From: Mike Bogias
To: s.19 [redacted]
Cc: William Allman; Graeme Hampshire; s.19 [redacted]
Subject: RE: DRAFT HSR Technical Briefing
Date: Sunday, September 3, 2023 11:51:00 PM
Attachments: 2023-09-03 - HSR Technical Briefing_DRAFTREV03MB.pptx
2023-09-03 - HSR Technical Briefing_DRAFTREV03MB.pdf

Laurant/Trevor;

Please find attached DraftREV03 on the CEO Technical Briefing.
Comments from GH have been incorporated into this latest draft.

General updates:

- More technical material provided;
- Global benchmarking content added;
- Contrasting BAU/HFR/HSR
- More content from HSR Study
- Hydro IA Phases added
- Format consistency
- 11 slides total.

Request: For Tuesday, please review the content for accuracy and respond by email with any changes needed.

I've pulled most info from the HSR Study and the HFR Business Case Update.
I just need a few more numbers on Slide 4 and Slide 10, if available.

Thank you,

Mike

Mike Bogias
Workstream Manager
Rail Systems and Infrastructure (RSI)
P: 438-686-4149
hfr-tgf
Home - tgf-hfr.ca / Accueil - tgf-hfr.ca

From: Graeme Hampshire <Graeme.Hampshire@hfr-tgf.ca>
Sent: Saturday, September 2, 2023 9:24 AM
To: Mike Bogias <Mike.Bogias@hfr-tgf.ca>
Cc: William Allman <William.Allman@hfr-tgf.ca>
Subject: RE: DRAFT HSR Technical Briefing

Thanks, Mike.

The structure is fine. I have made comments in yellow highlights. I have made other modifications but they do not show up in trach changes.
I think we should beef up the technical elements, as this is meant to be a technical briefing and I have given an indication of how we should do this. Please see the following article for more details

https://www.newcivilengineer.com/the-future-of/future-of-rail-high-speed-rail-networks-spring-up-worldwide-despite-engineering-challenges-29-08-2023/

Please let me know if my comments are not clear.

Best wishes?

Graeme Hampshire
Project Director
Via HFR – Via TGF
+1 514 207 0909

From: Mike Bogias <Mike.Bogias@hfr-tgf.ca>
Sent: Saturday, September 2, 2023 3:21 AM
To: Graeme Hampshire <Graeme.Hampshire@hfr-tgf.ca>
Cc: William Allman <William.Allman@hfr-tgf.ca>
Subject: DRAFT HSR Technical Briefing

Hi Graeme,

See attached draft slides in preparation for CEO Technical Briefing on Sept 6.
Please provide feedback, Q's, comments, at your earliest.

I'll look to brief Will on his return, and I plan to head out to Montreal Tuesday evening, ahead Wednesday session(s).

Best,

Mike

Mike Bogias
Workstream Manager
Rail Systems and Infrastructure (RSI)
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Home - tgf-hfr.ca / Accueil - tgf-hfr.ca

Technical Briefing

High Speed Rail and Conventional Intercity Systems | September 2023



Government of Canada / Gouvernement du Canada

Canada

Contents

- Differences between Conventional Intercity Rail and High-Speed Rail systems.
- Highlights from Preliminary HSR study.
- Update on power requirements to support electrification.

Intercity Overview

HSR Study

Hydro Update

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

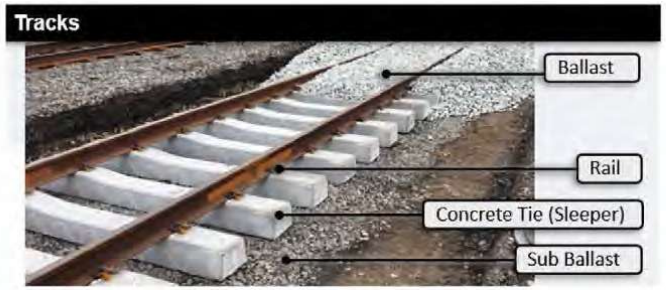
Characteristic	Existing Via Rail BAU Service	High Frequency Rail Business Case	Preliminary High Speed Rail Study
Operations:			
Speed	**Up to 160 km/h** (100mph)	Up to **201km/h** (125mph)	**Up to 300 km/h** (186mph)
Journey Times (ex.Tor-Mon)	s.18(b), s.21(1)(a)		
On-Time Performance	~67% (2019)	~95% (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

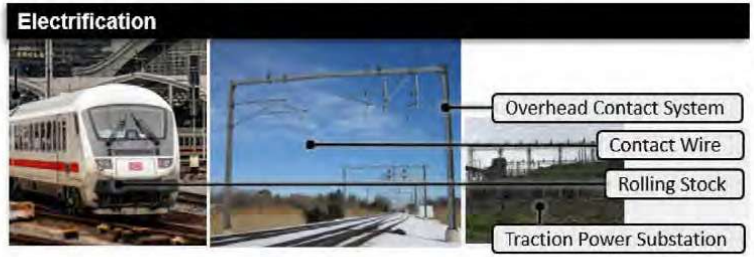
s.18(b), s.21(1)(a)

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
Class 5	80 mph (129 km/h)	100 mph (160 km/h)	Transport Canada
Class 6	110 mph (177 km/h)		FRA
Class 7	125 mph (200 km/h)		FRA
Class 8	160 mph (258 km/h)		FRA
Class 9	200 mph (320 km/h)		FRA

- 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)

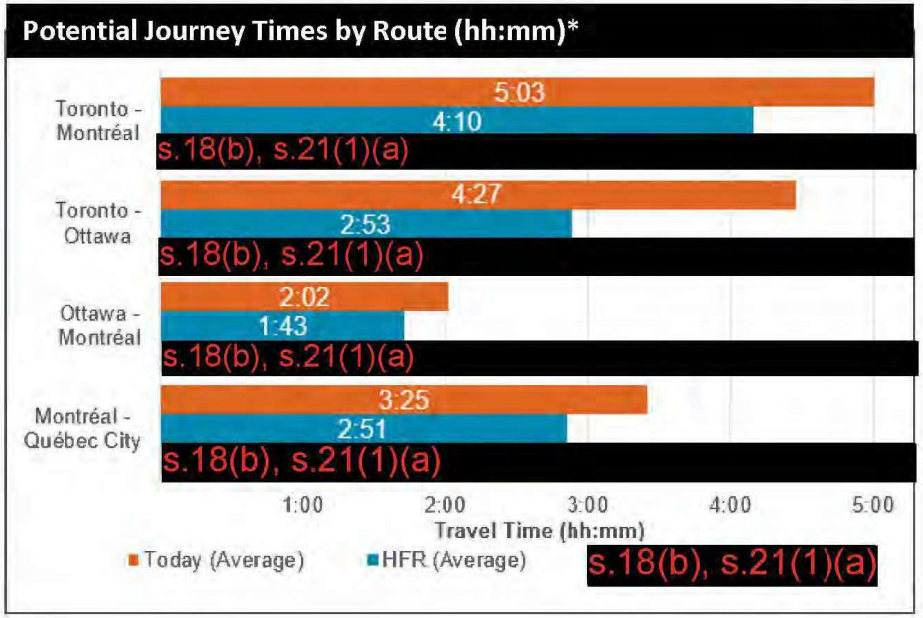
s.18(b), s.21(1)(a)

Journey Times

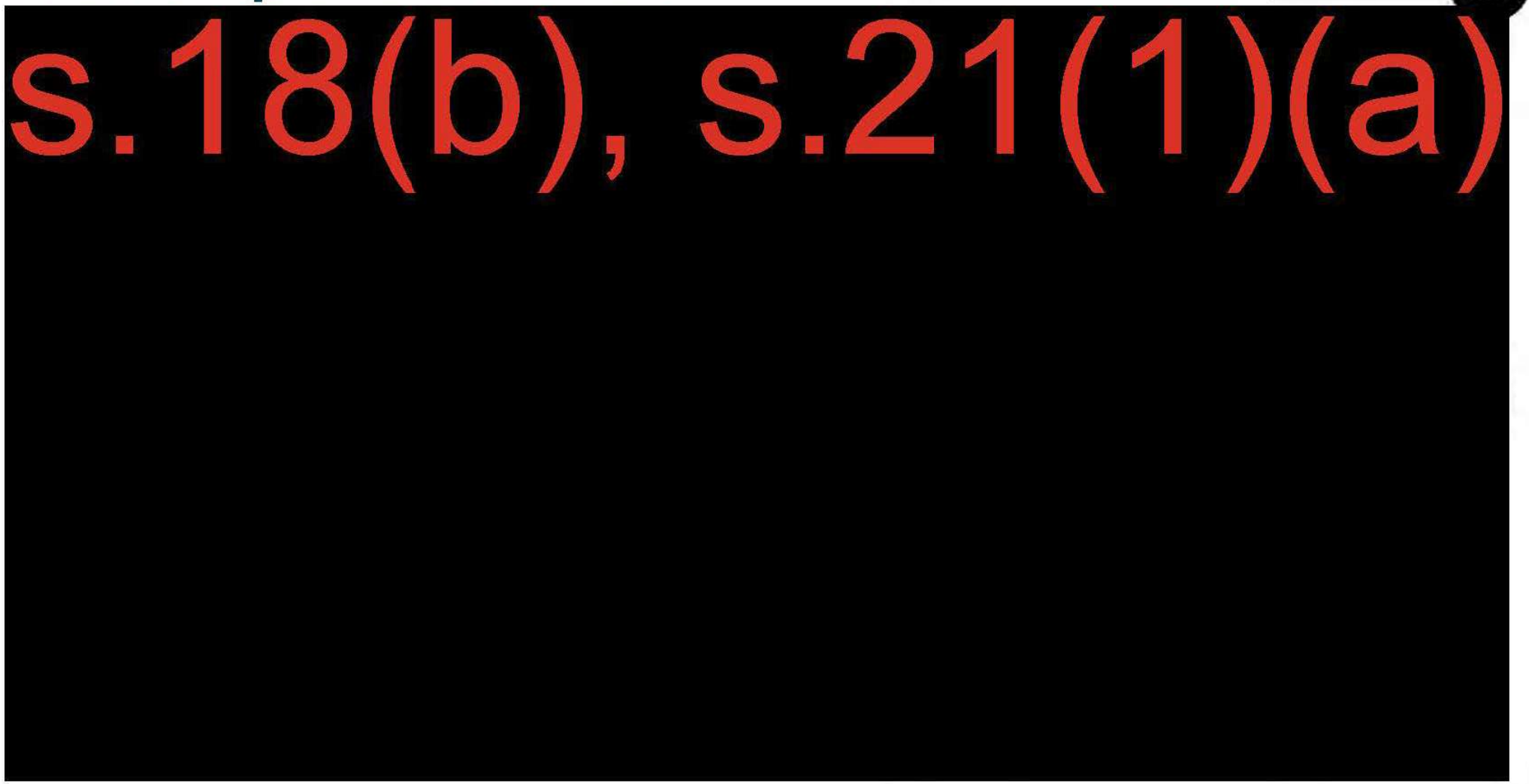
HSR Study

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



Capital Expenditure

HSR Study

Base Assumptions

- **Class Estimate:** All estimates are rough order magnitude.
- **Operating Expenditure:** HSR operating expenditure estimates utilized the OPEX modelling framework developed for in 2020, with assumed cost efficiencies applied for increased ridership estimates.
- Capital Expenditure estimate breakdown is as follows:

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

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

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

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

Typical Traction Power Arrangement

From:	Graeme Hampshire
To:	Mike Bogias
Cc:	William Allman
Subject:	RE: DRAFT HSR Technical Briefing
Date:	Saturday, September 2, 2023 9:24:00 AM
Attachments:	2023-09 01 HSR Technical Briefing DRAFTREV02GH.pptx

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Please use a common font throughout

Technical Briefing

High Speed Rail and Conventional Intercity Systems | September 2023

Government of Canada / Gouvernement du Canada

Canada

Contents

a. Differences between Conventional Intercity Rail and High-Speed Rail systems.

b. Highlights from Preliminary HSR study.

c. Update on power requirements to support electrification.

Intercity Overview

HSR Study

Hydro Update

Include these icons on each slide as signposts in top right corner. See next slide for an example

Passenger Rail Systems

Intercity Overview

- Passenger rail systems serve specific transportation needs within urban, regional and intercity settings.
- They improve connectivity, support the development of growing communities, and encourage a modal shift to reduce congestion and emissions.
- Each system has different characteristics, infrastructure requirements, technologies, and operational models to support the movement of people.

Please include some stats such a tph, pax per hour,

Light Rail Systems (LRT)
Urban
TTC Toronto; Ottawa LRT; Montreal REM
Quebec City Tramway

Commuter Rail System
Suburban-to-Urban Centre
Metrolinx Toronto
EXO Montreal

Intercity Rail System
Urban Centre -to- Urban Centre
VIA Rail Canada ; Amtrak USA

High Speed Rail System
Urban Centre-to-Urban Centre
HS1 UK ; TGV France ; ICE Germany

Intercity Rail: Definitions

Conventional Intercity Rail:
Long-distance rail services between communities. In Canada, VIA Rail operates on tracks shared with freight between Windsor-Quebec City at speeds of up to 160 km/h. In the United States, Amtrak

s.21(1)(a)

High Speed Rail:
The International Union of Railways (UIC) defines high speed rail as systems of rolling stock and infrastructure which regularly operate at or above 250 km/h on new (dedicated) tracks, or 200 km/h on existing (shared) tracks.

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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Class 8	160 mph (258 km/h)		FRA
Class 9	200 mph (320 km/h)		FRA

TrenItalia High Speed Train with Commercial Speed of 360km/h.
Milan to Rome, Italy

Comparison between conventional and high speed (quantitative)

- Signalling systems
- Cost per km
- Power draw
- Staffing
- Segregation
- Fencing
- Geometry
- Typical cross sections
- Tph
- Etc…

Conventional and High Speed: Comparison

Characteristic	Existing Via Rail Service	High Speed Rail Study Corridor
Speed	**Up to 100 mph** (160 km/h)	**Up to 186 mph** (300 km/h)
Journey Times	Similar to auto, with ~70% on-time performance ? tpd	Significant improvement, competitive with air; anticipated ~95% on-time performance, ? tpd
Alignment and Infrastructure	Shared Right-of-Way with Other Services Shared Station Stops Significant Curved Track Sections	Dedicated Right-of-Way Shared Station Stops Long Sections of Straight Track - rephrase Dedicated Station Platforms at key locations
At-grade Crossings	At-Grade Crossings Permissible	100% Grade Separated Corridor
Technology and Equipment	Conventional Locomotive-hauled Rolling Stock Fixed Block Signaling No train protection	Specialized HSR Rolling Stock Electrification Advanced Train Control
Host Railway Interaction	**~75%** route distance is shared track Between Toronto – Quebec City	**Anticipated ~5%** route distance with shared tracks (TOR, MTL and QC city access)

Conceptual comparison for discussion only. Existing systems may differ in characteristics.

HSR Study: Overview

- In 2023, VIA HFR completed the *Preliminary Corridor HSR Assessment*, a study of a conceptual HSR system connecting Toronto, Ottawa, Montréal, and Québec City.

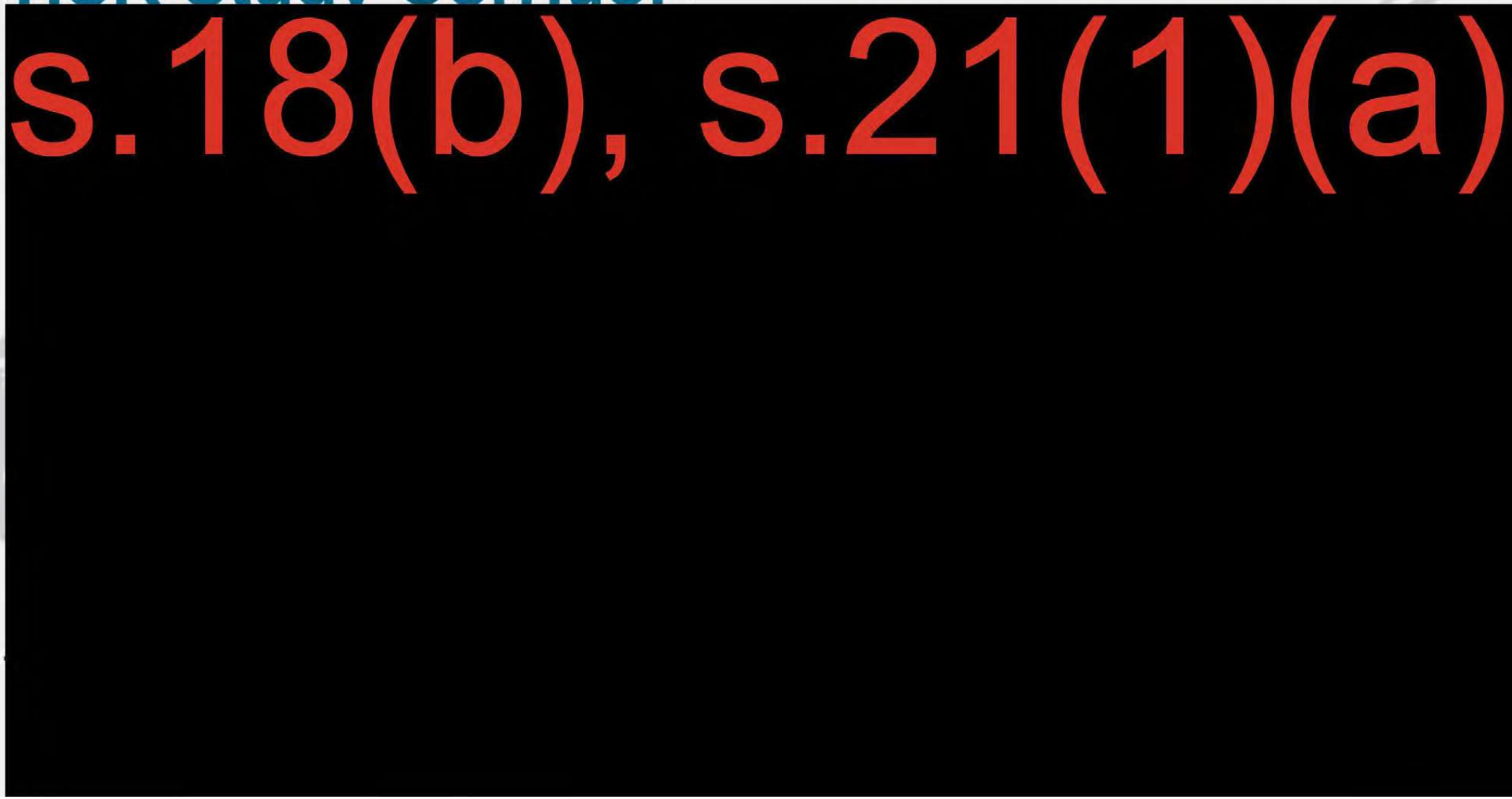
- The study was used to support a review of anticipated benefits for an HSR system, using examples and benchmarks [significant benchmarking is available] from global systems.

- 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.21(1)(a)

HSR Study Corridor

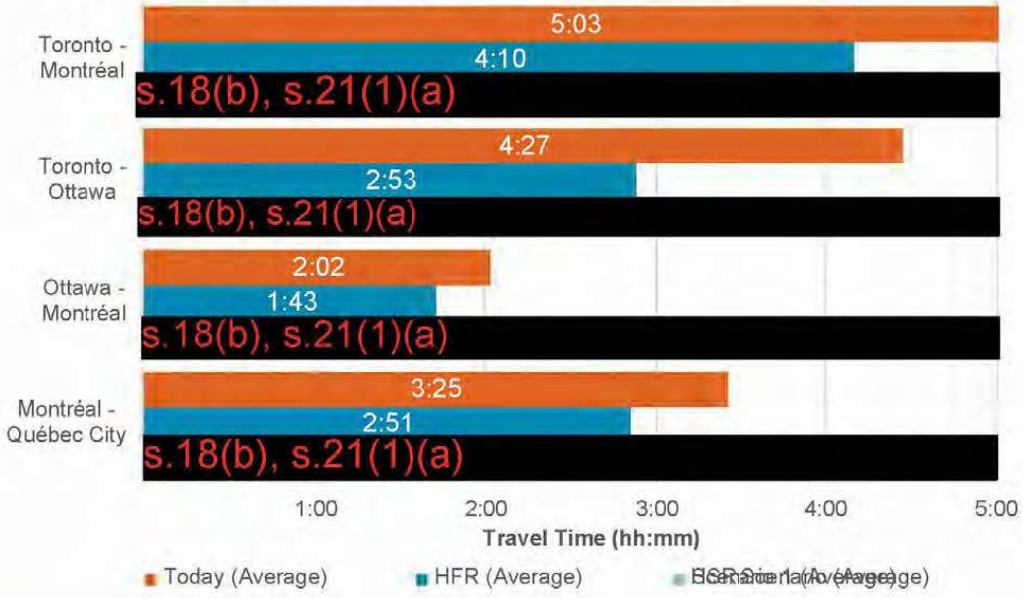


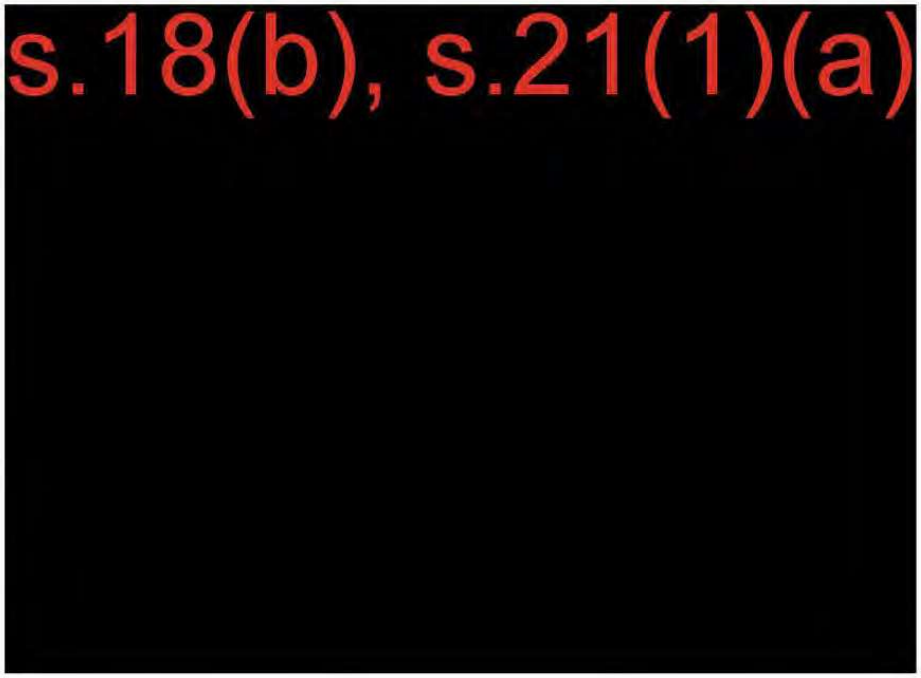
HSR Study: Journey Times & Ridership

HFR and HSR journey times are theoretical estimates based on average operating speeds benchmarked from intercity and high-speed rail projects. No rail simulation was conducted.

Ridership and revenue forecasts are initial indications of HSR benefits. Estimates are based on the forecasting framework developed for HFR.

Potential Journey Times by Route (hh:mm)*





***Source:** *Preliminary Corridor HSR Assessment (2023)*

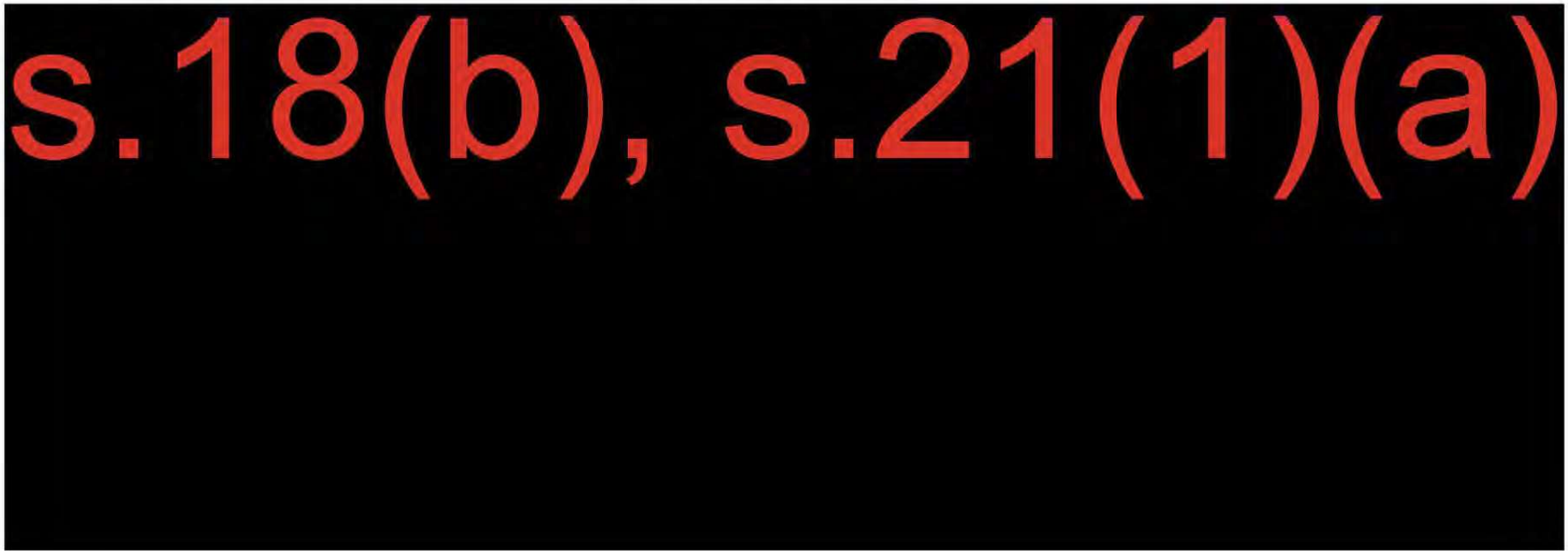
HSR Study: Key Outcomes

- HSR implementation, allowing for less than 3-hour journey times between TOR-MTL and 2-hour journey times between TOR-OTT and MTL-QC, enables significant rail demand, along with a significant modal shift from auto and air. The additional ridership benefits from shorter journey times are realized as revenue estimates in the assessment.
- Delete this slide and include details on the next slide

Format slide

CAPEX + OPEX: Class 5 Estimates

- HSR CAPEX is estimated on a dollar per kilometre basis, using capital cost benchmarks from 68 comparable international HSR projects; the Class 5 Cost estimates are a rough order-of-magnitude based on current project definition, and will require optimization as the project develops.
- HSR OPEX estimates utilized the OPEX modelling framework developed for in 2020, with assumed cost efficiencies applied for increased ridership estimates.



Electrification Power Supply Overview

VIA HFR will be reliant on Hydro Quebec and Hydro One for electrification.
Greater design definition of power consumption details will be identified in Co-Dev Stages 2 and 3.

- 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.

Example: Traction Power Facility

Electrification Power Supply Overview

- Recognizing that a limited amount of design has been completed for the network, power consumption details are not currently available. Power consumption requirements on an electric railway will vary greatly on account of (and not limited to):

    1. Chosen alignment;
    2. Chosen equipment;
    3. Spacing of power facilities;
    4. Number and frequency of trains;
    5. Stations; and
    6. Non-Revenue Facilities.

- While preliminary stakeholder outreach has commenced with Hydro One, Hydro Quebec and the Ontario IESO (Independent Electricity System Operator), the Phase 1 connection request requirements cannot be met until the above is modelled under CoDev Stage 2.
- Talk to Shona about IA implications

Further Resources / Background Material

- **Preliminary Corridor HSR Assessment (2023)**

  This assessment informs an initial exploration for High Speed Rail between Toronto and Québec City, with indicative CAPEX, OPEX, ridership and revenue.

- **HFR Host 3rd Party Railways (H3R) De-Risking and De-Constraining Report (2022)**

  This report consolidates and assesses the information received to date from host railways on interfaces and requirements related to HFR. Operational and technical assessments are based on currently available facts and evidence, while also highlighting any currently unknown data / position of host railways.

From: Graeme Hampshire
To: Robitaille, Vincent
Subject: FW: HFR Journey Time memo for HMC
Date: Wednesday, August 30, 2023 9:45:00 PM
Attachments: HFR Journey Time note 20230830.docx

Hi, Vincent,

s.19 [redacted]

Please note I am awaiting comments from my technical colleagues.

Does this answer your questions – I have 37 slides I can share with you....

Graeme Hampshire
Project Director
Via HFR – Via TGF
+1 514 207 0909

From: Graeme Hampshire
Sent: Wednesday, August 30, 2023 9:44 PM
To: s.19 [redacted]@arup.com>; Mike Bogias <Mike.Bogias@hfr-tgf.ca>
Cc: s.19 [redacted]@arup.com>; HFR_QMOT_DC <HFR_QMOT_DC@arup.com>; s.19 [redacted]@aecom.com>; William Allman <William.Allman@hfr-tgf.ca>
Subject: RE: HFR Journey Time memo for HMC

Please see enclosed. Comments by 1000 please – please check the accuracy of the speeds and times.

I note there was no calculation of journey times Ottawa, Montreal and Quebec at 160mph.

Graeme Hampshire
Project Director
Via HFR – Via TGF
+1 514 207 0909

From: s.19 [redacted]@arup.com>
Sent: Wednesday, August 30, 2023 5:27 PM
To: Mike Bogias <Mike.Bogias@hfr-tgf.ca>; Graeme Hampshire <Graeme.Hampshire@hfr-tgf.ca>
Cc: s.19 [redacted]arup.com>; HFR_QMOT_DC <HFR_QMOT_DC@arup.com>; s.19 [redacted]@aecom.com>; William Allman <William.Allman@hfr-tgf.ca>
Subject: HFR Journey Time memo for HMC

EXTERNAL SENDER: Use caution with links and attachments from an external sender.

Graen[redacted]ry memo based on the HFR Journey times presentations. Let me know if you need anything else regarding this document.

Thanks

[redacted]

s.19

[redacted]

[redacted]

From: Jacques Fauteux
To: Graeme Hampshire
Subject: FW: HFR CEO Briefing on HSR
Date: Thursday, September 7, 2023 8:20:15 AM
Attachments: 2023-09-03 - HSR Technical Briefing DRAFTREV05.pptx

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Graeme

This is more in the education piece for me (so therefore, no urgency nor likely priority related to this deck)

I note on p.7 that the benchmarking leads us to s.18(b), s.21(1)(a)

- Given the international standard is this U.S or Canadian funds?
- Noting that HS 1 and 2 plus Taiwan are higher than the mean. Can we reasonably assume that the [redacted] apply or should it be lesser
- Should the winter component apply ?

On ridership and revenue at p. 9-10, I note that s.18(b), s.21(1)(a) in Year 3 of operation

- From a comparison perspective, should I assume that s.18(b), s.21(1)(a) as per objectives?
- If so, I don't understand how we got to s.18(b), s.21(1)(a) given that there is a s.18(b), s.21(1)(a) between from HFR goals to s.18(b), s.21(1)(a) whereas on s.18(b), s.21(1)(a) from HFR scenario s.18(b), s.21(1)(a)

Thanks

J

From: [redacted]@aecom.com>
Sent: Wednesday, September 6, 2023 9:03 AM
To: Jacques Fauteux <Jacques.Fauteux@hfr-tgf.ca>; McDiarmid, Whitney (TC/TC) <whitney.mcdiarmid@tc.gc.ca>
Cc [redacted] arup.com>; [redacted]@aecom.com>; [redacted]@aecom.com>
Subject: FW: HFR CEO Briefing on HSR

As requested.

s.19 [redacted]

[redacted]
AECOM

From: [redacted]@arup.com>
Sent: September 5, 2023 18:31
To: William Allman <William.Allman@hfr-tgf.ca>; Mike Bogias <Mike.Bogias@hfr-tgf.ca>; [redacted]
[redacted]@arup.com>; [redacted]@aecom.com>
[redacted]<HFR_QMOT_DC@arup.com>
[redacted]n HSR

Will, attached is the latest version of the CEO briefing. I understand that the briefing will be moved to next week-please let us know if you need further work on this from us in the coming days.

Regards,

[redacted]
Arup
121 Bloor Street East, Suite 900
Toronto Ontario M4W 3M5 Canada
[redacted]@arup.com

Technical Briefing DRAFT

High Speed Rail and Conventional Intercity Systems | September 2023

Government of Canada / Gouvernement du Canada

Canada

Contents

- Key differences between Conventional Intercity Rail and High-Speed Rail systems.
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VIA Rail vs. Selected High-Speed Trains (km/h)

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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

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Key Characteristic	Existing Via Rail BAU Service	High Frequency Rail Base Case (2021)	Preliminary HSR Study (2023)
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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 (Assumed)
Design:			
Alignment	More Track Curves Permitted	More Track Curves Permitted	Less Track Curves Permitted
Grade Crossings	Permitted	Permitted	Not Permitted

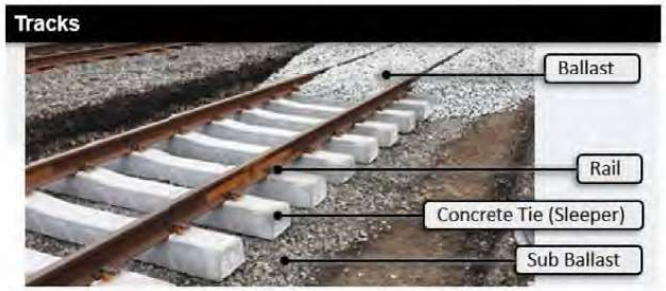
s.18(b), s.21(1)(a)

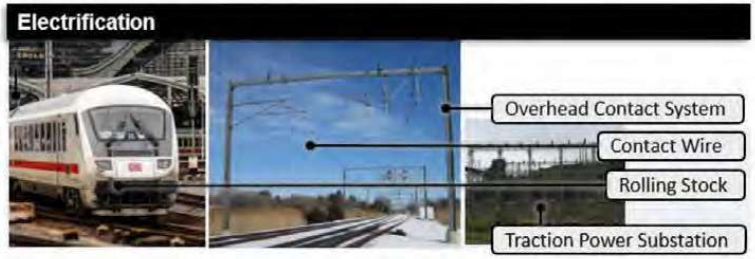
s.18(b), s.21(1)(a)

*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.





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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.

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- 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
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Class 6	110 mph (177 km/h)		FRA
Class 7	125 mph (200 km/h)		FRA
Class 8	160 mph (258 km/h)		FRA
Class 9	200 mph (320 km/h)		FRA

- 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.
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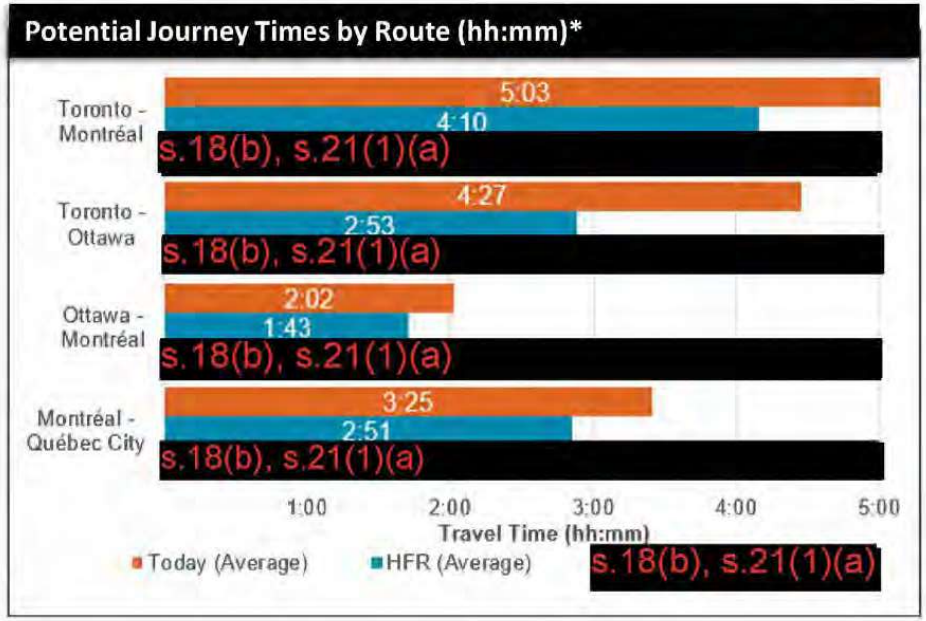
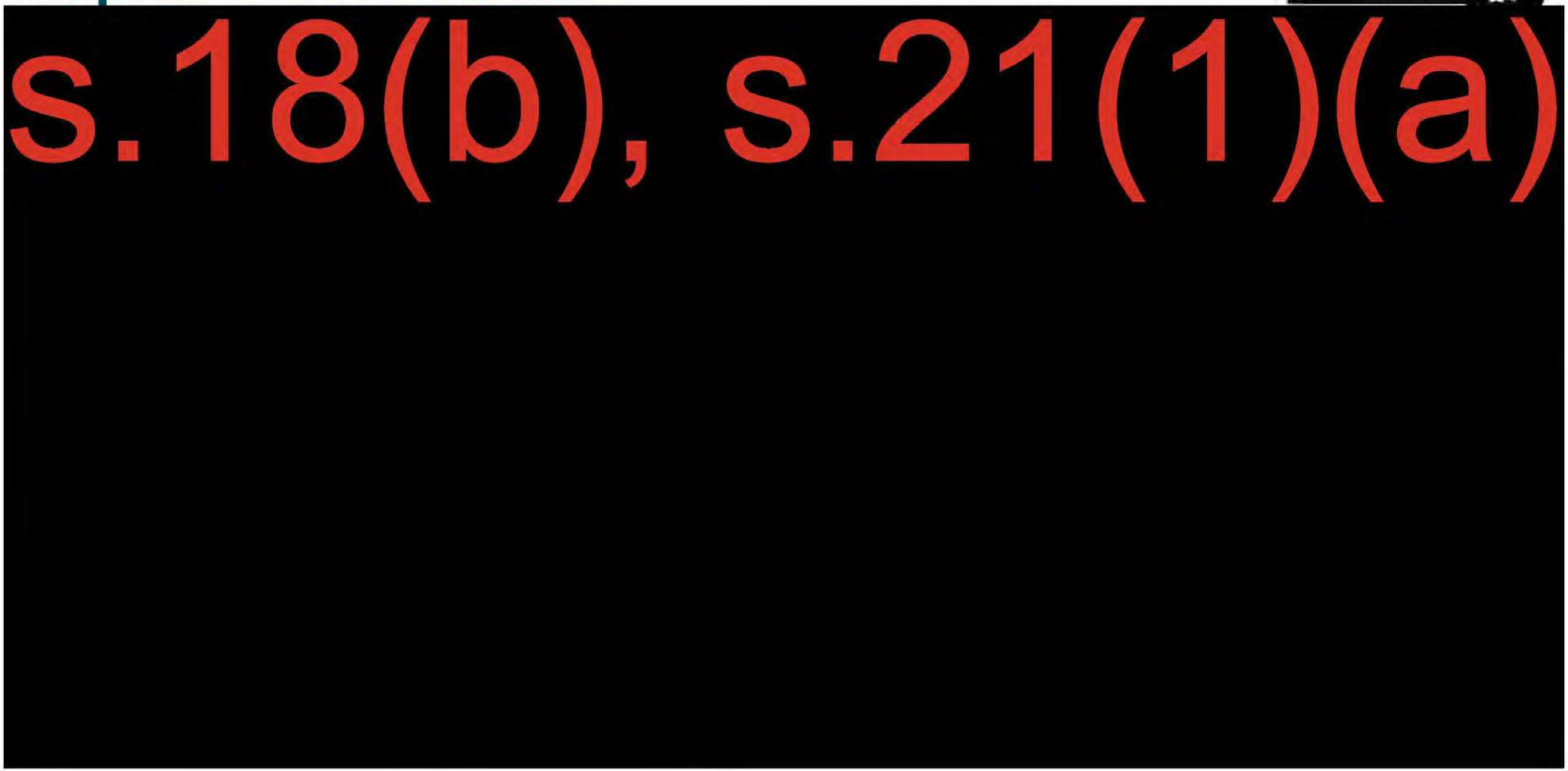
- **Station Dwell Times:** Assumes 2-minutes excluding Dorval which assumes 3-minutes.
- **Average Speed:** Based on international intercity and HSR benchmarks, it is assumed that the average operating speeds would be approximately 80-85% of the maximum permissible speed (to account for station stops 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

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

Capital Cost Estimate



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Hydro Overview

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Typical Hydro Transmission Level Connection Process

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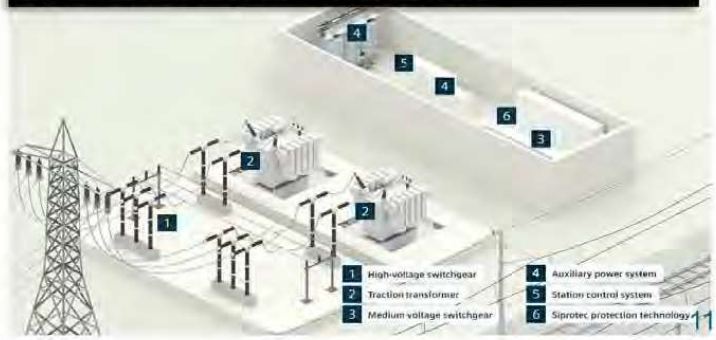
Typical Traction Power Arrangement



From: Jennifer Hu
To: Graeme Hampshire
Subject: FW: DRAFT HSR Technical Briefing
Date: Monday, September 4, 2023 2:00:07 PM
Attachments: 2023-09-03 - HSR Technical Briefing DRAFTREV03MB.pptx

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Hi Graeme,

Hope you enjoyed your weekend. I am finally back on Eastern Time as of yesterday evening. Last week Mike Bogias and I spoke about the HSR presentation, and he included Larry and Devin on a call with QMOT. However, s.19 [redacted]
s.19 [redacted]
Mike informed me that he borrowed information from our draft HFR Safety Guidance for his regulatory slide (p. 6) in the attached briefing. I am fine with the inclusion but would like to explore how the Regulatory and Safety Workstream can be incorporated in the technical briefings for the CEO.

Best,
Jen

From: s.19 [redacted]
To: William Allman; Mike Bogias
Subject: 2023-09-03 - HSR Technical Briefing DRAFTREV04TA - QMOT Review.pptx
Date: Tuesday, September 5, 2023 4:04:03 PM
Attachments: 2023-09-03 - HSR Technical Briefing DRAFTREV04TA - QMOT Review.pptx

As discussed. Still requires review from the team, I will send that reviewed version later.

Technical Briefing

High Speed Rail and Conventional Intercity Systems | September 2023

Government of Canada / Gouvernement du Canada

Canada

Contents

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

Intercity Overview

HSR Study

Hydro Overview

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 (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

Classic Intercity Rail Trainset

North American
VIA Rail Canada

High Speed Rail Trainset

European
ICE Germany

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

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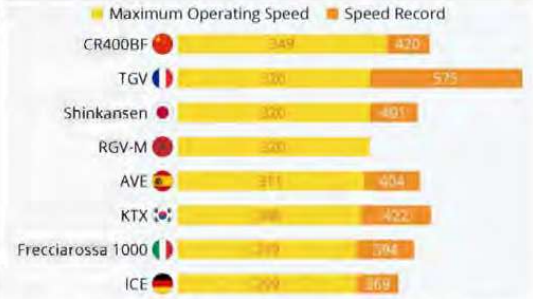

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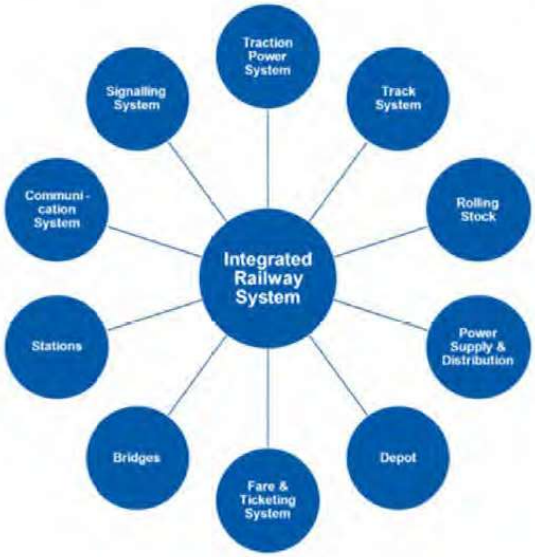

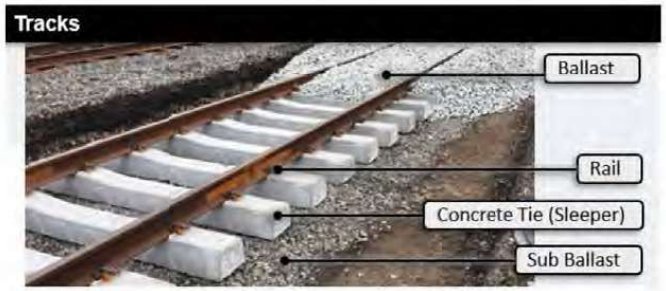

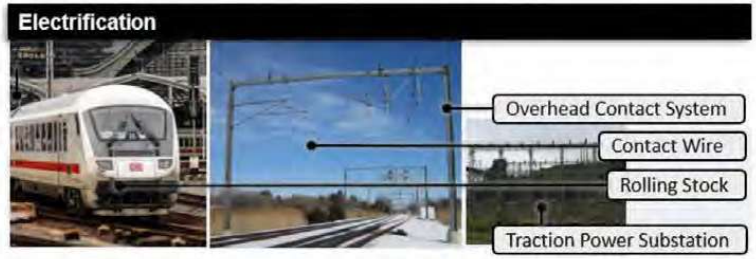

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HSR Study and Global Benchmarking

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

Journey Times

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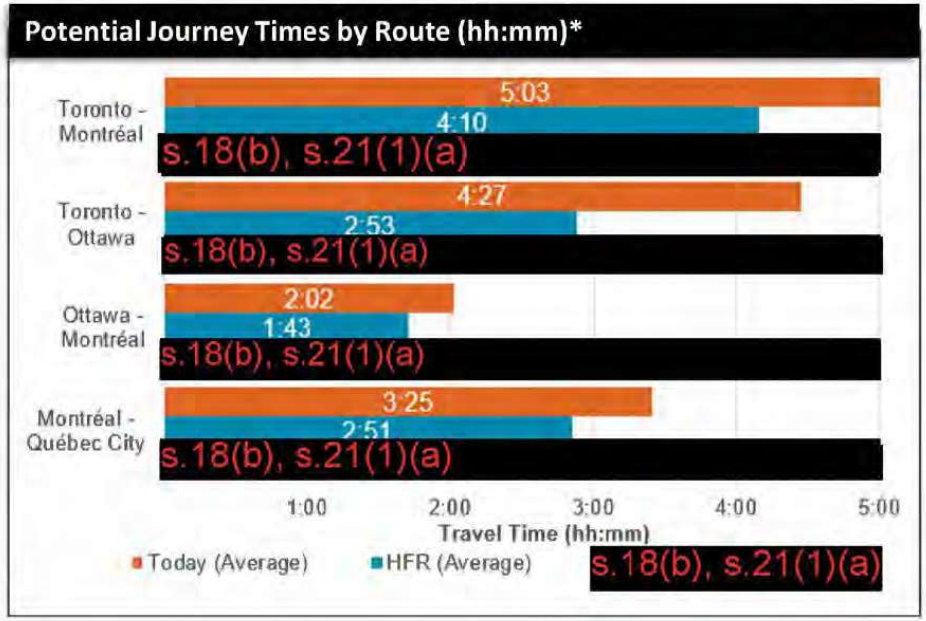

Ridership and Revenue

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

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

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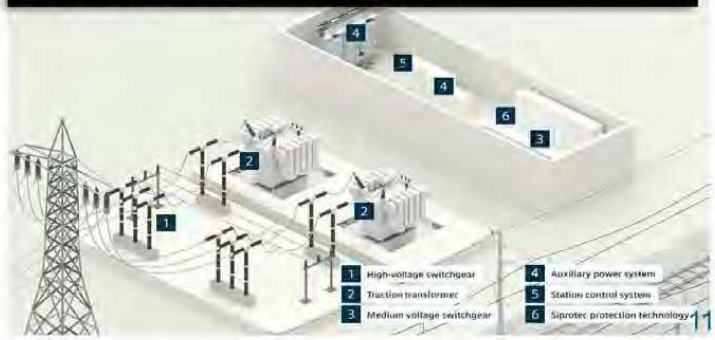

Technical Briefing

High Speed Rail and Conventional Intercity Systems | August 2023



Government of Canada | Gouvernement du Canada

Canada

Content

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b. Highlights from Preliminary HSR study.

c. Update on power requirements to support electrification.

Intercity Overview

HSR Study

Hydro Update

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Light Rail Systems (LRT)
Urban
TTC Toronto; Ottawa LRT; Montreal REM
Quebec City Tramway

Commuter Rail System
Suburban-to-Urban Centre
Metrolinx Toronto
EXO Montreal

Intercity Rail System
Urban Centre -to- Urban Centre
VIA Rail Canada ; Amtrak USA

High Speed Rail System
Urban Centre-to-Urban Centre
HS1 UK ; TGV France ; ICE Germany

Intercity Rail: Definitions

Conventional Intercity Rail:
Long-distance rail services between communities. In Canada, VIA Rail operates on tracks shared with freight between Windsor-Quebec City at speeds of up to 160 km/h. In the United States, Amtrak operates at up to 200 km/h for most services.

High Speed Rail:
The International Union of Railways (UIC) defines high speed rail as systems of rolling stock and infrastructure which regularly operate at or above 250 km/h on new (dedicated) tracks, or 200 km/h on existing (shared) tracks.

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Trenitalia High Speed Train with Commercial Speed of 360km/h.
Milan to Rome, Italy

Conventional and High Speed: Comparison

Characteristic	Existing Intercity Service	High Speed Rail Study Corridor
Speed	**Up to 100 mph** (160 km/h)	**Up to 186 mph** (300 km/h)
Journey Times	Similar to auto, with ~70% on-time performance	Significant improvement, competitive with auto and air; anticipated ~95% on-time performance
Alignment and Infrastructure	Shared Right-of-Way with Other Services Shared Station Stops Significant Curved Track Sections	Dedicated Right-of-Way Shared Station Stops Long Sections of Straight Track Dedicated Station Platforms at key locations
At-grade Crossings	At-Grade Crossings Permissible	100% Grade Separated Corridor
Technology and Equipment	Conventional Locomotive-hauled Rolling Stock Fixed Block Signaling	Specialized HSR Rolling Stock Electrification Advanced Train Control
Host Railway Interaction	**~75%** route distance is shared track Between Toronto – Quebec City	**Anticipated ~5%** route distance with shared tracks (TOR, MTL and QC city access)

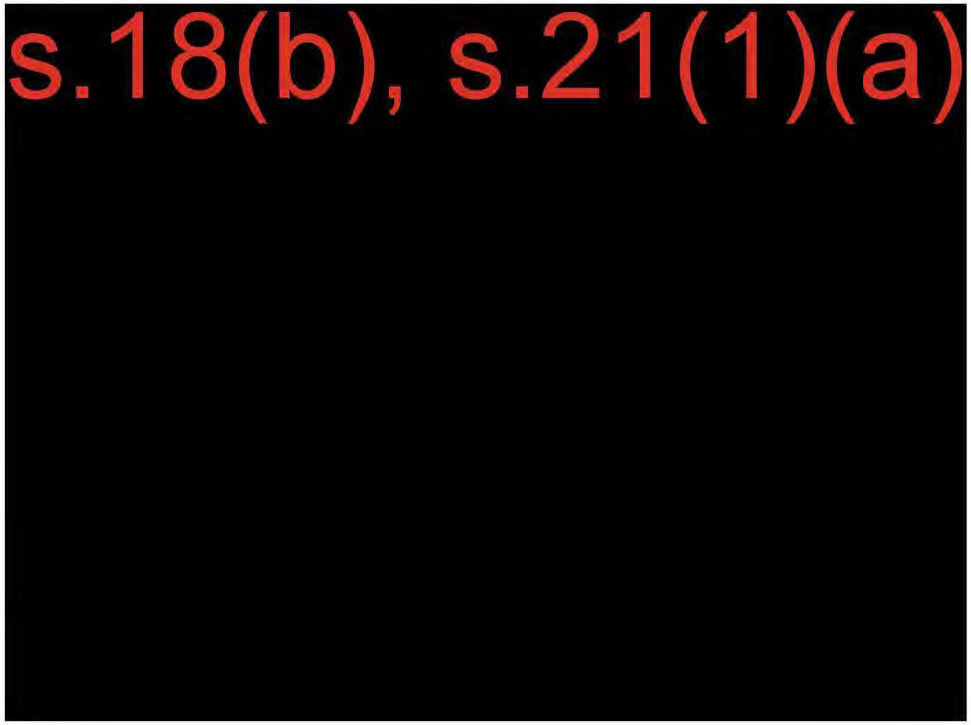
Conceptual comparison for discussion only. Existing systems may differ in characteristics.

HSR Study: Overview

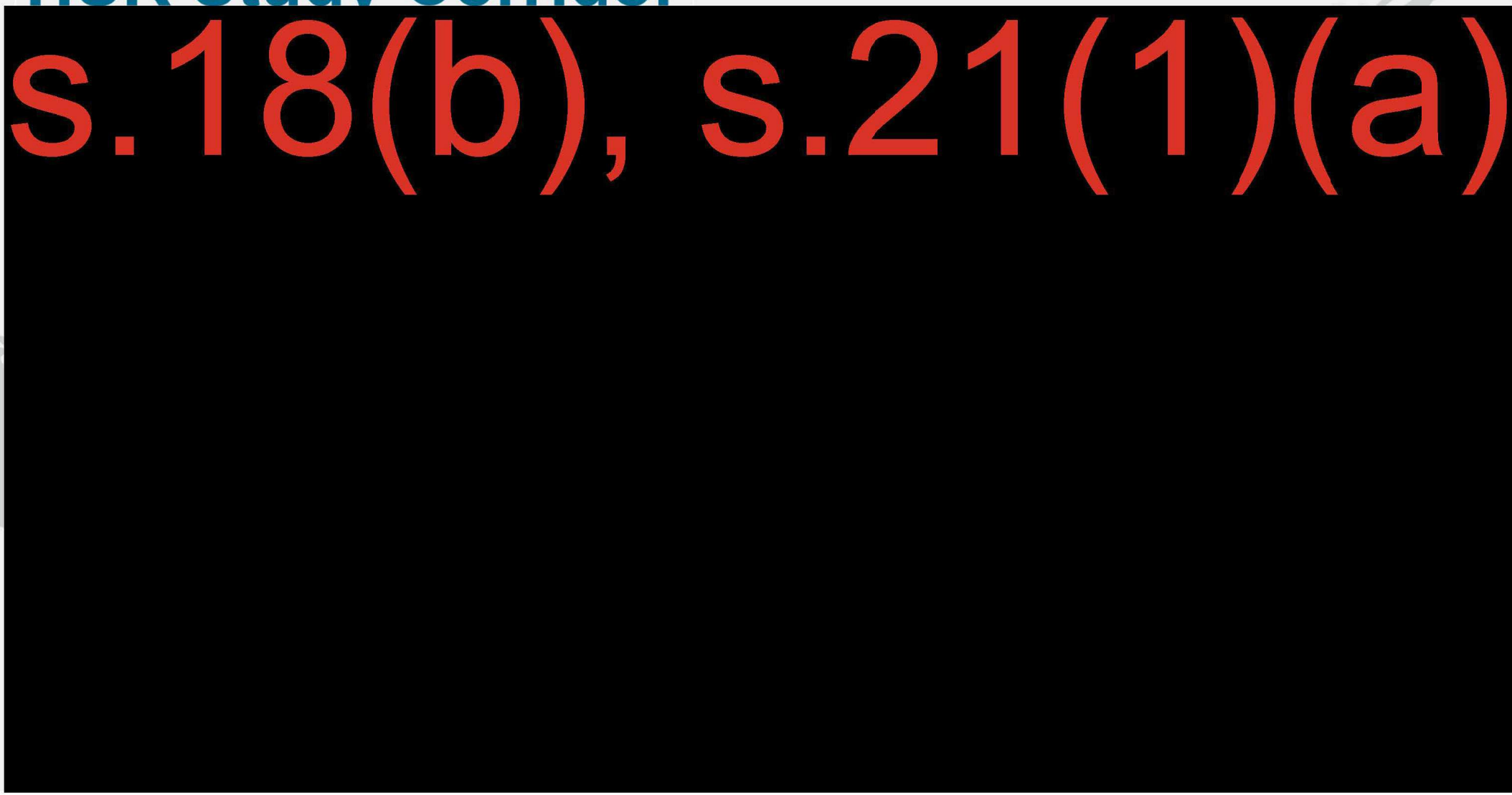
- In 2023, VIA HFR completed the *Preliminary Corridor HSR Assessment*, a study of a conceptual HSR system connecting Toronto, Ottawa, Montréal, and Québec City.

- The study was used to support a review of anticipated benefits for an HSR system, using examples and benchmarks from global systems.

- The output of the report was to provide indicative capital cost, operating cost estimates, journey times, ridership and revenue estimates for developing an HSR system.



HSR Study Corridor



HSR Study: Key Outcomes

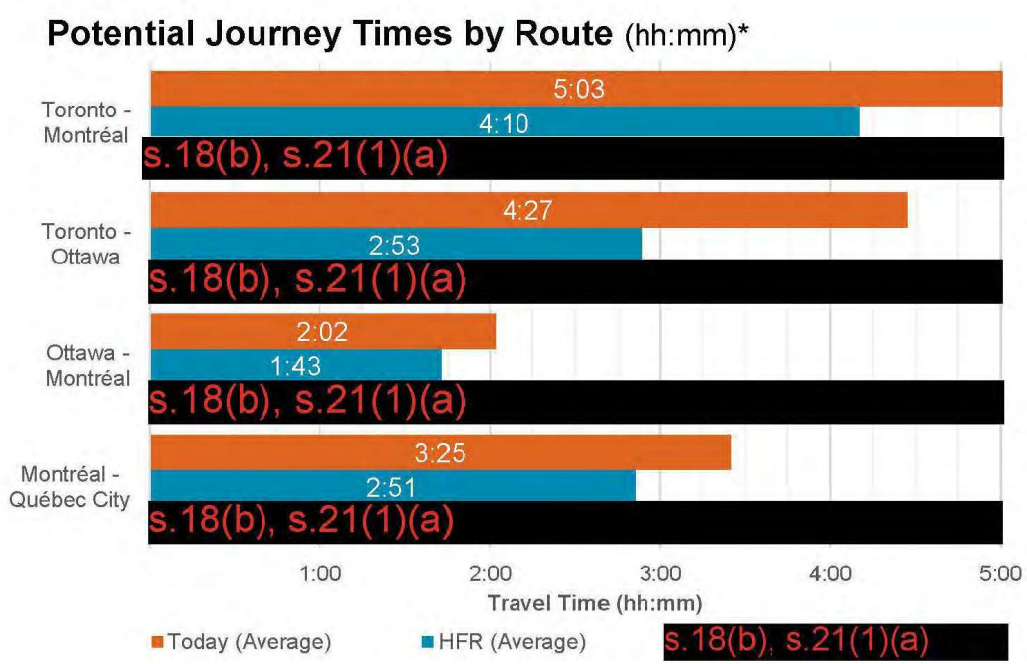
s.18(b), s.21(1)(a)

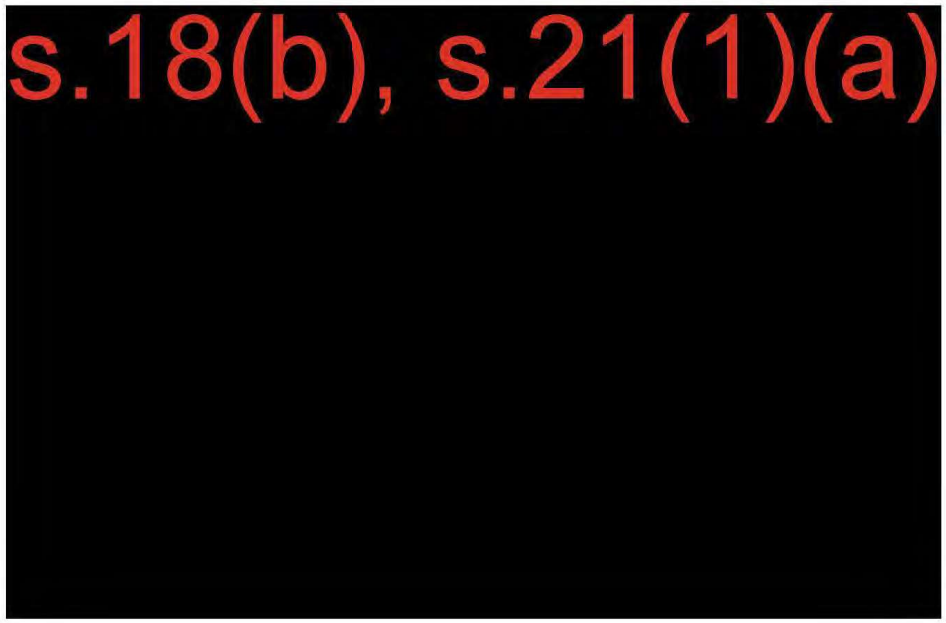
- HSR implementation, allowing for less than 3-hour journey times between TOR-MTL and 2-hour journey times between TOR-OTT and MTL-QC, enables significant rail demand, along with a significant modal shift from auto and air. The additional ridership benefits from shorter journey times are realized as revenue estimates in the assessment.

HSR Study: Journey Times & Ridership

HFR and HSR journey times are theoretical estimates based on average operating speeds benchmarked from intercity and high-speed rail projects. No rail simulation was conducted.

Ridership and revenue forecasts are initial indications of HSR benefits. Estimates are based on the forecasting framework developed by Steer for HFR.





***Source:** *Preliminary Corridor HSR Assessment (2023)*

Electrification Power Supply Overview

VIA HFR will be reliant on Hydro Quebec and Hydro One for electrification.
Greater design definition of power consumption details will be identified in Co-Dev Stages 2 and 3.

- 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.

Example: Traction Power Facility

Electrification Power Supply Overview

- Recognizing that a limited amount of design has been completed for the network, power consumption details are not currently available. Power consumption requirements on an electric railway will vary greatly on account of (and not limited to):

    1. Chosen alignment;
    2. Chosen equipment;
    3. Spacing of power facilities;
    4. Number and frequency of trains;
    5. Stations; and
    6. Non-Revenue Facilities.

- While preliminary stakeholder outreach has commenced with Hydro One, Hydro Quebec and the Ontario IESO (Independent Electricity System Operator), the Phase 1 connection request requirements cannot be met until the above is modelled under CoDev Stage 2.

Further Resources / Background Material

- **Preliminary Corridor HSR Assessment (2023)**

  This assessment informs an initial exploration for High Speed Rail between Toronto and Québec City, with indicative CAPEX, OPEX, ridership and revenue.

- **HFR Host 3rd Party Railways (H3R) De-Risking and De-Constraining Report (2022)**

  This report consolidates and assesses the information received to date from host railways on interfaces and requirements related to HFR. Operational and technical assessments are based on currently available facts and evidence, while also highlighting any currently unknown data / position of host railways.

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VIA Rail Canada ; Amtrak USA

High Speed Rail System
Urban Centre-to-Urban Centre
HS1 UK ; TGV France ; ICE Germany

Intercity Rail: Definitions

Conventional Intercity Rail:
Long-distance rail services between communities. In Canada, VIA Rail operates on tracks shared with freight between Windsor-Quebec City at speeds of up to 160 km/h. In the United States, Amtrak operates at up to 200 km/h for most services.

High Speed Rail:
The International Union of Railways (UIC) defines high speed rail as systems of rolling stock and infrastructure which regularly operate at or above 250 km/h on new (dedicated) tracks, or 200 km/h on existing (shared) tracks.

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
Class 5	80 mph (129 km/h)	100 mph (160 km/h)	Transport Canada
Class 6	110 mph (177 km/h)		FRA
Class 7	125 mph (200 km/h)		FRA
Class 8	160 mph (258 km/h)		FRA
Class 9	200 mph (320 km/h)		FRA

Trenitalia High Speed Train with Commercial Speed of 360km/h.
Milan to Rome, Italy