

Socialist Republic of Vietnam
Vietnam Railways

**Preparatory Survey for
Hanoi City Urban Railway
Construction Project (Line 1)**

**Final Report
Annexes
(Simple Binding)**

April 2012

Japan International Cooperation Agency

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Japan Railway Technical Service
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Annex 1 Transport Related Data

Annex 1 Transport Related Data

1. Distances between Stations
2. Passengers between Stations
3. Passenger-kilometer, Average Trip Length
4. Transport Mode Composition, Traffic Volume, Annual Vehicle-km
5. Saving Times When the UMRT is Operated

1. Distances between Stations

Table 1-1 Distance OD Matrix

(Unit: km)

	Yen Vien	Cau Duong	Duc Giang	Gia Lam	Long Bien Bac	Long blen Nam	Ha Noi	Cong Vien ThongNhat	Bac Mai	Phuon g Liet	Giap Bat	Hoang Liet	Van Dien	Vinh Quynh	Ngoc Hoi
Yen Vien	0.000	2.663	4.527	6.156	7.595	10.035	12.040	13.440	14.412	15.228	16.880	18.983	20.688	22.155	24.672
Cau Duong	2.663	0.000	1.864	3.493	4.932	7.372	9.377	10.777	11.749	12.565	14.217	16.320	18.025	19.492	22.009
Duc Giang	4.527	1.864	0.000	1.629	3.068	5.508	7.513	8.913	9.885	10.701	12.353	14.456	16.161	17.628	20.145
Gia Lam	6.156	3.493	1.629	0.000	1.439	3.879	5.884	7.284	8.256	9.072	10.724	12.827	14.532	15.999	18.516
Long Bien Bac	7.595	4.932	3.068	1.439	0.000	2.440	4.445	5.845	6.817	7.633	9.285	11.388	13.093	14.560	17.077
Long Bien Nam	10.035	7.372	5.508	3.879	2.440	0.000	2.005	3.405	4.377	5.193	6.845	8.948	10.653	12.120	14.637
Ha Noi	12.040	9.377	7.513	5.884	4.445	2.005	0.000	1.400	2.372	3.188	4.840	6.943	8.648	10.115	12.632
Cong Vien ThongNhat	13.440	10.777	8.913	7.284	5.845	3.405	1.400	0.000	0.972	1.788	3.440	5.543	7.248	8.715	11.232
Bac Mai	14.412	11.749	9.885	8.256	6.817	4.377	2.372	0.972	0.000	0.816	2.468	4.571	6.276	7.743	10.260
Phuong Liet	15.228	12.565	10.701	9.072	7.633	5.193	3.188	1.788	0.816	0.000	1.652	3.755	5.460	6.927	9.444
Giap Bat	16.880	14.217	12.353	10.724	9.285	6.845	4.840	3.440	2.468	1.652	0.000	2.103	3.808	5.275	7.792
Hoang Liet	18.983	16.320	14.456	12.827	11.388	8.948	6.943	5.543	4.571	3.755	2.103	0.000	1.705	3.172	5.689
Van Dien	20.688	18.025	16.161	14.532	13.093	10.653	8.648	7.248	6.276	5.460	3.808	1.705	0.000	1.467	3.984
Vinh Quynh	22.155	19.492	17.628	15.999	14.560	12.120	10.115	8.715	7.743	6.927	5.275	3.172	1.467	0.000	2.517
Ngoc Hoi	24.672	22.009	20.145	18.516	17.077	14.637	12.632	11.232	10.260	9.444	7.792	5.689	3.984	2.517	0.000

Source: JKT Team

2. Passengers between Stations

Table 1-2 Passenger OD Matrix in 2020 (Phase-1 Only)

(Unit: Trip/day)

	Yen Vien	Cau Duong	Duc Giang	Gia Lam	Long Bien Bac	Long blen Nam	Ha Noi	Cong Vien ThongNhat	Bac Mai	Phuon g Liet	Giap Bat	Hoang Liet	Van Dien	Vinh Quynh	Ngoc Hoi	Total
Yen Vien																0
Cau Duong																0
Duc Giang																0
Gia Lam				0	16	14,863	16,641	7,374	1,253	667	1,541					42,355
Long Bien Bac				17	0	744	1,965	878	114	62	146					3,926
Long blen Nam				9,056	788	0	2,187	1,385	839	452	1,271					15,978
Ha Noi				16,031	2,048	1,990	0	1,312	1,276	688	333					23,678
Cong Vien ThongNhat				4,932	636	820	1,057	0	438	204	1,049					9,136
Bac Mai				747	95	556	1,079	623	0	33	178					3,311
Phuong Liet				400	54	335	618	318	35	0	95					1,855
Giap Bat				1,373	145	1,261	371	1,602	238	110	0					5,100
Hoang Liet																0
Van Dien																0
Vinh Quynh																0
Ngoc Hoi																0
Total	0	0	0	32,556	3,782	20,569	23,918	13,492	4,193	2,216	4,613	0	0	0	0	105,339

Source: HAIMUD Study team

Table 1-3 Passenger OD Matrix in 2020 (Phase 1+2a)

(Unit: Trip/day)

	Yen Vien	Cau Duong	Duc Giang	Gia Lam	Long Bien Bac	Long blen Nam	Ha Noi	Cong Vien ThongNhat	Bac Mai	Phuon g Liet	Giap Bat	Hoang Liet	Van Dien	Vinh Quynh	Ngoc Hoi	Total
Yen Vien																0
Cau Duong																0
Duc Giang																0
Gia Lam				0	16	14,863	16,641	7,374	1,253	667	1,541	602	937	1,331	787	46,012
Long Bien Bac				17	0	744	1,965	878	114	62	146	42	122	159	120	4,369
Long blen Nam				9,056	788	0	2,187	1,385	839	452	1,271	1,665	1,838	2,593	12,358	34,432
Ha Noi				16,031	2,048	1,990	0	1,312	1,276	688	333	1,693	1,110	1,599	2,268	30,348
Cong Vien ThongNhat				4,932	636	820	1,057	0	438	204	1,049	5,900	2,796	3,694	6,210	27,736
Bac Mai				747	95	556	1,079	623	0	33	178	808	46	863	1,304	6,332
Phuong Liet				400	54	335	618	318	35	0	95	470	25	494	704	3,548
Giap Bat				1,373	145	1,261	371	1,602	238	110	0	697	311	465	8,250	14,823
Hoang Liet				611	68	1,563	1,713	5,803	825	488	558	0	46	57	352	12,084
Van Dien				1,172	166	1,870	1,286	3,442	788	22	379	55	0	13	24	9,217
Vinh Quynh				1,702	230	2,661	1,849	4,647	1,068	32	568	70	13	0	37	12,877
Ngoc Hoi				1,173	395	5,258	1,107	6,858	3,392	1,793	9,851	674	9	14	0	30,524
Total	0	0	0	37,214	4,641	31,921	29,873	34,242	10,266	4,551	15,969	12,676	7,253	11,282	32,414	232,302

Source: HAIMUD Study team

Table 1-4 Passenger OD Matrix in 2030 (Phase-1+2a)

(Unit: Trip/day)

	Yen Vien	Cau Duong	Duc Giang	Gia Lam	Long Bien Bac	Long blen Nam	Ha Noi	Cong Vien ThongNhat	Bac Mai	Phuon g Liet	Giap Bat	Hoang Liet	Van Dien	Vinh Quynh	Ngoc Hoi	Total
Yen Vien																0
Cau Duong																0
Duc Giang																0
Gia Lam				0	23	20,715	23,193	10,277	1,747	930	2,148	839	1,306	1,855	1,097	64,130
Long Bien Bac				24	0	1,036	2,739	1,224	159	86	204	58	170	221	167	6,088
Long blen Nam				12,622	1,098	0	3,047	1,930	1,169	630	1,771	2,321	2,562	3,613	17,224	47,987
Ha Noi				22,342	2,854	2,773	0	1,829	1,778	958	464	2,359	1,547	2,229	3,160	42,293
Cong Vien ThongNhat				6,874	887	1,142	1,474	0	611	285	1,462	8,223	3,896	5,148	8,655	38,657
Bac Mai				1,041	132	776	1,504	868	0	45	248	1,126	64	1,202	1,818	8,824
Phuong Liet				557	75	466	861	444	48	0	132	655	35	688	981	4,942
Giap Bat				1,914	202	1,758	516	2,232	332	153	0	971	433	648	11,498	20,657
Hoang Liet				852	94	2,178	2,387	8,088	1,150	680	778	0	64	79	491	16,841
Van Dien				1,633	231	2,606	1,792	4,797	1,098	31	528	77	0	18	33	12,844
Vinh Quynh				2,372	321	3,709	2,577	6,476	1,488	45	792	98	18	0	52	17,948
Ngoc Hoi				1,635	550	7,327	1,543	9,557	4,728	2,499	13,729	939	13	20	0	42,540
Total	0	0	0	51,866	6,467	44,486	41,633	47,722	14,308	6,342	22,256	17,666	10,108	15,721	45,176	323,751

Source: JKT Team

3. Passenger-kilometer, Average Trip Length

Passenger-km is calculated by multiplying Distance OD Matrix and Passenger OD Matrix in 2020 and 2030. After that, Passengers and Passenger-km in 2040 and 2050 is calculated by using extrapolation method.

Average trip length is calculated by dividing total of passenger-km by total of passengers.

Table 1-5 Passenger-km, Average Trip Length

	Year 2020		Year 2030	Year 2040	Year 2050
	Phase-1 only	Phase-1+2a			
Passengers(000 trip/day)	105	232	324	451	629
Passenger-km (000 trip-km/day)	540	1,797	2,505	3,491	4,865
Average trip length (km)	5.1	7.7	7.7	7.7	7.7

Source: JICA Survey Team

4. Transport Mode Composition, Traffic Volume, Annual Vehicle-km

Actual transport mode composition in 2005 and estimated composition in 2020 when the UMRT will not be developed are described in the HAIMUD Report.

(See Fig. 2-2 Change in Transport Mode Composition, Main Report)

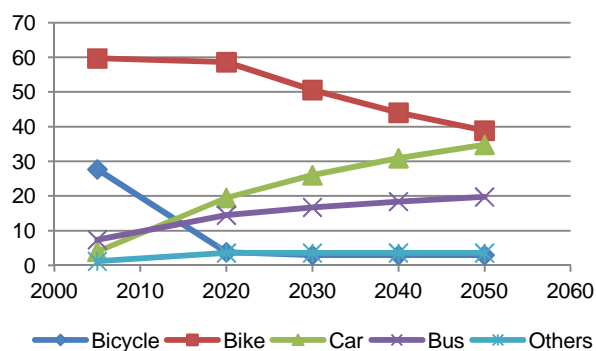
Subsequent composition after the 2030 is calculated by using the above two data.

Table 1-6 Transition of 5 Transport Mode Compositions

(Unit: %)

	2005	2020	2030	2040	2050
Bicycle	27.7	3.8	3.0	3.0	3.0
Motorcycle	59.7	58.6	50.6	44.0	38.9
Car	4.0	19.5	26.1	30.9	34.8
Bus	7.4	14.5	16.8	18.4	19.7
Others	1.2	3.6	3.6	3.6	3.6
Total	100.0	100.0	100.0	100.0	100.0

Source: JICA Survey Team



Source: JICA Survey Team

Fig. 1-1 Transition of 5 Transport Mode Compositions

After that, motorcycle, car and bus share are adjusted that the total becomes 100%.

Table 1-7 Transition of 3 Transport Mode Compositions

(Unit: %)

	2020	2030	2040	2050
Motorcycle	63.3	54.2	47.1	41.6
Car	21.1	27.9	33.1	37.3
Bus	15.7	17.9	19.7	21.1
Total	100.0	100.0	100.0	100.0

Source: JICA Survey Team

Numbers of passengers by the alternative modes when the UMRT does not exist are calculated by using the Table 1-7.

Table 1-8 Transition of Number of Passengers by 3 Transport Modes

(Unit:1,000 trips/day)

		2020	2030	2040	2050
Passengers		232	324	451	629
Alternative Mode	Motorcycle	147	176	213	262
	Car	49	90	149	234
	Bus	36	58	89	133

Source: JICA Survey Team

In addition, the numbers of passengers are converted in the numbers of vehicles by using the average number of passengers by modes.

Table 1-9 Number of Passengers by Transport Modes

(Unit: Passengers/vehicle)

Vehicle Type	Motorcycle	Car	Bus
Average number of passengers	1.36	2.02	30.0

Source: HAIDEP (2007)

Table 1-10 Transition of Number of Traffic Volume by Transport Modes

(Unit: 1000 Vehicles/day)

	2020	2030	2040	2050
Motorcycle	108	129	157	193
Car	24	45	74	116
Bus	1.2	1.9	3.0	4.4

Source: JICA Survey Team

Total of vehicle-km is calculated by multiplying the traffic volume, average trip length and 365 days/year.

Table 1-11 Transition of Vehicle-km by Transport Modes

(Unit: Million Vehicle-km/day)

	2020	2030	2040	2050
Motorcycle	305.5	364.5	441.5	543.4
Car	69.6	126.3	208.9	328.0
Bus	3.4	5.5	8.4	12.5

Note: The number is calculated on the EXCEL sheet. Therefore, some differs appears from the number calculated with the calculator because of the round off.

Source: JICA Survey Team

Saving cost for vehicle operation when the UMRT doesn't exist is determined by multiplying the above result and vehicle operation cost (VOC) by each transport mode.

5. Saving Times When the UMRT is Operated

According to HAIMUD, it is forecasted that the average speed will become 9.4 km/h in 2020, when the only predetermined projects (Do something case) will be executed.

Assuming the speed ratio by each mode is as below.

Motorcycle: Car: Bus = 1.5: 1.0: 0.8.

Assuming the average speed will be decreased by 10% in each 10 years.

Table 1-12 Average speed when the UMRT doesn't exist

(Unit: km/h)

	2020	2030	2040	2050
Average Speed	9.4	8.5	7.6	6.8

Source: JICA Survey Team

Average speed by each transport mode is calculated as below.

Table 1-13 Average Speed by Transport Mode by Year

(Unit: km/h)

	2020	2030	2040	2050
Motorcycle	11.0	10.3	9.6	8.8
Car	7.3	6.8	6.4	5.9
Bus	5.8	5.5	5.1	4.7
UMRT <u>1/</u>	30.4			

Source: JICA Survey Team 1/ : TRICC F/S Report

Driving times for the 7.7 km of average trip length by the transport mode are as follows.

Table 1-14 Average Travel Time by Transport Modes

(Unit: hour)

	2020	2030	2040	2050
Motorcycle	0.70	0.75	0.81	0.88
Car	1.06	1.14	1.21	1.31
Bus	1.33	1.41	1.52	1.65
UMRT	0.26			

Source: JICA Survey Team

Saving time by using UMRT will be as follows.

Table 1-15 Saving time by Transport Modes

(Unit: hour/trip)

	2020	2030	2040	2050
Motorcycle	0.44	0.49	0.55	0.62
Car	0.80	0.88	0.95	1.05
Bus	1.07	1.15	1.26	1.39

Source: JICA Survey Team

Annual saving time will be as follows.

Table 1-16 Annual Saving Time by Transport Modes

(Unit: 1000 hour/year)

	2020	2030	2040	2050
Motorcycle	24,100	31,822	42,790	59,670
Car	14,414	29,133	52,046	90,513
Bus	14,375	24,381	40,977	67,422
Total	52,889	85,336	135,813	217,065

Note: The number is calculated on the EXCEL sheet. Therefore, some differs appears from the number calculated with the calculator because of the round off.

Source: JICA Survey Team

Annex 2 Comparisons of items requiring adjustments and corrections in Phase 2a FS Report

Annex 2 Comparisons of items requiring adjustments and corrections in Phase 2a FS Report

1. Vehicle design specifications
2. Train operation plan
3. Civil engineering structures
4. Automatic Fair Collection system (AFC)
5. Power supply
6. Signaling and communications

1. Vehicle design specifications

1) Reviews of specifications and standards

Based on the Phase 2a FS, JKT's proposals, and the Ministerial Ordinance to Provide the Technical Standard on Railway of the Ministry of Land, Infrastructure, Transport and Tourism of Japan, from viewpoints of railway operations, and securement of passenger safety, we reviewed specifications and standards for rolling stock gauges, rolling stock weight, railcar driving equipment, carbody structures and railcar equipment, fire-disaster prevention measures for railcars, and rolling stock maintenance. Results of the reviews are indicated in Table 1-1.

Table 1-1 Reviewed items and their results for specifications and standards of vehicle design specifications

Item	Check point	Compliance to ministerial orders	Applications to other regulations
1. Rolling stock gauge	Should not exceed the rolling stock gauge.	Complied. Rolling stock gauge specified are indicated in IV.7.3.1. (Note) Confirmation of procedures for establishment of platform shortening limit (Chapter 4-110)	Railway Technical Code of Vietnam 22TCN340-05
2. Rolling stock weight etc.	Limits for tracks and structures	Complied. Durability of tracks: set to be axle load of a locomotive to haul passenger cars. Electric trains usually employ multiple-unit systems and axle load is small. Max. axle load is 18 ton/axle (Chapter 4-109).	
	Stability	Complied. Design complied with Japanese STRASYA. Max. speed for the line: 120 km/h Max. speed for the vehicle: 120km/h (Chapter 3-1, Chapter 4-109)	
		Complied. Carbody width: 3380mm, which is proven in Japan. (Chapter 4-108)	
3. Railcar driving equipment etc.	Railcar driving equipment	Complied. Design complied with Japanese STRASYA. (Chapter 4-109)	
	Wheels should not damage tracks.	Complied. Minimum radius: Track : main line: 250m; Depot: 100m Rolling stock: main line: 150m; Depot: 100m	
	Arrangements of wheel axis should pass minimum curve radius without trouble.	Complied.	
	Front section of the lead railcar should eliminate obstacles on rail top surfaces.	Complied.	

Item	Check point	Compliance to ministerial orders	Applications to other regulations
	Running gears should be rigid with enough strength and secure safe and stable operations.	Complied.	
Power generation equipment	Adapted to facilities and should be bearable for operations.	Complied.	
Electric facilities for electric circuits	Those without risk of insulation breakdown, electrification or fire disaster due to mixed melting	Complied.	
	Do not have effects on other electric facilities for railway operations due to failures by induction effects.	Complied.	
	Current collectors should have a compliance characteristic to overhead contact lines.	Complied.	
	Pantographs should be able to be lowered all together from the crew cabin.	Complied.	
	When lowering the pantographs, there should be no risk of causing fire disaster due to arcing.	Complied.	
	Make sure that there would be no risk of causing burnout by overhear due to current surge.	Complied.	
	Against entry of abnormal high voltage, safety of circuits should be secured.	Complied.	
	Railcars operating in sections with high voltage overhead contact lines should be forced to be cut from electricity when there is abnormality with overhead contact lines.	Complied.	
Brake system	Should be able to steadily slow down trains or stop the trains.	Complied.	
	Railcars in the trainset should be interlocked to be operated from the crew cabin for braking operations.	Complied.	
	Make sure that vibrations and impulses should not interfere with braking operations.	Complied.	
	Should be able to exert braking force uninterruptedly.	Complied.	
	Should be automatically activated when railcars in the trainset are separated.	Complied.	
	Should be able to stop trains rapidly.	Complied.	
	Should be able not to start the train when stopping force cannot be secured or there is risk that there might be troubles with braking force, etc.	Complied.	
	Should be able to prevent rolling of railcars on storage tracks and make sure that vibrations and impulses should not interfere with braking operations.	Complied.	
	Should be equipped with independent braking functions to be used in a case of a failure of rolling prevention equipment for trains on storage tracks.	Complied.	
4. Carbody	Carbody structure should be rigid with enough strength and	Complied.	

Item	Check point	Compliance to ministerial orders	Applications to other regulations	
structure and railcar equipment	structure of passenger cabins	<p>bearable for operations.</p> <p>Windows should have enough strength. When opening the windows, there should be no risk of touching other facilities etc. and of passengers falling from the windows.</p> <p>Passenger cabins should be able to conduct necessary ventilation.</p> <p>Should be equipped with necessary lighting facilities for night time and tunnel operations and necessary brightness should be secured inside passenger cabins for an emergency.</p> <p>Aisles should be safe for smooth passages.</p> <p>Seating and standing space for passengers should be secured for passenger safety, while taking trains' oscillation into consideration.</p> <p>Restrooms should be equipped as needed.</p> <p>Other than above, passengers should be able to use passenger cabins safely.</p>	<p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Restrooms are not equipped. This is an urban railway. It can be assumed that distances between stations are short and ride time for passengers is short.</p> <p>Complied.</p>	
	Structures of entrance and exit for boarding and de-boarding of passengers	<p>Should be equipped with automatic door operating equipment and should be able to secure safe and smooth boarding and de-boarding of passengers.</p> <p>Automatic door operating equipment should be able to open and close doors simultaneously.</p> <p>Crews should be able to confirm opening and closing status of the automatic door operating equipment.</p> <p>Trains should not be able to start unless doors are closed.</p> <p>Doors should be able to be opened manually in an emergency.</p> <p>Should be equipped with gangway doors and gangways so that passengers can safely and smoothly walk.</p>	<p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p>	
	Structures of gangway doors and gangways	<p>Emergency exits should be equipped, through which passengers can easily and surely exit in an emergency and which crews can easily confirm opening and closing status.</p> <p>Coupling device should be rigid with enough strength to bear vibrations and impulses, etc. and to surely couple both railcars.</p> <p>Crew cabins for operations of trains should be equipped with necessary facilities for train operations such as power traction control, braking control etc.</p> <p>Crews should be able to operate and confirm easily necessary facilities for operations.</p> <p>Opening switches for equipment to control train intervals and</p>	<p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p>	
	Structures of emergency exits			
	Coupling device			
	Facilities of crew cabins			

Item	Check point	Compliance to ministerial orders	Applications to other regulations
	equipment to automatically decelerate trains should not be easily operated by crews.		
Inner pressure container, other pressure supply source and accessory equipment	Should be able to prevent abnormal rises of pressures.	Complied.	
	Should be able to prevent lowering of functions by moisture, etc.	Complied.	
	Should not be damaged by vibrations and impulses.	Complied.	
Accessory equipment for railcars	Necessary equipment should not be installed if there is risk of electrification of passengers if passengers go outside the trains or if there is risk of causing interference to safety of passengers.	Complied.	
	Sign devices should be able for crews to surely exchange signs mutually.	Complied.	
	Audio communication devices should be able for crews to mutual and smoothly talk to each other.	Complied.	
	Air whistle should be large enough for warning of danger, etc.	Complied.	
	On-board broadcasting equipment should be able to broadcast to all passenger cabins.	Complied.	
	Emergency warning equipment should be able for passengers to easily notify crews in an emergency.	Complied.	
	Emergency stop equipment should be able for passengers to easily stop trains in an emergency.	Complied.	
	Marker light should be able to confirm the train's direction of traveling from both front and back of the train at night.	Complied.	
Signages of rolling stock	To be able to identify rolling stock etc., signage should include necessary indications.	Complied.	
5. Fire-disaster prevention measures for rolling stock	Electric cables for rolling stock should be able to prevent occurrence of fire disaster due to mixed melting and heat generation of devices.	Complied.	
	Devices with risk of generating arc or heat should be equipped with proper protective measures.	Complied.	
	Carbody should employ structures and materials to prevent expected occurrence and spreading of fire disaster.	Complied.	
	Should be equipped with facilities to extinguish fire disaster at its initial stage if it occurs.	Complied.	
Functions of equipment in power failure	Equipment to secure safety of operations and passengers should function for a certain time period even when major power supply is cut.	Complied.	
6. Rolling stock maintenance	Newly manufactured or purchased rolling stock and remodeled or repaired rolling stock cannot be used without inspections and test driving.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	

Item	Check point	Compliance to ministerial orders	Applications to other regulations
manufactured railcars, etc.	When using rolling stock derailed or underwent other operational accidents, those suspected of failures, and those suspended of usage must go through inspections and test driving beforehand and as needed.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
Inspections of the main line and trains on the main line	Depending of kinds and operational status, trains are required to inspect major components of rolling stock.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
Regular inspections of rolling stock	Depending on kinds, structures and usage status, regular inspections should be conducted by specifying locations requiring regular inspections and methods and inspection cycles. As for items related to regular inspections, an office in charge should be clarified.	Complied. Kinds of inspections and Japanese standards from 2001 described in IV.7.9 of report FS2a.	
Record	When conducting inspections, remodeling, repair or reconditioning of rolling stock, records should be formulated and saved.	Guidance required. Support in technology transfer for inspections is necessary. Guidance required. Support in technology transfer for inspections is necessary.	

2) Confirmation to guarantee alignment with Phase 1 section of vehicle design specifications

Confirmation to guarantee alignment with Phase 1 section related to vehicle design specifications should be conducted by following the following 2 points.
Specific contents confirmed are indicated in Table 1-2.

- No. of required railcars accompanied by changes in demand forecast
- Rolling stock maintenance conducted for Phase 1 section

Table 1-2 Items confirmed and their results to guarantee alignment with the Phase 1 section of vehicle design specifications

Item	Phase 1	Phase 2a
No. of cars in trainset	There are differences between JKT Plan and Phase 2a FS.	There are differences between JKT Plan and Phase 2a FS.
No. of required railcars by time point	Complied.	Complied.
Inspection systems for rolling stock	Complied with description in the JKT Plan.	Not indicated in Phase 2a FS.
Test driving for rolling stock	Complied with description in the JKT Plan.	Not indicated in Phase 2a FS.
Regular inspections for rolling stock	Complied with description in the JKT Plan.	Not indicated in Phase 2a FS.
Inspections record for rolling stock	Not indicated.	Not indicated in Phase 2a FS. Support in technology transfer for inspections is necessary.

3) Necessary adjustments and corrections for finalization of the Phase 2a FS Report

Since Phase 2a FS is diverged from the JKT Plan as indicated below, for finalization of the report, adjustments and corrections are necessary.

Page	Item	F/S	Confirmation	Answer
Chapter 4				
1	89 記載の車両の確認 Confirmation of event of description	IV.7.1.1. Specifications: Number of seats and standing area are determined by using specifications as follows: - Car width : 3,350mm - Length of car : 19,500mm - Side window : 4/ one side. (8 ones in each car). - Window width : 1,300mm	Window = Door?	JKT: =Vietnamese Version is "Door" = "Window" TRIGG: =Mistranslation
2	90 誤記の確認 Confirmation of error in writing	Figure 4.7.1. & Figure 4.7.2	How many is passenger density. ? Is it 4.0person/m ² ?	JKT: =It is 4.0person/m ² TRIGG: =Matches it to the report of JKT.
3	93 記載誤りの確認 Confirmation of description mistake	Architectural clearance gauge of VNR is 300m higher than Japanese one with AC 25kV. Hence, equipment limit is less than 5,750mm, 300m higher than 5,540mm (Japan).	5540mm=5450mm ?	JKT: =Vietnamese Version is "5,450" TRIGG: =Mistake of description
4	93 記載の車両の確認 Confirmation of event of description	2) Automatic train protection system (ATP) a) Signal system of ATP system: Automatic train protection equipments are compatible with technical features of earthing apparatus proposed by E&M team.	"earthing apparatus" = "wayside equipment" ?	JKT: =Vietnamese Version is "wayside equipment" TRIGG: =Mistranslation
5	100 記載の車両の確認 Confirmation of event of description	2) Lighting system in passenger car Lighting circuit shall be considered to supply power and keep stability that prevents unexpected tension changes, including in area without power (from overhead lines). For area without power, power supply shall be taken from battery by inverter. Lighting circuit for passenger car shall be supplied DC 110V from inverter. Battery shall ensure continuous power supply for lighting system for passenger car. 8) Lighting system Power supply for lighting passenger car, including emergency case, is 110V DC. Lighting intensity reaches 200 Lux or over . 750mm compared to car floor. 3) Bogie structure: Dynamic cars are equipped with running-surface brake. Pushed cars are equipped with disc brake combined with running-surface brake. Brake cylinder, type of running-surface brake, has small weight and simple structure. The brake cylinder is equipped with automatic controller for brake shoe opening. Bogies are installed spring brake .	for lighting system = for emergency lighting system?	JKT: = You should describe as the light for the emergency. TRIGG: =Matches it to the new report of JKT.
6	106 誤記の確認 Confirmation of error in writing		200 Lux or over= 200 Lux or more?	JKT: =Vietnamese Version is " 200 Lux or more" TRIGG: =Mistranslation
7	113 記載の車両の確認 Confirmation of event of description		Spring brake = Parking brakes ?	JKT: =Vietnamese Version is " Parking spring brakes" TRIGG: =Matches it to the new report of JKT.
8	116 記載の意味の確認 Confirmation of meaning of description	2) Central equipment and terminal equipment: Power supply : DC 110 V Transmission speed among terminal points: Over 2.5 Mb/s Transmission device : twin wrapped line	twin wrapped line = Twisted pair sealed line?	JKT: =Vietnamese Version is "Twisted pair sealed line" TRIGG: =Matches it to the new report of JKT.

2. Train operation plan

1) Reviews of specifications and standards

Based on the Phase 2a FS Report, JKT's proposals, and the Ministerial Ordinance to Provide the Technical Standard on Railway by the Ministry of Land, Infrastructure, Transport and Tourism of Japan, from viewpoints of securing safety of railway operations and passengers, we reviewed specifications and standards for loading limits for railcars, train operations, train driving, and railway signals. Results of the reviews are indicated in Table 2-1.

Table 2-1 Reviewed items and results of specifications and standards for the train operation plan

Item	Check point	Compliance to ministerial orders	Application of other regulations
1. Loading limits etc. for railcars	Max. load capacity of the railcar should not be exceeded.	Complied. (By taking rolling stock weight into consideration, tracks and civil engineering are designed.)	
	Freight should not be loaded exceeding the rolling stock gauge.	Complied. (Same as above)	
Indication for loading of hazardous materials	Rolling stock with loads of hazardous materials should indicate clearly that it is carrying hazardous materials at places where visible on its carbody.	No applicable item included. (They are exclusive tracks for passenger trains and freight trains do not operate.)	
2. Train operations	Max. No. of railcars to be coupled as a trainset etc.	Complied. (By taking UT and NIT trains into consideration, it is designed.)	
	Braking of trains	No applicable item included. (They are exclusive tracks for passenger trains and freight trains do not operate.)	
Braking force of trains	Braking should be activated for all interlocked railcars and should be automatically activated when a railcar is separated from the train.	Complied. (By taking UT and NIT trains into consideration, it is designed.)	
	Boundary of depots	Complied. (By taking UT and NIT trains into consideration, it is designed.)	
Driving on the main line outside the depots	If train operational handling methods are different for inside and outside of the depots, the boundary should be indicated both inside and outside the depots.	Complied. (Yard signals are set as a boundary to indicate inside and outside of depots.)	
	Railcars must not be driven on the main line outside the depots unless they are coupled as a train.	Complied. (By taking UT and NIT trains into consideration, it is designed.)	

Item	Check point	Compliance to ministerial orders	Application of other regulations
Time for train operations	Train operations should be conducted by setting departure time from depots, passage time, arrival time etc., as needed. In case of train operation disruptions, railway operators must try to recover its original operational schedule.	Complied. (By taking existing NIT trains into consideration, it is designed.) Complied. (By taking existing NIT trains into consideration, it is designed.)	
Prevention of accidents in train departures	When crews recognize that passengers are pinched between doors or passengers are in danger, crews must not start the train.	Complied. (UT has a structure to allow departure of trains after closing automatic doors. NIT assigns crews at each door and makes sure that passengers are safe in coalition with stations crews.)	
Securing safety between trains	To secure safety of passengers, trains must be operated by following either one of the following operational methods. (1) Blocking method (2) Methods to secure train intervals by equipment (3) Methods with crews driving motive power cars checking visibility of the train in front of it and necessary conditions for safe train operations	Complied. (Blocking method is employed.)	
A position for driving of trains	Crews operating motive power cars must drive the train at the front of the lead section of the train.	Complied. (Both UT and NIT employ driver's cabs at the front of the lead car.)	
Train operational speeds	Trains must operate at safe speeds depending on conditions of tracks and electric train tracks, rolling stock performance, driving methods, signal conditions, train protection methods etc.	Complied. (By taking UT and NIT trains into consideration, it is planned.)	
Backward operations of trains	Trains must not be operated backward.	Complied. (Double track automatic blocking method is employed.)	
Simultaneous entry to and exit from depots by trains	When more than 2 trains enter or exit from depots at the same time, if there is risk of mutually interfering each other's path by overrunning, these trains must not be operated simultaneously.	Complied. (Electronic interlocking devices employ Japanese methods. Measures against overrunning of trains for lines of the existing single-track sections are same as Japanese methods.)	
Train protection	If a failure occurs which requires to stop trains, by taking emergency braking of trains into consideration, stop signals should be indicated and measures should be taken to stop preceding trains promptly.	Complied.	Complied. (The max. braking distance of trains is regulated to be 800m.)
Track closure	When tracks need to be closed for construction work or maintenance, measures must be taken to prevent trains etc. from entering the section.	Technology transfer is needed. (The first railway construction for double track sections.)	Complied. (Existing railways employ the same method.)
Prevention of danger for trains	When there might be danger to trains due to storms, earthquake etc., by taking their situations into consideration, measures must be taken to prevent danger by temporary suspending train operations etc.	Complied. (There are plans to install wind gauges and rain gauges.)	Complied. (Existing railways are taking measures against disasters.)
3. Shunting of	Shunting of cars should be planned not to interfere with train	Complied.	

Item	Check point	Compliance to ministerial orders	Application of other regulations
cars	schedules.	(Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
	Shunting of rolling stock should be conducted without interfering train operations.	Complied.	
Storage of rolling stock	For storage of rolling stock, necessary measures must be taken to prevent rolling of the rolling stock, automatically or not.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
Prevention against danger for rolling stock with a load of hazardous materials	For storage of rolling stock with a load of hazardous materials, measures must be taken to prevent danger in transferring the rolling stock to other tracks etc., while taking surrounding situations into consideration.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
4. Railway signals	Relationships between railway signals and train operations	Complied. (Currently, in the process of approvals for regulations of signal indication methods.)	
Signals indicating train stops	When signals are indicating train stops, etc., trains must stop before reaching the stop signal. If the train cannot stop before reaching the stop signal, the train must stop promptly as quickly as possible. Trains etc. stopped by the stop signals must not proceed unless the signal indicates to proceed or it is instructed to proceed.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
Inaccurate signal indications	When there is no signal at a place where there should be one or it is not accurate, it must be assumed that there are signals to indicate the max. operational limits of trains etc.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
Prohibition for concurrent use of same signals	A signal must not be used for an objective for more than two tracks or for more than two kinds of objectives.	—	Complied. Routes with speed limits accommodate speed limits with signal indications. (a modification of speed signal methods)
Conditions for signal indications for proceed signals	Signals for proceed indications can only be indicated when there is no interference for trains etc. to proceed.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
Items related	Kinds, indication methods, conditions, and handling of signals	Complied.	

Item	Check point	Compliance to ministerial orders	Application of other regulations
to other signal indications	must be designated for their use so that crews can accurately judge train operation conditions when driving trains, etc. by the indications and secure safety in operations of trains, etc.	(Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
Procedures after directing trains to proceed	When signals indicate proceed signals for trains, etc., trains' routes should not be interfered.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	
Signs and signages	Kinds and indication methods of signs and signages must be designated to be used to secure safety in operations of trains etc.	Complied. (Existing railways employ this method. HURC-1 is a plan possessed by existing railways.)	

2) Confirmation to guarantee alignment with Phase 1 section

Differences between Phase 1 section and Phase 2a section related to the train operation plan are confirmed to be the following 2 points. Specific contents confirmed are indicated in Table 2-2.

- i) Train operation plan accompanied by the changes in demand forecasts
- ii) Overnight storage plan for rolling stock
- iii) Handling in a case of train operation disruptions
- iv) Training of drivers and crews
- v) Train operation plan for opening preparation

Table 2-2 Items confirmed to guarantee alignment with Phase 1 section of the train operation plan

Item	Phase 1 (JKT design contents)	Phase 2a FS
Demand forecast	Complied.	Complied. (increased portion)
Train headway	Complied.	Complied.
Crew plan	Complied.	Complied.
Route control handling methods	Complied.	Complied.
Locations of storing rolling stock overnight	Complied.	Complied.
Traffic control plan	Complied.	Complied.
Driver and crew training	Complied.	Not indicated.
Opening audit train plan	Complied.	Not indicated.

3) Items requiring adjustments and corrections for finalization of Phase 2a FS

Since Phase 2a FS is diverged from JKT Plan as indicated below, adjustments and corrections are necessary for finalization of Phase 2a FS. Adjustments and corrections are indicated in Table 2-3.

Table 2-3 Items requiring adjustments and corrections (train operation plan)

Page	Item	F/S	Confirmation	Answer
Chapter 2	Ha Noi駅の鉄道施設の移動先の確認 10 Confirmation of move destination of railway facilities at Ha Noi station	The industrial and service units of the railway sector within the Ha Noi station area will be moved to the Ngoc Hoi and Yen Vien station.	Yen Vien → Gia Lam & Yen Vien?	JKT: =Ha Noi →South Giap Bat & Ngoc Hoi North Gia Lam & Yen Vien TRICG: =It will be moved to Gia Lam and Ngoc Hoi in the Phase I period.
2	用語の定義 10 Definition of term	Urban railway and rapid bus: Urban railway system of Hanoi City will play the main roll in the public passenger transport system with high-speed and mass transit.	High speed =Urban train?	JKT: =High speed =Urban train TRICG: = It is not High speed
Chapter 3	用語の定義 1 Definition of term	The Consultant worked with Japan Transport Consultant to prepare technical framework for the sub-project .	"sub-project"="Phase II a"?	JKT: =Vietnamese Version is "Project" TRICG: =It is this project.
4	記載の意味の確認 3 Confirmation of meaning of description	15 Electrification system: +25 KV AC from overhead contact lines; + Power distribution: 3 double wire lines , AC, 3 phases;	"3 double wire lines" = 2 circuits , 3 Phase?	JKT: = 3 Phase (u,v,w) x 2 Circuits TRICG: =Mistake of description
Chapter 5	記載の事柄の確認 9 Confirmation of event of description	2) Determination of number of trains and cars: In this Project, the transport capacity of urban trains is expected to be 4.1 persons/m2 and 4.4 persons/m2 at normal hours and 6 persons/m2 at peak hours.	4.1 persons/m2 and 4.4 persons/m2 at normal hours = 4.0 persons/m2 at normal hours?	JKT: =it is necessary to correct the mistake. TRICG: =Mistake of description
5	記載の事柄の確認 9 Confirmation of event of description	Components of 6 - car tram: Tc + M + M + T + M + Tc = (38+230) persons x 2 + (48+249) x 4 = 1,724 persons/train	Chapter 4-102 6-car train mode 6-car train mode (plus car T – bold additional car)	JKT: = it is necessary to change it. TRICG: =Matches it to the new report of JKT.
7	記載の意味の確認 11	Table 7.3 Transport volume and ... Left & Upper " Shunting "	What meaning is "Shunting"?	JKT: = This table 7.3 is no good TRICG: = The table will be revised.
Chapter 7	記載の事柄の確認 3 Confirmation of event of description	VII.4. TRAIN OPERATION METHOD DURING PHASE I(A)-CONSTRUCTION - Construction at the same time with Phase I: Express trains or Reunification ones run to Giap Bat station for passengers to get up and down temporarily. The trains in the North stop at Yen Vien station .	In case of Phase I + Phase II a, at Yen Vien station = at Gia Lam station? Or After East Ring Ling is completed, is the construction start done?	JKT: = The Gia Lam is terminal station when during construction of Phase I + II a. TRICG: =Replaced by Gia Lam

3. Civil Engineering Structure

Table 3-1 Comparisons of items requiring adjustments and corrections

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
1	Chapter 2	II.2.3.	Correction to new regulation	90/QĐ-TTg by Prime Minister on July 9, 2008 in regard to "Approval of the transport and traffic planning of Hanoi City to 2020"	1259/QĐ-TTg by Prime Minister on July 26, 2011 in regard to "Approval of general planning of Hanoi Construction dated to 2030 and vision to 2050"
2			Not suitable (Deletion)	However, this decision was approved before Hanoi was extended	Unnecessary
3			Correction to new regulation	Figure 2.3 Traffic network planning of Hanoi City of 2020 (Attached the Decision 90/2008/QĐ-TTg)	Figure 2.3 Traffic network planning of Hanoi City of 2030 (Attached the Decision 1259/2011/QĐ-TTg)
4			Addition of explanation		In year 2030 edition, Line 8 is added. Line 8 is running from east Duong Xa via Yen So to the west Co Nue. This line has crossing area with Line 1 in Phap Van.
5	Chapter 3	(None)	Correction of the technical standard	2. Distance between 2 track centerlines + Other tracks : 4.2m or 4.0m (1000mm-gauge track) 5. Curve radius : Spur track and depot : Rmin=100m 6. Restricted gradient : ip=18% 9. Superstructure : rail P50 11. Platform : National railway : Low platform : h=30cm ; 300m Urban railway : High platform : h=90-110cm ; 210m	2. Distance between 2 track centerlines + Other tracks : 4.2m, 4.0m (1000mm-gauge track), or 4.4m, 5.0m (Depot) 5. Curve radius : Spur track and depot : Rmin=120m 6. Restricted gradient : ip=18%, 25% (Temporary) 9. Superstructure : 50N rail 11. Platform : National railway : Low platform : h=30cm ; 325m Urban railway : High platform : h=110cm ; 210m
6			Correction of the figure	Rolling stock gauge and Architectural clearance : Figure 1, 2, 3	Correction to new regulation
7	Chapter 4	(None) IV.1.2.1.	Correction of chainage	Giap Bat to Ngoc Hoi (Km 5+500 - Km 11+000)	Giap Bat to Ngoc Hoi (Km 5+221 - Km 10+851.317)
8			Correction of chainage	from Giap Bat terminal (Km5+500), line II A runs at right side of existing railway (about 7m) to Vinh Quynh station (Km10+115), then connecting to start of Ngoc Hoi complex at chainage Km11+000.	from Giap Bat terminal (Km4+840), line II A runs at right side of existing railway (about 9m) to Vinh Quynh station (Km10+115), then connecting to start of Ngoc Hoi complex at chainage Km 12+632
9			Not suitable (Deletion)	Corridor between urban and existing railway (temporary railway) shall be stored high speed in future. Ga Long Bien nam, Ga Long Bien bac	Unnecessary
10			Correction of station name of the figure	Ga Long Bien nam, Ga Long Bien bac	Ga Yen Vien nam, Ga Yen Vien bac
11		IV.1.2.2.	Correction of value of table	Table 4.1.1 General result plan design	Matching to the JKT plan
12		IV.1.2.3.	Correction of height	... is 8-10m to ensure urban space along the railway.	... is 4.9m to ensure urban space along the railway.

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
13			Correction of chainage and height	Vinh Quynh station (+13.30m), continuing to lower height +7.00m at Km10.730, thenending at Km11+000 (behind Ngoc Hoi bridge).	Vinh Quynh station (+14.30m), continuing to lower height +6.80m at Km11.300, thenending at Km10+851.317 (behind Ngoc Hoi bridge).
14			Correction of value of table	Table 4.1.1 General result plan design	Matching to the JKT plan
15		IV.1.2.4.	Correction of height	Viaduct : Which is over <u>4m</u> higher than embankment. Retaining wall : Which is <u>1-3m</u> higher than embankment ... Normal embankment : ... <u>1m</u> higher embankment compared to existing embankment.	Viaduct : Which is over <u>5m</u> higher than embankment. Retaining wall : Which is <u>0-5m</u> higher than embankment ... Normal embankment : ... <u>0m</u> higher embankment compared to existing embankment.
16			Correction of the figure	Figure 4.1.2, Figure 4.1.3, Figure 4.1.4, Figure 4.1.5	Matching to the JKT plan
17		IV.1.2.5.	Correction of name	rail <u>50kg</u>	<u>50N rail</u>
18			Correction of value of table	Table 4.1.3 Layout of sleepers : On viaduct n> <u>38/25m</u>	Table 4.1.3 Layout of sleepers : On viaduct n> <u>39/25m</u>
19		IV.3.1.3.	Correction of distance between 2 track centerlines	... for other track is <u>4.0m</u>	... for other track is <u>4.0m, 4.4m and 5.0m</u>
20			Correction of width of platform	platform is <u>4m</u> and normal width is <u>6m</u> ;	platform is <u>normal width 6m</u> ;
21			Correction of name	rail <u>50kg</u>	<u>50N rail</u>
22		IV.3.1.4.	Correction of chainage of table	Table of IV.2.1.4 Location, function, task and scope of station Ngoc Hoi : Km12+620 Hoang Liet : Km7+030 Ngoc Hoi : <u>On ground</u>	Table of IV.2.1.4 Location, function, task and scope of station Ngoc Hoi : Km12+632 Hoang Liet : Km6+943 Ngoc Hoi : <u>Over track</u>
23			Correction of station's location of table	Ngoc Hoi : <u>On ground</u>	Ngoc Hoi : <u>Over track</u>
24		IV.3.2.1.	Addition of explanation	Rescue path network	In DD, rescue path network for safety evacuation of passengers during panic condition is necessary.
25			Addition of explanation	Devices for fireproofing and fire extinction	Japanese standard for Device for fireproofing and fire extinction will be applied. However, their compatibility with Vietnamese standard will be confirmed.
26		IV.3.2.2.	Not suitable (Deletion)	Station waiting room	It isn't considered at intermediate station
27		IV.3.1.	Correction of the design standards	rail <u>50kg</u> Total architectural height is H= <u>570mm</u> Clearance for high bridge : <u>4.75m</u> at minimum. <u>8-12</u> at normal level	<u>50N rail</u> Total architectural height is H= <u>730mm</u> Clearance for high bridge : <u>4.90m</u> at minimum
28			Not suitable (Deletion)	wooden sleeper	It isn't considered in phase 2a
29		IV.3.1.1.	Correction of dimension	Alternative 1 : <u>Combined girder structure</u> ... with span of L= <u>30.8m</u> (distance of center L= <u>30.85m</u>). Height of a girder : <u>150cm</u> Superstructure : <u>57cm</u> Architecture height : <u>207cm</u>	Alternative 1 : <u>PC box girder structure</u> ... with span of L= <u>38.66m</u> (distance of center L= <u>40.0m</u>). Height of a girder : <u>280cm</u> Superstructure : <u>73cm</u> Architecture height : <u>353cm</u>

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
30			Correction of explanation and dimension	Alternative 1 : T-shaped girder (or I-shape girder) Height of a girder : <u>170cm</u> Supersystructure : <u>57cm</u> Architectural height : <u>257cm</u>	Alternative 1 : T-shaped girder (or I-shape girder) PC T-shape girder will be constructed in the south side of Giap Bat Station. Standard of distance between centers of abutment is 37.5m. Height of a girder : <u>250cm</u> Superstructure : <u>73cm</u> Architecture height : <u>353cm</u>
31			Correction of dimension	Reinforced concrete girder structure ... T-shaped girder bridges in <u>15.20m</u> length.	Reinforced concrete girder structure ... T-shaped girder bridges in <u>11.0m</u> length.
32			Correction of number	... with two box girder,	... with one box girder,
33			Correction of explanation	Anti-noise structure The structure of <u>1.95m</u> high anti-noise wall is made of <u>1em thick blue mica</u> . It has a <u>hard aluminum frame</u> and is mounted to the concrete uptum ...	Anti-noise structure The structure of <u>1.5m</u> from Rail level <u>high anti-noise wall</u> is made of <u>light reinforced concrete plate</u> . It is mounted to the concrete uptum ...
34		IV.3.3.2.	It is not possible to confirm it.	A. Features and physico-macanical characteristics of soil layer Fill layer - Layer 9b	It is not possible to confirm it in a present state.
35			Correction of explanation	Selection of foundation structure Foundation structure can be composed of driven pile foundation, bored pile foundation and pneumatic caisson foundation.	Selection of foundation structure Foundation structure in urban area is generally adopted cast-in-place pile in order to reduce noise and vibration pollution. Pneumatic caisson foundation work is generally not appropriate for elevated bridge.
36		IV.3.3.3.	Correction of title	IV.3.3.3. <u>Pedestrian flyover</u>	IV.3.3.3. <u>Flyover</u>
37			Correction of bridge name and girder style	A. <u>Flyover in ring road No.3</u> ... steel truss, L= <u>69.6m</u> .	A. <u>Ring Road No.3 intersection</u> ... steel rohse arch, L= <u>70.0m</u> .
38			Correction of bridge name	B. <u>Van Dien flyover</u>	B. <u>Van Dien bridge</u>
39			Correction of bridge name and dimension	C. <u>Van Dien railway flyover</u> ... box girder span, L= <u>59.5m</u>	C. <u>Van Dien intersection</u> ... box girder span, L= <u>60.0m</u>
40			Addition of bridge		D. To Lich bridge A bridge with I-box PC girder will be constructed on To Lich River. Cast-in-place construction method will be adopted. Bridge length is 45m on kilometerage Km10+828.317
41		IV.3.4.	Correction of girder style	... prestressed girder structure with the profiles including <u>two box girders</u> prestressed girder structure with the profiles including <u>one box girder</u> ...
42			Correction of construction method	- Because weight of box girder is rather high, ...	The construction depends on precast segment method
43			Correction of erection method	+ For the flyover having steel structure, the span structure shall be formed by <u>balanced erection</u> ...	+ For the flyover having steel structure, the span structure shall be formed by crane erection ...
44			Not suitable (Deletion)	+ For Long Bien flyover, due to deep river ...	Long Bien bridge (Red River Railway bridge) is not included in phase 2a.
45	Chapter 7	VII.3.1.	Correction of explanation	- Due to relatively huge weight of girder, ...	Same as item "42"

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
46			Not suitable (Deletion)	- The superstructure of the viaduct shall be built by cast-in-place method	The construction depends on precast segment method
47			Correction of construction method	- For flyover (Van Dien flyover, over Belt-line 3) made of concrete, because concrete spans are very long (50m for box girder), construction implementation by hoisting method shall encounter much difficulty, therefore, the Consultant shall recommend using the launching method on the specialized vehicles (like Ngoc Hoi – Giap Bat viaduct section) to put the girders in the right positions.	Van Dien intersection is constructed by cast-in-place method.
48					Ring Road No.3 intersection is steel arch. This bridge is erected by crane method.
49		VII.4.	Correction of station name Correction of explanation	The trains in the North stop at Yen Vien station. Particularly, the trains towards to Hai Phong run in accordance with the East Belt-line to come to Yen Vien station	The trains in the North stop at Gia Lam station. Particularly, the freight trains run by way of Gia Lam station towards to Hai Phong
50			Not suitable (Deletion)	- Construction after completion of Phase I: Express trains or Reunification ones, which use Hanoi station to allow passengers to get up and down, ...	Phase 2a is constructed at the same time with Phase 1

4. Automatic Fare Collection (AFC)

Table 4-1 Comparisons of items requiring adjustments and corrections

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
1	Chapter IV	8.1.2		Design solution Stored fare shall be manually done at ticket office	While automatic Ticket Vending Machine (TVM) needs coins for small change, coins are not usually available in Vietnam. Thus, in Phase I, all tickets, not only for stored value card but also single journey ticket, are planned to be issued by station staff at ticket office with using Ticket Office Machine.
2		8.1.2	Mis-translation	Design solution Often closing, foldable swing.	Normal Close, Flapper Door
3		8.2	Be in conformity with DD for phase 1	Applicable laws and standards ISO 18092	Type B of ISO14443 is included by ISO 21481. Thus, ISO 21418 instead of ISO18092 is better for the standard.
4		8.3.1	Confirmation is required	AFC system for urban railway Stage 1	Definition of Stage I is required.
5		8.4.1	Be in conformity with DD for phase 1	Ticket medium Dimension of card is equal to credit card's	Single journey ticket (SJT) is collected at exit gate. Hence, it is requested for SJT to be as thinner than credit card in order to store the collected SJT as many as possible in a cartridge.
6			Mis translation	Ticket medium reader/printer	reader/writer
7			Be in conformity with DD for phase 1	Ticket medium Duration of data storage shall be at least 10 years	SJT is basically used for single trip. It is not continuously used for many years. From the view point of balance between allowed cost for SJT and the requested performance, 5 years is acceptable for the retention of SJT.
8			Need correction	Ticket medium Dimension of memory expansion shall be less than 6mm2	The dimension of IC chip for SJT card shall be much smaller than 6mm2 since reinforced plate is hardly incorporated in the card for SJT. It is usually requested to be 1mm2 or smaller. On the other hand, stored value card can incorporate same techniques to reinforce the chip. Hence, SVC does not need requirement of the size of chip.
9			Need correction	Ticket medium at least 10cm	Considering the maximum electromagnetic field strength and the size of antenna of card under standards and regulations, '8cm or longer' may be the appropriate requirement.
10			Need correction	Ticket medium The card has two only format numbers, of which one is printed in card manufacture factory and other is printed in card center	Each IC card will have more than two format numbers requested by AFC system. The number of format number depends on the AFC system architecture. Hence, 'IC card shall have unique ID number to be identified uniquely' seems to be appropriate requirement.

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
11	Chapter IV	8.4.2	Not suitable	Type of ticket There shall be at least 3 types of tickets: - Single journey ticket; - Daily ticket; - Stored value card.	The variety of tickets depends on the needs of passengers and the degree of interoperability of Hanoi City Urban Railways. Thus, it seems to be reasonable to start with simple ticket system of stored value card and single journey ticket. Along with the maturity of Urban Railways and AFC, the daily tickets will be incorporated based on the requirements of customer and O&M.
12			Not suitable	Type of ticket There shall be at least 2 types of daily tickets: - One-day ticket; - Three-day ticket;	For the above view point, daily tickets are not requested at initial periods.
13			Mis translation	Type of ticket unidentification types of tickets	anonymous types of tickets' is usually used for the term.
14		8.4.3	Not suitable	1) recycle and deposit	In phase I, single journey ticket is not requested to pay deposit and all single journey tickets are collected at exit fare gate. The scheme is convenient for customers and good for saving resources.
15			Not suitable	3) card insurance and car status staff pass shall be handled at card handling centre	
16			Be in conformity with DD for phase 1	4) Unique card identification number	The codes on the card surface is related to the design of data base, which is closely related to the architecture of interoperable AFC system. Thus, it may be better to describe it in the manner that 'Unique ID number shall be marked on the IC card to identify the card in the database even if the IC card is damaged'
17		8.4.4	Mis translation	Single journey ticket Requirements for the fare structure of the system include	Fare structure is one of the most crucial issues to be defined by O&M company, which is directly related to the P/L. The title may be typo. Correct title is required. And please clarify the meanings of "the system".
18			Need definition of term	Single journey ticket The system shall be able to support at least 16 types	Please clarify the meanings of 16 types of fare, 128 fare stages. And please review the design of Phase I and reflect the description.
19		8.4.5	Be in conformity with DD for phase 1	Ticket vending machine	While automatic Ticket Vending Machine (TVM) needs coins for small change, coins are not usually available in Vietnam. Thus, in Phase I, all tickets, not only for stored value card but also single journey ticket, are planned to be issued by station staff at ticket office with using Ticket Office Machine. Requirements about ticket office machine and automatic add value machine should be described in this F/S.
20	Chapter IV	8.4.6	Be in conformity with DD for phase 1		For the same reasons above, Fare adjustment is planned to be done by station staff. Fare adjustment machine is not

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
21			Be in conformity with DD for phase 1	1) Device monitoring Name of AFC Device	planned.
22			Not suitable	1) Device monitoring DDE in management Office	
23			Confirm definition of terms	1) Device monitoring Operator may release transaction of detailed card	Please clarify the meanings of 'release transaction of detailed card'
24			Not suitable	2) Ticket card arrangement and management All return cards(except for single journey ticket) shall be move to ticket card recycling centre at OCC: Single journey ticket shall be recycled in station or issued at ticket vending machine or ticket office	With respect to the stored value card, it is not usually recycled due to the increased risk about degraded quality , security management and expensive recycle cost. Please review the description in the design of Phase I for the issue and life cycle management of stored value card and single journey ticket.
25		8.4.8	Mistranslation	1) General The system shall apply modes of data transmission,....	Please clarify the meanings of "modes of data transmission"
26			Confirm description	1) General Financial data shall apply high-security encryption	
27			Be in conformity with DD for phase 1	2) Transaction data -Ticket vending machine -Fare adjustment machine -Station staff terminal -Card recycling system	Please review the design of Phase I .
28			Be in conformity with DDF for phase 1	2) Transaction data Transaction data shall be able to be retained in each machine and in station server at least five (5) days.	Please review the design of Phase I.
29		8.5.1	Confirm definition of terms	General Fare vending system Bills and coins	Please clarify the meanings of 'Fare vending system'
30	Chapter IV	8.5.6	Conformity with DD for phase 1		As long as coins are not usually available, technical issues related to the acceptance rate of cotton banknotes should be resolved in R&D. The project toward commercial operation shall proceed with proven technology and products. That is why the design of Phase I does not propose to incorporate ticket vending machine and fare adjustment machine.
31		8.6.1	Not suitable	Scale of content Daily ticket service	As described above, daily ticket is not proposed in the design of Phase I. Please review the design.
32			Not suitable	Park and ride service e-cash service	

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
33			Not suitable	AFC system must be designed to integrate as a part of clearing system later without any change...	
34		8.6.2	Not suitable	- Main components of the system at least includes: + Ticket vending machine TVM; + Automatic fare adjustment machine;	As described above, TVM and automatic fare adjustment machine are not proposed in the design of Phase I. Please review the design.
35			Not suitable	Park and ride service e-cash service	
36			Confirm the description	Financial system of O&M company	Financial system of O&M shall be designed and installed by O&M company. AFC support s O&M to implement the softwares in the servers and computers.
37			Confirm the description	AFC training device for station and maintenance staffs shall not mentioned the document	It should be consider with other training course
38			Confirm the description	Interface with mentioned other systems shall be included in design document in stage I	It is the matter of Phase I. Hence, this sentence is not necessary in the F/S of Phase II-a
39		8.7.1	Confirm the description	Number of contactless IC cards	Commercial operation of Phase I and Phase IIa is planned to start from the end of November , 2018. Thus, the estimation is requested from 2018,not from 2015. Please clarify the source of data with the title and the date of issue, and the formula to calculate the number of IC cards.
40		8.7.2	Be in conformity with DD for phase 1	Card issuing conditions	Phase II-a can utilize the scheme for card issuing of Phase I.
41			Confirm the description	NUMBER OF PASSENGER GATES ANDTICKET VENDING MACHINES IN STAGE II(STAGE IIA) page All part of this section	Since commercial operation will start from the end of 2018, estimation shall be done for the years after 2018. The source of data , the reason of assumptions and calculation formula are requested to be clarified. Despite the description about minimum installation of TVM in the previous section, the table shows 129 TVM machines is requested.
42			Confirm the description	NUMBER OF STATION SERVERS-CENTRAL SERVERS-STATIONSTAFF TERMINAL-STAFF-PASS ISSUING MACHINE FOR PRODUCTION STAGE II(STAGE IIA) All part of this section	Please clarify the source of data, assumptions and calculation formula.
43			Confirm the description	TABLE OF LIST OF MAIN VOLUME OF AUTOMATIC TICKET VENDING SYSTEM WORK;	Please revise the table based on the above re-consideration.

5. Power supply

Table 5-1 Comparisons of items requiring adjustments and corrections

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
1	Chapter 6	IV.6.	Electrification		
2		IV.6.2.1.	Describe the general structure of the whole power supply system:	IV.6.2.1. Page-Chapter 4-52. "Additionally, there is the 22kV backup feeding for ATs, even for traction substation at Ngoc Hoi Railway substation."	<p>The dedicated power cables were employed and designed in the BD of the power distribution system. The reliability of 22kV power source has been increased very much. Therefore, the substation engineer has changed the standby power of 22kV to Railway Power Substation, ATP and SSP from the external EVN power of 22kV to the internal power distribution line of 22kV. It is a reasonable change to ensure the reliability of the standby power. If the normal power grid is used, the power may be cut off due to emergency plan when there is a possibility that the electric power supply may become less than electricity demand. On the other hand, the power will not be cut off if the system uses the dedicated power line from the substation of the electric power company. For this reason, the 22-kV power supply will be kept almost ensured, and the reliability of a power supply increases.</p> <p>IV.6.2.1. Page-Chapter 4-52 says "Additionally, there is the 22kV backup feeding for ATs, even for traction substation at Ngoc Hoi Railway substation." The stand-by power of the railway power substation, etc. was originally planned to receive power from the normal power grid in the power distribution basic design of JKT as the TRICC F/S-2a report of the phase-2a. However, there is no coordination between D/D report and the F/S-2a report of TRICC since it was changed in D/D.</p> <p>It is better to change the figure 4.6.1 in the TRICC F/S-2a report to make it consistent with "JKT/REP/0338/E "DETAILED DESIGN for POWER DISTRIBUTION SYSTEM ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I".</p>
3		IV.6.3.1.	Ngoc Hoi Railway substation:	IV.6.3.1.3, Page-Chapter 4-56, FS2a recommends overhead transmission line.	IV.6.3.1.3, Page-Chapter 4-56 in the TRICC F/S-2a report recommends overhead transmission line. The route of the transmission line of 110kV to Ngoc Hoi Railway Power Substation has been changed on the phase of D/D. The route

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
4		IV.6.3.2.	Auto transformer (AT) post:	IV.6.3.2., Page-Chapter 4-56, There is no calculation on the capacity of AT.	<p>runs from the Van Dien substation of EVN to the elevated structure of HURC1 and comes down to Ngoc Hoi alongside the HURC1 structure by the power cable. Therefore IV.6.3.1.3), Page-Chapter 4-56, will be changed according to the HATEC's D/D.</p> <p>IV.6.3.2, Page-Chapter 4-56 in the TRICC F/S-2a report does not show the calculation on the capacity of AT.</p> <p>IV.6.3.3.2), Page-Chapter 4-57, Table 4.6.1 in the TRICC F/S-2a report recommends 25MVAx2. In this case, electrical load of an AT becomes 25/4x120%=8MVA, line capacity. It is the reasonable if we consider the emergency case when one AT was failed. During the crowded commuting hours in the morning, trains will run with 2 km interval. Therefore, one AT supplies powers for 6 trains when the other AT on the same post were not available. Then the maximum power demand may become 6x6MVA=36MVA if all the train started simultaneously after the recovery of the power supply. In this case the required continuous rated capacity becomes 36/3=12MVA. 300% means the short time overload within 3 minutes according to the specifications. However, it could be reduced half to control the interval between trains as 4km. It also could be effective to suppress the speed of trains such as 30 km/h just after the recovery of the power supply. If the countermeasures of these items to reduce the train current were guaranteed, in this case, 8MVA is acceptable for HURC1. Otherwise, it would be better to consider other options such as 12 MVA.</p>
5		IV.6.3.3.	Traction power feeding transformer :	IV.6.3.3.2), Page-Chapter 4-57, Table 4.6.1, FS2a recommends 25MVAx2.	<p>IV.6.3.3.2), Page-Chapter 4-57, Table 4.6.1 in the TRICC F/S-2a report recommends 25MVAx2. Table 4.6.1, Page-Chapter 4-58, is same as the table 3-4 -Load of HURCP Line 1 of the DD document named "JKT/REP/0337/E, DETAIL DESIGN FOR RAILWAY POWER SUBSTATION SYSTEM ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I", page 17. This table says that the capacity of the feeding transformer is rated as 25x2MVA.</p> <p>However, on the Basic Design named "JKT/REP/0088/E BASIC DESIGN CONCEPT & INTEGRATION DESIGN FOR ELECTRIFICATION ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN</p>

No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
6		IV.6.6.	Traction power feeding transformer :	IV.6.3.3.2), Page-Chapter 4-58, "Ensure the reliability and operation demand in the future under the estimation."	<p>RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I", the short circuit current was studied and the electrification system has been designed on "the Item 6. FEEDING TRANSFORMER". The capacity of the feeding transformer was 22x2 MVA with 12% impedance(%Z). Therefore the short circuit current shall be designed to be same as BD document. If the capacity of FTTr is 25MVA, the %Z becomes 13.6%. This value affects the short circuit current as well as the rail potential.</p> <p>IV.6.3.3.2), Page-Chapter 4-58 in the TRICC F/S-2a report says "Ensure the reliability and operation demand in the future under the estimation". The train operation in this JICA team needs the power which will be used for the train operation with 4M4T, 4 minutes head on the whole line. Therefore the TRICC F/S-2a report should mention about it because the project period of the electrification should be 30 years which means the life time of the main transformer.</p> <p>Now, the capacity of the main transformer is 25MV Ax2 per feeding transformer. The estimated electrical load is 21.8MV Ax114%=25MVA based on the JKT/REP/0335 /E DETAILED DESIGN FOR ELECTRIFICATION ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I.</p>

6. Signaling and communications

Table 6-1 Comparisons of items requiring adjustments and corrections

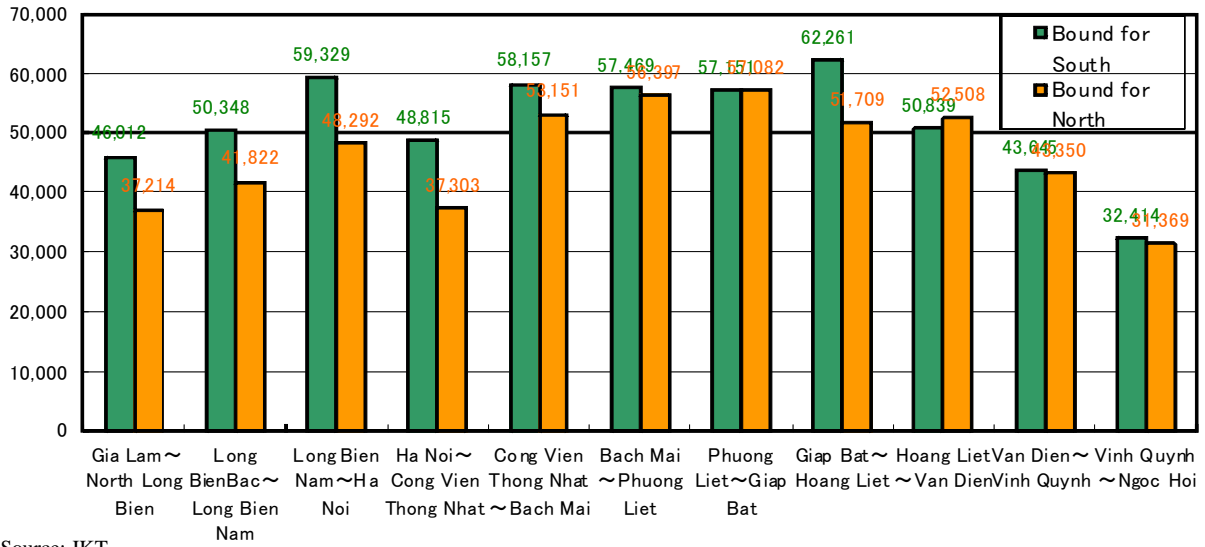
No.	Chapter	Title No.	Items	Description of Phase 2a FS	Review/Comment
1		IV.4.2.	TECHNICAL SOLUTION PHASE I (DETAILED DESIGN)	No description	<ul style="list-style-type: none"> The standards such as ITU, IEC, JIS, and so on to be applied are not referred. To be added.
2		IV.4.2.12.	Control telephone system	No description	<ul style="list-style-type: none"> Control telephone system → Dedicated telephone system (Suitable)
3		IV.5.1.1.	Public Address System (PA)	No description	<ul style="list-style-type: none"> CTCs of Signaling system → Signaling system (Suitable)
4			Natural Disaster Prevention System along Railway	No description	<ul style="list-style-type: none"> Natural Disaster Prevention System along Railway → Way-side Disaster Prevention system (Suitable)
5		IV.4.2.4.	Central Supervision System	No description	<ul style="list-style-type: none"> Central Supervision System → Centralized Monitoring System (Suitable)
6		IV.4.2.7.	Closed Circuit Television System (CCTV)	No description	<ul style="list-style-type: none"> The installation of CCTV on the OCC is not described. To be added.
7		IV.4.2.10.	Control telephone system	No description	<ul style="list-style-type: none"> Control telephone system → Dedicated telephone system (Suitable)
8		IV.4.2.11.	Public Address (PA) System	No description	<ul style="list-style-type: none"> CTCs or Signaling system → Signaling system (Suitable)
9		IV.4.3.2.4.	Central Supervision System	No description	<ul style="list-style-type: none"> Central Supervision System → Centralized Monitoring System (Suitable)
10		IV.4.3.2.5.	GENERAL ISSUES	No description	<ul style="list-style-type: none"> PRC: Running track control center → Programmed route control system (Suitable)
11		IV.4.3.2.8.	Design standard of system	No description	<ul style="list-style-type: none"> The standards such as IEC, ISO, JIS, and so on to be applied are not referred. To be added.
12		IV.5.1.	TECHNICAL ALTERNATIVE APPLICABLE TO THE PHASE I (DETAILED DESIGN STAGE)	No description	<ul style="list-style-type: none"> Transportation information display system → Traffic information display system (Suitable)
13		IV.5.2.	Scope of signaling system	No description	<ul style="list-style-type: none"> PRC and CMS are not described. To be added.
14		IV.5.3.1.	Definition of system functions	No description	<ul style="list-style-type: none"> CTC, PRC and CMS are not described. To be added.

Annex 3 Train operation plan data

Annex 3 Train operation plan data

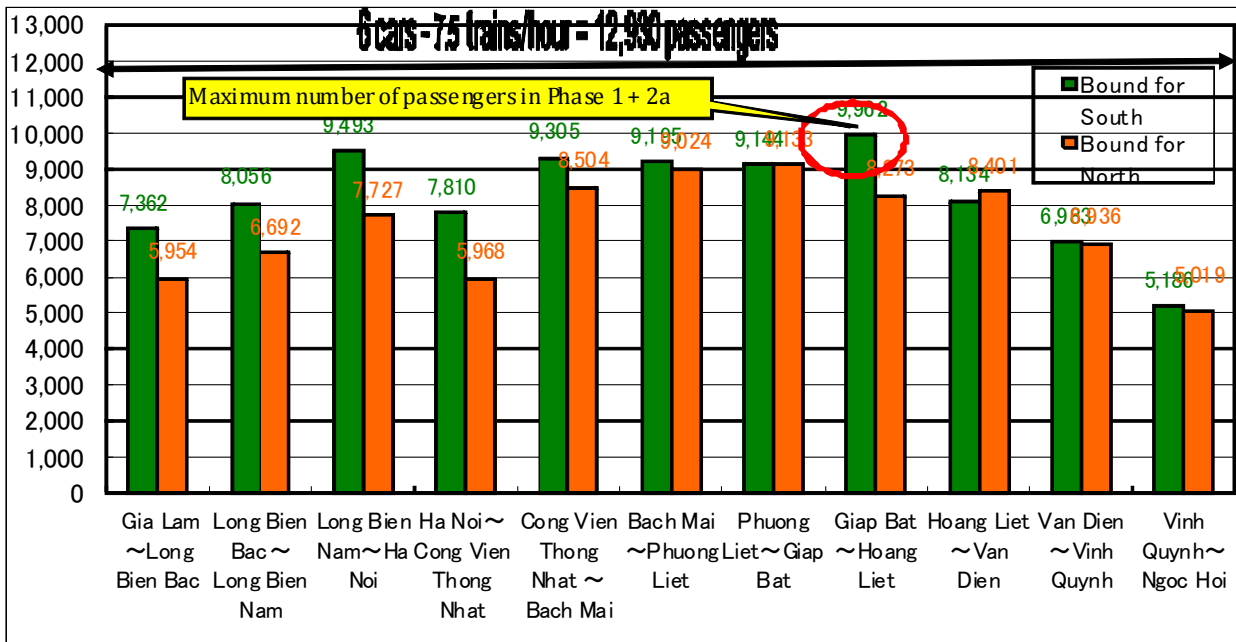
1. Section traffic volume
2. General descriptions of transport plans
3. Preconditions of transport plans
4. Operation time between stations
5. Dwell time
6. Train diagrams
7. Car mileage
8. No. of required crews

1. Section traffic volume



Source: JKT

Fig. 3-1 No. of passengers between stations per day



Source: JKT

Fig. 3-2 No. of passengers per hour during peak hours

2. General descriptions of transport plans

The following 2 transport plans with different construction procedures are described in Phase 2a FS.

a) Construction of Phase 2a after the completion of the Phase 1

This idea is described in the Phase 1 FS as a plan to utilize existing sites to construct elevated tracks above the area of land of the existing lines.

b) Simultaneous construction of Phase 1 and Phase 2a

This idea is a plan to simultaneously construct Phase 1 and 2a by securing construction lots of the elevated tracks at places other than those for the existing lines.

Construction cost for the Plan b) above is less than that for the Plan a) above and since a transport plan for Plan b) will be simpler, the JICA Survey team considers that a plan to simultaneously start operations of the Plan b)'s Phase 1 and Phase 2a has validity.

General descriptions of transport plans to simultaneously construct Phase 1 and Phase 2a described in Phase 1's detailed design are indicated below.

3. Preconditions of transport plans

Construction work procedures are as follows and the general descriptions of the procedures are indicated in Fig. 3-3.

- a) Freight station functions of Giap Bat Station will be transferred to Ngoc Hoi.
- b) Hanoi's terminal functions will be moved to Giap Bat Station and Gia Lam Station operations between Gia Lam and Giap Bat will be suspended.
- c) Passenger trains from the south will terminate at Giap Bat. Trains from the north will terminate at Gia Lam. Constructions for elevated structures between Gia Lam and Ngoc Hoi will be started.
- d) After completing the construction of elevated sections, passing completion inspections, and training operations, service operations will be commenced.

Train Operation Plan Between Ha Noi - Ngoc Hoi (In case Phase I + II a)

16/06/2011
JKT Train Operation Team

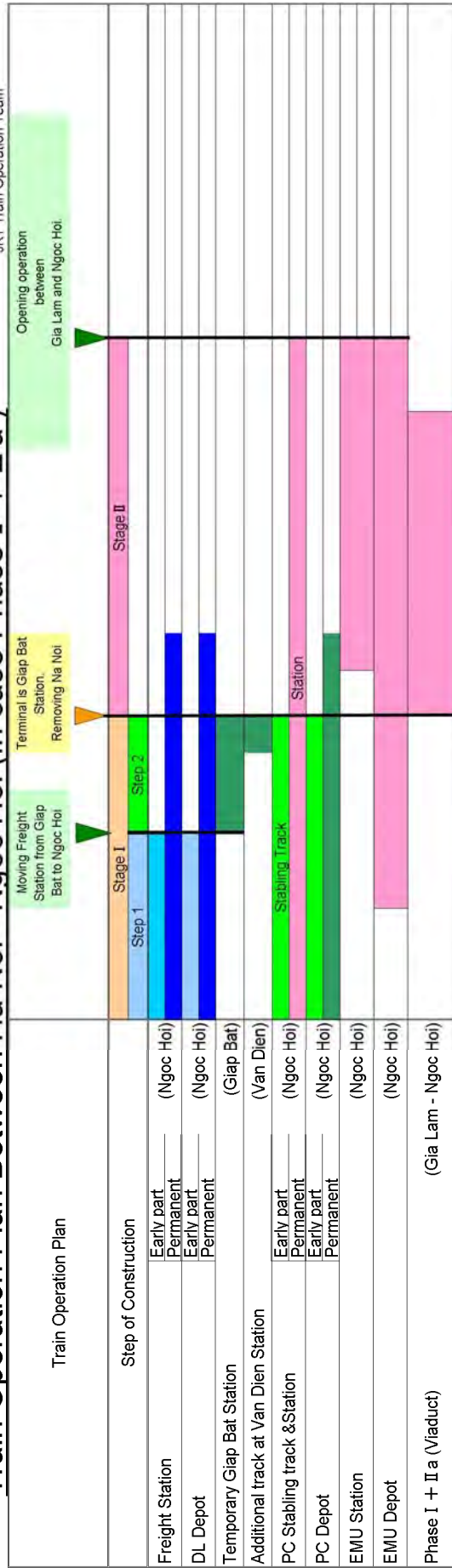


Fig. 3-3 Construction work procedures

Source: JKT

4. Travel time between stations

Operation time between stations is calculated from the driving simulation result (refer to Fig. 3-5) with track specification data and railcar specification data for the Line 1 (refer to Fig. 3-4 and Fig. 3-5).

Consequently, Travel time between Ngoc Hoi and Gia Lam was 37 minutes.

Vehicle performance and driving conditions are as indicated below.

- Acceleration 0.75m/s/s(2.7 km/h/s)
- Deceleration (Operation Brake) 0.58m/s/s(2.0 km/h/s)
- Standing density Peak hour 6.0 persons/m²
 Normal hour 4.0 persons/m²
- Electrification 25kv 1ph 50Hz A.C
- Maximum Design Speed 110km/h
- Capacity of Vehicle 4 car/set (6.0 persons/m²): 1,130 persons
8 car/set (6.0 persons/m²): 2,318 persons

Table 3-1 Capacity of Vehicle

	Car with cabin	Intermediate Car
	With wheelchair area	
Seats (person)	37	47
Standing (person)	6.0 persons/m ² : 230 Wheel chair: +1	6.0 persons/m ² : 249 Wheel chair: +1
Total (person)	6.0 persons/m ² : 268	6.0 persons/m ² : 297

5. Dwell time

Dwell time for urban railways (electric trains) is the time from the stopping of a train to the closing of all doors. In general, it is approx. 20 sec. In Vietnam, since there is no operational records of urban railways (electric trains), as a result of discussions with persons involved, we decided to use Dwell time of 90 sec. for stations with a large No. of boarding and alighting passengers and Dwell time of 60 sec. for other stations. Since we consider that these Dwell times are too long, after collecting actual data from driving training etc. before the commencement of service operations, we propose to reconsider appropriate stopping time.

6. Train diagrams

Train diagrams for Phase 1 + 2a formulated in detailed design are indicated in Fig. 3-6. The daily number of train on the weekday is 122 for one way and 244 for round trip (refer to Table 3-3).

This diagram is formulated based on the following prerequisites.

- a) No. of passengers during peak hours per hour for the simultaneous opening of Phase 1 + 2a in 2020 (section traffic volume)
- b) Based on track conditions and vehicle conditions of the Line No. 1, operation time between stations obtained from simulation results.
- c) Dwell time etc. for each station

7. Car mileage

Car schedule for Phase 1 + 2a formulated in the detailed design (Year 2020) is indicated as Table 3-2.

This schedule is formulated based on the train diagram for Phase 1 + 2a formulated in detailed design (Fig. 3-6).

Daily driving distance per train (train km) is 4,465Km/day.

Since the No. of vehicles per train-set is 6, the Car km is 26,790km/day (4,465km/day x 6 cars).

(No. of operating trains and No. of vehicles will be the same for both Year 2022 and Year 2020.)

Table 3-2 Car schedule (Phase 1 + 2a) for Year 2020

NO.	Number of Car Schedule	Dep.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Dep.	km/Day	
1	03	Ngoc Hoi	[Blue bar from 4 to 23]																				Giap Bat	473.6	
2	01	GiapBat	[Blue bar from 4 to 23]																				Ngoc Hoi	473.6	
3	05	Ngoc Hoi		[Blue bar from 5 to 23]																				Ha noi	431.7
4	15	Ha Noi	[Blue bar from 4 to 18]																		Ngoc Hoi	345.9			
5	07	Ngoc Hoi	[Blue bar from 4 to 9]																					Ngoc Hoi	111.1
6	09	Ngoc Hoi	[Blue bar from 4 to 22]																				Ngoc Hoi	444.3	
7	11	Ngoc Hoi		[Blue bar from 6 to 23]																			Gia Lam	425.8	
8	19	Gia Lam	[Blue bar from 4 to 22]																				Ngoc Hoi	462.9	
9	13	Ngoc Hoi		[Blue bar from 6 to 23]																			Ha noi	419.9	
10	23	Ha Noi	[Blue bar from 4 to 18]																		Ngoc Hoi	357.7			
11	17	Ngoc Hoi	[Blue bar from 4 to 9]						Ngoc Hoi						[Blue bar from 15 to 22]						Ngoc Hoi	259.2			
12	21	Ngoc Hoi	[Blue bar from 4 to 9]						Ngoc Hoi						[Blue bar from 16 to 23]						Ngoc Hoi	259.2			
13	Standby	Ngoc Hoi	[Cyan bar from 4 to 23]																				Ngoc Hoi	0	
14	Maintenance	Ngoc Hoi	[Cyan bar from 4 to 23]																				Ngoc Hoi	0	
Total																								4,465	

Source: JKT

8. No. of required crews

Based on train diagrams for Phase 1 + 2a formulated in detailed design (Fig. 3-6), No. of required crews for Year 2022 is calculated.

No. of crews is calculated in accordance to Japanese rules.

- a) No. of drivers

By totalling travel time, turning back time, time from a station to a depot and time from a depot to a station, No. of required persons is calculated (5 hours/person/day). Reserve rate of 1.6 is added for holidays etc.

b) No. of conductors

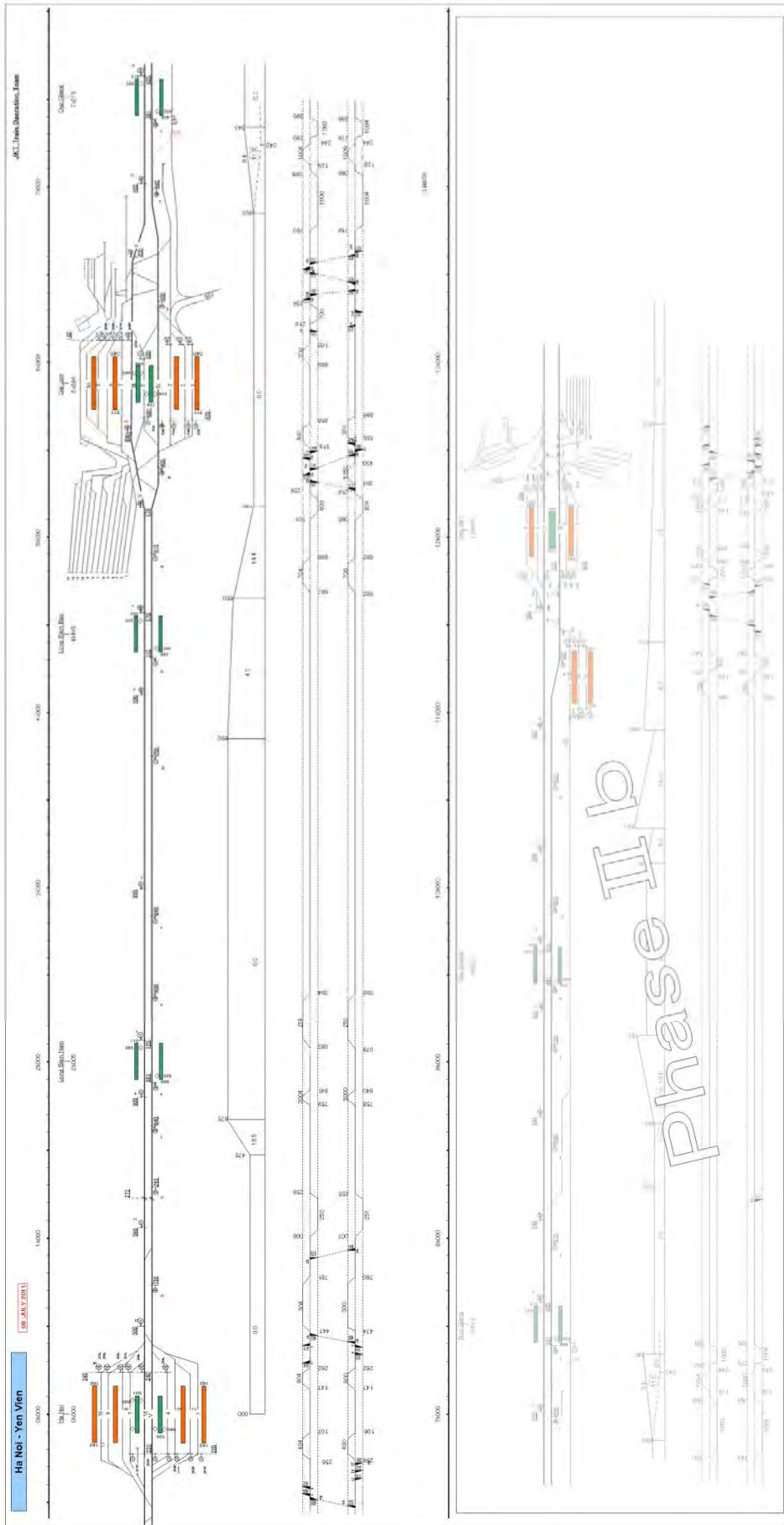
By totalling travel time and turning back time, No. of required persons is calculated (5 hours/person/day). Reserve rate of 1.6 is added for holidays etc.

The calculation results are indicated in Table 3-3.

Table 3-3 Calculation results of No. of required crews

Total Driving Time				
Origin	Destination	Number of trains	Driving Time	Operation base time
Gia Lam	Ngoc Hoi	119	73:51:15	0:36:45
Gia Lam	Giap Bat	1		0:22:45
Gia Lam	Ha noi	1		0:10:15
Ha noi	Ngoc Hoi	1		0:25:00
Ngoc Hoi	Gia Lam	119	74:51:45	0:37:15
Ngoc Hoi	Ha noi	1		0:25:30
Giap Bat	Gia Lam	1		0:23:15
Ha noi	Gia Lam	1		0:10:15
Turn Back Time				
Station		Turn Back Time		
Gia Lam		9:56:00		
Ngoc Hoi		14:11:00		
Total Working Time(Conductor)			172:50:00	
Other Working Time related to drivers				
Matters	Number of trains	Working Time	Operation base time	
From depo to station	11	9:10:00	0:50:00	
From station to depo	11	5:30:00	0:30:00	
Total Working Time(Driver)			187:30:00	
Demanded Numbers				
		Conductor	60	
		Driver	70	

Source: JKT



Source: JKT

Fig. 3-5 Track layout between Hanoi and Yen Vien



Source: JKT

Fig. 3-6: Train diagram for simultaneous opening of Phase 1 + 2a in 2020
 (Red line: hauling trains for locomotives; Black lines: electric trains of urban railways)

Annex 4 Structural Profile of Phase 2a Section

Annex 4 Structural Profile of Phase 2a Section

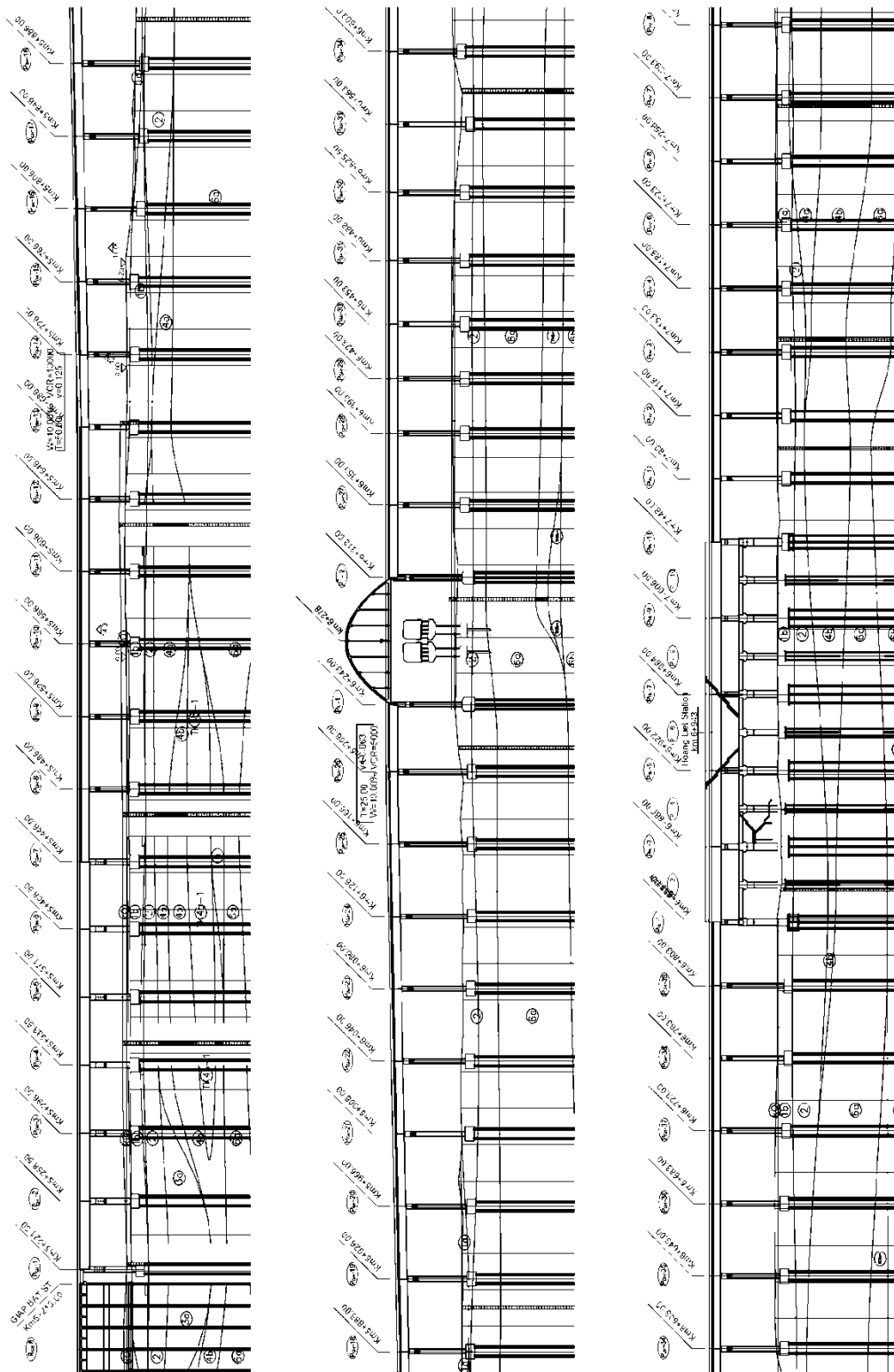


Fig. 4-1 Structural Profile of Phase 2a Section (Part 1 : between Giap Bat and Hoang Liet)

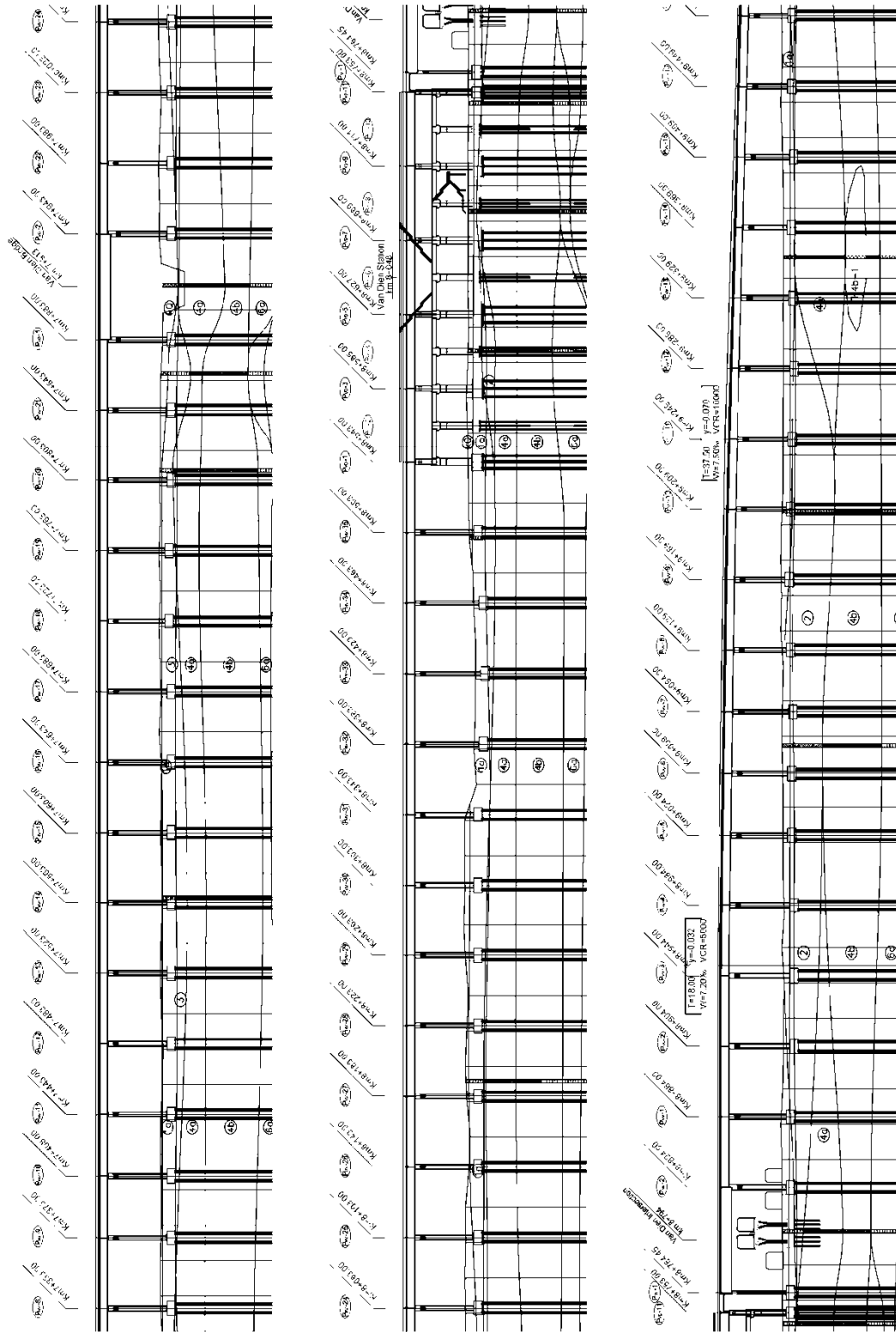


Fig. 4-2 Structural Profile of Phase 2a Section (Part 2: between Giap Bat and Hoang Liet)

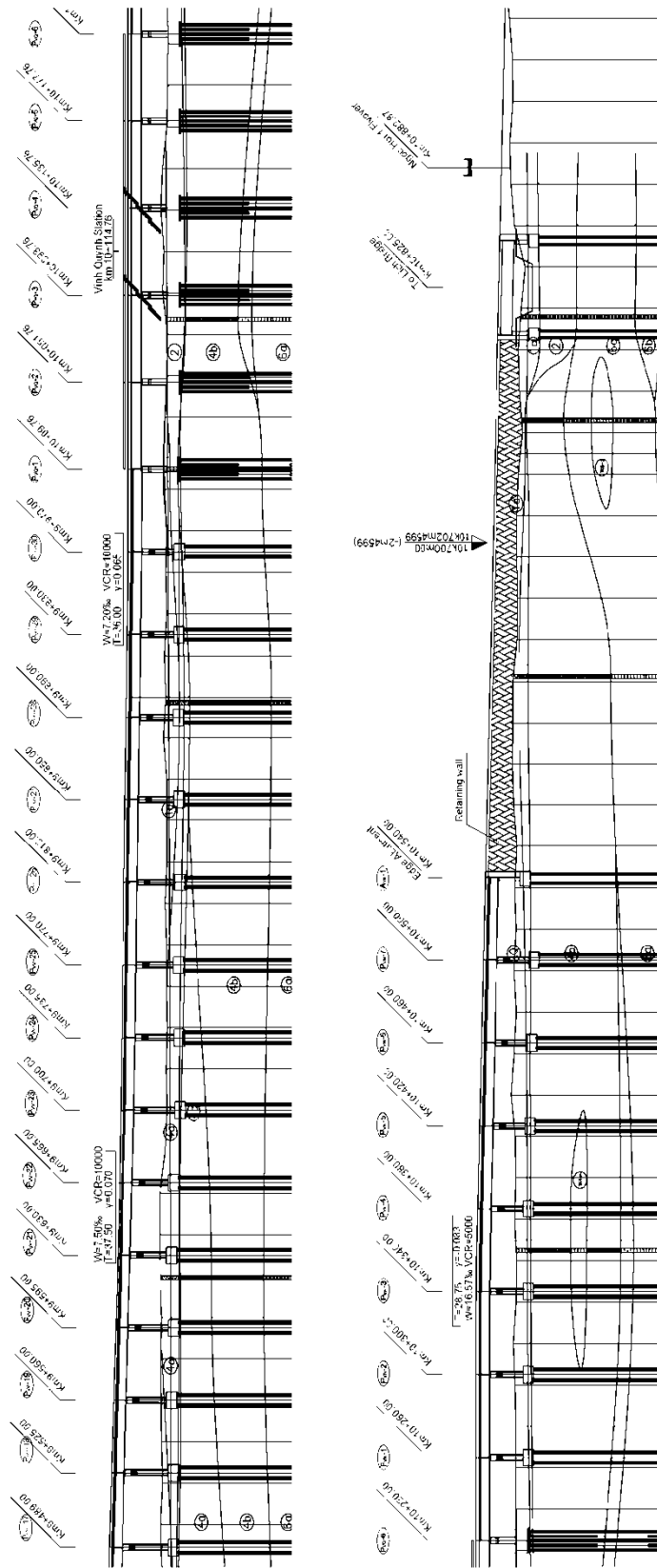


Fig. 4-3 Structural Profile of Phase 2a Section (Part 3: between Giap Bat and Hoang Liet)

Annex 5 Safety and Quality Control System Checklist

SAFETY QUALITY CONTROL SYSTEM CHECKLIST

Country: Vietnam
 Project Name: Hanoi city Urban Railway Construction Project (Line 1), Phase I – Ngoc Hoi Complex

Items to Confirm	Items to be Confirmed	Confirmation Result
<p>(1) Laws and standards related to safety and quality control</p>	<p>The existence or nonexistence of laws and various standards related to safety and quality control, as well as the names of those laws and contents of related provisions</p> <p>(1) Names of laws (2) Contents of related provisions</p>	<p>a) Decree 49/2008/ND-CP dated 18 April 2008 of the Government amending and supplementing some articles of Decree No. 209/2004/ND-CP of the Government regarding to the management of construction quality including contents as following:</p> <ol style="list-style-type: none"> 1) Management about quality of survey processing 2) Management about quality of design processing 3) Management about quality of construction processing 4) Warranty and maintenance...etc. <p>b) Circular No.22/2010/TT-BXD dated 03 February 2010 of Ministry of Construction regulations on labor safety in construction work including the contents as following:</p> <ul style="list-style-type: none"> • The requirements of safety in construction works: + General requirements for construction works (construction master plan must be designed and approved as required, in accordance with construction site; Supplies and materials must be neatly ordered in accordance with the overall design is approved; Electrical safety; Safety of fire and explosion) + Requirements for construction • Responsibilities of the Subjects for safety in construction work • Standards about safety in construction as following: + TCXD 66-1991 - Technical regulations for safety in construction + TCVN 3254-1989 Fire Safety - General requirements + TCVN 3255-1986 explosive safety - General requirements + QCVN 01:2008/BCT- National technical regulations on

Items to Confirm	Items to be Confirmed	Confirmation Result
	<p>The existence or nonexistence of safety and quality control manuals at the executing agency</p> <p>(1) Names</p> <p>(2) Contents (examples of items to be described)</p> <ul style="list-style-type: none"> • Is the method of patrolling the sites (frequency of such patrols, etc.) indicated as reference? • Is the frequency with which consultants and contractors are consulted indicated as reference? • Are the rules and regulations (or manuals) governing safety and quality control included? 	<p>electrical safety 12/2008/QD-BCT Decision of the Ministry of Industry and Trade and other standards...etc.</p> <p>Executing Agency: Vietnam Railways</p> <p>(1) Railway Operation Regulation Train Operation Process and Shunting Activity Railway Signaling Regulation Station Technical Management Rule Rolling stock maintenance procedure</p> <p>(2) Contents (examples of items to be described) These rule and regulations govern the safety and quality control of all the railway operating activities among Vietnam railway system such as: signaling, train operation, shunting activities, rolling stock maintenance, stand-by emergency craned-trains, ect.</p>
<p>(2) Mandates of the departments in the executing agency in charge of safety and quality control and the services the staff</p>	<p>Identification of the safety and quality control department and number of staff members</p> <p>Details of the mandates of the department in charge of safety and quality control</p> <p>(1) State of implementation of site patrols</p> <p>(2) Availability of accident statistics related to all projects under jurisdiction of the executing agency (Attach</p>	<ul style="list-style-type: none"> • No. of total staff members at the executing agency: 500 persons in VNR headquarter • Name of the safety and quality control department: Railway safety Department • No. of staff members in the department above: 9 persons (head quarter) and about 150 persons in the branches along Vietnam railway system <p>1) Good condition of infrastructure is the most important for the safety train operation, thus, site patrols is carried out with frequency 1time per day to find out damages to give the countermeasures.</p> <p>2) Accident statistics is available</p>

Items to Confirm	Items to be Confirmed	Confirmation Result
	<p>accident data for the past three years)</p> <p>(3) Guidance and instructions for consultants and contractors</p> <p>(4) Documents on the mandates of the department in charge of safety and quality control (Attach the document)</p> <p>(5) Others (Describe specifically)</p>	<p>3) All the issued regulations, rules as a role of instruction for every activity affecting to safety operation, especially for construction on and near by the existing railway track.</p> <p>4) Documents on the mandates of the Safety Railway Department had been issued by General Director of VietNam Railways.</p>
	<p>State of implementation of training for staff in charge of safety and quality control</p> <p>(Reference)</p> <ul style="list-style-type: none"> • Training in the safety and quality management system • Training in matters related to laws • Training in developing awareness of the dangers of accidents • Training in the role of safety and quality control in the executing agency • Training in construction method and method of safety and quality control • Training in method of collecting accident statistics and their effective utilization • Training in accident prevention techniques • Others 	<p>In Vietnam Railways, safety related contents are usually be merged in a training course, include some of contents bellow:</p> <ul style="list-style-type: none"> • Training in the safety and quality management system • Training in matters related to safety laws • Training in developing awareness of the dangers of accidents • Training in the role of safety and quality control in the executing agency • Training in accident prevention techniques

Items to Confirm	Items to be Confirmed	Confirmation Result
	<p>Information concerning past accidents in construction, etc.</p> <p>(1) Has the information concerning past accidents been accumulated? In addition, ascertain what the policy is for accumulating accident information (e.g., recording information on only accidents resulting in death in accordance with the organizational rules).</p> <p>(2) Components and contents of accident information (Reference)</p> <ul style="list-style-type: none"> • No. of accidents • Situation in which accidents occur • Scale of accident (amount, number of casualties, existence or nonexistence of third-party injuries) • Emergency response • Cause of accident • Future prevention method • Others (Describe specifically) 	<p>- Yes, information concerning to past accidents has been accumulated. The information is not only in death results but also injured results.</p> <p>- Contents of accident information mainly as follows:</p> <ul style="list-style-type: none"> • No. of accidents • Situation in which accidents occur • Scale of accident (amount, number of casualties, existence or nonexistence of third-party injuries) • Emergency response • Cause of accident • Responsibility of related partners
<p>(3) Assignment plan for staff in charge of safety control related to the Japanese ODA loan project</p>	<p>Assignment plan for staff in charge of safety control related to the Japanese ODA loan project</p> <p>(1) No. of staff members in charge of safety control</p> <p>(2) Is there any specific assignment plan, with a specific job description for each person?</p>	<p>There is no specific assignment plan for staff incharge of safety control related to Japanese ODA loan project. Depend on current situations of each project, Chief of Department will assign people in charge.</p>

Items to Confirm	Items to be Confirmed	Confirmation Result
(4) Competence and experience of staff in charge of safety and quality control	Projects in which the staff handled safety and quality control (1) Projects handled (2) Names of positions the staff held or their status therein (3) Details of the service performed	- Project handled: Bridges Safety Improvement Project (BSIP) - Position: Safety controller - Service performed: + Checking the safety organization of contractors + Checking the responded activities if accident happen + Checking the ready status of responded activities + Checking safety certification of workers + Checking the construction plans to ensure safety
(5) System of confirming safety and quality control in the executing agency	Method of confirming safety and quality control in the executing agency (1) Regular consultative meetings with construction managers and contractors (2) Site patrol (3) Others (Describe specifically)	Method of confirming safety and quality control (1) Regular consultative meetings with construction managers and contractors (2) Site patrol (3) Checking real condition of construction site with the proposed construction method (4) Asking contractor to make panel talking about importance of safety maintain (5) Others (Describe specifically)
(6) Confirmation related to the framework for responding to accidents	Specific method of sharing information within the executing agency when an accidents occurs * Briefly describe the framework for sharing information when an accident occurs. Attach a phone calling tree, relevant regulations, etc. as needed. (1) The manual for responding to an accident (2) Is the department to contact in the case of an accident described in the manual?	When accidents occur due to failures or due to safety problems must be resolved works as follows: <i>I. When accidents occur due to failures caused occupational safety:</i> a) The Contractor shall at all preliminary measures, provide first aid to injured workers, then forwarded to the medical facility to handle; b) The investors, contractors and related entities shall report promptly to the management agencies involved in conducting examination and inspection in accordance to determine the cause of the incident, occupational accidents; c) The declaration, investigation records, statistics, reports, process troubleshooting; solving mode upon the occurrence of

Items to Confirm	Items to be Confirmed	Confirmation Result
		<p>occupational accidents shall comply with current regulations;</p> <p>d) After marking the site, the consent of the competent authorities and investors, contractors perform the cleanup where incidents occur and to continue the construction.</p> <p>2. <i>When accidents occur due to construction problems:</i></p> <p>a) To comply with the provisions at Points a, b, c, Clause 1 of this Article;</p> <p>b) After marking the site, the consent of the competent agency, the contractor shall clean the place of the incident and at the same time, inspect and assess the stability of the building or work under construction as prescribed, if safe, to report that allows investors to continue the construction.</p>
	<p>Method of keeping staff members in the executing agency informed about the framework for responding to an accident</p> <p>(1) Implementation status of holding a briefing session to inform all staff members about the manual and its contents.</p> <p>(2) Submission of an accident report and holding of investigative commissions</p>	<p>- Under preparation</p>
(7) Method adopted by the executing agency to confirm training programs in safety and quality control provided by contractors for workers	<p>Method of confirmation adopted by the executing agency</p> <p>(3) Method of confirmation of preliminary training (in-house education, qualification process)</p> <p>(4) Method of confirmation of the training schedule during construction (safety conventions, consultative meetings to discuss safety, post accident response conference, etc.)</p>	<p>- Under preparation</p>
(8) Others	Public agencies with jurisdiction over safety issues (in	- Public agencies with jurisdiction over safety issues in VietNam:

Items to Confirm	Items to be Confirmed	Confirmation Result
	<p>Japan, the Ministry of Health, Labor and Welfare)</p> <p>(5) Names of the public agencies</p> <p>(6) Demarcation between those public agencies and the executing agency regarding safety</p> <p>(7) Existence or non-existence of an official certification system governing specialist labor (heavy-construction-equipment operator, etc.)</p> <p>(8) On-site inspections of construction sites, guidance, etc.</p>	<p>Ministry of Construction (MOC)</p> <p>- MOC in charge of issuing legal documents to instruct maintaining safety in all the aspects. MOC's safety department will incharge of investigation depend on the serious of the accident.</p> <p>- Vietnam Railways is incharge of implementing the legal documents to ensure all activities in their management is suitable with legal documents</p>

**Annex 6 Analyses of Factors for Construction Cost Increase
(Comparison between Phase 1 FS and Design by JKT)
(This part was deleted to disclose information in certain
period)**

Annex 7 Number of Staff Required in Urban Railway

Annex 7 Number of Staff Required in Urban Railway

Table 7-1 Number of Staff Required in Ho Chi Minh City UMRT Line 1

Number of Staff for Ben Than~Suoi Tien, 19.7km	2026 (5 years after inauguration in 2021)	
	Department	Number of staff
Board members	8	
Administration (general affairs, human resources, IT management, legal affairs, public information)	17	
Financial affairs	10	
Planning	6	
Safety	3	
Training center	4	
Operation management (transportation planning, station services, IC card, OCC, 50 drivers, 151 station staff)	236	
Rolling stock (32 staff), track and facilities (32 staff), Electricity (50 staff)	114	
Non- railway business	10	
Headquarter and worksite total	408	20.7 staff/ operation-km

Table 7-2 O&M Company for Ho Chi Minh City Elevated Urban Railway

Number of Staff for Di An~New Bien Hoa, 31.1km	Number of staff	Remarks
Headquarter		
Administration (general affairs, management planning, human resources, financial affairs, safety management)	50	
Transportation (station services, train planning)	30	
Infrastructure and facilities (civil infrastructure, track maintenance, architecture, power supply, signal, telecommunication)	40	
Rolling stock	20	
Headquarter Sub-total	140	
Worksite		
Station	160	
Driver	80	
Conductor	70	
Infrastructure and facilities (civil infrastructure, track maintenance, architecture)	50	
Electricity (power supply, signal, telecommunication)	50	
Rolling stock (car depot, work shop)	120	
Dispatcher (train operation, facilities, power supply, signal, telecommunication)	60	
Worksite Sub-total	590	
Grand total	730	22.5 staff/ operation-km

Note: Based on the actual performance of urban railway in Japan, these staff number was presumed from the scale of facilities, number of passenger, train, rolling stock and rolling stock running-km.

Table 7-3 Employee Composition of Japanese Urban Metro

Railway Operator		Kyoto	Kobe	Fukuoka	Hanoi Line 1 (Ngoc Hoi – Gia Lam)
Operation length (km)		31.2	30.6	29.8	24.7
Number of passenger (1,000/day)		319	292	339	-
Total number of staff		607	605	588	601
Staff/operation-km		19.5	19.8	19.8	24.3
Breakdown of staff	Headquarter Sub-total	136	74	148	129
	Administration Dept.	41	37	44	63
	Transportation Dept.	25	10	30	19
	Facilities Dept.	13	23	26	19
	Electric Dept.	17		21	14
	Car Dept.	9		7	14
	Construction Dept.	31	4	20	-
	Worksite Sub-total	471	531	440	472
	Station	169	132	150	75
	Driver	129	116	116	70
	Conductor	40	55	-	60
	Others	19	65	96	31
	Facilities Depot	12	33	14	236
	Electric Depot	42	72	27	
	Car Depot	55	49	37	
	Construction Depot	5	9	-	
	Total	607	605	588	601

Source: The 2007 Railway Statistics Annual Report

Annex 8 Method of Fare Setup of Other Urban Railway Lines

Annex 8 Method of Fare Setup of Other Urban Railway Lines

- 1. Hanoi Urban Railway Line 1
- 2. Ho Chi Minh City Urban Railway Line 1

1. Hanoi Urban Railway Line 1

In this calculation, affordability of the passengers is assumed based on current bus fare and taxi fare. One time ticket and monthly pass is estimated by considering current fare system of transportation in Hanoi. Accordingly, fare revenue is calculated based on occupancy rate. Occupancy rate of Tokyo Metro is taken as an example, whose 60% of passengers are using monthly pass, and 40% are using other tickets, as a model case.

Minimum fare of bus is VND 3,000 and initial fare of taxi is VND 12,000. Thus, fare of railway is set at the midpoint, VND 7,500. Average trip length is 5.3km, based on HAIDEP.

Table 8-1 Fare Price for Revenue Calculation

Year	Fare level in each year	Average fare price
2015-2017	VND 6,000 + 600 x (Travel length in km)	VND 9,500
2018-2020	VND 7,000 + 700 x (Travel length in km)	VND10,700
2021-2027	VND 8,000 + 800 x (Travel length in km)	VND12,500
2028-2030	VND 10,000 + 1000 x (Travel length in km)	VND15,500
2031-2040	VND 12,000 + 1200 x (Travel length in km)	VND18,500
2041-2044	VND 14,000 + 1400 x (Travel length in km)	VND21,500

Note: 5.3km is used for average travel length.

2. Ho Chi Minh City Urban Railway Line 1

The fare setting level of Ho Chi Minh City Line 1 will be decided formally one year before inauguration. Currently, 5 patterns are being considered. Based on examination result of company balance and passenger affordability, the starting fare is VND 5000 in year 2011, and VND 8000 (VND 15,200 with average trip length 9.0 km) at inauguration time in year 2017. This proposal is approved by Joint Committee.

Table 8-2 Comparison of Metro`s Fare Price to another Transportation Vehicles

Transportation vehicles	Average km/day/ Round trip	Advantages	Disadvantages	Expenditure	Note
Metro	18	+ Fast and convenient, no traffic jams. + No road dust and get rid of sun or rain + Good and modern accomodations. + Pension fair	Passengers have to stand during the rush hours due for lacking seats.	(2 routes *[5000 + 500 *9km) * 24 days =456.000	+ It takes 18 minutes to go through 9km. + Fare Price 5.000 VND count on year 2011.
Bus	18	+ No road dust and get rid of sun or rain + Convenient	+ Passengers have to stand during the rush hours due for lacking seats (over capacity usually) + Traffic jams + Base on suitable routes	(4000 + 4000) * 24 days = 192.000 VND ~ 200.000 VND (takes 10% income)	+ 9km takes 25 minutes in rush hour + Under 31km is 4.000 VND (pension fare)
Motorcycle	18	Flexible, may active in movement.	+ Inconvenient rain and sunny, road dust too. + Maintenance cost + Traffic jams always	Pay more parking fee, fuel, maintenance around 700.000 VND/month (not counting depreciation cost for using)	+ 9km takes 25 minutes in rush hour
Taxi	18	+ No rain and sunny, road dust. + Convinient with good service	+ Traffic jams always + It's hard to take taxi in rush hour + High cost	+ aound 120.000 VNĐ/ 1 trip 9km Cost = 120.000 *2* 24 days = 5.760.000 VNĐ	+ 9km takes 25 minutes in rush hour

Annex 9 Economic Evaluation: Phase 1 + 2a

Annex 9 Economic Evaluation: Phase 1 + 2a

(VND billion)

EIRR		3.3%		Project Cost				Benefit			Net Benefit
Year		Replacement	O&M	Total	Saving of TTC	Saving of VOC	Reduction of CO ²	Total			
-7	2012	1,118		1,118				0	-1,118		
-6	2013	979		979				0	-979		
-5	2014	2,363		2,363				0	-2,363		
-4	2015	7,297		7,297				0	-7,297		
-3	2016	15,400		15,400				0	-15,400		
-2	2017	18,024		18,024				0	-18,024		
-1	2018	11,640		11,640				0	-11,640		
0	2019	4,500		4,500				0	-4,500		
1	2020		347	347	743	1,115	1	1,860	1,512		
2	2021		347	347	811	1,186	1	1,999	1,652		
3	2022		543	543	885	1,258	2	2,144	1,601		
4	2023		543	543	961	1,329	2	2,292	1,748		
5	2024		543	543	1,044	1,400	2	2,446	1,903		
6	2025		543	543	1,130	1,471	2	2,603	2,060		
7	2026		543	543	1,219	1,542	2	2,764	2,220		
8	2027	2,150	586	2,736	1,312	1,613	2	2,927	191		
9	2028		603	603	1,411	1,685	2	3,098	2,495		
10	2029		603	603	1,515	1,756	2	3,272	2,670		
11	2030		603	603	1,621	1,827	2	3,451	2,848		
12	2031		603	603	1,762	1,928	2	3,693	3,090		
13	2032		603	603	1,909	2,029	3	3,940	3,337		
14	2033		603	603	2,060	2,130	3	4,192	3,590		
15	2034	3,011	603	3,613	2,221	2,231	3	4,455	842		
16	2035		675	675	2,383	2,331	3	4,718	4,042		
17	2036	3,687	682	4,369	2,555	2,432	3	4,991	622		
18	2037		704	704	2,739	2,533	3	5,276	4,572		
19	2038		704	704	2,929	2,634	4	5,567	4,863		
20	2039		704	704	3,125	2,735	4	5,864	5,160		
21	2040		704	704	3,327	2,836	4	6,168	5,463		
22	2041		704	704	3,600	2,981	4	6,585	5,880		
23	2042		704	704	3,880	3,125	5	7,010	6,306		
24	2043		704	704	4,177	3,270	5	7,452	6,747		
25	2044		704	704	4,483	3,414	5	7,902	7,198		
26	2045	6,144	719	6,863	4,798	3,559	6	8,362	1,499		
27	2046		761	761	5,121	3,703	6	8,831	8,070		
28	2047		761	761	5,464	3,848	6	9,318	8,557		
29	2048	3,011	882	3,893	5,816	3,993	6	9,815	5,922		
30	2049	-7,988	-2,796	-9,901	6,178	4,137	7	10,322	20,223		

Source: JICA Survey Team

Annex 10 Financial Evaluation

Annex 10 Financial Evaluation

Base Case: (Phase 1 + 2a) - New Company operates only. Government owns all assets.

(VND billion)

FIRR		398%		Cost						Revenue					Net Income
Year		Investment	Replacement	O&M	Non-fare	Leasing	Repayment	Interest &	Total	Fare	Non-fare	Soft Loan	VG Subsidy	Total	Net Income
-7	2012								0					0	0
-6	2013								0					0	0
-5	2014								0					0	0
-4	2015								0					0	0
-3	2016								0					0	0
-2	2017								0					0	0
-1	2018								0					0	0
0	2019								0					0	0
1	2020			175	4	60			239	604	6			610	371
2	2021			175	4	63			242	627	31			658	417
3	2022			280	4	65			349	650	45			695	347
4	2023			280	4	67			351	673	67			740	389
5	2024			280	4	70			353	695	70			765	412
6	2025			280	4	72			355	718	72			790	434
7	2026			280	4	74			358	741	74			815	457
8	2027			280	4	76			360	763	76			839	479
9	2028			299	4	79			381	785	79			864	483
10	2029			299	4	81			383	808	81			889	505
11	2030			299	4	83			386	830	83			913	527
12	2031			299	4	86			389	862	86			948	559
13	2032			299	4	89			392	893	89			982	590
14	2033			299	4	92			395	924	92			1,017	622
15	2034			299	4	96			398	955	96			1,051	653
16	2035			299	4	99			401	986	99			1,085	684
17	2036			307	4	102			412	1,017	102			1,119	707
18	2037			331	4	105			440	1,048	105			1,153	714
19	2038			331	4	108			443	1,079	108			1,187	744
20	2039			331	4	111			446	1,110	111			1,221	775
21	2040			331	4	114			449	1,140	114			1,255	806
22	2041			331	4	118			453	1,184	118			1,302	849
23	2042			331	4	123			457	1,227	123			1,349	892
24	2043			331	4	127			462	1,270	127			1,397	935
25	2044			331	4	131			466	1,312	131			1,444	978
26	2045			347	4	136			486	1,355	136			1,491	1,004
27	2046			394	4	140			537	1,398	140			1,537	1,000
28	2047			394	4	144			541	1,440	144			1,584	1,043
29	2048			394	4	148			546	1,482	148			1,631	1,085
30	2049			394	4	152			550	1,524	152			1,677	1,127

Source: JICA Survey Team

Reference 1: (Phase 1 + 2a) - New Company owns all assets (self-finance) and operates.

(VND billion)

FIRR		-7.0%														
Year		Cost							Revenue					Net Income		
		Investment	Replacement	O&M	Non-fare	Leasing	Repayment	Interest &	Total	Fare	Non-fare	Soft Loan	Capital Injection		Total	
-7	2012	1,246							1,246						0	-1,246
-6	2013	1,119							1,119						0	-1,119
-5	2014	2,739							2,739						0	-2,739
-4	2015	8,533							8,533						0	-8,533
-3	2016	18,093							18,093						0	-18,093
-2	2017	21,075							21,075						0	-21,075
-1	2018	13,594							13,594						0	-13,594
0	2019	5,150							5,150						0	-5,150
1	2020	0		386	4	0			389	604	6				610	221
2	2021	0		386	19	0			404	627	31				658	254
3	2022	0		604	27	0			631	650	45				695	64
4	2023	0		604	40	0			644	673	67				740	96
5	2024	0		604	42	0			645	695	70				765	120
6	2025	0		604	43	0			647	718	72				790	143
7	2026	0		604	44	0			648	741	74				815	167
8	2027	2,416		604	46	0			3,065	763	76				839	-2,226
9	2028	0		623	47	0			670	785	79				864	194
10	2029	0		623	48	0			671	808	81				889	218
11	2030	0		623	50	0			672	830	83				913	241
12	2031	0		623	52	0			674	862	86				948	273
13	2032	0		623	54	0			676	893	89				982	306
14	2033	0		623	55	0			678	924	92				1,017	339
15	2034	0	3,425	623	57	0			4,105	955	96				1,051	-3,054
16	2035	0		623	59	0			682	986	99				1,085	403
17	2036	4,142		630	61	0			4,833	1,017	102				1,119	-3,714
18	2037	0		655	63	0			718	1,048	105				1,153	435
19	2038	0		655	65	0			720	1,079	108				1,187	468
20	2039	0		655	67	0			721	1,110	111				1,221	499
21	2040	0		655	68	0			723	1,140	114				1,255	531
22	2041	0		655	71	0			726	1,184	118				1,302	576
23	2042	0		655	74	0			728	1,227	123				1,349	621
24	2043	0		655	76	0			731	1,270	127				1,397	666
25	2044	0		655	79	0			734	1,312	131				1,444	710
26	2045	6,911		671	81	0			7,663	1,355	136				1,491	-6,172
27	2046	0		717	84	0			801	1,398	140				1,537	736
28	2047	0	3,425	717	86	0			4,228	1,440	144				1,584	-2,644
29	2048	0	0	717	89	0			806	1,482	148				1,631	824
30	2049	-8,682	-2,935	717	91	0			-10,808	1,524	152				1,677	12,485

Source: JICA Survey Team

Reference 2: (Phase 1 + 2a) - New Company owns E&M and EMU (with Soft Loan) and operates.

(VND billion)

FIRR		7.5%		Cost						Revenue					Net Income
Year		Investment	Replacement	O&M	Non-fare	Leasing	Repayment	Interest &	Total	Fare	Non-fare	Soft Loan	VG Subsidy	Total	
-7	2012													0	0
-6	2013													0	0
-5	2014													0	0
-4	2015													0	0
-3	2016	2,632							2,632			2,264	368	2,632	0
-2	2017	5,904						18	5,922			5,080	829	5,908	-14
-1	2018	6,030						23	6,053			5,198	847	6,044	-9
0	2019	4,638						28	4,666			4,014	648	4,662	-4
1	2020			175	4	15		31	226	604	6			610	385
2	2021			175	19	16		31	241	627	31			658	417
3	2022			393	27	16		31	468	650	45			695	227
4	2023			393	40	17		31	482	673	67			740	258
5	2024			393	42	17		31	484	695	70			765	281
6	2025			393	43	18		31	486	718	72			790	304
7	2026			393	44	19	523	31	1,011	741	74			815	-196
8	2027	2,416		393	46	19	523	30	3,428	763	76	2,416		3,255	-172
9	2028			412	47	20	523	29	1,032	785	79			864	-168
10	2029			412	48	20	523	28	1,033	808	81			889	-144
11	2030			412	50	21	523	27	1,033	830	83			913	-120
12	2031			412	52	22	523	26	1,035	862	86			948	-87
13	2032			412	54	22	523	25	1,037	893	89			982	-54
14	2033			412	55	23	523	24	1,038	924	92			1,017	-22
15	2034		3,425	412	57	24	523	23	4,464	955	96			1,051	-3,414
16	2035			412	59	25	523	22	1,041	986	99			1,085	44
17	2036	4,142		420	61	25	523	21	5,192	1,017	102	4,142		5,261	68
18	2037			445	63	26	523	20	1,077	1,048	105			1,153	76
19	2038			445	65	27	523	19	1,078	1,079	108			1,187	109
20	2039			445	67	28	523	18	1,080	1,110	111			1,221	141
21	2040			445	68	29	523	17	1,081	1,140	114			1,255	173
22	2041			445	71	30	523	16	1,084	1,184	118			1,302	218
23	2042			445	74	31	523	15	1,087	1,227	123			1,349	263
24	2043			445	76	32	523	14	1,089	1,270	127			1,397	307
25	2044			445	79	33	523	13	1,092	1,312	131			1,444	352
26	2045	6,911		460	81	34	523	12	8,021	1,355	136	6,911		8,402	380
27	2046			507	84	35	523	10	1,160	1,398	140			1,537	378
28	2047		3,425	507	86	36	523	9	4,587	1,440	144			1,584	-3,003
29	2048			507	89	37	523	8	1,165	1,482	148			1,631	466
30	2049			507	91	38	523	7	1,167	1,524	152			1,677	510

Source: JICA Survey Team

Annex 11 Data used to compute: Economic and Financial Analysis of Phase 1 + 2a + 2b

Annex 11 Data used to compute: Economic and Financial Analysis of Phase 1 + 2a + 2b

1. Passenger OD Table between Stations
2. Economic Analysis
3. Financial Analysis

1. Passenger OD Table between Stations

Table 11-1 Year 2020 (trips/day)

	Yen Vien	Cau Duong	Duc Giang	Gia Lam	Long Bien Bac	Long blen Nam	Ha Noi	Cong Vien ThongNhat	Bac Mai	Phuon g Liet	Giap Bat	Hoang Liet	Van Dien	Vinh Quynh	Ngoc Hoi	Total
Yen Vien	0	805	823	2,841	35	8,564	12,380	2,638	1,538	803	4,662	407	566	839	1,058	37,959
Cau Duong	693	0	2,988	1,546	28	10,676	12,749	3,931	652	342	848	232	1,000	1,408	498	37,591
Duc Giang	757	2,843	0	666	103	2,561	2,201	1,055	192	99	231	41	83	98	82	11,012
Gia Lam	2,145	1,699	710	0	16	14,863	16,641	7,374	1,253	667	1,541	602	937	1,331	787	50,566
Long Bien Bac	39	32	72	17	0	744	1,965	878	114	62	146	42	122	159	120	4,512
Long blen Nam	7,675	9,184	2,430	9,056	788	0	2,187	1,385	839	452	1,271	1,665	1,838	2,593	12,358	53,721
Ha Noi	12,680	12,085	2,973	16,031	2,048	1,990	0	1,312	1,276	688	333	1,693	1,110	1,599	2,268	58,086
Cong Vien ThongNhat	1,914	3,022	546	4,932	636	820	1,057	0	438	204	1,049	5,900	2,796	3,694	6,210	33,218
Bac Mai	613	525	100	747	95	556	1,079	623	0	33	178	808	46	863	1,304	7,570
Phuong Liet	325	278	54	400	54	335	618	318	35	0	95	470	25	494	704	4,205
Giap Bat	4,756	833	211	1,373	145	1,261	371	1,602	238	110	0	697	311	465	8,250	20,623
Hoang Liet	366	230	33	611	68	1,563	1,713	5,803	825	488	558	0	46	57	352	12,713
Van Dien	811	1,142	60	1,172	166	1,870	1,286	3,442	788	22	379	55	0	13	24	11,230
Vinh Quynh	1,203	1,640	78	1,702	230	2,661	1,849	4,647	1,068	32	568	70	13	0	37	15,798
Ngoc Hoi	139	621	85	1,173	395	5,258	1,107	6,858	3,392	1,793	9,851	674	9	14	0	31,369
Total	34,116	34,939	11,163	42,267	4,807	53,722	57,203	41,866	12,648	5,795	21,710	13,356	8,902	13,627	34,052	390,173

Source : HAIMUD

Table 11-2 Year 2030 (trips/day)

	Yen Vien	Cau Duong	Duc Giang	Gia Lam	Long Bien Bac	Long blen Nam	Ha Noi	Cong Vien ThongNhat	Bac Mai	Phuon g Liet	Giap Bat	Hoang Liet	Van Dien	Vinh Quynh	Ngoc Hoi	Total
Yen Vien	0	1,122	1,147	3,960	49	11,936	17,254	3,676	2,143	1,119	6,497	567	789	1,169	1,475	52,903
Cau Duong	966	0	4,164	2,155	39	14,879	17,768	5,478	909	477	1,182	323	1,394	1,962	694	52,390
Duc Giang	1,055	3,962	0	928	144	3,569	3,068	1,470	267	138	322	57	116	137	114	15,347
Gia Lam	2,989	2,368	990	0	23	20,715	23,193	10,277	1,747	930	2,148	839	1,306	1,855	1,097	70,477
Long Bien Bac	54	44	101	24	0	1,036	2,739	1,224	159	86	204	58	170	221	167	6,287
Long blen Nam	10,697	12,799	3,386	12,622	1,098	0	3,047	1,930	1,169	630	1,771	2,321	2,562	3,613	17,224	74,869
Ha Noi	17,672	16,842	4,143	22,342	2,854	2,773	0	1,829	1,778	958	464	2,359	1,547	2,229	3,160	80,950
Cong Vien ThongNhat	2,668	4,211	761	6,874	887	1,142	1,474	0	611	285	1,462	8,223	3,896	5,148	8,655	46,297
Bac Mai	854	732	140	1,041	132	776	1,504	868	0	45	248	1,126	64	1,202	1,818	10,550
Phuong Liet	453	387	75	557	75	466	861	444	48	0	132	655	35	688	981	5,857
Giap Bat	6,628	1,161	294	1,914	202	1,758	516	2,232	332	153	0	971	433	648	11,498	28,740
Hoang Liet	510	321	46	852	94	2,178	2,387	8,088	1,150	680	778	0	64	79	491	17,718
Van Dien	1,130	1,592	84	1,633	231	2,606	1,792	4,797	1,098	31	528	77	0	18	33	15,650
Vinh Quynh	1,677	2,286	109	2,372	321	3,709	2,577	6,476	1,488	45	792	98	18	0	52	22,020
Ngoc Hoi	194	865	118	1,635	550	7,327	1,543	9,557	4,728	2,499	13,729	939	13	20	0	43,717
Total	47,547	48,692	15,558	58,909	6,699	74,870	79,723	58,346	17,627	8,076	30,257	18,613	12,407	18,989	47,459	543,772

Source: JKT

2. Economic Analysis

The same preconditions and calculation manners used for Phase1+2a are applied also for Phase 1 + 2a + 2b.

2.1 Economic Benefits

The same type of benefits selected for Phase1+2a are also applied for Phase 1 +2a + 2b: 1) Saving of Time Travel Cost (TTC), (2) Saving of Vehicle Operation Cost (VOC) and 3) Reduction of CO² Emission

1) Saving of TTC

The tables presented below are the data used for compute the saving of TTC. The GDP/capita per hour is the same as applied for Phase 1 + 2a (see Table 2.4.8.2-4 of Chapter 2.4.8.2).

Table 11-3 Saving of Travel Time

Unit	Particulars	2020	2030	2040	2049
Hours/day (thousand)	Motorbike	126.5	167.1	224.6	304.4
	Passenger Car	75.7	152.9	273.2	455.0
	Bus	75.5	128.0	215.1	340.0
	Total	277.7	448.0	712.9	1,099.4
Hours/year (thousand)		101,343.9	163,515.2	260,237.8	416,962.5

Source: Demand Projection of JICA Survey Team

Table 11-4 Saving of TTC

Items	Unit	2020	2030	2040	2049
Working Trip	%	Assumed to be 50 ^(note)			
Saving of TTC	VND billion/year	1,424	3,107	6,376	11,838

Note: The same assumption used in “Feasibility Survey on Hanoi Elevated Railway Project, Ngoc Hoi – Yen Vien, 2005, JETRO” is applied.

Source: JICA Survey Team

2) Saving of VOC

The tables presented below are the data used for compute the saving of VOC. The vehicle operation cost is the same as applied for Phase 1 + 2a (see Table 2.4.8.2-7 of Chapter 2.4.8.2).

Table 11-5 Travel Distance

Unit	Particulars	2020	2030	2040	2049
Vehicles/day (thousand)	Motorbike	181.6	216.7	262.5	317.0
	Passenger Car	40.7	75.1	124.2	187.9
	Bus	2.0	3.2	5.0	7.2
Average Travel Distance (km/day)		8.83			
Vehicle-km/year (million)	Motorbike	585.3	698.4	845.9	1,021.7
	Passenger Car	131.4	242.1	400.2	605.7
	Bus	6.6	10.5	16.0	23.2

Source: JICA Survey Team

Table 11-6 Saving of VOC (VND billion)

Vehicles	2020	2030	2040	2049
Motorbike	644	768	930	1,124
Passenger Car	1,419	2,615	4,323	6,541
Bus	74	118	181	262
Total	2,137	3,501	5,434	7,927

Source: JICA Survey Team

3) Reduction Value of CO² Emission

The table presented below is the data used for compute the reduction.

Table 11-7 Reduction Value of CO₂ Emission

Items	Unit	2020	2030	2040	2049
Reduction of CO ² Emission ¹⁾	Ton/year	21,959	38,831	74,482	122,542
CER price ²⁾	EURO/ton	4			
	VND/ton	107,840			
Reduction Value	VND billion	2.4	4.2	8.0	13.2

Source: 1) CO² Emission – JICA Survey Team and. 2) CER - Web of Point Carbon, secondary CER OTC future price of Dec. 2012 as of end 2011

2.2 Economic Project Cost

The tables presented below are the data used for compute the economic cost.

1) Initial and Additional Investment Cost

Table 11-8 Initial Investment Cost

Year	2012	2013	2014	2015	2016	2017	2018	2019	Total
VND billion	1,433	1,186	2,471	7,549	18,119	22,159	15,019	6,682	74,618

Source: JICA Survey Team

Table 11-9 Additional Investment Cost after starting operation

Unit	2024	2034	Total
No. of EMU	56	32	88
VND billion	4,280	2,446	6,726

Source: JICA Survey Team

2) Replacement Cost

Table 11-10 Replacement Cost of E&M

Year	2034	2048
VND billion	3,620	3,620

Source: JICA Survey Team

3) O&M Cost

Table 11-11 Personnel Cost

Items	Particulars	2020	2035
No. of Staff ¹⁾	Directorate	2	2
	Managing Unit	148	148
	Operating Unit	454	494
	Depot & Workshop	171	171
	Total	775	815
Monthly Salary ²⁾	Directorate	Same as Phase 1+2a	
	Managing Unit		
	Operating Unit		
	Depot & Workshop		
Personnel Cost	VND billion	99.1	104.4

Source: 1) Elaborated by JICA Survey Team based on the operation planning and F/S Report of TRICC. 2) Elaborated by JICA Survey Team based on "SAPI for Establishment of an Organization for the Operation and Maintenance of Metropolitan Railway Line in Hanoi City, November 2011, JICA"

Table 11-12 Power Cost

Year	2020-24	2025-34	2035-49
VND billion	95.5	120.5	128.1

Source: JICA Survey Team

Table 11-13 Repair and Maintenance Cost

Assumptions	E&M ^(note 1)	1.0% ^(note 2) of procurement cost from the 3 rd year of operation		
	EMU ^(note 1)	1.5% ^(note 2) of procurement cost from the 3 rd year of operation		
	Other Assets	0.5% ^(note 2) of initial investment cost excluding E&M and EMU		
Year	2020-21	2022-24	2024-2033	2034-49
VND billion	204	442	500	534

Note: 1) 2-years' spare parts of E&M and EMU are included in the initial procurement cost. 2) The same figures that were used in JICA SAPI survey are applied.

Source: JICA Survey Team

Table 11-14 Other Miscellaneous Cost

Assumptions ^(note)	30% of (Personnel + Power + Repair & Maintenance) Cost			
Year	2020	2030	2040	2049
VND billion	114	211	223	223

Note: The same figures that were used in JICA SAPI survey are applied.

Source: JICA Survey Team

2.3 EIRR: Phase 1 + 2a + 2b

The EIRR is figured out from the above economic benefits and costs (see Table 11-15).

Table 11-15 EIRR : Phase 1 + 2a + 2b

(VND billion)

EIRR		6.1%		Project Cost				Benefit			Net Benefit
Year		Investment	Replacement	O&M	Total	Saving of TTC	Saving of VOC	Reduction of CO ₂	Total		
-7	2012	1,433			1,433				0	-1,433	
-6	2013	1,186			1,186				0	-1,186	
-5	2014	2,471			2,471				0	-2,471	
-4	2015	7,549			7,549				0	-7,549	
-3	2016	18,119			18,119				0	-18,119	
-2	2017	22,159			22,159				0	-22,159	
-1	2018	15,019			15,019				0	-15,019	
0	2019	6,682			6,682				0	-6,682	
1	2020	0		482	482	1,424	2,137	2	3,583	3,071	
2	2021	0		482	482	1,554	2,273	3	3,830	3,338	
3	2022	0		802	802	1,695	2,410	3	4,108	3,306	
4	2023	0		802	802	1,842	2,546	3	4,381	3,580	
5	2024	4,280		878	5,158	2,000	2,682	4	4,686	-472	
6	2025	0		907	907	2,185	2,819	3	4,987	4,079	
7	2026	0		907	907	2,336	2,955	3	5,284	4,387	
8	2027	0		907	907	2,513	3,082	3	5,608	4,701	
9	2028	0		914	914	2,704	3,228	4	5,936	5,022	
10	2029	0		914	914	2,902	3,364	4	6,270	5,357	
11	2030	0		914	914	3,107	3,501	4	6,612	5,688	
12	2031	0		914	914	3,377	3,684	5	7,076	6,162	
13	2032	0		914	914	3,657	3,887	5	7,550	6,638	
14	2033	0		914	914	3,947	4,081	5	8,033	7,119	
15	2034	2,446	3,620	957	7,023	4,256	4,274	6	8,536	1,514	
16	2035	0		988	988	4,566	4,467	6	9,039	8,073	
17	2036	0		988	988	4,896	4,661	6	9,563	8,588	
18	2037	0		988	988	5,249	4,854	7	10,110	9,144	
19	2038	0		988	988	5,613	5,047	7	10,668	9,702	
20	2039	0		988	988	5,989	5,241	8	11,237	10,271	
21	2040	0		988	988	6,376	5,434	8	11,818	10,852	
22	2041	0		988	988	6,768	5,711	9	12,618	11,652	
23	2042	0		988	988	7,165	5,988	9	13,433	12,467	
24	2043	0		988	988	7,567	6,265	10	14,279	13,313	
25	2044	0		988	988	7,974	6,542	10	15,142	14,177	
26	2045	0		988	988	8,386	6,819	11	16,023	15,057	
27	2046	0		988	988	8,803	7,086	11	16,921	15,955	
28	2047	0		988	988	9,225	7,373	12	17,855	16,889	
29	2048	0	3,620	988	4,585	11,144	7,650	13	18,807	14,222	
30	2049	-1,936	-3,381	988	-4,332	11,838	7,927	13	19,779	24,110	

Source: JICA Survey Team

3. Financial Analysis

The same preconditions and calculation manners used for Phase1+2a are applied also for Phase 1 + 2a + 2b.

3.1 Revenue

The tables presented below are the data used for compute the revenue.

Table 11-16 Passengers and Revenues

Items	Unit	2020	2030	2040	2049	
Passengers	Per day	390,000	544,000	758,000	1,026,000	
Revenue	Fair	VDN billion/year	1,015	1,394	1,916	2,560
	Non-fare	VDN billion/year	10	139	192	256
	Total		1,394	2,108	2,816	

Source: JICA Survey Team

3.2 Financial Project Cost

The tables presented below are the data used for compute the financial cost.

1) Initial and Additional Investment Cos

Table 11-17 Initial Investment Cost

Year	2012	2013	2014	2015	2016	2017	2018	2019	Total
VND billion	1,602	1,354	2,859	8,819	21,236	25,836	17,463	7,614	86,782

Source: JICA Survey Team

Table 11-18 Additional Investment Cost after starting operation

Unit	2024	2034	Total
No. of EMU	56	32	88
VDN billion	4,326	2,472	6,726

Source: JICA Survey Team

2) Replacement Cost and O&M Cost

These costs are also estimated with the same preconditions and manners used for Phase 1 + 2a.

3.3 FIRR : Phase 1 + 2a + 2b

The FIRR is figured out from the above revenues and costs (see Table 11-19).