training. There is no SPAD history on this signal.

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3992
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Gradient rises initially then falls steeply on approach to the stop signal at gradients of 1:164 and 1:167.
Changes in speed – particularly increases in speed.	Line speed is 60mph.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	Wing tunnel (323m) between caution and stop signals.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1722m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Line speed is 60mph.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal most likely to be displaying a proceed aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	3-aspect caution to a 2-aspect stop signal.
Number of warnings – three aspect only gives one caution, four aspect gives two.	2/3-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	Transition from 3 to 2 aspect occurs at this point.
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3992
(TI 085: Excess Signal Spacing over 100% and over 1000m)

4. Spacing and Location

4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A
Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient rises initially then falls on approach to stop signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	No, Glaston tunnel ahead.

5. Junction controls

Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A
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A.39 Signal KM3995 – KM3991 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		142933
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		300(300)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		1
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3991	2526
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	166 R
Excess spacing from first caution to stop signal (%)		164(F)/329(P)/420(E)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	MJ5	1926
Excess spacing of next stop signal (%)		65(F)/194(P)/266(E)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information:	Auto section on the Down Corby. Signal is a non-plated auto	

Table 2 – Route Assessment Questions: Stop Signal No. KM3995	
Constraints on position of stop signal:	New 3-aspect non-plated LED auto signal on the Down Corby.
Constraints on position of caution signal:	New 3-aspect non-plated LED auto signal on the Down Corby.
Record any Protection and Mitigation measures in the design for this signal.	None.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	The reduction of signal spacing with the preceding section, although greater than 34% is not considered an issue with driver training. There is no SPAD history on this signal.

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3995
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Rising gradient between caution and stop signal.
Changes in speed – particularly increases in speed.	Line speed is 60mph.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	Glaston tunnel (1692m) situated between caution and stop signals.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	This is present in the area
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	2526m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Line speed is 60mph.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal is most likely to be displaying a yellow aspect.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	New 3-aspect sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	3-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	
4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. KM3995
(TI 085: Excess Signal Spacing over 100% and over 1000m)

Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient is rising between caution and stop signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.40 Signal MJ6 – MJ14 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		144215
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		300(250)
SORAT risk level of signal under review, if available		M4
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		2
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	MJ14	825
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	343 R
Excess spacing from first caution to stop signal (%)		228(P)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	KM3992	1722
Excess spacing of next stop signal (%)		168(P)
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information: Stop signal on the Up Corby on the approach to Wing tunnel. Signal was under Manton Junction SB control and now falls under EMCC control.		

Table 2 – Route Assessment Questions: Stop Signal No. MJ6	
Constraints on position of stop signal:	Existing signal position with new 3-aspect LED signal head. Wing tunnel situated ahead of signal.
Constraints on position of caution signal:	Existing 2-aspect distant signal.
Record any Protection and Mitigation measures in the design for this signal.	Signal ahead reminder board situated at 665m. Sited as mitigation measure instigated by previous SPAD occurrence.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	None

Table 3 – Risk Factors for Consideration: Stop Signal No. MJ6
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Gradient rises on approach.
Changes in speed – particularly increases in speed.	Line speed is 60mph.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	N/A
Loss of reference – tunnels or twisting routes may make it hard to judge position.	No tunnels or bridges between caution and stop signal.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	N/A
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	60mph speed board sited at the caution signal.
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	825m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Line speed is 60mph.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	Signal is most likely to be at red.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	3-aspect stop signal with a 2-aspect caution.
Number of warnings – three aspect only gives one caution, four aspect gives two.	2/3-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	
4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A

Table 3 – Risk Factors for Consideration: Stop Signal No. MJ6
(TI 085: Excess Signal Spacing over 100% and over 1000m)

Speed reduction – a significant drop in speed often means the new speed is hard to judge.	N/A
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient rises on approach to stop signal.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	No, Wing tunnel ahead.
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

A.41 Signal MJ5 – KM3995 (Stop Signal – Caution Signal)

Table 1 - Geographical Data		
Datum of signal under review, in metres		144859
Line speed at stop signal under review (<i>mph</i>)		60
Sighting Distance (Required Reading Distance) of stop signal under review (<i>m</i>)		550(*1)
SORAT risk level of signal under review, if available		Not Assessed (Outside Project Area).
How often can a train expect to approach this stop signal at red? (1) Rarely (<6%), (2) Occasionally (6-20%), (3) Some of the time (21-49%), (4) Most of the time (50-75%), (5) Frequently (76-94%), (6) Almost always (>94%).		4
Signal No. and Distance to rear of first cautionary signal (<i>metres</i>)	KM3995	1926
Line speed at first caution (<i>mph</i>)		60
Average gradient from first caution to stop signal (<i>xxx F or R</i>)	1:	508 F
Excess spacing from first caution to stop signal (%)		65(F)/194(P)/266(E)
Distance to rear of intermediate cautionary signal if applicable (<i>metres</i>)		N/A
Line speed (<i>mph</i>) at intermediate caution (4 aspect only)		N/A
Signal No. and Distance ahead to next stop signal (<i>metres</i>)	MJ1	2798
Excess spacing of next stop signal (%)		N/A
Does the signal sighting committee consider the signal spacing in this area to be irregular? (<i>Yes or No</i>)		No
Additional Geographical Information:	Junction protecting signal at Manton on the Down Corby. *1 the sighting of this signal is outside the scope for these works. The available sighting distance determined using Omnicom. This is not considered to be an issue.	

Table 2 – Route Assessment Questions: Stop Signal No. MJ5	
Constraints on position of stop signal:	Existing 3-aspect signal on the Down Corby.
Constraints on position of caution signal:	New 3-aspect LED auto signal on the Down Corby.
Record any Protection and Mitigation measures in the design for this signal.	Signal is fitted with TPWS, both TSS and OSS loops.
Record any Mitigation measures rejected (including the reason for rejection).	None
HAZOP Comments:	The reduction of signal spacing with the preceding section, although greater than 34% is not considered an issue with driver training. There is no SPAD history on this signal and the signal is fitted with TPWS.

Table 3 – Risk Factors for Consideration: Stop Signal No. MJ5
(TI 085: Excess Signal Spacing over 100% and over 1000m)

1. Driver distraction (particularly between the caution signal and the point where trains need to start braking)	
Platform duties – where the starter may be at yellow.	N/A
Rising gradients – the need to apply power to keep the train moving.	Gradient changes from rising at 1:379 to falling at 1:200 and then level for final 127m on approach to the stop signal.
Changes in speed – particularly increases in speed.	Line speed is 60mph.
AWS warnings – repetitive cancellations for advance warning of speed restrictions	AWS for 40mph AWI between caution and stop.
Loss of reference – tunnels or twisting routes may make it hard to judge position.	Wing tunnel (323m) is situated between caution and stop signals.
Poor adhesion – driver concentrating on controlling the train or keeping it moving.	N/A
Joining a faster line or increase of speed following a junction – risk that the caution signal is forgotten and over-ridden by the increase in speed.	N/A
Distance to run – a long distance from a station start or a junction gives opportunity to forget a caution signal.	1926m between caution and stop signal.
2. Signal Sighting	
Poor visibility of red signal – with the risk that a driver has forgotten the caution or mistaken the distance travelled, good visibility of the red is essential, (N.B. good sighting is preferable to regular spacing of signals).	N/A
Line speed – at lower speeds drivers tend to “drive on sight”.	Line speed is 60mph.
Likelihood of signal at danger – if it is unexpected then a driver may take longer to react.	It is likely that the signal will be at danger.
3. Aspect Sequences	
Correct arrangements – can the over-braking be reduced by changing to two aspect or three aspect sequences?	3-aspect sequence.
Number of warnings – three aspect only gives one caution, four aspect gives two.	3-aspect sequence giving one caution.
Transitions – 3 to 4 (either plain line or slow line to main line) can cause confusion and risk of assuming double yellow on first 4 aspect since it normally is (conditioning).	N/A
Parallel lines – drivers on slow lines can often drive at full speed on double yellow, risk that when they change to fast line they may forget.	N/A
4. Spacing and Location	

Table 3 – Risk Factors for Consideration: Stop Signal No. MJ5
(TI 085: Excess Signal Spacing over 100% and over 1000m)

4 aspect – a shorter final caution (i.e. yellow to red less than double yellow to yellow) raises the risk as the ratio approaches the 1/3, 2/3 rule.	N/A
Speed reduction – a significant drop in speed often means the new speed is hard to judge.	Line speed is 60mph.
Gradient change – a change from rising to falling on the approach to the red signal makes it harder to recover from a misjudgement.	Gradient changes from rising to falling between caution and stop signal but is level for the final 127m on approach.
Read through – drivers tend to look ahead to prepare themselves, this may form a distraction.	N/A
5. Junction controls	
Approach release – regular approach to red aspects which release may condition drivers to expect the signal to clear, this is worse where the release point is close to the signal.	N/A

Appendix B Quantitative Risk Assessment

This section is populated with data for signals identified as requiring further risk assessment in Section A – Qualitative Risk Assessments.

No signals were identified as requiring a Quantitative risk assessment following application of TI085.

Signal No. (1)	Risk / Accident (2)	Causes (3)	Risk Level (4)				Comments (5)
			F	S	L	R	

Appendix C Workshop Attendees

The following staff attended the Kettering to Corby VariSPAD Workshop held on Tuesday 13/01/15 at Jacobs Derby Office.

Name	Signature	Company	Role / Responsibility
		Jacobs	Workshop Facilitator
		Jacobs	SORAT Assessor/Recorder
		Jacobs	Signalling CRE
		Jacobs	Signal Sighting Chairman
		Network Rail	Project Engineer (Rail)
		Network Rail	DPE
		Network Rail	Signal Sighting
		Network Rail	Operations
		Network Rail	Signal Sighting
		Network Rail	RAM
		DB Schenker	FOC Representative
		GB Railfreight	FOC Representative
		East Midlands Trains	TOC Representative
		Freightliner	FOC Representative
		DB SCHENKER	FOC REPRESENTATIVE
		NR	GRADUATE