

Sub-System Item	Sub-Item	Description	Units	Elements Included	Measurements and Costing Methods
A: Right-of-Way Acquisition					
1	Residential Land				
	1.1	Québec-Montréal	ha	All costs associated with purchasing non-railway land (for completely new right-of-way and additional land required adjacent to existing railway right-of-ways) and making it available in a useable condition for the project. This includes severances, other injurious allocations, and demolition of structures and facilities.	Quantities and costs developed to be representative of the requirements for a high speed rail system. Final costs upon project implementation will be the result of individual negotiations for each parcel of land to be acquired.
	1.2	Montréal-Ottawa	ha		
	1.3	Ottawa-Toronto	ha		
	1.4	Toronto-Windsor	ha		
2	Commercial Land				
	2.1	Québec-Montréal	ha		
	2.2	Montréal-Ottawa	ha		
	2.3	Ottawa-Toronto	ha		
	2.4	Toronto-Windsor	ha		
3	Industrial Land				
	3.1	Québec-Montréal	ha		
	3.2	Montréal-Ottawa	ha		
	3.3	Ottawa-Toronto	ha		
	3.4	Toronto-Windsor	ha		
4	Agricultural Land				
	4.1	Québec-Montréal	ha		
	4.2	Montréal-Ottawa	ha		
	4.3	Ottawa-Toronto	ha		
	4.4	Toronto-Windsor	ha		
5	Natural Land				
	5.1	Québec-Montréal	ha		
	5.2	Montréal-Ottawa	ha		
	5.3	Ottawa-Toronto	ha		
	5.4	Toronto-Windsor	ha		
6	Existing CN Right-of-way			Costs for purchasing existing or abandoned RoW for exclusive use by the HSR system. Costs presented include disruption, capital improvement removal, and land costs. Does not include purchase of railway lands for shared rights-of-way. Does not include the cost for removing or relocating tracks.	Quantities and costs developed to be representative of the requirements for a high speed rail system. Final costs upon project implementation will be the result of individual negotiations for each parcel of land to be acquired.
	6.1	Québec-Montréal	ha		
	6.2	Montréal-Ottawa	ha		
	6.3	Ottawa-Toronto	ha		
	6.4	Toronto-Windsor	ha		
7	Existing CP Right-of-way				
	7.1	Québec-Montréal	ha		
	7.2	Montréal-Ottawa	ha		
	7.3	Ottawa-Toronto	ha		
	7.4	Toronto-Windsor	ha		
8	Other Existing Rail Right-of-way				
	8.1	Québec-Montréal	ha		
	8.2	Montréal-Ottawa	ha		
	8.3	Ottawa-Toronto	ha		
	8.4	Toronto-Windsor	ha		
B- Earthworks and Drainage					
1	Clearing and roadbed preparation				
	1.1	in Type 1 soils.	Route-km	Clearing of ROW vegetation, removal of remaining foundations of demolished existing buildings, preparation and/or replacement of existing roadbed including geo-textiles etc. across rock or other solid material restoration.	Geological mapping of routes. Unit price has been developed for all work for 1 km of route based on cross-sections recommended by Soferail or DBI from HSR projects experience.
	1.2	in Type 2 soils.	Route-km	As above for roadbed across till, sands, and clays.	Geological mapping of routes. Unit price has been developed for all work for 1 km of route based on cross-sections recommended by Soferail or DBI from HSR projects experience.
	1.3	in Type 3 soils.	Route-km	As above for roadbed across wetlands. Marshy areas, and water-sensitive clays.	Geological mapping of routes. Unit price has been developed for all work for 1 km of route based on cross-sections recommended by Soferail or DBI from HSR projects experience.
2	Embankment construction				
	2.1	from ROW cut in soft material.	Thousand Cubic Meters	Excavation of general or rippable fill material from cuts in the ROW using scrapers and placing in embankment, including compaction (excludes selected sub-ballast layers).	Quantities determined from geological mapping and cut and fill calculations using profiles at 1:50000 scale and 10 meter contours (accuracy verified by typical sections with larger scale).
	2.2	from ROW cut in rock.	Thousand Cubic Meters	Excavation of rock using explosives from cuts in ROW and selection and placing of suitable material in embankment, including compaction (excludes selected sub-ballast layers).	Quantities determined from geological mapping and cut and fill calculations using profiles at 1:50000 scale and 10 meter contours (accuracy verified by typical sections with larger scale).

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	2.3	from borrow material.	Thousand Cubic Meters	Excavation of general fill material in borrow pit and placing in embankment including compaction (excludes selected sub-ballast layers).	Borrow material determined from cut and fill calculations using profiles at 1:50000 scale and 10 meter contours (accuracy verified by typical sections with larger scale).
	2.4	Disposal of unsuitable material.	Thousand Cubic Meters	Loading, hauling and dumping of excavated material found to be unsuitable for embankment construction.	Geological mapping of routes has been used to assess percentage of excavations likely to be unsuitable.
	2.5	Extra cost for fills on sensitive clays	route-km	Extra fill material, vertical drains or polystyrene	Geological maps by the Canadian Geologic Commission: « Géologie des formations superficielles » (No. 2994,1999); « Géologie des formations superficielles » (No. 1197A, 1970); « Géologie des formations superficielles » (No. 1506A, 1976). Also, many geotechnical study reports produced by Dessau and its subsidiaries.
3	Haulage of fill material (from borrow excavation).		Thousand Cubic Meters	Loading, hauling and tipping of material suitable for general embankment fill or selected sub-ballast layers. Haulage either from borrow pits or along ROW from cuts.	The cost implications for haul of excavated fill or borrow have been included in the unit costs developed for item 2, Embankment Construction.
4	Sub-ballast layers				
	4.1	New ROW	Route-km	Placing and compaction of selected material in two layers above general roadbed fill.	Quantities from typical cross-sections provided by Technology Consultant from European experience. Unit prices from current contracts for similar work items.
	4.2	Existing ROW	Route-km	Placing and compaction of selected material in two layers above general roadbed fill.	Quantities from typical cross-sections provided by Technology Consultant from European experience. Unit prices from current from contracts for similar work items.
5	Drainage Systems				
	5.1	Normal ROW drainage system.	Route-km	Minor culverts, parallel ditches, (including lining if required) sub-drainage systems.	Quantities from a typical 1 km section of ROW. Unit prices from current highway contracts for similar work items.
	5.2	Major watercourse culverts.	Each	Culvert across ROW complete, including headwalls, outlet works, grading and structure.	Unit cost developed from current contract prices for a representative major culvert approximately 6-10 meters across.
	5.3	Environmental stormwater controls.	Route-km	Provision of facilities such as settling ponds to mitigate transport of silts and debris into sensitive water courses.	Quantities to be identified b environmental specialists. Representative price to be developed for a typical facility.
6	Upgrade of existing roadbed on existing ROW.		Route-km	Removal of unsuitable material, placing of selected sub-ballast layers, drainage improvent, minor widening if required.	Roadbed standards from technical consultant and European experience. Quantities based on data from railways on condition of existing roadbeds.
7	Retaining Structures				
	7.1	up to 3 meters height.	km	Retaining walls, including foundations, to support embankments or sides of cuts.	Urban area mapping, aerial photographs for quantities. Unit prices from current contracts for similar structures.
	7.2	over 3 meters height.	km	Retaining walls, including foundations, to support embankments or sides of cuts.	Urban area mapping, aerial photographs for quantities. Unit prices from current contracts for similar structures.
8	Intrusion Barriers.		km	Concrete barriers or berm designed to prevent derailed trains on shared Right-of-Way from interfering with the high speed tracks.	Final assumptions for track configuration and operating regulation eliminated requirement for solid barriers. Consequently, costs and quantities not assessed.
9	Noise Attenuation Structures				
	9.1	Barriers	km	Complete noise attenuation structure including foundations, manufacture and installation.	Configuration and materials to be developed from Ontario and Québec experience and local applications. Unit price from potential local suppliers and similar highway/ railway applications. Measured per side of ROW.
	9.2	Berms	km	Complete noise attenuation berm including placement of material, compaction and drainage.	Configuration to be developed from Ontario and Québec experience and local applications. Unit price from similar highway/ railway applications.

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10	ROW security fencing (2 sided).	Route-km	Complete security fencing of the ROW.	Configuration and materials from Canadian experience of similar fencing projects. Unit prices from potential suppliers and Ontario and Québec recent contracts.
11	Snow control measures.	km	Manufacture and installation of snow control barriers.	This is a minor cost with difficult to estimate quantities. Cost implications have been covered by contingencies.
12	Utility Interferences			
12.1	Major Hydro relocation.	Each	Representative allowance for relocation of Hydro lines and towers.	Cost implications included in contingencies.
12.2	Major Oil/Gas line relocation.	Each	Representative allowance for relocation or crossing of oil/gas lines.	Cost implications included in contingencies.
12.3	Minor pipe or wire crossings	Route-km	Representative allowance for minor pipe and wire crossings including all works required.	Cost implications included in contingencies.
13	Other items.	Lump Sum	These items are intended to address any particular cases which have not been covered by the standard cost items elsewhere. They have been defined specifically for each case and may differ from one geographical segment to the next.	These items have been identified on an individual basis as stations which must be addressed during construction, but which do not fall into any other category. A lump sum has been developed representing the cost of all work required to accommodate the particular situation.
13.1	Audit for contaminated soil	Route-km	This item is to cover the cost of site and lab investigations required to assess the presence of contaminated soils on railway lands.	Quantities based on length of right-of-way to be acquired. Unit costs are typical costs encountered by MTO for similar investigations.
13.2	Audit for contaminated Rail Yards	Each	This item is to cover the cost of site and lab investigations required to assess the presence of contaminated soils on railway lands.	Quantities based on length of right-of-way to be acquired. Unit costs are typical costs encountered by MTO for similar investigations.
13.2	Minor wildlife passages (large culverts)	Each	Culvert across ROW complete, including headwalls, approach works, grading and structure.	Quantities based on length of project in rural areas, at a rate of 1 passage per 10 km

C- Bridges, Viaducts and tunnels

1	Bridges			
1.1	Small river crossings (up to 30 meters in length).	Each	Complete bridge including associated earthworks, river protection works, but excluding track structure.	Rivers, creeks identified on 1:50,000 and 1:10,000 or 1:20,000 plans. Unit cost for a typical bridge of an assumed length from local contracts for similar multi-structure projects.
1.2	Extra over 1,1 for height over 10 meters.	Each	Effect of sub-structure height on cost of all bridge components.	Additional cost per linear meter of bridge to be applied to small but high river bridges. Cost to be based on past local experience.
1.3	Intermediate river crossings (30-100 meters in length).	Linear Meter	Complete bridge including associated earthworks, river protection works, but excluding track structure.	Rivers identified on 1:10,000 and 1:20,000 plans. Bridge lengths estimated from plans and profiles. Unit cost per meter length of bridge from local contracts for similar multi-structure projects.
1.4	Extra over 1,2 for height over 10 meters.	Linear Meter	Effect of sub-structure height on cost of all bridge components.	Additional cost per linear meter of bridge to be applied to intermediate but high river bridges. Cost to be based on past local experience.
1.5	Large river crossings (100 to 250 meters in length).	Linear Meter	Complete bridge including associated earthworks, river protection works, but excluding track structure.	Rivers identified on 1:10,000 and 1:20,000 plans. Bridge lengths estimated from plans and profiles. Unit cost per meter length of bridge from local contracts for similar multi-structure projects.
1.6	Extra over 1,3 for height over 10 meters.	Linear Meter	Effect of sub-structure height on cost of all bridge components.	Additional cost per linear meter of bridge to be applied to large but high river bridges. Cost to be based on past local experience.
1.7	Major river crossings (over 250 meters).	Linear Meter	Complete bridge including associated earthworks, river protection works, but excluding track structure.	Rivers identified on 1:10,000 and 1:20,000 plans. Bridge lengths estimated from plans and profiles. Unit cost per meter length of bridge from local contracts for similar large bridge projects.
1.8	Extra over 1.1, 1.3, 1.5, and 1.7 for difficult foundation conditions.	Linear Meter	Effect of poor soil conditions or complex foundation requirements on the cost of bridges of each size.	Additional cost per linear meter of bridge to be applied to each size of bridge if location is known to involve poor soil conditions. Geological mapping, past experience to be used to identify complexity of foundations.

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	1.9	Modifications to existing bridges (new deck).	Linear Meter	Replacement or modification of existing bridge deck to accommodate HSR track structure. As most existing corridor bridges are single track, this includes the cost for constructing an additional single track span adjacent to the existing bridge.	Railway databases, 1:10000 or larger scale plans of existing bridges. Unit cost developed from local experience applied to deck configuration specified by Technology Consultant.
2	Viaducts				
	2.1	Viaducts exceeding 250 meters in length.	Linear Meter	Complete viaduct (elevated ROW) including temporary works, slope protection at abutments, any channelization or protection works if waterways under viaduct.	Locations identified on 1:50,000 or 10,000 plans. Lengths from track profiles. Unit costs per meter of viaduct from European experience applied to local construction industry.
	2.2	Extra over 2.0 for height over 10 meters.	Linear Meter	Effect of sub-structure height on cost of all viaduct components.	Additional cost per linear meter of bridge to be applied to small but high viaducts. Cost to be based on past local experience.
	2.3	Extra over 2.1 for difficult foundation conditions.	Linear Meter	Effect of poor soil conditions or complex foundation requirements on the cost of a viaduct.	Additional cost per linear meter of viaduct to be applied to each size of bridge if location is known to involve poor soil conditions. Geological mapping, past experience to be used to identify complexity of foundations.
3	Tunnels				
	3.1	Tunnelling in soft ground.	Meter	Complete tunnel in soft ground including all equipment, materials and labour for excavation. Dewatering, lining and portal works.	Size and configuration from European experience. Lengths from track profiles. Ground conditions from geological mapping. Unit cost from European experience and local tunnelling contract records.
	3.2	Tunnelling in rock.	Meter	Complete tunnel in rock including all equipment, materials and labour for excavation. Dewatering, lining and portal works.	Size and configuration from European experience. Lengths from track profiles. Ground conditions from geological mapping. Unit cost from European experience and local tunnelling contract records.
	3.3	Modifications to existing Mont-Royal tunnel.	Lump Sum	Addition of a parallel evacuation tunnel, including ventilation and lighting, and approaches at both ends	Cost from German experience for similar works, adjusted to local conditions.
D - Grade Separations					
1	New Grade Separation. Rural				
	1.1	2 Lane rural highway crossing.	Each	All works to grade separate HSR from highway including bridge, approach earthworks, drainage, paving, signing, land detours, traffic accommodation.	Quantities from 1:50:000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
	1.2	2 Lane rural highway crossing, dual ROW.	Each	All works to grade separate HSR from highway including bridge, approach earthworks, drainage, paving, signing, land detours, traffic accommodation.	Quantities from 1:50:000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
	1.3	4 Lane rural highway crossing.	Each	All works to grade separate HSR from highway including bridge, approach earthworks, drainage, paving, signing, land detours, traffic accommodation.	Quantities from 1:50:000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
	1.4	4 Lane rural highway crossing, dual ROW.	Each	All works to grade separate HSR from highway including bridge, approach earthworks, drainage, paving, signing, land detours, traffic accommodation.	Quantities from 1:50:000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
	1.5	Major rural highway crossing.	Each	All works to grade separate HSR from freeways (401, 40, ect...) including bridge, approach earthworks, drainage, paving, signing, land detours, traffic accommodation.	Quantities from 1:50:000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
	1.6	Extra-over items 1.1 to 1.3 for difficult foundation conditions.	Each	Effect of poor soil conditions on complex foundation requirements on the cost of bridges of each size.	Additional cost per linear meter of bridge to be applied to each size of bridge if location is known to involve poor soil conditions. Geological mapping, past experience to be used to identify complexity of foundations.
2	New Grade Separation. Urban				
	2.1	Secondary urban highway (2-4 lanes) crossing.	Each	All works to grade separate HSR from urban highway including bridge, approach earthworks, drainage, paving, signing, land detours, traffic accommodation.	Quantities from 1:50:000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local municipal contracts.

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	2.2	Secondary urban highway (2-4 lanes) crossing, dual ROW.	Each	All works to grade separate HSR plus an adjacent railway line from urban highway including bridge, approach earthworks, drainage, paving, signing, land detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local municipal contracts.
	2.3	Major urban highway (over 4 lanes).	Each	All works to grade separate HSR from urban highway including bridge, approach earthworks, drainage, paving, signing, land detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local municipal contracts.
	2.4	Extra-over items 2.1 to 2.3 for difficult foundation conditions.	Each	Effect of poor soil conditions or complex foundation requirements on the cost of bridges of each size.	Additional cost per linear meter of bridge to be applied to each size of bridge if location is known to involve poor soil conditions. Geological mapping, past experience to be used to identify complexity of foundations.
3	Modification of Exist. Grade Separations				
	3.1	Urban grade separations.	Each	Works to increase horizontal or vertical clearances through existing grade separations including earthworks and structural modifications.	A lump sum will be developed representing the cost of all works for a typical modification.
	3.2	Rural grade separations.	Each	Works to increase horizontal or vertical clearances through existing grade separations including earthworks and structural modifications.	A lump sum will be developed representing the cost of all works for a typical modification.
4	Automatic crossing protection.		Each	Fixed barriers, gates, fencing, highway surfacing, railway drainage, electronic detection equipment, and signalling modifications.	Not used
5	Closure and diversion of roads.		km of Road	Roadworks to link roads cut off by HSR ROW to other grade separated roads.	Not used
6	Private farm crossing.		Each	All works to provide a grade separated crossing structure for private property owners adjacent to ROW (approx 5 meter square opening).	Quantities from MTQ for Québec; from assessment of land use to adjacent to ROWs in Ontario, with frequency based on precedents from other limited access corridors. Unit costs from similar local contract works.
7	Major Wildlife passages		Each	All works to provide a grade separated crossing structure for wildlife moving from one side of the ROW to the other.	Quantities from assessment of land use to adjacent to ROWs and from environmental assessment. Frequencies based on precedents from other limited access corridors. Unit costs from similar local contract works.
E- Other Accommodation Works					
1	Removal of rail lines		km	The removal of rail, ties, OTM, and other railway plant to make an existing line available for construction works or due relocation of rail services to another subdivision.	Quantities will be identified from topographic and railway maps and requirements to either perform work on existing subgrade or to remove existing infrastructure due to relocation of railway services to another subdivision. Costs will be estimated from the work effort associated with removal of typical railway track.
2	Construction of new rail lines		km	The provision a subgrade construction of railway track and associated facilities.	This item will be used where existing rail lines must be relocated to accommodate the larger radius curves of adjacent high speed lines or where new tracks are required to provide access to railway customers. Quantities will be identified from topographic and railway maps. A unit cost will be developed to represent the cost of all works required for a typical rail line.
3	Rail / rail grade separation 3.1 Urban 3.2 Rural		Each	All works required to grade separate HSR from other railways lines that it may cross. These include structures to pass over or beneath intersecting lines and/or tracks providing paralleling lines with access to the other side of the right-of-way.	Quantities from locations of existing railway lines and railway operating and service requirements. A lump sum will be developed representing the cost of all works for a typical rail/rail grade separation.

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4	Other particular items	Lump Sum	These items are intended to address any particular cases which have not been covered by the standard cost items elsewhere. They have been defined specifically for each case and may differ from one geographical segment to the next.	These items have been identified on an individual basis as stations which must be addressed during construction, but which do not fall into any other category. A lump sum has been developed representing the cost of all work required to accommodate the particular situation.
F- Track				
1	Ballast Track	m double track	Material, supply and construction.	Quantities from trackage required and designed tie spacing. Costs from source A.
2	Ballastless Track on Earthworks (and short bridges)	m double track	Material, supply and construction.	Quantities from track layout and civil engineering. Costs from DB experience based on system Rheda.
3	Ballastless Track in Tunnels	m double track	Material, supply and construction.	Quantities from track layout and civil engineering. Costs from DB experience based on system Rheda.
4	Ballastless track on long bridges (> 25 m)	m double track	Material, supply and construction.	Quantities from track layout and civil engineering. Costs from source A based on system Rheda.
5	Ballast mats to provide additional elasticity on medium and long bridges and for noise attenuation	m double track	Procurement, delivery and installation of ballast mats	Quantities from track layout, environmental requirements and civil engineering. Costs from source A.
6	Absorbers for noise attenuation on slab track	m double track	Procurement, delivery, and installation of absorbers	Quantities from track layout, environmental requirements and civil engineering. Costs from source A.
7	Turnouts deviation speed 60km/h (manly side protection)	each	Procurement, delivery and installation of turnouts (track side equipment).	Quantities from track and station layout. Costs from source B.
8	Turnouts deviation speed 100 km/h (cross overs. platform tracks)	each	Procurement, delivery and installation of turnouts (track side equipment).	Quantities from track and station layout. Costs from source B.
9	Switch heaters	each	Procurement, delivery, and installation of equipment to prevent build-up of snow between switch points and stock rails and at moveable point frogs.	Quantities developed in accordance with the requirements of the operations. Costs from European experience and B.
10	Turnouts deviation speed 40km/h (manly side	each	Procurement, delivery and installation of turnouts (track side equipment).	Quantities from track and station layout. Costs from source B.
G - Power Supply				
1	Catenary			
1.1	High Speed OCS at grade	km single track	Supply, delivery and installation of OCS for speeds up to 350 km/h. Single track, independent structure, at grade	Length based on track layout. Cost are based on actual European market prices.
1.2	High Speed OCS in tunnel	km single track	Supply, delivery and installation of OCS for speeds up to 350 km/h. Single track, independent structure, in tunnel	Length based on track layout. Cost are based on actual European market prices.
1.3	OCS yards, stations	km single track	Supply, delivery and installation of OCS for speeds up to 100 km/h. Single track, independent structure	Length based on track layout. Cost are based on actual European market prices.
1.4	Catenary above switches	unit	Supply, delivery and installation of catenary construction above switches	Number of switches. Cost from DB AG standard cost catalog
2	Electric Power Supply			
2.1	Substations	unit	Supply, delivery and installation of substations	Quantity based on track layout and substation spacing. Cost are based on actual European prices.
2.2	Auto transformers stations	unit	Supply, delivery and installation of auto transformer stations	Optional - depending on feeding concept. Cost are based on actual European prices.
3	Diesel Power Supply			
3.1	Filling station	unit	Supply, delivery and installation of diesel filling station	Quantity based on operation program. Cost based 2009 prices of DB Energy.
H- Stations				
1	Station Modification			
1.1	Modifications to Gare du Palais, Quebec	Lump Sum	Platforms, concourse, parking, and service facilities.	Prior studies, European experience.
1.2	Modifications to Central Station, Montréal	Lump Sum	Platforms, concourse, parking, and service facilities.	Prior studies, European experience.
1.3	Modifications to Ottawa Station	Lump Sum	Platforms, concourse, parking, and service facilities.	Prior studies, European experience.
1.4	Modification to Union Station	Lump Sum	Platforms, concourse, parking, service facilities and intermodal connections.	Prior studies, European experience.
2	New Station			
2.1	Standard Line Station	Lump Sum	Platforms, concourse, parking, auto and bus access.	European HSR and local commuter rail station experience. Contract costs for similar work items.

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	2.2	Terminal Station	Lump Sum	Platforms, concourse, parking, auto and bus access.	European HSR and local commuter rail station experience. Contract costs for similar work items.
I - Signals / Telecom					
1	Interlocking System				
	1.1	Adaptation of existing stations (Quebec, Montreal Ottawa und Toronto)	unit	The adaptation to the existing stations will be necessary for 4 stations.	Rough assumption based on comparable objects and projects.
	1.2	Intermediate Stations	unit	Interlocking system for 2 sidings and 8 high-speed switches and the fictive signals, switching-machines, axle counting systems and other external and internal accessories	No. of intermediate stations. Cost based on actual market prices.
	1.3	Cross overs	unit	Interlocking system for 4 high-speed switches and the fictive signals, switching-machines, axle counting systems and other external and internal accessories	Quantities estimated from track layout (number of crossovers). Cost based on actual market prices.
	1.4	Fictive Block Installations	unit	Interlocking system fictive signals, axle counting systems and other external and internal accessoriesSupply,	Quantities estimated from track layout (track length). Basic: fictive block every 5 km. Cost based on actual market prices.
2	Automatic Train Control				
	2.1	Total Installations ETCS	km double track	Included are all centralized installations with the Radio Block Centre and the adaptation to the interlocking and the balises. The costs will be split to the installations of ETCS (signaling) and GSM-R (telecommunications). .	Quantities estimated from track layout (line length). Cost based on actual market prices.
	2.2	Total Installations GSM-R	km double track	Included are all centralized installations with the Radio Block Centre and the adaptation to the interlocking and the balises. The costs will be split to the installations of ETCS (signaling) and GSM-R (telecommunications). .	Quantities estimated from track layout (line length). Cost based on actual market prices.
3	Operation Control Center - Total Installations Sig/Telecom				
	3.1	Building and Basic Installations	lump sum	Basic installations for OCC including signaling, telecommunications and building.	Quantities estimated from line layout. Cost based on actual market prices.
	3.2	Technical Installations - Length dependent	km double track	Line dependent installations for OCC including signaling, telecommunications and buildings.	Quantities estimated from track layout (line length). Cost based on actual market prices.
4	Telecommunication Installations				
	4.1	Technical Installations - Length dependent	km double track	General communication installations, telecommunication cables along the line and in stations, passenger information systems and all communication systems in stations.	Quantities estimated from track layout (line length). Cost based on actual market prices.
5	Equipment of conventional trains with ERTMS Level 2				
	5.1	ETCS Level 2 and GSM-R	unit	Installation of signaling (ETCS Level 2) and telecommunication (GSM-R) equipment on-board third party (AMT, GO Transit) conventional trains using HSR tracks.	Quantities estimated from existing operation. Cost based on actual market prices.
J - Rolling Stock					
1	Trainset				
	1.1	Electric train set, lenght about 200 m, 9000 kW power, 400 seats, 300 - 350 km/h top speed	unit	Procurement of high speed trains including adaption to North american standards	Estimation based on published prices of actual projects.
	1.2	Diesel-fueled train set, length about 200 m, 4500 kW power, 400 seats, 200 - 250 km/h top speed	unit	Procurement of high speed trains including adaption to North american standards	Estimation based on published prices of actual projects.
	1.3	Hybrid train set, length about 200 m, 4500 kW power diesel, 2200 kW power electric, 400 seats, 200 - 250 km/h top speed	unit	Procurement of high speed trains including adaption to North american standards	Estimation based on published prices of actual projects.
K - Maintenance Facilities					
1	Maintenance Vehicles Power Supply		total	Measuring and maintenance cars, multi-purpose vehicles, diesel locomotives and road vehicles.	Number of vehicles per type and world market prices.
2	Maintenance Vehicles Signalling/Telecom		total	Road vehicles and multi-purpose vehicles.	Number of vehicles per type and world market prices.

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3		Maintenance Vehicles Track	total	Measurement and train working vehicles, multi-purpose vehicles and road vehicles.	Number of vehicles per type and world market prices.
4		Snow Fighting Vehicles	total	Snow blowers.	Number of vehicles per type and world market prices.
5		Maintenance Bases	total		
	5.1	Diesel operation	total	Buildings for staff, workshops and inhouse storage for maintenance of track and signals/telecom. Covering of stabling tracks.	Staff numbers per base and average area per staff member. Average construction costs per square meter..
	5.2	Electric operation	total	Buildings for staff, workshops and inhouse storage for maintenance of track, power supply and signals/telecom. Covering of stabling tracks.	Staff numbers per base and average area per staff member. Average construction costs per square meter..
6		Central Administration Building	total	Building for the headquarters of the HSR company.	Staff numbers per base and average area per staff member. Average construction costs per square meter.
7		Train Wash	total	Train washing facilities at the central workshops.	Staff number in the headquarters and average area per staff member. Average construction costs per square meter..
8		Central Maintenance Depots	total	Maintenance facilities in the depots including building and workshop equipment.	Actually provisional lump sums only.
9		Yards (Roof)	total	Covering of the storage tracks in the stabling yards.	Train numbers to be stabled and average track length and track distance. Average construction costs per square metre of covering. Actually provisional train numbers only.
10		Shops	m working track	Workshops including tracks, building, equipment.	Number of working tracks depending on the number of trains to be maintained. Actually provisional track numbers only.
11		Track and Power Supply			
	11.1	Ballast Track on earthworks	km single track	Material, supply and construction.	Quantities from trackage required and designed tie spacing. Costs from source A.
	11.2	Turnout - 60 km/h deviation speed	each	Procurement, delivery and installation of turnouts (track side equipment).	Quantities from track and station layout. Costs from source B.
	11.3	Turnout -40 km/h deviation speed	each	Procurement, delivery and installation of turnouts (track side equipment).	Quantities from track and station layout. Costs from source B.
	11.4	Catenary - OCS yards, stations	km single track	Supply, delivery and installation of catenary conductors, grounding conductors, grounding rods, tensioning equipment, clamps, fittings, catenary posts including arms and insulators, shield wire, and foundations.	Length based on track layout, with typical span for catenary structure. Cost will be based on Deux-Montagnes experience and suppliers' data. Structures and foundations will be estimated from steel weight.
	11.5	Catenary above switches	unit	Supply, delivery and installation of additional catenary above switches	Number of switches. Cost from DB AG calculations
	11.6	Switch heaters	each	Procurement, delivery, and installation of equipment to prevent build-up of snow between switch points and stock rails and at moveable point frogs.	Quantities developed in accordance with the requirements of the operations. Costs from European experience and B.
12		Land acquisition for O&M facilities	m ²	Land acquisition for maintenance basis, administration building, yards and shops	Number and length of tracks, number of personnel
L - Information and Ticketing					
1		Passenger transportation backend software	unit	Software licenses for application servers, E-mail software, firewalls, Portal server, Timetable and routing engines, Pricing engines, Reservation system	Estimation based on published prices of recent projects.
2		Ticketing machines	unit		Estimation based on published prices of recent projects.
3		Hardware for Sales Counters at Stations	counter		Estimation based on published prices of recent projects.
4		Internet Server	unit	One central website for reservation and Ticket sales	Estimation based on published prices of recent projects.
5		eTicketing	unit	SMS and e-mail server infrastructure	Estimation based on published prices of recent projects.
6		IT data center	unit	Initial setup	Estimation based on published prices of recent projects.

Sub-System Item Sub-Item	Description	Units	Elements Included	Measurements and Costing Methods
M - Startup				
1	Commisioning Sub-items 1.1 to 1.5	%	Final testing and adjustment of all systems (Tracks, Power Supply, Signals/Telecom, Maintenances Facilities and Information/Ticketing) after the infrastructure and the rolling stock has been handed over from suppliers to client.	Experience from other projects. Data from previous study
2	Administration allowance	Lump sum	Gradual build-up of the workforce according to the progress of implementation of the HSR System	Staff numbers per type of staff. Cost according to to actual salary levels.
3	Training	Lump sum	Training of operational and maintenance staff according to the specific requirements for the various staff functions.	Staff numbers per type of staff. Cost data from previous study adaptated to actual salary levels.