Classic Rail vs. HSR

What is High Speed Rail (HSR):

- "High-speed rail combines many different elements which constitute a "whole, integrated system": an infrastructure for new lines designed for speeds of **250 km/h and above; upgraded existing lines for speeds of up to 200 or even 220 km/h**, including interconnecting lines between high-speed sections;
    - its rolling stock, specially designed for train sets;
    - telecommunications,
    - signaling,
    - operating conditions and
    - equipment, etc.
- Technology is expected to have a major influence on infrastructure development over the next 20 years."
  - International Union of Railways (UIC)

General Note:
Source quote obtained from International Union of Railways (UIC):
Intercity and High-Speed | UIC - International union of railways
World's Fastest High Speed Trains Source Graphic:
Chart: The World's Fastest High-Speed Trains | Statista

Classic Intercity Rail Locomotive

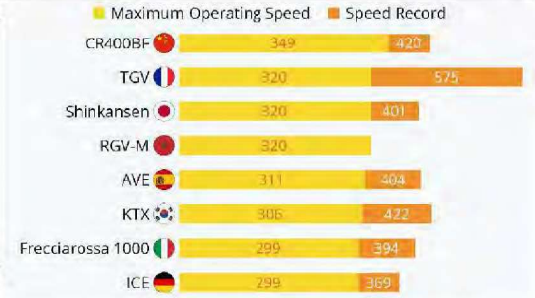
North American
VIA Rail Canada

High Speed Rail Locomotive

European
ICE Germany

VIA Rail vs. World's Fastest High-Speed Trains (km/h)

VIA Rail operates on tracks shared with freight between Windsor-Quebec City at speeds of up to **160 km/h.**



When viewing these charts consider that performance is a measure of not just rolling stock, but a harmonization of rail systems that consider track geometry, vehicle loading, signaling technology, power, operational constraints, and environmental factors, etc.

VIA-BAU, HFR and HSR Overview

Intercity Overview

The table below provides comparative analysis using key railway performance measures, contrasting VIA-Business-as-Usual alongside projected HFR and HSR scenarios. Data for this analysis was collected from the HFR Business Case Update 2021 and Primary HSR Study 2023

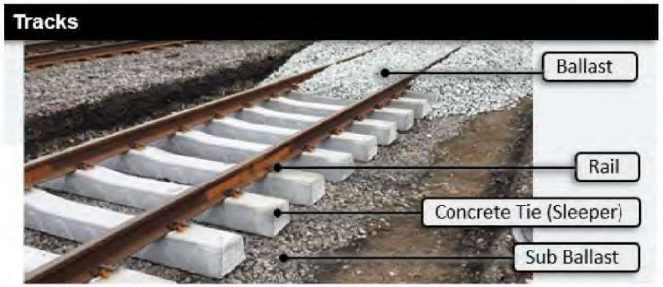
Characteristic	Existing Via Rail BAU Service	High Frequency Rail Business Case	Preliminary High Speed Rail Study
Operations:			
Speed	**Up to 160 km/h** (100mph)	Up to **201km/h** (125mph)	**Up to 300 km/h** (186mph)
Journey Times (ex.Tor-Mon)	s.18(b), s.21(1)(a)		
On-Time Performance	~67% (2019)	~95% (Assumed)	~95%
Trains Per Day	24 (2023)	52 (2044)	72 (2039)
Ridership (40yr Period)	s.18(b), s.21(1)(a)		
Host Railway Interface	Shared Right-of-Way	Shared Right-of-Way (Assumed)	Dedicated Right-of-Way (Assumed)
Stations:			
Station Stops	Shared	Shared	Shared
Station Platform Heights	Mixed (49" 25" 5")	Mixed (49" 25" 5")	Level Boarding (Assumed)
Technology:			
Rolling Stock	Deisel Locomotive-Hauled	Bi-Modal (Assumed)	Electric Multiple Unit (Assumed)
Signaling	Fixed Block Signaling	Advanced Train Control	Advanced Train Control
Electrification (25kVa)	No	Yes (93% Assumed)	Yes (Assumed)
Design:			
Alignment	More Track Curves Permitted	More Track Curves Permitted	Less Track Curves Permitted
Grade Crossings	Permitted	Permitted	Not Permitted

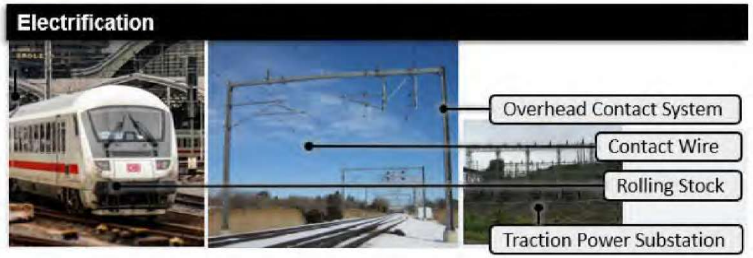
s.18(b), s.21(1)(a)

s.18(b), s.21(1)(a)

Technical Considerations:

- During Co-Development, the project development partner will need to assess a collection of available railway technologies and through a process of systems engineering, demonstrate compliance against with the project requirements.
- The railway must be designed as an integrated system balancing efficiency, safety, and reliability to achieve a stated performance outcome.
- A non-exhaustive, but foundational depiction of common railway elements is provided as introduction to railway terminology





General Note:
System configurations and components will vary. Content is an introductory non-exhaustive review of local applications, excluding electrification. For general education only.

Regulatory Considerations:

- The legislative framework under the ***Railway Safety Act*** includes regulations, rules, and engineering standards that all have equal force of law.
- Rail Speeds and related Classes with Transport Canada and Federal Railroad Administration regulations:

Track Type	Freight	Passenger	Regulations
Class 3	40 mph (64 km/h)	60 mph (97 km/h)	Transport Canada
Class 4	60 mph (97 km/h)	80 mph (129 km/h)	Transport Canada
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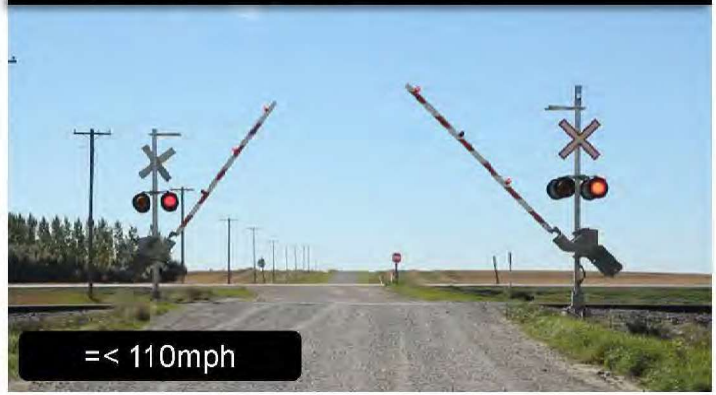
- Transport Canada does not currently have regulations or standards that address all areas of safety for operations above 95 mph (maximum speed for track class 5).
- **Transport Canada's regulations on grade crossings require grade separation for railway design speeds above 177 km/h (110 mph);** the current maximum operating speed through grade crossings is 100mph.

Example Signalized Grade Crossing



Example West Toronto Diamond Grade Separation

Credit Source Information to HFR Safety Workstream: HFR Safety Guidance Document

HSR Study and Global Benchmarking

HSR Study

HSR Study Background:

- In 2023, VIA HFR completed the Preliminary Corridor HSR Assessment, a study of a conceptual HSR system connecting Toronto, Ottawa, Montréal, and Québec City.
- The output of the report was indicative capital costs, operating cost estimates, journey times, ridership and revenue estimates for developing an HSR system.

s.18(b), s.21(1)(a)

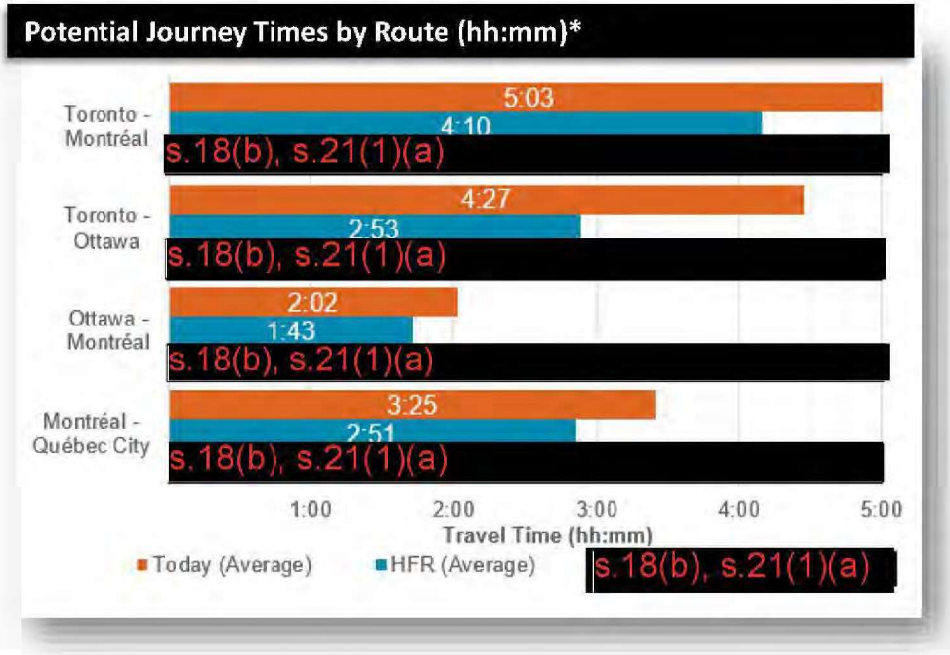
s.18(b), s.21(1)(a)

Journey Times

HSR Study

Base Assumptions

- **Rolling Stock:** This analysis assumes the typical characteristics of an electric multiple unit (EMU) train that can achieve speeds up to 300km/h (186mph).
- **Stopping Patterns:** Two different service types have been assumed – Express Service and Stopping Service.
- **Station Stops:** HSR is assumed to serve existing city center stations in Toronto-Ottawa-Montréal-Québec City, as well as secondary city stations within the major cities.
- **Station Dwells:** Assumes 2-minutes excluding Dorval which assumes 3-minutes.
- **Average Speed:** Based on international intercity and HSR benchmarks, it is assumed that the average operating speeds would be approximately 80-85% of the maximum permissible speed.
- **Simulation Modeling:** Spreadsheet analysis only.
- **Host Railway Conflicts:** None assumed. No model or data to support.



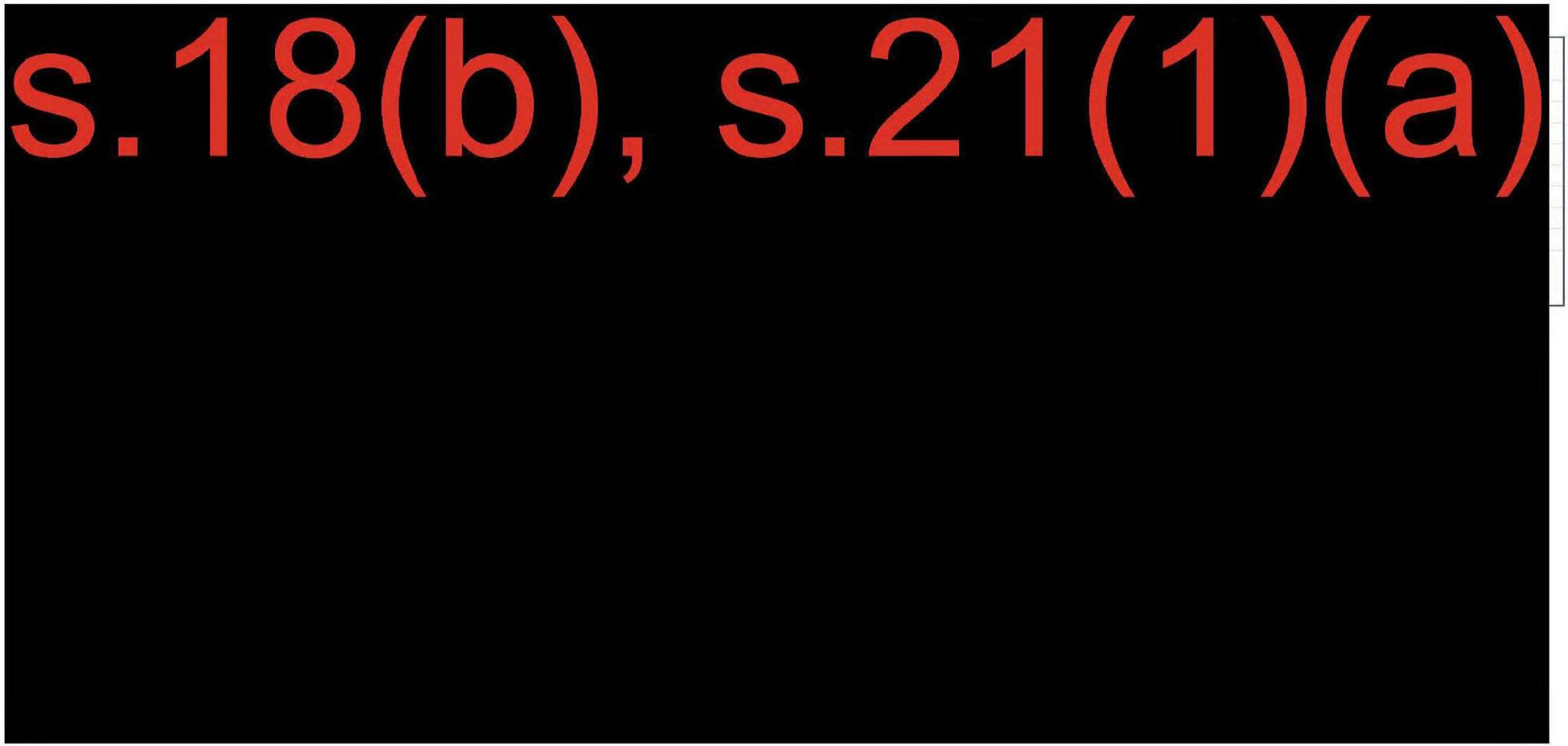
Ridership and Revenue

HSR Study

s.18(b), s.21(1)(a)

Capital Expenditure

HSR Study



Ridership and Revenue Compared

HSR Study

Total 40-year operating period	BAU Scenario (Today)	HFR Scenario	HSR scenario
Total revenue (billion CAD 2022)	s.18(b), s.21(1)(a)		
Revenue Increment to BAU			
Farebox revenue			
Onboard ancillary revenue			
Total Riders (million)			
Ridership Increment to BAU			

Electrification Power Supply Overview

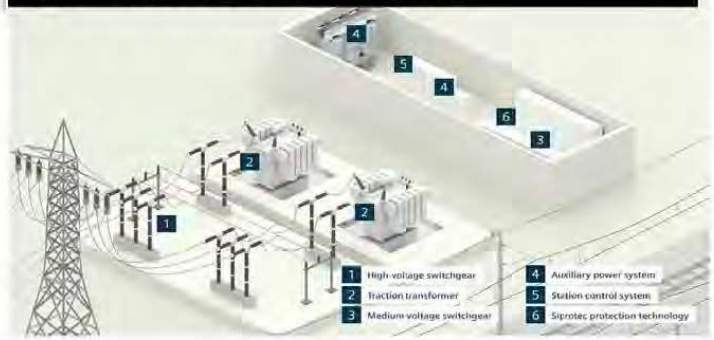
Hydro Update

- The VIA-HFR project team has carried out a conceptual review of power consumption to support discussions with Hydro One and Hydro Quebec over the last 3 years.
- The level of high-level of analysis currently taken for the HFR project, in reference to the Base Case alignment, assumes: 850 km electrified network length with a traction power station every 50 km along the route; a projected power range of 30-40MVA.
- Under conceptual agreement, 1/3 of power is projected from Quebec Hydro, with the remaining from Hydro One.
- **Key Issue: Electrified Railroad Loading is Dynamic, Single Phase and Could Impact Power Quality of Utility System.**
- Prior to these Utility required Engineering Studies, VIA should determine the following:
  - Select trainset and assess its electrical characteristics (operating voltage limits, power consumption, etc.);
  - Select a perceived train operating schedule (that includes provisions for growth);
  - Define the design/operational characteristics for the Traction Electrification System;
  - Perform their own **Traction Power Load Flow Simulation**

Typical Hydro Transmission Level Connection Process

10-12 months: Phase 0 – Feasibility Study	1-3 months: Phase 1 – Connection Application	3-6 months: Phase 2 – Impact Assessments	4-8 month: Phase 3 – Connection Cost Estimate	1 or more months: Phase 4 – Connection Approval and Connection Cost Recovery Agreement (CCRA)	1-2 years: Phase 5 – Design and Build	1-2 months: Phase 6 - Commissioning

Typical Traction Power Arrangement



Technical Briefing DRAFT

High Speed Rail and Conventional Intercity Systems | September 2023

Government of Canada / Gouvernement du Canada

Canada

Contents

- Railway System overview
- Key differences between Conventional Intercity Rail and High-Speed Rail systems.
- Highlights from Internal Preliminary HSR study.
- Overview on power supply analysis and process to support electrification.

Intercity Overview

HSR Study

Hydro Overview

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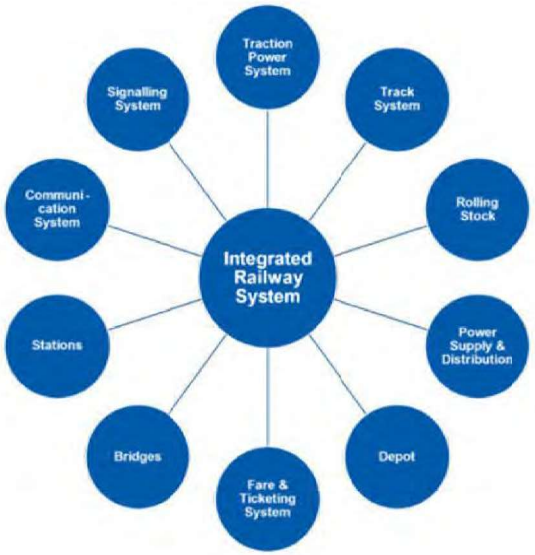

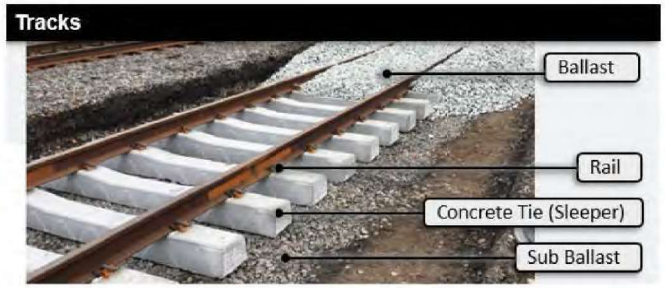

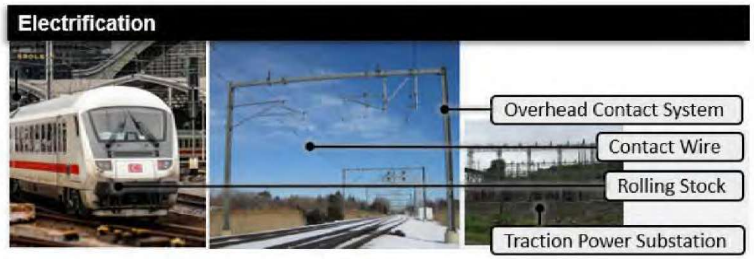

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System configurations and components will vary. Content is an introductory non-exhaustive review of local applications, excluding electrification. For general education only.

Conventional North American Rail vs HSR

What is High Speed Rail (HSR):

- "High-speed rail combines many different elements which constitute a "whole and integrated system": an infrastructure for new lines designed for speeds of **250 km/h and above; upgraded existing lines for speeds of up to 200 or even 220 km/h**, including interconnecting lines between high-speed sections (which contains):
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- "Technology is expected to have a major influence on infrastructure development over the next 20 years."
  - International Union of Railways (UIC)

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North America
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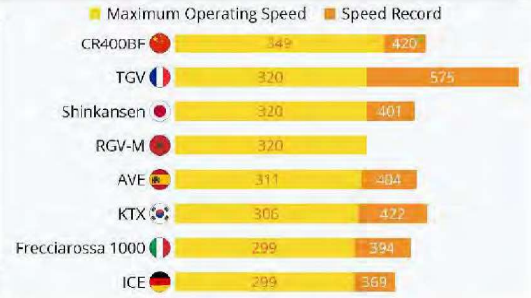
VIA Rail vs. Selected High-Speed Trains (km/h)

VIA Rail operates on tracks shared with freight trains between Windsor-Quebec City at speeds of up to **160 km/h.**



When viewing these charts, consider that performance is a measure of not just rolling stock, but a harmonization of rail systems that consider track geometry, vehicle loading, signaling technology, power, operational constraints, environmental factors, etc.

Regulatory Considerations for Intercity Rail

- The legislative framework under Canada's ***Railway Safety Act*** includes regulations, rules, and engineering standards that all have equal force of law.
- Rail Speeds and related Classes with Transport Canada and Federal Railroad Administration (FRA) regulations:

Track Type	Freight	Passenger	Regulations
Class 3	40 mph (64 km/h)	60 mph (97 km/h)	Transport Canada
Class 4	60 mph (97 km/h)	80 mph (129 km/h)	Transport Canada
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- Transport Canada does not currently have regulations or standards that address all areas of safety for operations above 95 mph (maximum speed for track class 5). Crossings may be permitted subject to appropriate safety and risk analysis.
- Transport Canada's regulations on grade crossings require grade separations for railway design speeds above 177 km/h (110 mph)
- **Through hazard analysis benchmarking, t**he current maximum operating speed through grade crossings is 100mph.

Example: Signalized Grade Crossing

Example: Urban Road/Rail Grade Separation

Credit Source Information to HFR Safety Workstream: HFR Safety Guidance Document

VIA-BAU, HFR and HSR Overview

Intercity Overview

The table below provides comparative analysis using key railway performance measures, contrasting VIA-Business-as-Usual alongside projected HFR and HSR scenarios. Data for this analysis was collected from the HFR Business Case Update in December 2021 and Primary HSR Study in August 2023.

Key Characteristic	Existing Via Rail BAU Service	High Frequency Rail Base Case (2021)	Preliminary HSR Study (2023)
Operations:			
Speed	**Up to 160 km/h** (100mph)	Up to **201km/h** (125mph)	**Up to 300 km/h** (186mph)
Journey Times (Tor - Mtl)	s.18(b), s.21(1)(a)		
On-Time Performance	~67% (2019)	~95% (Assumed)	~95%
Trains Per Day	24 (2023)	58 (2045)*	72 (2039)
Ridership (40yr Period)	s.18(b), s.21(1)(a)		
Host Railway Interface	Shared Tracks	Shared Tracks / Right-of-Way (Assumed)	Dedicated Right-of-Way (Assumed)
Stations:			
Station Stops	Shared	Shared	Shared
Station Platform Heights	Mixed (49" 5")	Mixed (49" 25" 5")	Level Boarding (Assumed)
Technology:			
Rolling Stock	Diesel Locomotive-Hauled	Bi-Modal (Assumed)	Electric Multiple Unit (Assumed)
Signaling	Fixed Block Signaling	Enhanced Train Control	Enhanced Train Control
Electrification (25kVa)	No	Yes (93% Assumed)	Yes (93% Assumed)
Design:			
Alignment	More Track Curves Permitted	More Track Curves Permitted	Less Track Curves Permitted
Grade Crossings	Permitted	Permitted	Not Permitted

s.18(b), s.21(1)(a)

s.18(b), s.21(1)(a)

*Service Level 3 estimated within the 40 year ridership horizon, subject to change

HSR Study and Global Benchmarking

HSR Study

HSR Study Background:

- In 2023, VIA HFR completed the Preliminary Corridor HSR Assessment, a study of a conceptual HSR system connecting Toronto, Ottawa, Montréal, and Québec City.
- The output of the report includes rough order-of- magnitude capital cost estimates, operating cost estimates, journey times, ridership and revenue estimates for developing an HSR system.

s.18(b), s.21(1)(a)

s.18(b), s.21(1)(a)

Journey Times

HSR Study

Base Assumptions

- **Rolling Stock:** This analysis assumes the typical characteristics of an electric multiple unit (EMU) train that can achieve speeds up to 300km/h (186mph).
- **Stopping Patterns**: Two different service types have been assumed – Express Service and Stopping Service.
- **Station Stops:** HSR is assumed to serve existing city centre stations in Toronto-Ottawa-Montréal-Québec City, as well as secondary city stations within the major cities. Stations are also assumed in Peterborough s.18(b), s.21(1)(a) Laval.
- **Station Dwell Times:** Assumes 2-minutes excluding Dorval which assumes 3-minutes.
- **Average Speed:** Based on international intercity and HSR benchmarks, it is assumed that the average operating speeds would be approximately 80-85% of the maximum permissible speed (to account for station stops and other technical and operational considerations).
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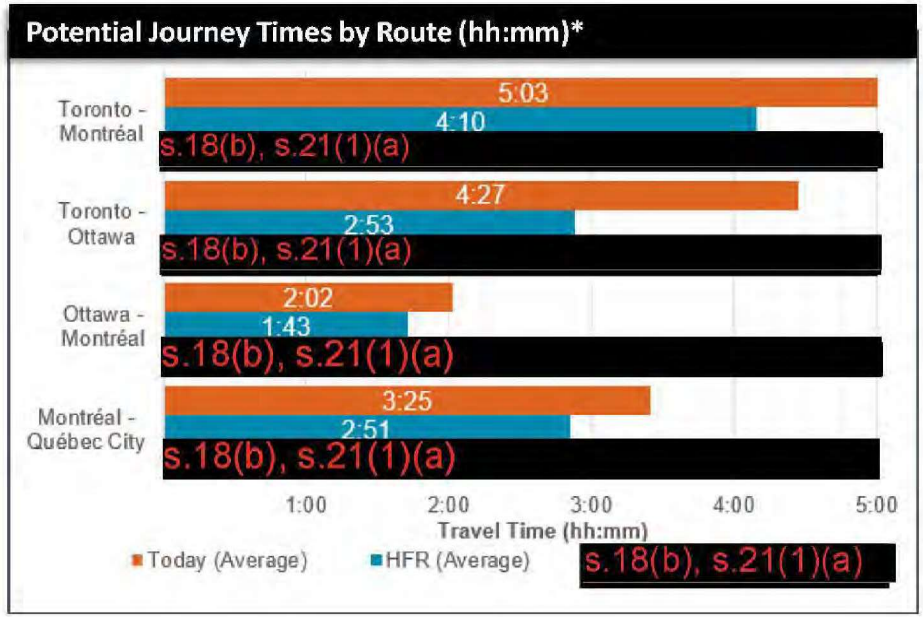
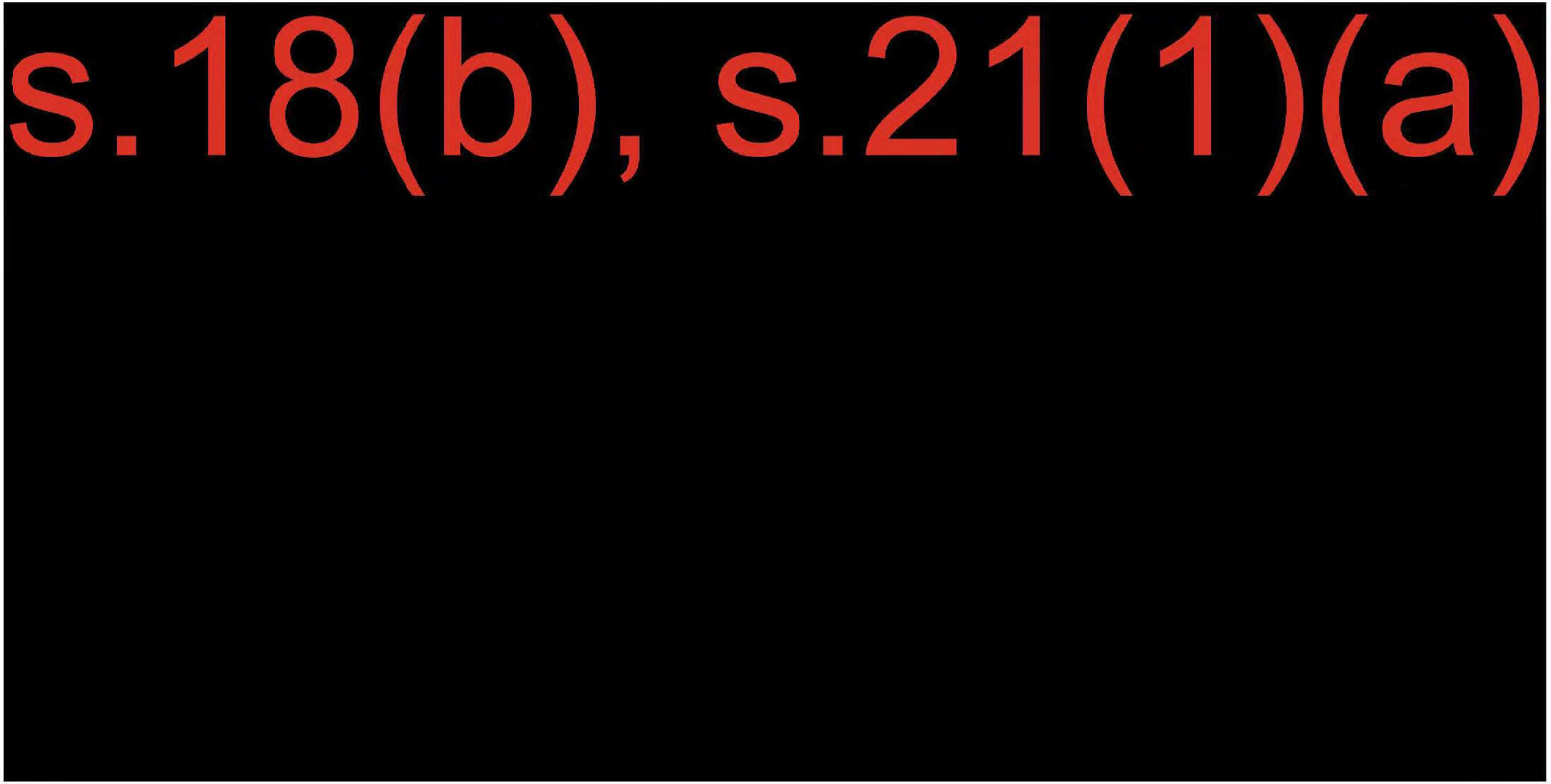
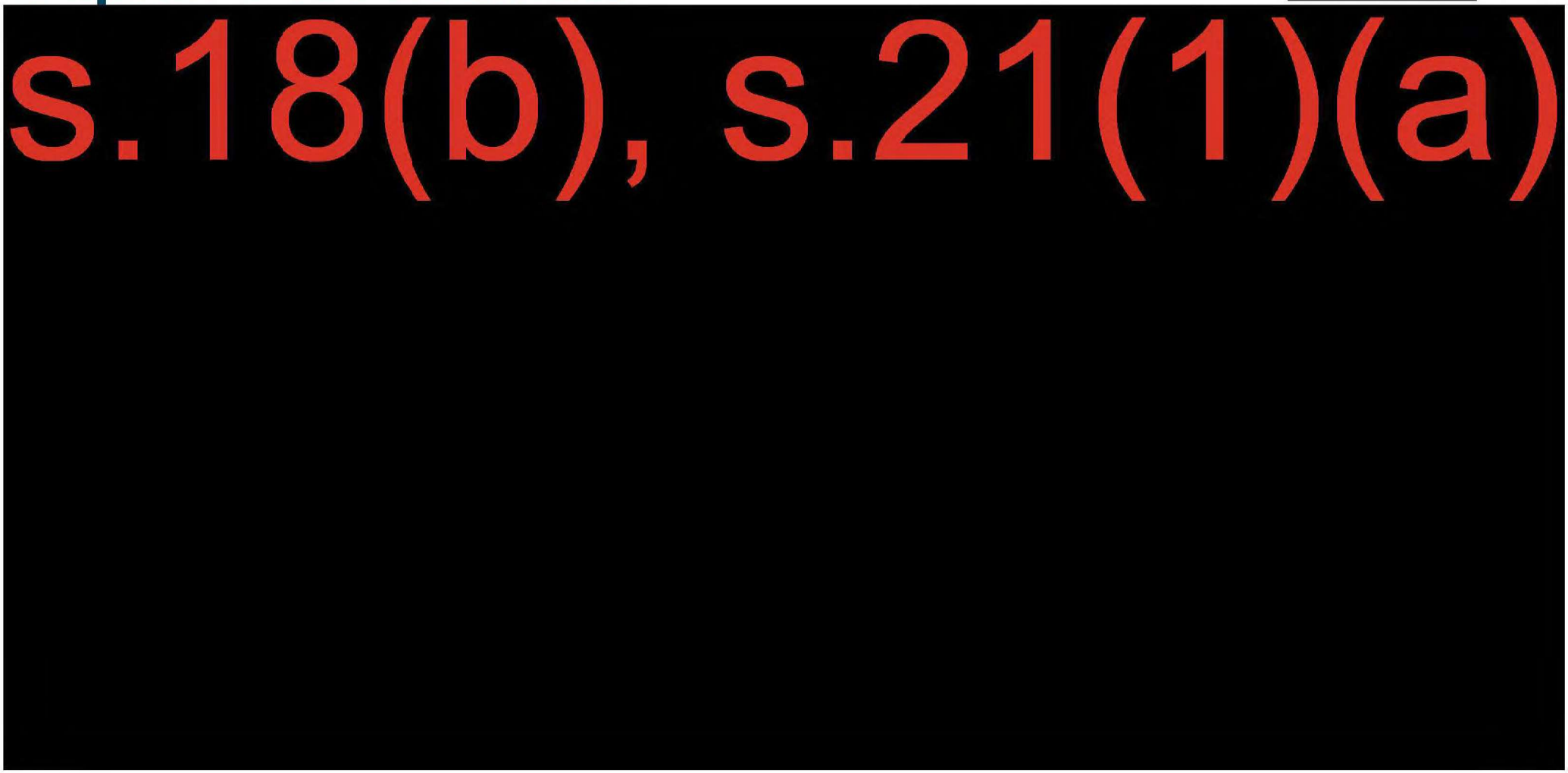
- **Host Railway Conflicts:** None assumed. No model or data to support.



Ridership and Revenue



Capital Cost Estimate



Electrification Power Supply Overview

Hydro Overview

- The VIA-HFR project team has carried out a conceptual review of power consumption to support discussions with Hydro One, Hydro-Québec and related agencies over the last 3 years.
- This high-level of analysis currently taken for the HFR project, in reference to the Base Case alignment, assumes: approximately 850 km electrified network length, a traction power station approximately every 50 km along the route and a projected power range of 30-40MVA.
- It is assumed that 1/3 of power connections are in Quebec, with the remaining in Ontario.
- Engagement has been ongoing with Hydro-Québec and Hydro One over the past 3 years along with updates related to the HFR Procurement process and Co-Development activities. They are aware that the PDP will be engaging with them based on a confirmed alignment, as well as a technology and service proposition, which is anticipated through Stages 2 and 3 of the Co-development phase. Transmission Connection Requests will also be developed during this time as required.

Typical Hydro Transmission Level Connection Process

10-12 months	1-3 months	3-6 months	4-8 month	1 or more months	1-2 years	1-2 months
Phase 0 – Feasibility Study	Phase 1 – Connection Application	Phase 2 – Impact Assessments	Phase 3 – Connection Cost Estimate	Phase 4 – Connection Approval and Connection Cost Recovery Agreement (CCRA)	Phase 5 – Design and Build	Phase 6 - Commissioning

Typical Traction Power Arrangement

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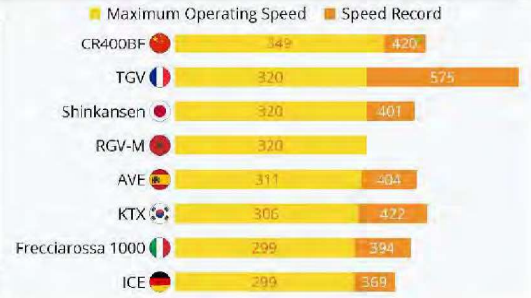

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VIA-BAU, HFR and HSR Overview

Key Characteristic	Existing Via Rail BAU Service	High Frequency Rail Base Case (2021)	HSR Study Scenario 1 (2023)	HSR Study Scenario 2 (2023)
Level of Analysis				
	Actual Condition	Business Case	Conceptual	Conceptual
Operations:				
Highest Speed	**Up to 160 km/h** (100mph)	**Up to 201km/h** (125mph)	**Up to 300 km/h** (186mph)	
Avg. Operating Speed		**109km/h** (Assumed)		
Journey (Tor - Mtl)	s.18(b), s.21(1)(a)			
On-Time Performance	~67% (2019)	~95% (Assumed)	~95% (Assumed)	
Trains Per Day	24 (2023)	58 (2045)*	72 (2039)	
Ridership (40yr Period)	s.18(b), s.21(1)(a)			
Host Railway Interface	Shared Tracks	Shared Tracks (Assumed)	Dedicated Tracks (Assumed)	Dedicated Tracks (Assumed)
Host ROW Interface	Shared ROW	Shared ROW (Assumed)	Mixed	Mixed
Stations:				
Station Stops	Shared	Shared	Shared	Shared
Platform Heights	Mixed (49" 5")	Mixed (49" 25" 5")	Level Boarding (Assumed)	Level Boarding (Assumed)
Technology:				
Rolling Stock	Diesel Locomotive-Hauled	Bi-Modal (Assumed)	Electric Multiple Unit (Assumed)	Electric Multiple Unit (Assumed)
Signaling	Fixed Block Signaling	Enhanced Train Control	Enhanced Train Control	Enhanced Train Control
Electrification (25kVa)	No	Yes (93% Assumed)	Yes (Assumed)	Yes (Assumed)
Design:				
Alignment	More Track Curves Permitted	More Track Curves Permitted	Less Track Curves Permitted	Less Track Curves Permitted
Grade Crossings	Permitted	Permitted	Not Permitted	Not Permitted

s.18(b), s.21(1)(a)

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Technical Comparison

HSR Study

Key Characteristic	Existing Via Rail BAU Service	High Frequency Rail Base Case (2021)	HSR Study Scenario 1 (2023)	HSR Study Scenario 2 (2023)
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Host Railway Interface	Shared Tracks	Shared Right-of-Way (Assumec)	Dedicated Right-of-Way (Assumed)	
Stations:				
Station Stops	Shared	Shared	Shared	
Platform Heights	Mixed (49" 5")	Mixed (49" 25" 5")	Level Boarding (Assumed)	
Technology:				
Rolling Stock	Diesel Locomotive-Hauled	Bi-Modal (Assumed)	Electric Multiple Unit (Assumed)	
Signaling	Fixed Block Signaling	Enhanced Train Control	Enhanced Train Control	
Electrification (25kVa)	No	Yes (93% Assumed)	Yes (Assumed)	
Design:				
Alignment	More Track Curves Permitted	More Track Curves Permitted	Less Track Curves Permitted	
Grade Crossings	Permitted	Permitted	Not Permitted	

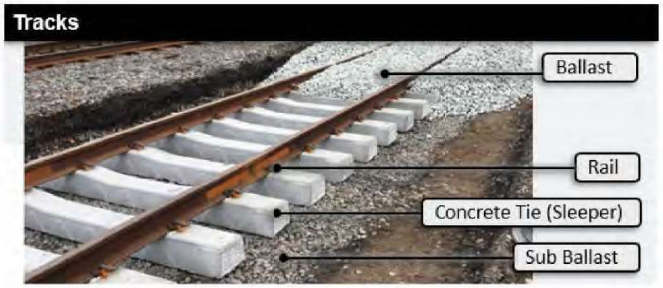
s.18(b), s.21(1)(a)

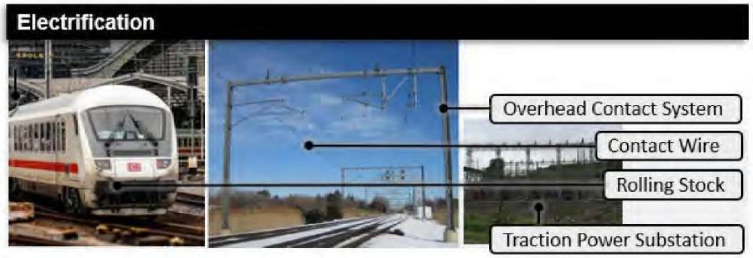
s.18(b), s.21(1)(a)

*Service Level 3 estimated within the 40 year ridership horizon, subject to change

Technical Considerations for Intercity Rail

- Railways must be designed as an integrated system balancing efficiency, safety, and reliability to achieve a stated performance outcome.
- A non-exhaustive, but foundational depiction of common railway elements is provided as introduction to railway terminology
- During Co-Development phase of the HFR project, the Project Development Partner will need to assess a collection of available railway technologies and, through a process of systems engineering, demonstrate compliance with project requirements.





General Note:
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Regulatory Considerations for Intercity Rail

- The legislative framework under Canada's ***Railway Safety Act*** includes regulations, rules, and engineering standards that all have equal force of law.
- Rail Speeds and related Classes with Transport Canada and Federal Railroad Administration (FRA) regulations:

Track Type	Freight	Passenger	Regulations
Class 3	40 mph (64 km/h)	60 mph (97 km/h)	Transport Canada
Class 4	60 mph (97 km/h)	80 mph (129 km/h)	Transport Canada
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- Transport Canada does not currently have regulations or standards that address all areas of safety for operations above 95 mph (maximum speed for track class 5). Crossings may be permitted subject to appropriate safety and risk analysis.
- **Transport Canada's regulations on grade crossings require grade separations for railway design speeds above 177 km/h (110 mph);** the current maximum operating speed through grade crossings is 100mph.

Example: Signalized Grade Crossing

Example: Modern Road/Rail Grade Separation

Credit Source Information to HFR Safety Workstream: HFR Safety Guidance Document

HSR Study and Global Benchmarking

HSR Study

HSR Study Background:

- In 2023, VIA HFR completed the Preliminary Corridor HSR Assessment, a study of a conceptual HSR system connecting Toronto, Ottawa, Montréal, and Québec City.
- The output of the report includes rough order-of- magnitude capital cost estimates, operating cost estimates, journey times, ridership and revenue estimates for developing an HSR system.

s.18(b), s.21(1)(a)

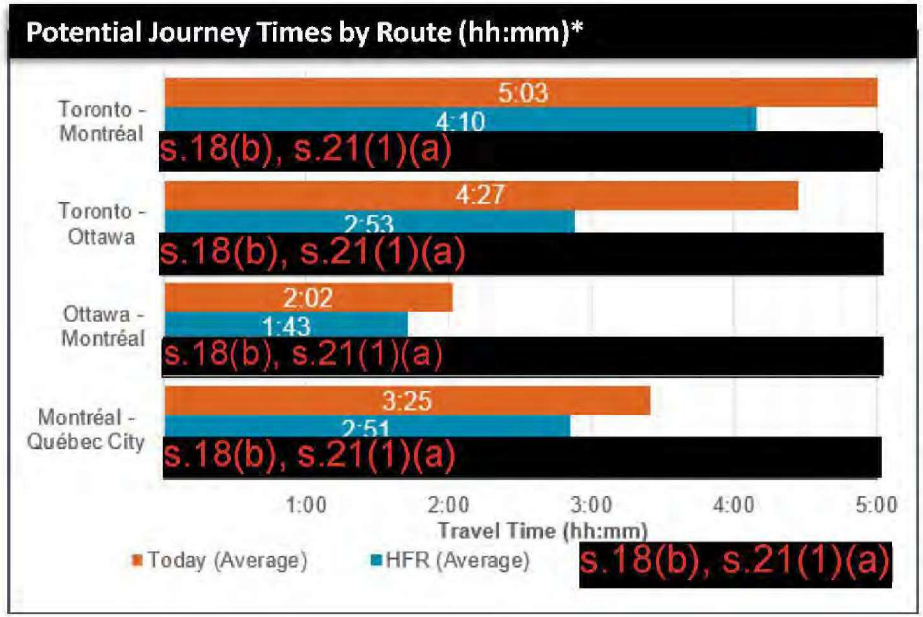
s.18(b), s.21(1)(a)

Journey Times

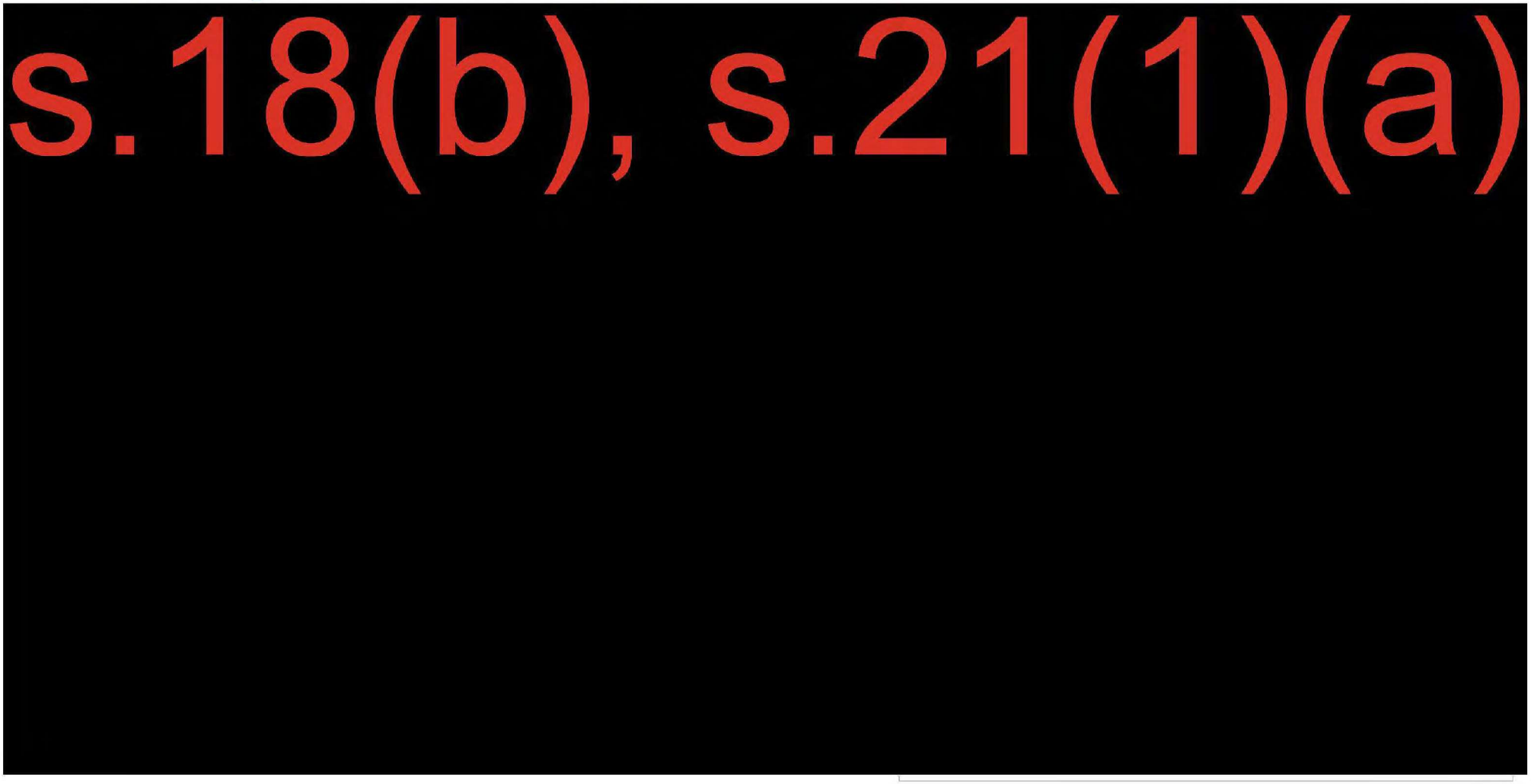
HSR Study

Base Assumptions

- **Rolling Stock:** This analysis assumes the typical characteristics of an electric multiple unit (EMU) train that can achieve speeds up to 300km/h (186mph).
- **Stopping Patterns**: Two different service types have been assumed – Express Service and Stopping Service.
- **Station Stops:** HSR is assumed to serve existing city centre stations in Toronto-Ottawa-Montréal-Québec City, as well as secondary city stations within the major cities. Stations are also assumed in Peterborough s.18(b), s.21(1)(a) Laval.
- **Station Dwell Times:** Assumes 2-minutes excluding Dorval which assumes 3-minutes.
- **Average Speed:** Based on international intercity and HSR benchmarks, it is assumed that the average operating speeds would be approximately 80-85% of the maximum permissible speed (to account for station stops and other technical and operational considerations).
- **Simulation Modeling:** Spreadsheet analysis only.
- **Host Railway Conflicts:** None assumed. No model or data to support.



Ridership and Revenue



Capital Cost Estimate

HSR Study

s.18(b), s.21(1)(a)

Electrification Power Supply Overview

- The VIA-HFR project team has carried out a conceptual review of power consumption to support discussions with Hydro One, Hydro-Québec and related agencies over the last 3 years.
- This high-level of analysis currently taken for the HFR project, in reference to the Base Case alignment, assumes: approximately 850 km electrified network length, a traction power station approximately every 50 km along the route and a projected power range of 30-40MVA.
- It is assumed that 1/3 of power connections are in Quebec, with the remaining in Ontario.
- Engagement has been ongoing with Hydro-Québec and Hydro One over the past 3 years along with updates related to the HFR Procurement process and Co-Development activities. They are aware that the PDP will be engaging with them based on a confirmed alignment, as well as a technology and service proposition, which is anticipated through Stages 2 and 3 of the Co-development phase. Transmission Connection Requests will also be developed during this time as required.

Typical Hydro Transmission Level Connection Process

10-12 months	1-3 months	3-6 months	4-8 month	1 or more months	1-2 years	1-2 months
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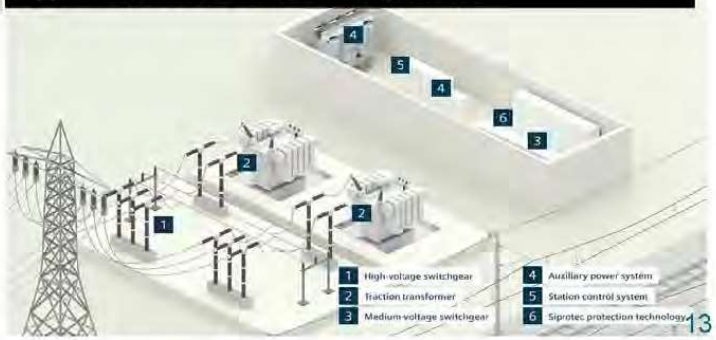
Typical Traction Power Arrangement



Technical Briefing

High Speed Rail and Conventional Intercity Systems | September 2023



Government of Canada / Gouvernement du Canada

Canada

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- Regulatory Considerations for Intercity Rail
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HSR Study

Hydro Overview

Technical Considerations for Intercity Rail

- Proven technology with international standards
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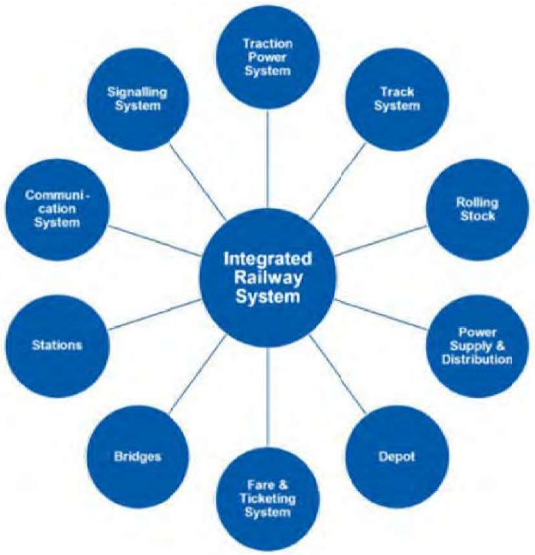
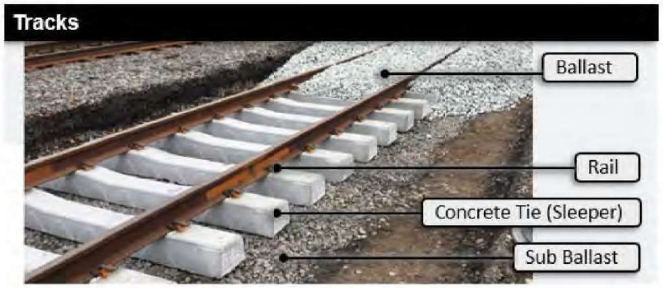
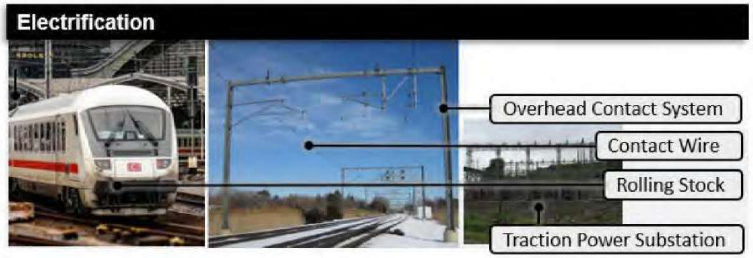
- A non-exhaustive, but foundational depiction of common railway elements is provided as introduction to railway terminology







General Note:
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Regulatory Considerations for Intercity Rail

- The legislative framework under Canada's ***Railway Safety Act*** includes regulations, rules, and engineering standards that all have equal force of law

- Top speeds and related track Classes with Transport Canada and the U.S. Federal Railroad Administration (FRA) regulations:

Track Type	Freight	Passenger	Regulations
Class 3	40 mph (64 km/h)	60 mph (97 km/h)	Transport Canada
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Grade Crossings, the key differentiator to higher speeds

- Transport Canada does not currently have regulations or standards that address all areas of safety for operations above 95 mph (152 km/h - maximum speed for track class 5)

- Transport Canada's regulations on grade crossings require grade separations for railway design speeds above 177 km/h (110 mph); 2021 Business Case assumed max operating speed of 109mph to reduce capital costs

- HFR is reducing maximum operating speeds through grade crossings to 95 mph, this is in line with other new intercity railways and meets HFR Safety Project Outcome

Example: Signalized Grade Crossing

Example: Urban Road/Rail Grade Separation

Conventional Rail vs HSR

What is High Speed Rail (HSR):

- "High-speed rail combines many different elements which constitute a "whole and integrated system": an infrastructure for new lines designed for speeds of **250 km/h and above; upgraded existing lines for speeds of up to 200 or even 220 km/h**, including interconnecting lines between high-speed sections (which contains):
    - rolling stock, specially designed for train sets;
    - telecommunications,
    - signaling,
    - operating conditions and
    - equipment, etc.

- "Technology is expected to have a major influence on infrastructure development over the next 20 years."
  - International Union of Railways (UIC)

General Note:
Source quote obtained from International Union of Railways (UIC):
Intercity and High-Speed | UIC - International union of railways
World's Fastest High Speed Trains Source Graphic:
Chart: The World's Fastest High-Speed Trains | Statista

North America Intercity Rail Trainset

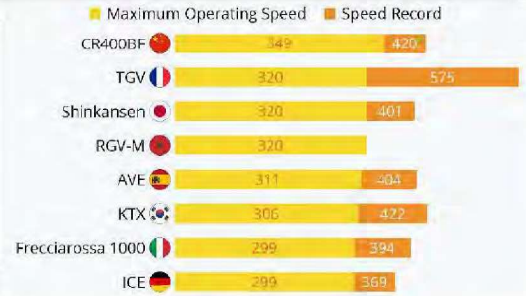
North America
VIA Rail Canada

High-Speed Rail Trainset

Europe
ICE Germany

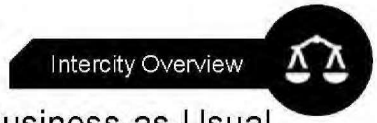
VIA Rail vs. Selected High-Speed Trains (km/h)

VIA Rail operates on tracks shared with freight trains between Windsor-Quebec City at speeds of up to **160 km/h.**



When viewing these charts, consider that performance is a measure of not just rolling stock, but a harmonization of rail systems that consider track geometry, vehicle loading, signaling technology, power, operational constraints, environmental factors, etc.

VIA-BAU, HFR and HSR Overview



The table below provides comparative analysis using key railway performance measures, contrasting VIA-Business-as-Usual alongside projected HFR and HSR scenarios

Key Characteristic	Existing Via Rail BAU Service	High Frequency Rail Base Case used for 2021 Business Case	Preliminary HSR Study (2023) Scenario 1 "Speed Focused"	Preliminary HSR Study (2023) Scenario 2 "Journey Time Focused"
Operations:				
Operating Speed	**Up to 160 km/h** (100mph)	Up to **176 km/h** (109 mph)	**Up to 300 km/h** (186 mph)	**Up to 257 km/h** (160 mph)
Journey Times (Tor - Mtl)	s.18(b), s.21(1)(a)			
On-Time Performance	~67% (2019)	~95% (Assumed)	~95%	~95%
Trains Per Day	24 (2023)	58 (2045)*	72 (2039)	
Ridership (40yr Period)	s.18(b), s.21(1)(a)			
Host Railway Interface	Shared Tracks	Shared Tracks / Right-of-Way (Assumed)	Intercity Dedicated Right-of-Way City Access Shared	InterCity Dedicated Right-of-Way City Access Shared
Stations:				
Station Stops	Shared	Shared & Dedicated	Shared & Dedicated	Shared & Dedicated
Station Platform Heights	Mixed (49" 5")	Level Boarding with one exception (Union Station)	Level Boarding with one exception (Union Station)	Level Boarding with one exception (Union Station)
Technology:				
Rolling Stock	Diesel Locomotive-Hauled	Bi-Modal (Assumed)	Electric Multiple Unit (Assumed)	Bi-Modal Unit (Assumed)
Signaling	Fixed Block Signaling	Enhanced Train Control	Enhanced Train Control	Enhanced Train Control
Electrification (25kVa)	No	Yes (93% Assumed)	Yes (Assumed)	Yes (93% Assumed)
Design:				
Alignment	More Track Curves Permitted	More Track Curves Permitted	Less Track Curves Permitted	Less Track Curves Permitted
Grade Crossings	Permitted	Permitted 202' Business Case 2023 (iPRS) Not Permitted speeds above 95 mph	2023 (iPRS) Not Permitted speeds above 95 mph	2023 (iPRS) Not Permitted speeds above 95 mph

HFR Base Business Case and HSR Studies

s.18(b), s.21(1)(a)

Scenario Maps

- ***HFR Base Case*** – Conventional Rail – Shared Tracks
- ***HSR Scenario 1*** – Speed Focused
- ***HSR Scenario 2*** – Journey Time Focused

s.18(b), s.21(1)(a)

Journey Times

HSR Study

Base Assumptions

- **Rolling Stock:** This analysis assumes different characteristics of electric multiple unit and bi-mode trains that can achieve speeds up to 300 km/h (186 mph).
- **Stopping Patterns:** Two different service types have been assumed – Express Service and Stopping Service.
- **Station Stops:** HSR is assumed to serve existing city centre stations in Toronto-Ottawa-Montréal-Québec City, as well as secondary city stations within the major cities. Stations are also assumed in Peterborough s.18(b), s.21(1)(a) Laval.
- **Station Dwell Times:** Assumes 2-minutes excluding Dorval which assumes 3-minutes.
- **Average Speed:** Based on international intercity and HSR benchmarks, it is assumed that the average operating speeds would be approximately 80-85% of the maximum permissible speed (to account for station stops and other technical and operational considerations).
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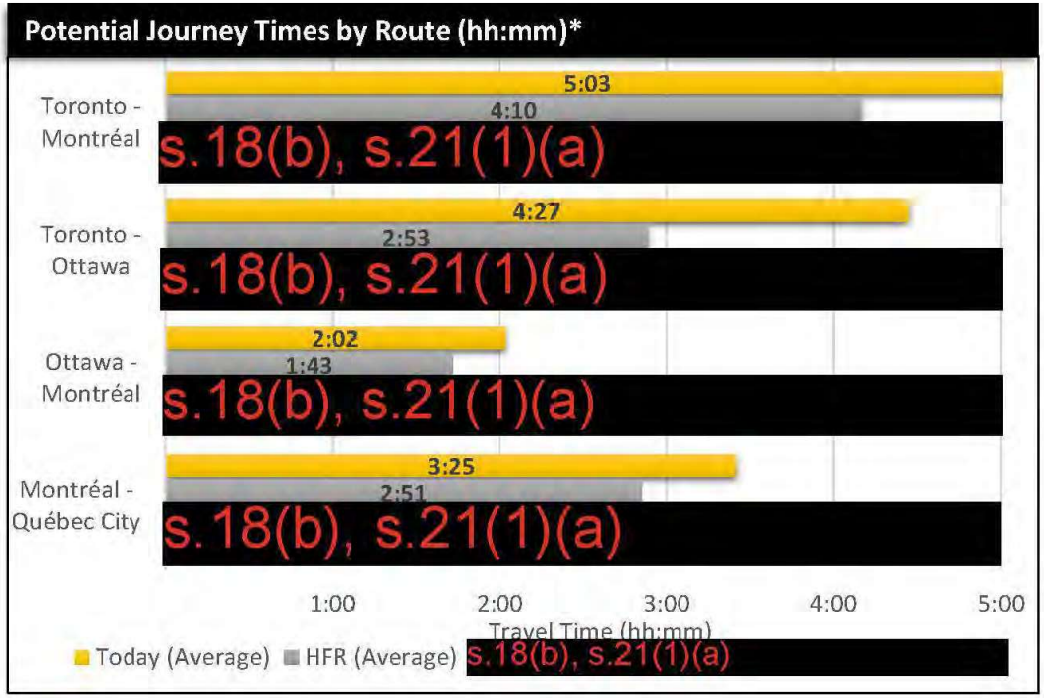
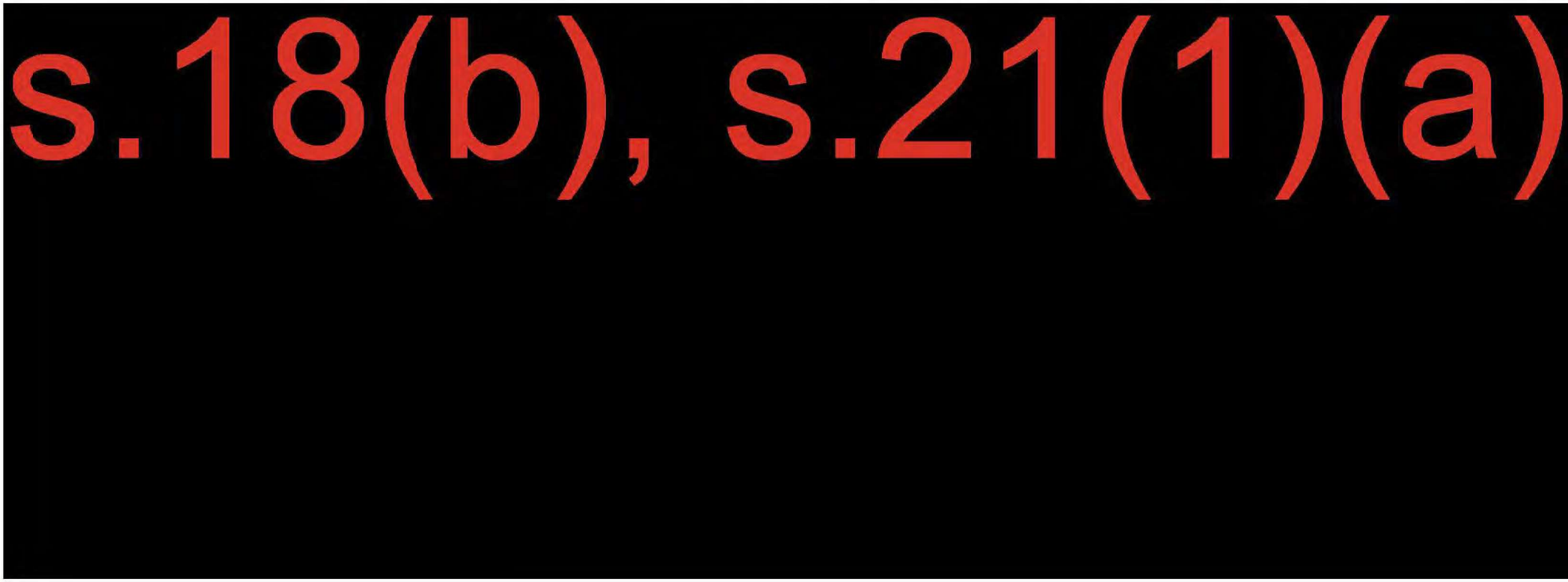


* Note: Potential journey times for Ottawa – Montreal and Montreal-Quebec City for Scenario 2 are based on conventional intercity rail speeds up to 177km/h (110mph).

Revenue

HSR Study

Following the same pattern as Ridership, the Revenue of HSR is s.18(b), s.21(1)(a) Revenue is s.18(b), s.21(1)(a) for the overall speed increases in Scenario 1 compared to Scenario 2.

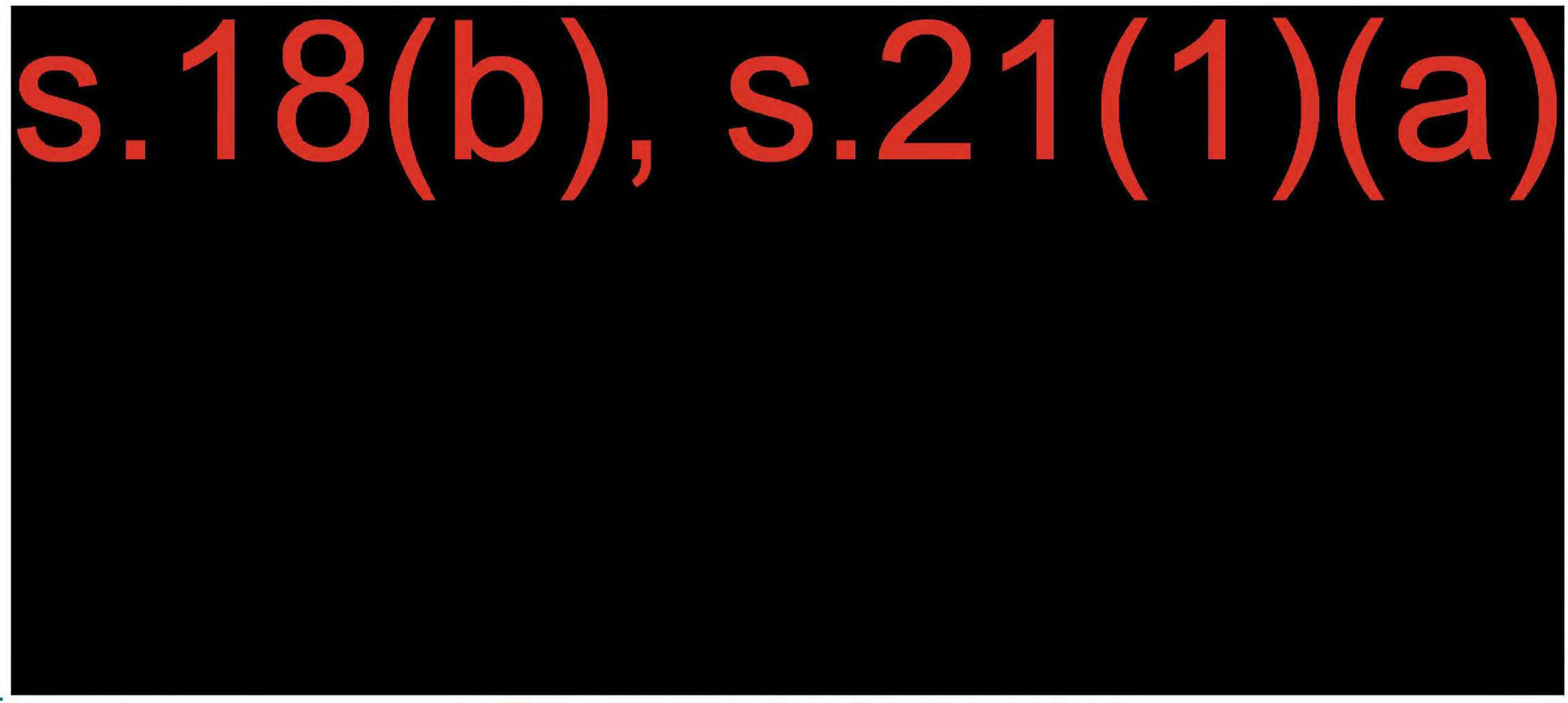


*Source: Steer forecasts (March 2023) without double count, including ramp-up, yield management uplift and 2019 validation uplift assumptions

Results Summary

HSR Study

s.18(b), s.21(1)(a)



HSR Next Steps

HSR Working Committee (GO-VHFR) is being established to ensure;

1) Different studies and analysis are consistent and integrated where applicable across the project.

2) Common set of HSR-related definitions

3) Once central source of information for briefings and communications

4) Build Canadian expertise in preparation for CoDevelopment

5) Inform the development of VIA-HFR Basis of Design, to enable the PDP to commence design development with confirmed requirements/assumptions from all stakeholders

Electrification Power Supply Overview

Hydro Overview

Note: Detailed Update at separate briefing

- The VIA-HFR project team has carried out a conceptual review of power consumption to support discussions with Hydro One, Hydro-Québec and related agencies over the last 3 years.
- This high-level of analysis currently taken for the HFR project, in reference to the Base Case alignment, assumes: approximately 850 km electrified network length, a traction power station approximately every 50 km along the route and a projected power range of 30-40MVA.
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Hydro Overview

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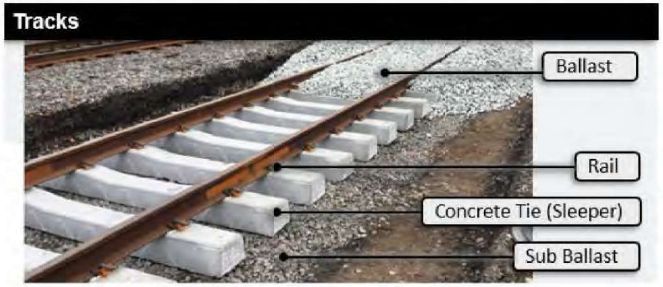

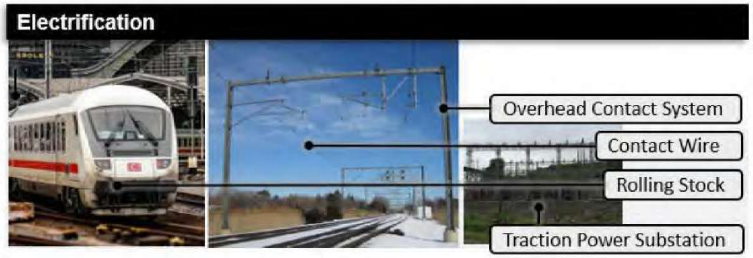

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- Transport Canada does not currently have regulations or standards that address all areas of safety for operations above 95 mph (152 km/h - maximum speed for track class 5)
  - Transport Canada's regulation on grade crossings allows for design speeds for up to 110 mph; HFR Project requirement specification limits speed to 95 mph with risk-based exceptions
  - Grade crossings at all speeds should be avoided in a greenfield corridor

- Most regulations are based on historical industry standards and operating practices, some of which date back over 100 years
  - Written for existing railroads and not necessarily for new construction of passenger rail systems such as HFR
  - Heavily influenced by freight railroads to permit seamless interchange

Example: Signalized Grade Crossing

Example: Urban Road/Rail Grade Separation

Approach to Safety

VIA HFR?

Conventional Rail

Dedicated HSR

Risk Mitigation

- Interoperable passenger and freight operations
- Open right-of-way
- Highway-rail grade crossings

Risk Elimination/ Avoidance

Dedicated ROW

Grade separation

Systems approach

Crash avoidance vs. occupant survival

Conventional Rail vs HSR

What is High Speed Rail (HSR):

- "High-speed rail combines many different elements which constitute a 'whole and integrated system': an infrastructure for new lines designed for speeds of **250 km/h and above; upgraded existing lines for speeds of up to 200 or even 220 km/h**, including interconnecting lines between high-speed sections (which contains):
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World's Fastest High Speed Trains Source Graphic:
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North America Intercity Passenger Rail Trainset

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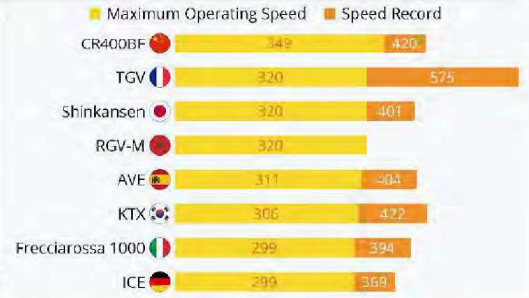

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Intercity Overview

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HFR Base Business Case and HSR Studies

s.18(b), s.21(1)(a)

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s.18(b), s.21(1)(a)

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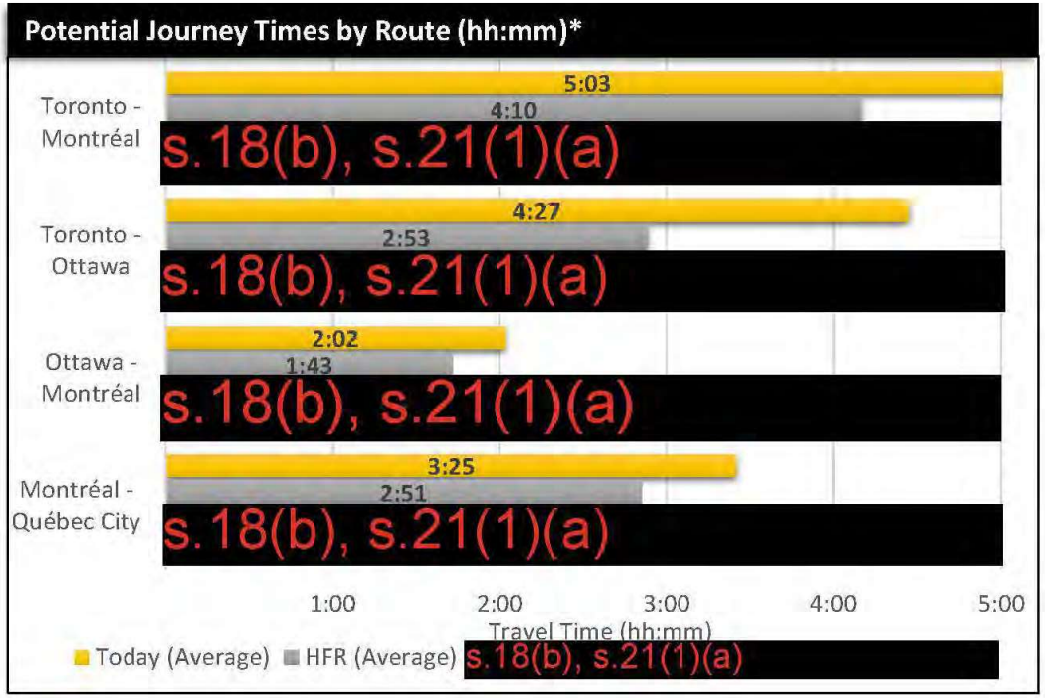

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Revenue

HSR Study

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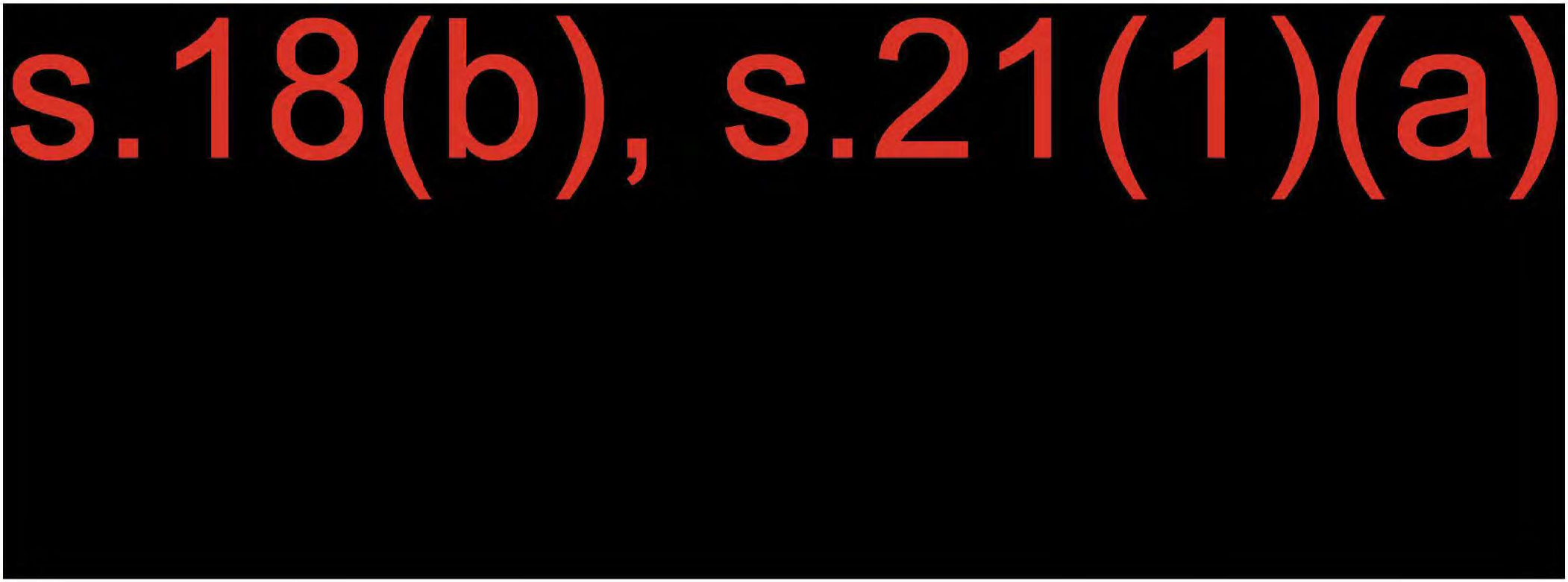
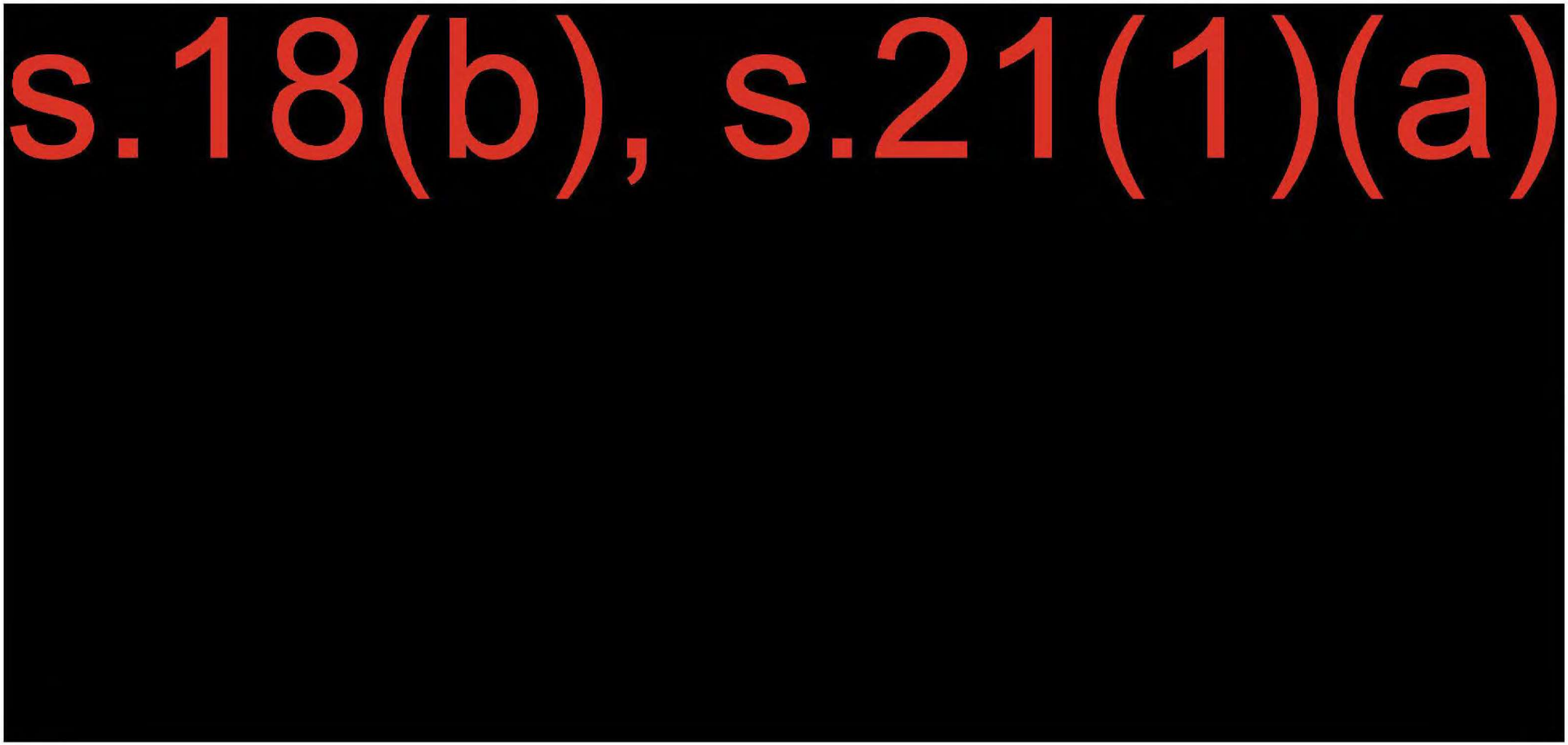


*Source: Steer forecasts (March 2023) without double count, including ramp-up, yield management uplift and 2019 validation uplift assumptions

Results Summary

HSR Study



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Electrification Power Supply Overview

Hydro Overview

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Typical Hydro Transmission Level Connection Process

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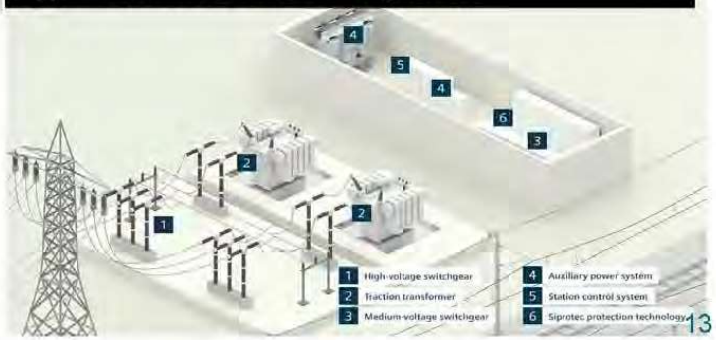
Typical Traction Power Arrangement



Technical Briefing

High Speed Rail and Conventional Intercity Systems | September 2023



Government of Canada / Gouvernement du Canada

Canada

Contents

- Railway Technology – Technical Considerations for Intercity Passenger Railway
- Regulatory Considerations for Intercity Passenger Rail
- Key differences between Conventional Rail and High-Speed Rail
- Highlights from Preliminary HSR study Scenario 1 and Scenario 2
- Overview on power supply analysis and process to support electrification

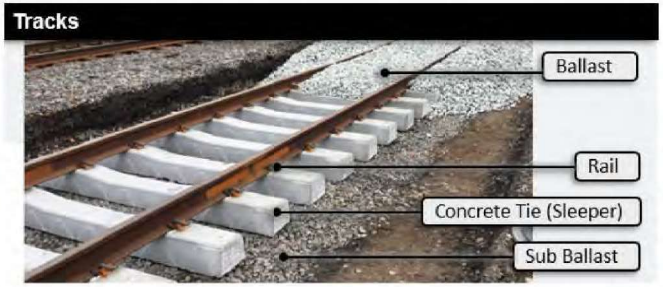
Intercity Overview

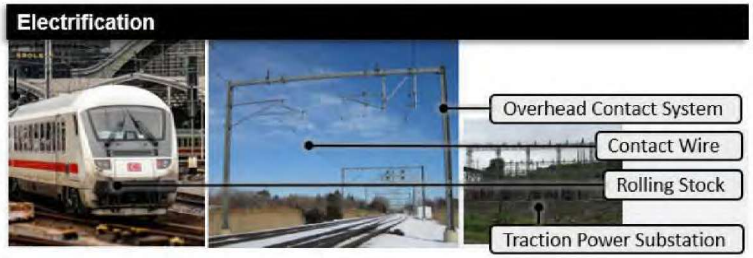
HSR Study

Hydro Overview

Technical Considerations for Intercity Passenger Rail

- Proven technology with international standards
- Railways must be designed as an integrated system balancing efficiency, safety, and reliability to achieve a stated performance outcome
- A non-exhaustive, but foundational depiction of common railway elements is provided as introduction to railway terminology





General Note:
System configurations and components will vary. Content is an introductory non-exhaustive review of local applications, excluding electrification. For general education only.

Regulatory and Safety Considerations for Intercity Passenger Rail

- The legislative framework under Canada's ***Railway Safety Act*** includes regulations, rules, and engineering standards that all have equal force of law

- Transport Canada does not currently have regulations or standards that address all areas of safety for operations above 95 mph (152 km/h - maximum speed for track class 5)
  - Transport Canada's regulation on grade crossings allows for design speeds for up to 110 mph; HFR Project requirement specification limits speed to 95 mph with risk-based exceptions
  - Grade crossings at all speeds should be avoided in a greenfield corridor

- Most regulations are based on historical industry standards and operating practices, some of which date back over 100 years
  - Written for existing railroads and not necessarily for new construction of passenger rail systems such as HFR
  - Heavily influenced by freight railroads to permit seamless interchange

Example: Signalized Grade Crossing

Example: Urban Road/Rail Grade Separation

Approach to Safety

Risk Mitigation

- Interoperable passenger and freight operations
- Open right-of-way
- Highway-rail grade crossings

Risk Elimination/ Avoidance

Dedicated ROW

Grade separation

Systems approach

Crash avoidance vs. occupant survival

Conventional Rail vs HSR

What is High Speed Rail (HSR):

- "High-speed rail combines many different elements which constitute a "whole and integrated system": an infrastructure for new lines designed for speeds of **250 km/h and above; upgraded existing lines for speeds of up to 200 or even 220 km/h**, including interconnecting lines between high-speed sections (which contains):
  - rolling stock, specially designed for trainsets;
  - telecommunications,
  - signaling,
  - operating conditions and
  - equipment, etc.

- "Technology is expected to have a major influence on infrastructure development over the next 20 years."
  - International Union of Railways (UIC)

General Note:
Source quote obtained from International Union of Railways (UIC):
Intercity and High-Speed | UIC - International union of railways
World's Fastest High Speed Trains Source Graphic:
Chart: The World's Fastest High-Speed Trains | Statista

North America Intercity Passenger Rail Trainset

North America
VIA Rail Canada

High-Speed Rail Trainset

Europe
ICE Germany

VIA Rail vs. Selected High-Speed Trains (km/h)

VIA Rail operates on tracks shared with freight trains between Windsor-Quebec City at speeds of up to **160 km/h.**

When viewing these charts, consider that performance is a measure of not just rolling stock, but a harmonization of rail systems that consider track geometry, vehicle loading, signaling technology, power, operational constraints, environmental factors, etc.

VIA-BAU, HFR and HSR Overview

Intercity Overview

The table below provides comparative analysis using key railway performance measures, contrasting VIA-Business-as-Usual (BAU) alongside projected HFR and HSR scenarios.

Key Characteristic	Existing Via Rail BAU Service	High Frequency Rail Base Case used for 2021 Business Case	Preliminary HSR Study (2023) Scenario 1 "Speed Focused"	Preliminary HSR Study (2023) Scenario 2 "Journey Time Focused"
Operations:				
Operating Speed	**Up to 160 km/h** (100mph)	Up to **176 km/h** (109 mph)	**Up to 300 km/h** (186 mph)	**Up to 257 km/h** (160 mph)
Journey Times (Tor - Mtl)	s.18(b), s.21(1)(a)			
On-Time Performance	~67% (2019)	~95% (Assumed)	~95%	~95%
Trains Per Day	24 (2023)	58 (2045)*	72 (2039)	62 (2039)
Ridership (40yr Period)	s.18(b), s.21(1)(a)			
Host Railway Interface	Shared Tracks	Shared Tracks / Right-of-Way (Assumed)	Intercity Dedicated Right-of-Way City Access Shared	Intercity Dedicated Right-of-Way City Access Shared
Stations:				
Station Stops	Shared	Shared & Dedicated	Shared & Dedicated	Shared & Dedicated
Station Platform Heights	Mixed (49" 5")	Level Boarding with one exception (Union Station)	Level Boarding with one exception (Union Station)	Level Boarding with one exception (Union Station)
Technology:				
Rolling Stock	Diesel Locomotive-Hauled	Bi-Modal (Assumed)	Electric Multiple Unit (Assumed)	Bi-Modal Unit (Assumed)
Signaling	Fixed Block Signaling	Enhanced Train Control	Enhanced Train Control	Enhanced Train Control
Electrification (25kVa)	No	Yes (93% Assumed)	Yes (Assumed)	Yes (93% Assumed)
Design:				
Alignment	More Track Curves Permitted	More Track Curves Permitted	Less Track Curves Permitted	Less Track Curves Permitted
Grade Crossings	Permitted	Permitted 202' Business Case 2023 (iPRS) Not Permitted speeds above 95 mph	2023 (iPRS) Not Permitted speeds above 95 mph	2023 (iPRS) Not Permitted speeds above 95 mph

HFR Base Business Case and HSR Studies

s.18(b), s.21(1)(a)

Scenario Maps

- ***HFR Base Case*** – Conventional Rail – Shared Tracks
- ***HSR Scenario 1*** – Speed Focused
- ***HSR Scenario 2*** – Journey Time Focused

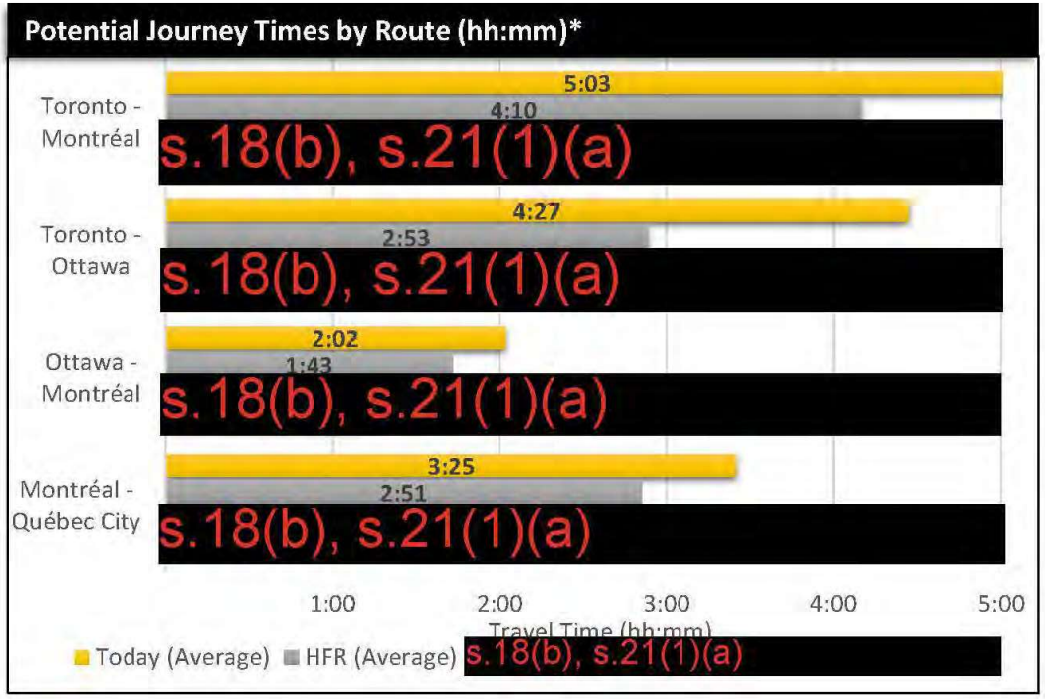
s.18(b), s.21(1)(a)

Journey Times

HSR Study

Base Assumptions

- **Rolling Stock:** This analysis assumes different characteristics of electric multiple unit and bi-mode trains that can achieve speeds up to 300 km/h (186 mph).
- **Stopping Patterns:** Two different service types have been assumed – Express Service and Stopping Service.
- **Station Stops:** HSR is assumed to serve existing city centre stations in Toronto-Ottawa-Montréal-Québec City, as well as secondary city stations within the major cities. Stations are also assumed in Peterborough s.18(b), s.21(1)(a) Laval.
- **Station Dwell Times:** Assumes 2-minutes excluding Dorval which assumes 3-minutes.
- **Average Speed:** Based on international intercity and HSR benchmarks, it is assumed that the average operating speeds would be approximately 80-85% of the maximum permissible speed (to account for station stops and other technical and operational considerations).
- **Simulation Modeling:** Spreadsheet analysis only.
- **Host Railway Conflicts:** None assumed. No model or data to support.



* Note: Potential journey times for Ottawa – Montreal and Montreal-Quebec City for Scenario 2 are based on conventional intercity rail speeds up to 177km/h (110mph).

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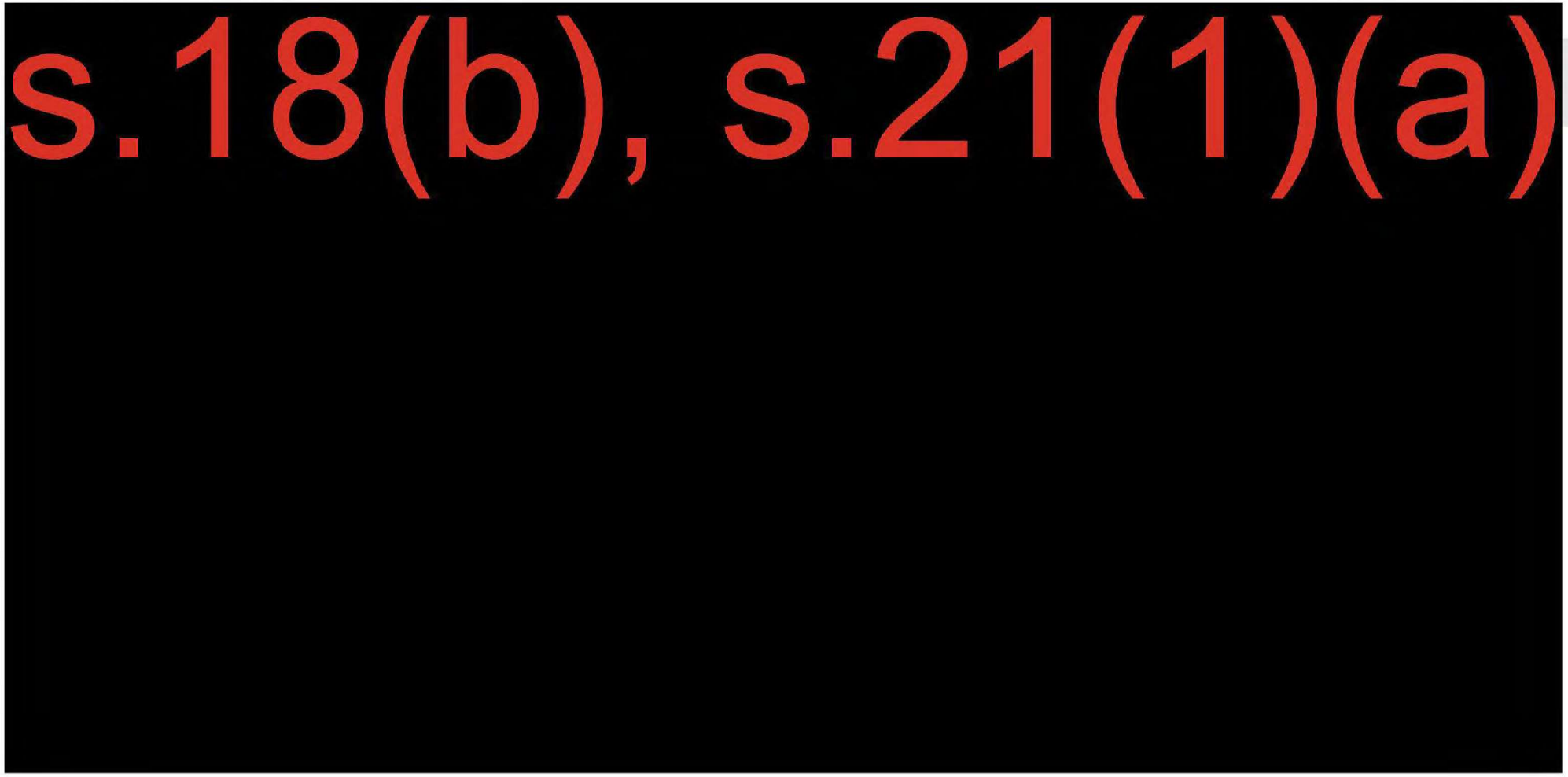

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