RAILWAY PROJECTS MANAGEMENT UNIT (RPMU)
VIETNAM RAILWAYS (VNR)
VIETNAM

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STUDY ON THE VALIDITY OF BASIC DESIGN FOR HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT LINE 1

FINAL REPORT

JANUARY 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

TONICHI ENGINEERING CONSULTANTS, INC.

RAILWAY PROJECTS MANAGEMENT UNIT (RPMU)
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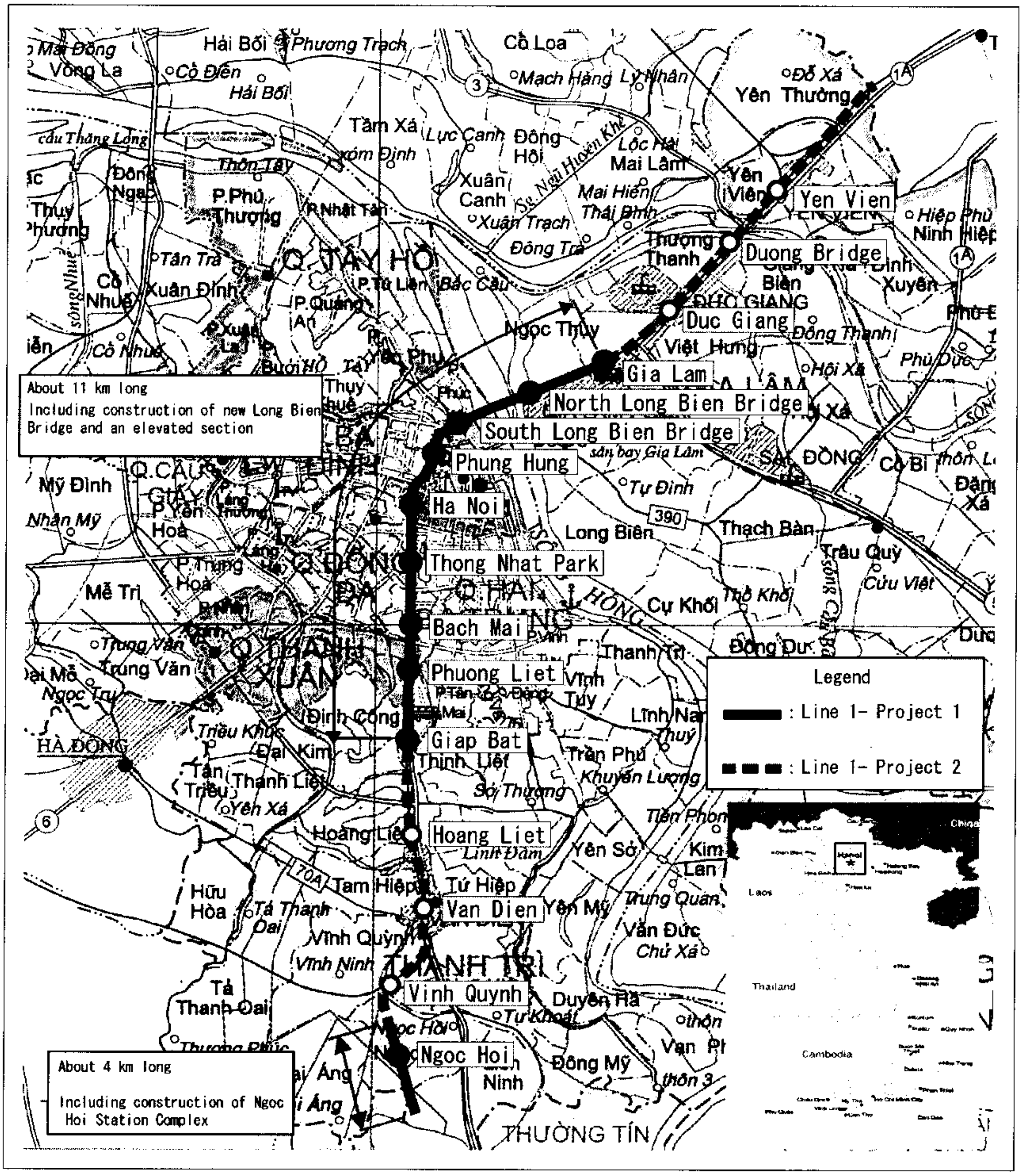

LOCATION MAP

Abbreviation

<Concerned Vietnamese Agencies>

HAPI	: Hanoi Authority of Planning and Investment
HPC	: Hanoi People's Committee
HRB	: Hanoi Railway Board
HUTDPMU	: Hanoi Urban Transport Development Project Management Unit
MOC	: Ministry of Construction
MOCPT	: Management and Operation Center for Public Transportation
MOT	: Ministry of Transport
MPI	: Ministry of Planning and Investment
NGO	: Non Government Organization
PMU	: Project Management Unit
RPMU	: Railway Project Management Unit
TEDI	: Transport Engineering Design Institute
TUPWS	: Hanoi Transport and Urban Public Works Service
VNR	: Vietnam National Railway

<International Agencies>

ADB	: Asian Development Bank
JBIC	: Japan Bank for International Cooperation
JICA	: Japan International Cooperation Agency
UNDP	: United Nations Development Program
WHO	: World health Organization

<Technical words and Others>

ABS	: Automatic Block Signaling System
ATP	: Automatic Train Protection System
BOT	: Built-Operation-Transfer
BRT	: Bus Rapid Transit System
CCTV	: Closed Circuit Television System
CFC	: Centralized Facility Control System
CMS	: Centralized Signaling Monitoring System
CSC	: Centralized Substation Control System
CTC	: Centralized Traffic Control System
EMU	: Electrical Multiple Unit

EIA : Environmental Impact Assessment
FDI : Foreign Direct Investment
F/S : Feasibility Study
GDP : Gross Domestic Product
GIS : Generalized Information System
HCMC : Ho Chi Minh City
IT : International Train
ILK : Interlocking System
JKT : JKT Association (Basic Design Contractor)
M-gauge : Meter gauge
M/P : Master Plan
NH : National Highway
NT : National Train
OCC : Operation Control System
ODA : Official Development Assistance
PIS : Passenger Information System
PRC : Programmed Route Control System
RRD : Red River Delta
TDS : Train Detection System
TID : Train Information Display System
UT : Urban Train
VND : Vietnam Dong

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Chapter 1: BACKGROUND OF THE STUDY

1.1 Introduction (Key Points of this Study)

This study is implemented following completion of the basic design of the Hanoi City Urban Railway Construction Project Line 1 (Hereinafter referred as to HURCP Line 1) yen loan project that is currently being developed in Vietnam. The implementation is based on the stipulation which is obligatory under Vietnamese law that "revalidation study on basic design of infrastructure project shall be carried out by a third party."

Because it was determined that it would be difficult to carry out a third party evaluation by local consultants concerning the parts relating to "urban railway system E&M such as rolling stock, train operation control facilities, and electricity power system", the Railway Project Management Unit (RPMU), under supervision of Vietnam National Railways, requested support from JICA regarding this revalidation study. This request was accepted by JICA, who dispatched a study team for the implementation of the project.

1.2 Study Objectives and Background

1.2.1 Circumstances leading to the Construction of the Hanoi Urban Area Transport Infrastructure

Following the end of the Vietnam War, the Doi Moi Policy was begun in the 1980s. In recent years the Vietnamese economy and society have been enjoying a long period of growth. During this time, although the increases in both population and GDP have been remarkable throughout the country, the concentration of wealth and population in urban areas is becoming noticeable.

Accordingly, in addition to being the administrative center of Vietnam, Hanoi urban area is becoming the center of economic activities. The concentration of economic activities and increase in population has been so rapid that the urban infrastructure has been unable to keep pace, which results in various serious problem including the aggravation of road congestion and worsening of living environment that are liable to hinder part of Vietnam's economic activities.

Although the main transportation method in the Hanoi urban area is road traffic, the principal part of this traffic overwhelmingly consists of individual transport (motorbikes). While motorbikes play a large part in the degree of traffic congestion, because the amounts they transport are small and their speed is also slow, they restrict the speeds of automobiles, which comprise the other transportation method. As a result, the transportation capacity of the roads is being reduced.

In recent years, the emission of exhaust gases by road traffic has been cited as a source of environmental pollution. Hence, there are increasing demand to review road transportation. In this situation, because urban railways are large-scale, safe, and low-polluting, they are in accord with the economic and social development of Vietnam, and there has become a clamor over their necessity.

The Hanoi urban area has been unable to keep pace with the economic and social developments, and has currently fallen into a state of infrastructure development insufficiency. As one solution for the current urban transportation problem, it was decided to construct HURCP Line 1 as an urban railway network development using the Special Terms for Economic Partnership (STEP).

For the services relating to the study and design required for this project, an Exchange of Notes (E/N) was signed between Japan and Vietnam in the year 2007, and in September 2009 a technical consulting agreement for the Phase I section was concluded between the Railway Project Management Unit (RPMU), under supervision of Vietnam National Railways, and the basic design contractor (JKT Association).

Based on this agreement, the basic design contractor (JKT) developed the basic design, which was completed in June 2010. Following this, a revalidation study of the contents of this basic design was required to be carried out according to the regulations in Vietnam. However, concerning the revalidation of the basic design of the electric systems and rolling stock, which are fields that Vietnam lacks experience in, it was judged to be difficult to employ a Vietnamese consultant. Therefore, a request for assistance was made by the Vietnamese side to JICA. In response, JICA commissioned this study team to carry out the study.

1.2.2 Development of a Large-scale Transportation System in Hanoi City

In July 2008, the "Master Plan of Urban Transportation for the Hanoi Urban Area" was formulated, in which it was agreed to introduce five urban railway lines and two bus rapid transit systems (BRT) by 2020. Hanoi is the Vietnamese capital city and the center of Vietnam's northern economic area. This large-scale transportation traffic system plan is to be introduced with the objective of alleviating the transportation congestion and atmospheric pollution inside Hanoi City. The following describes an overview of the system.

(1) Line 1

There are four routes in the Hanoi urban area that are predicted to have the greatest demand

(consisting of □ Ngoc Hoi to Yen Vien and Nhu Quynh, □ Ha Dong to Noi Bai, □ Nhon and Hoa Lac to Hai Ba Trung & Ba Dinh, and □ Tu Liem to Co Bi & Noi Bai; traffic volume: 500,000-900,000 persons/day). HURCP Line 1 is the □ Ngoc Hoi to Yen Vien and Nhu Quynh route . Because this route is expected to see the most rapid increase, it was the decided that this route should be implemented first.

The total length of the route is 28.68km, and it will have 16 stations. It is planned that the construction will be separated into two phases, Phase I and Phase II (consisting of the section between Giap Bat and the Ngoc Hoi Depot).

(2) Line 2

Hanoi City Line 2 is the urban railway planned from the Noi Bai International Airport in the northern part of Hanoi City to Ha Dong located in the south-western part of the city (41.5 kilometers). The highest priority section between Nam Thanh Long and Tran Hung Dao (17.2km) with 15 stations is to be constructed as the Phase I construction section.

Also concerning this plan, the SAPROF was completed by JICA in November 2007, and an Exchange of Notes (E/N) was signed between Japan and Vietnam in 2008. Currently, according to the result of the bidding relating to the technical consulting agreement, negotiations over the agreement are being carried out between the candidate design contractor and the Hanoi Railway Board (HRB), which comes under the umbrella of the Hanoi People's Committee.

(3) Line 3

Hanoi Line 3 has seen the completion of a signing agreement relating to the provision of a loan by France. It has a total length of 21km, and the design has also been completed. The highest priority Phase I construction is between Nhon and Hanoi, while the section from Hanoi to Hoang Mai is the Phase II construction. The design has been completed, and it was also reputed that construction was to begin very soon. However, according to the most recent news the project has been suspended due to financial difficulties in France.

(4) Line 4

Hanoi Line 4 is a project in which the Ministry of Transport (MOT) forms the main core that has been formulated as the route plan for a loop line encircling Hanoi City. It has a total length of 53.1km, and although currently ring roads are in the process of being developed in Hanoi, there is a plan to introduce Line 4 to make use of a gap in the ring road Line 2. According to Hanoi City, a BRT will be operated utilizing an exclusive bus lane, and matching the increase in demand the plan to introduce railway urban transportation will become effective.

(5) Line 5

Hanoi Line 5 is being implemented as a plan to introduce a track-type system in which the Ministry of Transport (MOT) forms the main core with support from the ADB. The candidate route is from Ho Tay South (south coast of West Lake) to Hoa Lac, with a total length of 34.5km.

(6) BRT Introduction Plan

Two routes are being planned for the Bus Rapid Transport System (BRT). The BRT-1 Line is planned to take a route that is almost parallel with Hanoi Line 2 described above, while in the same way the route planned for the BRT-2 Line is almost parallel with Hanoi Line 1.

Not only will the BRT secure the use of an exclusive bus lane so that it will operate separately from other automobiles, but it will also be a large-scale transportation organization with similar kinds of systems to track-type urban transport, including stations and terminals, signal controlling systems, and automatic ticket gates.

It is planned to prioritize the BRT-1 Line, and then to introduce the BRT-2 Line after verifying the BRT-1 Line operation.

1.2.3 Objective for implementing the Feasibility Study of Hanoi Urban Transportation Line 1

As described above, the basic design was completed in June 2010 by the design consultant (design contractor) involved with this project. Although it is necessary in Vietnam to have a revalidation study carried out by a third party, it was judged to be difficult for this to be implemented by a local consultant in Vietnam, which has no experience in the operation management of urban railways.

Due to this kind of situation on the Vietnamese side, a request for assistance was received by JICA from the RPMU. JICA then selected a Japanese consultant with experience in evaluating basic designs for urban railways, resulting in the implementation of this study.

Accordingly, the objective of implementing this study is to technically evaluate the basic design implemented by the design contractor (JKT) to verify its validation.

Chapter 2: STUDY METHODOLOGY

2.1 Overview of the Study

The main items of this study, including the study name, the parties placing and accepting the order, the study period, and the study conditions are as shown in Table 2-1.

Table 2-1: Overview of the Study

Item	Name and Details
Study Name	Revalidation of basic design for Hanoi City Urban Railway Construction Project Line 1
Order Placer	Japan International Cooperation Agency
Order Receiver	Tonichi Engineering Consultants, Inc.
Agreement Period	November 11, 2010 to February 14, 2011
Scope of Study	Among the basic design items, revalidation studies were carried out on the electric systems and the rolling stock.
Study Method	The consultant dispatched a team of experts to Hanoi, where they conducted the study after collecting related information by borrowing documents, on-site investigations, and meetings with the design contractor.

2.2 Materials Collection

2.2.1 Borrowed Documentation

The materials that were borrowed from JKT when the study was started are as shown in Table 2-2.

Table 2-2: Borrowed Documentation

Title	Pages
Basic Design – 31 August 2010 Electrification	60
Basic Design – 31 August 2010 OCS System	54
Basic Design – 31 August 2010 PDS	30
Basic Design – 31 August 2010 Substation System	28
BASIC DESIGN FINAL REPORT 31 August 2010 General Condition on E – M	12
BASIC DESIGN FINAL REPORT 31 August 2010 OCC	69
BASIC DESIGN FINAL REPORT 31 August 2010 Signaling	112
BASIC DESIGN FINAL REPORT 31 August 2010 Telecommunication	51 + 7
Concept & Integration Design (J) Revisions	54
Electric Basic Design – Vol. 1 General Design	5
Initial Design Framework (201004)	54 + 22
Initial Design Framework (Addendum)	6

2.2.2 JKT Disclosed Documentation

The materials disclosed by JKT during the meetings in Hanoi are shown in Table 2-3.

Table 2-3: Disclosed Documentation

Doc. No.	Title	Pages
JKT/REP/0010/E	Feasibility Study Review Report	16+11+6
JKT/REP/0020/E	Report on Feasibility Study – Train Operation	20+24
JKT/REP/0117/E	Basic Design (EMU) Report	32
JKT/REP/0122/E	Report for Survey Existing Electrical Power System at the Project Area	15
JKT/REP/0126/E	Transportation Integration Plan	25

2.3 Details of the Study Work

According to the JICA instructions, the details of the study work comprise each of the following items.

Table 2-4: Work Details

Work		Details
1	Preparation Work in Japan	Collection and analysis of related Documentation and Data Before going to Hanoi for field study, to acquire the basic design documentation and to gather related documentation and information to enhance the effectiveness of the study. Preparation of Inception Report These materials are used for acquiring approval by JICA regarding the methods of implementing the on-location study, and are also used for obtaining understanding, confirmation, and cooperation concerning the study when carrying out the field study in Vietnam.
2	Field Work in Vietnam	①Explanation and Discussion of the Inception Report Explanations and discussions will be carried out with the implementing agency, the government, and the design contractor to obtain their understanding, confirmation, and cooperation. ②Review of Project Overview Regarding the background, objectives, and circumstances of the study implementation, a review of the overview will be carried out. ③Technical Evaluation of the Design A technical evaluation will be carried out following the evaluation scheme indicated by the authority on three components of the basic design including system design, concept design, and integration design. ④Viewpoints relating to the Design Evaluation * The basic design must be in accordance with the related specifications, standards, and design request items that were agreed to by the Vietnamese side. * In the situation where the design contractor has carried out the designing based on assumptions, these assumptions must be appropriate. ⑤Preparation, Explanation, and Discussion of the Draft Final Report The result of revalidation study will be summarized, and explanations and discussions are carried out with the implementing agency to gain their understanding.
3	Compilation Work	Production of the Final Report The comments of JICA and the other parties are incorporated into the Final Report, and the report is submitted.

2.4 Items Examined in the Revalidation Study

The key components of the study are the ① Review of Project Overview, etc., ② Technical Evaluation of the Design, and ③Points of View relating to the Design Evaluation shown in "2. Field work in Vietnam" of Table 2.4 in the previous section. Details of these examinations are given below.

2.4.1 Design Technical Evaluation

The railway system technical standards that have been determined at each stage of the basic design are evaluated. The scope to be carried out by this study team is described in the scope of study in section 2.3, consisting of the components in the table below.

Table 2-5: Scope of Technical Evaluation

Item	Details
Electric System	Electrification Planning Power Substation System Overhead Catenary System Power Distribution System Signaling System SCADA (Supervisory Control and Data Acquisition) Telecommunication System Train Operation System
Rolling Stock (Electric)	

2.4.2 Viewpoints and Evaluation System used for the Design Evaluation

The design evaluation is to assure that the basic design is in accordance with the specifications and standards, together with the design requirements agreed by Vietnamese side from viewpoints of operation. These viewpoints are shown in Table 2.6.

Table 2-6: Viewpoints for the Design Evaluation

(Items Requirements for Each Function)

Requirements for the Functions
Requirements for the Performance
Requirements for Operations and Maintenance Management
Requirements for the Design
Requirements relating to the Compatibility with Other Systems
Requirements for the Safety
Requirements for the Environment

The evaluation from the viewpoints described above is implemented using the evaluation system specified by JICA. The flow is shown in the following table. This work is carried out in the field study period.

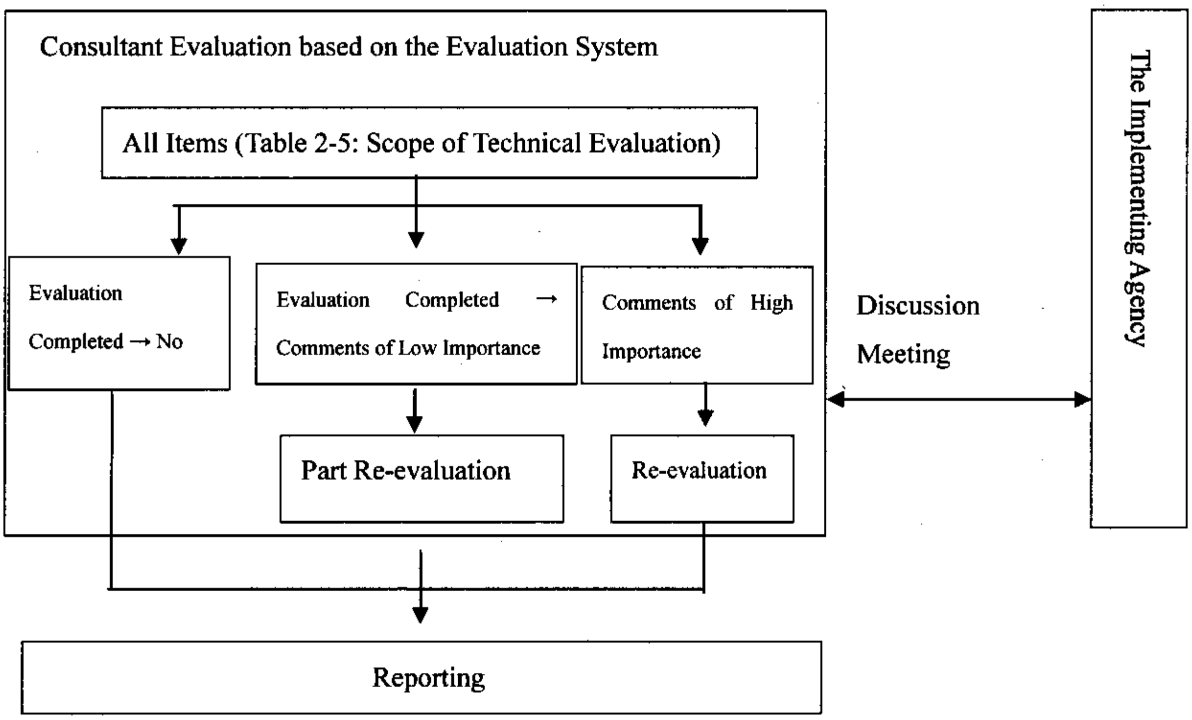


Figure 2-1: Flow of the Revalidation Study

2.5 Acquisition of Materials for the Study

The materials for the study were obtained by the methods described below, and were used either as subjects for revalidation study or as reference materials.

(1) Basic design documents during the preparation work in Japan borrowed from the authorities concerned. (Refer to 2.2.1)

(2) Examination documents and reports disclosed by the basic design contractor during the field study in Vietnam. (Refer to 2.2.2)

(3) Inception Report explanations and discussions implemented during the field study period, and questions and answers in questionnaire conducted between the study team with the implementing agency and the design contractor.

(4) Related information obtained through information exchanges with related technicians conducted during the field study period, and materials and data obtained through the field study

(5) Other related technical documents, articles on industrial reports and magazines, etc...

2.6 Results of the Study

The results of the study have been compiled as this Draft Final Report. (The study results are described in Chapters 3, 4, and 5.) Note that at the point of time when the study is completed, this will be edited into the Final Report.

2.7 Composition of the Study Team

Tonichi Engineering Consultants, Inc., who was commissioned to implement this study, formed a Revalidation Study Team from the specialists described in the following table.

Table 2-7: The Study Team

Assignments	Name
Team Leader/Railway System Design	Hisashi KOSHIMIZU (The first half) Hiroshi YAJIMA (The second half)
Electricity Power System Design Work Coordination /System Design Support(1)	Koji YAMANO (The first half) Koji YAMANO (The second half)
Signaling/Telecommunication Design	Masanori YAMAMOTO
Railway Rolling Stock Design	Tadashi TAKAOKA
Work Coordination /System Design Support(1)	Hiroshi YAJIMA (The first half)
Work Coordination /System Design Support(2)	Shinji KAKINAKA

2.8 Vietnamese Government-related Organizations related to this Project

The following are organizations which are related to the development of Hanoi urban railway system.

(1) Ministry of Transport (MOT)

This is the central government ministry for transportation administration throughout Vietnam, and in the Hanoi urban area it also carries out the formulation of traffic/transportation strategies, designing of public transport plans, and investigation of transportation infrastructure development. In addition, it also oversees the creation of the standards for transportation safety and various types of transportation infrastructure development, and formulates operation and maintenance management guidelines such as for public transportation.

(2) Vietnam National Railways (VNR)

The length of railways owned by Vietnam National Railways throughout Vietnam encompasses 2,600 kilometers, and the organization has more than 40,000 employees. Although VNR manages and operates the railways nationwide, the actual transportation business is managed by each of the companies consisting of the Hanoi Railway Passenger Transport Co., the Saigon Railway Passenger Transport Co., and the Railway Freight Transport Co., affiliated with VNR. However, the accounting of each of these companies is consolidated with VNR.

(3) Ministry of Construction (MOC)

MOC oversees the development planning for almost all of the infrastructure systems including transportation in the Hanoi urban area. Note that while MOC oversees the overall planning related to infrastructure, the detailed examinations below this are mostly implemented by the Hanoi Department of Transport (HDOT). In addition, in case of the transportation-related infrastructure, the facility examinations relating to public transportation comes under MOT's jurisdiction instead of MOC.

(4) Hanoi People's Committee (HPC)

Among the higher level plans determined by MOT and MOC, the HPC is the organization that implements developments regarding approved projects in the Hanoi urban area. In addition, the HPC's work also includes the construction and formulation of policies for public transportation networks including railways and buses, together with work relating to transportation infrastructure maintenance management.

(5) Railway Project Management Unit (RPMU)

This organization comes below the umbrella of VNR and implements railway maintenance management centered on the repair and construction of railways in Vietnam. It is also the operation implementing organization for this Hanoi Line 1 project.

(6) Hanoi Railway Board (HRB)

This organization comes below the umbrella of the HPC, and is in charge of project planning for Hanoi Line 2 and Hanoi Line 3 that are currently being developed.

(7) Others

In addition to the above organizations, there are several other organizations related to urban transportation development in the Hanoi City urban area. Among these, there are relationships with organizations consisting of the Hanoi Department of Transport (HDOT), the Hanoi Transport Management and Operation Center (TRAMOC), and the Hanoi Urban Transport Development Project Management Unit (HUTDPMU).

Chapter 3: REVIEW OF THE PROJECT

3.1 Current Situation

3.1.1 Hanoi Urban Area Development and the Necessity for a Mass Rapid Transit System

In addition to being Vietnam's administrative center, the Hanoi urban area has seen a concentration of economic activities and a rapid increase in population. The city's infrastructure has been unable to keep pace, creating conditions such as the aggravation of road congestion and worsening of living conditions that are liable to hinder part of Vietnam's economic activities. Although the characteristic transportation method in the Hanoi urban area is road traffic, the principal part of this traffic overwhelmingly consists of individual transport (motorbikes). While motorbikes play a large part in the degree of traffic congestion, because their transport capacity is small and their speed is also slow, they restrict the speeds of automobiles. As a result, the transportation capacity of the roads is being reduced significantly. In recent years, the emission of exhaust gases by road traffic has been cited as a source of environmental pollution. Hence, there are increasing demand to review road transportation. In this situation, because urban railways are large-scale, safe, and low-polluting, they are in accord with the economic and social development of Vietnam, and there has become a clamor over their necessity.

The following table shows major Asian cities and their urban railway networks. Both the Hanoi and Ho Chi Minh urban areas are clearly lagging behind the others. According to Table 3-1, major Asian cities maintain urban railways of between several tens to several hundreds of kilometers in length. These urban railways transport several millions of passengers every day, with individual citizen travelling 0.5-1.0km daily. Therefore, there is a deep relationship between the railways and peoples' lifestyles. On the other hand, Hanoi and Ho Chi Minh are not yet realizing these benefits.

Table 3-1: Main Asian Cities and their Urban Railways (Excluding national railways)

City Name	Population (*10^6)	Operated Kilometers (km)	Length in Kilometers per Million Persons
Hanoi	3.4	0 + VNR	0
Ho Chi Minh	7.2	0 + VNR	0
Tokyo Metropolitan Area Wards	8.8	366 + JR + PR	34.5 + x
Osaka	2.7	260 + JR + PR	48.1 + x
Beijing	17.4	228	13.1
Shanghai	19.2	425	22.1
Hong Kong	7.0	91	13
Bangkok City	Approximately 8	44 + TNR	5.5 + x
DKI Jakarta	9.6	+ INR	+ x

Note: Each of the statistical values are between 2006 and 2009, but are not all the same year. VNR:

Vietnam National Railways, JR: East Japan Railway Company, PR: Private railway companies, TNR: Thailand National Railways, INR Indonesian National Railways. +x: Shows the situation when it is certain that state railways and private railways other than subways and elevated railways are carrying out function of an urban mass rapid transit system.

3.1.2 Investment in the Railways

Investment in railways in Vietnam is lagging behind even among developing countries, having been restricted to the level of renewing the rolling stock. The investment in infrastructure has consisted mainly of maintenance and renewal. The bridge improvements carried out with Japanese assistance have also consisted of rebuilding existing bridges rather than making investments to enhance the transportation capacity. The 2700km nationwide railway network consists entirely of single track sections, and while construction was previously carried out on two lines in the north part of Vietnam, the operating length has hardly changed in recent years. In recognition of the necessity of railway development to economic and social development, studies for urban railway network in the Hanoi and Ho Chi Minh urban area has been implemented. Further, Vietnam high speed railway plan recently reached the stage of being discussed in the Vietnamese National Assembly. Among these trends towards increasing interest in railways, studies have been carried out on a number of urban transport railways in the Hanoi urban area. The HURCP Line 1 has reached the basic design stage.

3.2 Overview of Project Plan

3.2.1 Role that should be Played by the Urban Transportation Line 1 that is to be Introduced

According to the demand forecast in the VITRANSS Survey that was implemented by JICA, the demand between Yen Vien and Giap Bat is as described below. It is assumed that the entire line of Hanoi Line 1 will serve less than 300,000 passengers in 2020, and about 430,000 passengers in 2030.

Table 3-2: Projected Passenger Number (Units: Thousand passengers/day)

	2020 (Predicted Values)	2030 (Predicted Values)
HURCP Line 1 Line (28.7km)	282	430
Most Congested Section: Gia Lam to Hanoi	155	262

As a comparison, in 2010, the number of passengers per day on the Marunouchi Line in Tokyo was 1,094,000 persons, while the Nanboku Line served 446,000 passengers daily. Therefore, in 2030 the HURCP Line 1 will attain the role of an urban mass rapid transit line handling transportation demand approximating of Tokyo's Nanboku Line.

3.2.2 Overview of the Basic Specifications

(1) Length 28.68km

(2) Number of stations: 16 stations

Hanoi Line 1 will have 16 stations, and these consist of five Common Train Stations (CTS) for National Train and Urban Trains and 11 Urban Train Stations (UTS). While the CTS equips respective platforms for National Trains and Urban Trains, UTS equips only platform for Urban Trains.

1) Five CTS (NT and UT Stations)

The number of passengers using the five CS is presumed as shown in Table 3-3. Since the number of users of Tokyo's Marunouchi Line in 2010 was 279,358 persons at Ikebukuro Station and 67,591 persons at Ogikubo Station, it is presumed that the number of passengers at the HURCP Line 1 CTS in 2030 will be approximately the same level as the current situation at Ogikubo Station.

Table 3-3: Number of Passengers using the NT Stations

NT Station Name	2020			2030		
	UT	NT	Total	UT	NT	Total
Ngoc Hoi	34168	43	34211	47620	60	47680
Giap Bat	20384	43	20427	28409	60	28469
Hanoi	55881	1714	57595	77881	2389	80270
Gia Lam	50904	140	51044	70945	195	71140
Yen Vien	36875	140	37015	51393	195	51588

The CTS will serve both UT and NT train passengers. In the three-rail track sections, the passenger handling for the UT and NT trains will both be carried out using independent dedicated platforms (the gauge center differs from the rolling stock center due to different rolling stock clearance). Because the turnout will branch to the left side in the direction of travel, the UT platform will be on the inside and the NT platform will be on the outside. Accordingly, the NT will have separate platforms for the up line and down line on the outside. Although this is more convenient for passengers, it has the demerit of requiring the construction of respected dedicated platform for the three-rail track. Consequently, there will be an increase in the station facilities and equipment including tracks, catenaries, telecommunications and signaling equipment for these platforms.

2) UTS (UT Stations)

The number of passengers using the 11 UT S is presumed as shown in Table 3-4.

Table 3-4: Number of Passengers at the UT Stations

Station Name	2020	2030
Vinh Quynh	15884	22138
Van Dien	11289	15733
Hoang Liet	12789	17824
Phuong Liet	4164	5803
Bach Mai	7574	10556
Thong Nhat Park	33332	46455
Phung Hung	7412	10330
South Long Bien	51117	71242
North Long Bien	4645	6474
Duc Giang	10876	15158
Duong Bridge	37376	52091

Since NT trains will not stop at the 11 UTS exclusive for UT trains, unlike the design at the CTS there will be no platforms for the NT trains and the stations will basically have island-type platforms with simple shapes.

(3) Distance between stations

The characteristic of urban mass rapid railway is that they allow passengers to travel to their destination without having to use a secondary transportation system; the so-called "door-to-door" is one of the most recommended policies. As the scope of usage becomes wider, from walking range to bus range, taxi range, and railway range, the urban railway should be planned so that passengers can find a UT station within a range of around 500m to 1km. The HURCP Line 1 also follows this rule for stations near Hanoi Station.

Table 3-5: Distances between Stations

	Section	Distance (km) a	No. of Station Spacing b	Average Distance between Stations (km) c = a/b
Hanoi Line 1	Ngoc Hoi to Yen Vien	28.68	15	1.9
	Giap Bat to Gia Lam	10.4	8	1.3
Reference	Tokyo (Overall Average)	366	274	1.33
	Beijing (Overall Average)	228	126	1.81

In the comparison with the above reference, the average distance can be said to be almost the same as the average interval between subway stations in Tokyo and Beijing.

(4) Rolling Stock Depot and Freight Station (Ngoc Hoi)

1) Rolling Stock Depot (Electric trains, locomotives, passenger coaches, freight cars)

Table 3-6: Number of Vehicles handled by the Ngoc Hoi Rolling Stock Depot

Item		2020	2030
Urban Transportation Line			200 electric cars (8 cars* 25 train sets (21 operating sets + 2 standby sets + 2 shop-in sets)
National Train Line	Locomotives	Freight Locomotives: 158 Passenger Locomotives: 121 Total handling: 279 * 3/4 = 210	
	Passenger Cars	1000 of the 2707 cars shall be handled.	
	Freight cars inspection	65% of 6120 cars shall be handled (35% will be handled by Yen Vien).	

Note: Although the target year of car depot is set as 2030 for the UT line, it is 2020 for the existing national railway lines.

2) Freight Station

Ngoc Hoi Freight Station Specifications are as shown below.

i. Number of arriving and departing lines: 4 lines x 500m

ii. Function: For sorting by directions: 4 lines,

For sorting by destinations: 3 lines,

Unspecified: 1 line

iii. Loading and unloading lines: 2 lines

iv. Container lines: 2 lines (Container yard + cranes)

Currently, railway freight are being handled at 4 stations on outskirts of Hanoi city, in the future, they will be all handled in the Ngoc Hoi freight station.

(5) Design Speed: 120km/h

The design speed is set at 120km/h or more for curve radius of 1000m or greater. Note that the minimum curve radius in the section is 250m, and the running speed limit in this section is set at 60km/h.

(6) Maximum Operating Speed: 120km/h

Although the maximum operating speed is set at 120km/h, in order to make effective use of the maximum operating speed it is necessary to improve the acceleration of the rolling stock.

(7) Gauge: 1,435mm (Dual gauge three-rail track will be used in the section that is in common use with the national railway of 1000mm)

As described in the TOR by JICA, 1,435mm and 1,000mm gauge lines will be used jointly in the section that is commonly used by the UT trains, the NT trains, and the international trains (IT). Although this has the merit of allowing two types of trains to run on the same track, there are also demerits. The survey team has attained the understanding that the Implementing Agency and the design contractor had extensively reviewed the issues related the dual gauge system and that their decision for 1435mm gauge for UT had been finally made in conformance with the Vietnam Railway Law (enacted in 2005) on gauge of urban railway (Refer to Section 3.1.3 (1).)

Because considerations of the issues concerning the three-rail track were not found in the disclosed materials, the study team described the related characteristics and issues in Table 3-7.

Table 3-7: Three-rail Track Characteristics and Issues due to the Standard Gauge and M-gauge

Characteristics	Issues	Remarks
Different types of trains with differenct running performance can run on the same track	Because the block length is matched to the train with the lowest acceleration/ deceleration performance: i) The number of trains per hour will be reduced. ii) The detection of each train type will become more complicated. iii) The scheduled speeds will become slower. □) The signaling facilities will become complicated, and high	Because three types of trains, UT, NT, and IT, run on the three-rail track, there are variations in the train acceleration and deceleration. At the time of mixed operations of UT trains, which have good acceleration and deceleration, and the NT and IT trains which have poor acceleration and deceleration, the trains with poor acceleration and deceleration speeds will affect the other trains. As a result, the number of trains per hour will be restricted. (This is explained in more detail in the later chapter.)

	technical abilities will be required for maintenance and management.	
Special track maintenance work is required	The track maintenance work will become more difficult. The turnouts will be complicated, and high technical abilities will be required for maintenance.	Regarding the ballast bed part, the existence of the central rail becomes inconvenient when carrying out tamping works and the works will become complicated. (Although VNR already has this know-how, they previously conducted the work when the frequency of the international trains was very low. For HURCP Line 1, the frequency will be much higher than before, more troublesome and complicated maintenance technology, will be required.)
Special turnouts are required	The three-rail track turnouts require high technology	High-quality and durability is required. Due to the linkage with the signaling and communications, it is desirable that turnouts must be developed with extremely low rates of mistaken operation and signal failures.
Separate platforms are required for each direction	The scale of station facilities becomes larger.	Customer guidance will become easy. The numbers of platforms, amounts of rail tracks, catenaries, and various signal and communications facilities will increase.
Depot facilities must accommodate rolling stocks with different gauges	Facilities supporting rolling stocks with both gauges will become necessary, and the facilities and equipment will increase.	Even for the same function, it will be necessary to prepare facilities and equipment for the two different gauges, or complicated facilities and equipment that support the different gauges.

(8) Train sets: Should be flexibly supported, from minimum three-cars set to maximum eight-cars set.

(Note: Although the TOR stated that maximum 10-cars set were to be supported, it is confirmed in this study that this should be eight-cars set.)

(9) Traction Power System: AC 25kV

Although in the F/S, power supply was set as DC 1,500V for an urban railway, in the Basic Design this was set as AC 25kV.

(10) Number of trains in operation: 15 trains per hour

By back-calculating from the expected demand in 2030, the train operations at peak time will be adequately possible to realize the required passenger transport capacity by eight-car set trains at four-minute headway or 15 trains per hour. In the meantime, in order to match the block section length with the NT and IT trains which have poor acceleration and deceleration performance, the possible number of trains in operation is to be limited to maximum15 trains every hour.

(11) Construction

According to the construction plan, passenger train operations are to be halted between Giap Bat and Gia Lam during the construction period.

Generally, construction plan is made so that railways which are currently being operated should only be interrupted in exceptional circumstances. In particular, efforts are normally made to avoid interrupting operations for long periods stretching over several years.

The cause of the operation halting is the construction work between Le Ninh Park to Hanoi to Phung Hung, where both sides of the existing railway are closely bordered by private houses.

Under these conditions, the method constructing new elevated track just above the existing track on the ground can be proposed as a method that may enable the existing train operation without significant halting of operations. However, as the construction method is carried out while train operations are taking place, it is unavoidable to involve high technical abilities removing difficulties relating to the construction period and construction costs, and also securing the safety in all aspects of construction and train operation.

3.3 Electrical System and Rolling Stock Basic Specifications

3.3.1 Background, Objectives, and Circumstances integrated in the Basic Specification

The objectives of the HURCP Line 1("This Project") are explained as follows in the document titled "Initial Design Framework" used for explaining the contents of the Basic Plan prepared by the design contractor.

- Improve urban traffic conditions in Hanoi city and enhance operating capacity of national railways by upgrading radial railway lines to meet the following basic requirements;
- Construct Hanoi elevated railway line, Ngoc Hoi- Yen Vien section to serve national trains, international trains and urban trains;
- Realize the first section in the rail-based transport system of the capital city;
- Re-invigorate operating performance and service quality of the national railway service;
- Provide a regular, punctual, safe and quick public passenger transport mode;
- Lessen traffic congestion at at-grade intersections; enable travel for a high volume of passengers on a north-south corridor within the city of Hanoi;

- Help to save fuel and preserve the urban environment.

In addition, according to the Law No. 35/2005/QH11 on Railway of Vietnam (Vietnam Railways Law), the gauge for urban railways is stipulated as 1,435mm or as a monorail.

On the other hand, because the gauge of the national trains running between Ngoc Hoi and Yen Vien is 1,000mm, the use of dual gauge three-rail track in order to satisfy the requirements described above will be unavoidable in this section.

For this reason, in the basic design, the dual gauge of 1,435mm and 1,000mm is used for section where there is mixed operation of NT trains, IT trains, and UT trains.

3.3.2 Standards and Regulations specially used as the Foundation and Basis for Formulating this Plan

In the Basic Plan the Vietnamese laws, regulations, and standards are arranged in the "Initial Design Framework" as shown below.

(1) Legal Basis

1) Law on Land Transportation No. 26/2001/QH10 dated 29/6/2001

2) Law on Cultural Heritage No. 28/2001/QH10

3) Law on Environmental Protection No. 52/2005/QH11 dated 29/11/2005

4) Law on Electricity No. 28/2004/QH11 dated 03/12/2004

5) Law on Lands No. 13/2003/QH11 dated 26/11/2003, Law on revision and supplementation Clause 126 of Law on housing and Clause 121 of Law on Land No. 34/2009/QH12 dated 18/6/2009

6) Law on Dykes No. 79/2009/QH10 dated 29/11/2006

7) Law on Fire Prevention and Protection No. 27/2001/QH10 dated 29/6/2001

8) Law on Technical Norms and Standards No. 68/2006/QH11 ratified on 29/6/2006

9) Law 35/2005/QH11 on Railway of Vietnam

10) Law on Construction No. 16/2003/QH11 dated 26/11/2003

In addition, there are the various documents required for implementation of each of the laws described above.

Among these laws, those that directly affect the Basic Design of electric systems and rolling stock are the Law on Electricity No. 28/2004/QH11, Law on Technical Norms and Standards No. 68/2006/QH11, and the Vietnam Railway Law (35/2005/QH11) referred to in (1) above.

(2) Vietnamese Regulations

1) Building Code, Volume 1 (General Provisions and Construction Planning) promulgated together with the Construction Minister's Decision No. 682/BXD-CSXD of 14/12/1996

2) Building Code, Volume II and III promulgated together with the Construction Minister's Decision No. 439/BXD-CSXD dated 25/9/1997

3) Building Code QCXDVN 01:2002 "Building Code of Construction Accessibility for People with Disabilities" issued by Decision 01/2002/QD-BXD dated 17/01/2002

4) Building Code QCXDVN 09:2005 "Energy Efficiency Building Code" issued by Decision No. 40/2005/QD-BXD dated 17/11/2005

5) Building Code QCXDVN 01:2008/BXD promulgated together with the Construction Minister's Decision No. 04/2008/QD-BXD of 3/4/2008 (replacing Building Code Part II in Volume I of Building Code promulgated together with the Construction Minister's Decision No. 682/BXD-CSXD dated 14/12/1996.

6) Construction Building Code on Water Supply and Water Discharge Systems In-house and for Projects, according to Decision No. 47/1999/QD-BXD dated 21/12/1999

7) Building Code, Natural Physical & Climate Data for Construction QCXDVN 02:2009/BXD

8) National Technical Regulation on Fire Safety of Building and Structures QCVN 06/2010/BXD

9) Building Code – Urban Engineering Infrastructures QCVN 07/2010/BXD

10) Building Code QCXDVN 05:2008 – Houses and Public Works: Safety of Living and Health

11) National Technical Regulation on Ambient Air Quality QCVN 05:2009/BTNMT

12) National Technical Regulation on Hazardous Substances in Ambient Air QCVN 06:2009/BTNMT

13) National Technical Regulation on Surface Water Quality QCVN 08:2008/BTNMT

14) National Technical Regulation on Underground Water Quality QCVN 09:2008/BTNMT

15) National Technical Regulation on Domestic Wastewater QCVN 14:2008/BTNMT

16) National Technical Regulation on Industrial Wastewater QCVN 24: 2009/BTNMT

17) National Technical Regulation on the Allowable Limits of Heavy Metals in the Soil QCVN 03:2008/BTNMT

All of the laws described above relate to the design and construction in civil engineering and architecture. Although they do not directly concern the electric system and rolling stock, there are situations where the Building Code regulations are applied for the environment conditions of electric system.

(3) Standards

Vietnamese standards, Japanese standards, and other countries standards covering civil engineering to E&M systems are listed.

Among these standards, those that are thought to relate to electric systems and rolling stock design have been arranged in the appended table.

According to these standards, although Vietnamese standards and regulations exist in the required fields of general electrical facilities and equipment such as electrical distribution and communications, there are no standards relating to the fields particular to railways, such as in railway operation control and protection system and rolling stock. In such as case, foreign country standards and regulations were applied.

The regulations and standards of the electrical system described in the System Design for E&M of the Basic Design are as shown below.

Table 3-8: Electric System Regulations and Standards

System		Applicable Regulations and Standards
1	Power Substation	JIS, JEC, and JEM
2	Overhead Catenary	General: IEC, Wire: JIS
3	Power Distribution System	Japanese ordinances, JIS, JESC, Vietnam Building Code Dwelling and Public Buildings Vietnamese regulations for national electric system
4	Lighting Protection System	BS
5	Signaling System	VNR Internal technical standards based on the Railway Law. Vietnam national technical regulations drafted in 2009 subject to approval.
6	Telecommunication	Local requirements, ITU, UIC, and IEC
7	OCC	JIS and ISO

Chapter 4 REVIEW OF THE BASIC DESIGN

4.1 Electrification System

(1) AC Electrification System

This section describes various features of three types in AC electrification system including Simple AC Electrification System, Boosting Transformer (BT) Feeding System and Autotransformer (AT) Feeding System. Comparatively, AT feeding System have a number of advantages. The span length of substation (SS) is longer than those of other systems; maintenance is simpler because there is no booster section; the inductive inference on the communication cable is less in comparison with other systems. For those reasons, AT feeding was chosen.

(2) Traction load for electrification system

For one train set (4M4T) the traction load is set as 4360kW, and other auxiliary power capacity is assumed to be 480kW. In consideration of operating conditions (15trains/hour) and other alignment conditions, the required traction load for substation is about 21.8MVA.

(3) Transmission line system of Power Supply Company and location of railway SS

Four sites for railway SS-Ngoc Hoi, Giap Bat, Gia Lam and Yen Vien -were investigated considering transmission system and land acquisition. It is concluded that, in the first phase of the construction works, Ngoc Hoi complex is the optimal location for railway SS.

(4) Electrical effects on receiving substation of power supply company

Railway traction load is widely fluctuated. If power supply of receiving SS for the railway SS is deficient and power load is excessively fluctuated, power supply to general households will be affected. Several regulations are established to prevent such a negative effect.

(5) Traction power supply for EMUs at Ngoc Hoi Complex

Assuming that 20 train sets are stationed at Ngoc Hoi Complex and auxiliary power for each train set is 480 kW, the total required feeding power will be 9.6 MVA (20×480kVA). If three trains run at low speed with traction load of 500 kW/train set, the total amount of power required will be 11.1MVA (9.6MVA+ 3×500kAV).

(6) Feeding transformer capacity

Roof-delta transformer with capacity 44MVA was drawn.

(7) Location of Auto Transformer (AT)

To reduce the inductive inference to communication cables and to prevent the rail potential, distance between ATs is 6 km. The locations for those ATs are Yen Vien, Gia Lam, Hanoi and Giap Bat.

(8) Voltage of Overhead Contact System

Standard voltage for the overhead contact system is 25kV (30kV at no load condition). Assuming that 24 train sets operate inside the section, voltage at the end of feeding section near Yen Vien-the furthest station, is estimated to drop to 26.7kV (89%). This value is judged to be sufficient for train operation.

(9) Earth and Bonding for protection

Under normal operation, the rail potential is about 30V, which is less than 65V for the duration between 1 second and 300 seconds.

(10) Electromagnetic Compatibility (EMC)

Various items of EMC were investigated. Those items include (i) Induced voltage in normal operation (ii) Induced voltage under fault condition, and (iii) Induced noise voltage. Calculation method and preventive measures were also presented.

(11) Future electrification system required for extension to Nhu Quynh

The electrified section is planned to be extended to Nhu Quynh in the future.

4.2 Railway Power Substation

4.2.1 Scopes of Basic Design

(1) Equipments for SS, auxiliary feeding sectioning post and AT post.

(2) Required area and civil works for SS

(3) Location of SS in consideration to land acquisition and power receiving system from Power Company.

4.2.2 Basic design condition

Basic design for SS is based on the preconditions as shown in the following table.

Table 4-1: Train Operation Plan

Item	Detail
Headway for the year 2030	4 minutes
Train set	8 cars (4M4T)
Train weight (boarding rate 150%)	456 tons
Maximum operating speed	120 km/h
Length of route (distance between terminal station)	23.85 km

Table 4-2: Other conditions

Item	Detail
Power consumption rate	53 kWh/1000 ton-km (*1)
Maximum starting current	200A (*2)
Receiving voltage from EVN	110 kV
Short circuit capacity of EVN power	1150 MVA (*3)
Feeding circuit impedance at 25kV	(0.0563+j0.1778) Ω/km (*4)
Maximum voltage	30kV(*5)
Nominal voltage	25kV(*5)
Minimum voltage	22.5kV(*5)

Note:
*1: Typical value in Japanese AC feeding system
*2: 25kV current of electric cars used in HURCP Line 1
*3: Based on the report "Basic Design for Electrification"
*4: Feeding circuit consists of:
Contact Wire GT-Sn 170mm^2,
Messenger wire ST 135mm^2,
Feeder Al 300mm^2 and
Rail 50kg/m.
*5: IEC60850

4.2.3 Electrified section and scope of works

The electrified section and scope of works are illustrated in table 4-3 below

Table 4-3: Electrified section and Scope of works

Section	Works
Phase 1 (Ngoc Hoi Station, Giap Bat-Gia Lam)	• Installation of SS: 1 place • Installation of SSP: 1 place • Installation of ATP: 2 places • Installation of Power Transmission Line for SS: 1 set • Installation of Substation Remote Control Equipment at Hanoi OCC: 1 set
Phase 2 (Ngoc Hoi- Giap Bat, Gia Lam- Yen Vien)	• Installation of ATP: 1 place • Improvement of Substation Remote Control Equipment at Hanoi OCC: 1 set

4.2.4 Design Concept

(1) Decision of SS location

① Site selection: SS location was selected in consideration to the following criteria:

- To maintain a required minimum voltage of 22.5kV
- To have easy access to power supply from EVN
- To easily bring in and out SS equipment and easily to move SS equipment within the area
- To secure adequate space for expanding SS equipment in the future

② Location of SS

Table 4-4 shows the maximum allowable SS distance and possible one-side feeding distance. Based on data in Table 4-4 and above site selection criteria, the result of SS location is shown in Table 4-5.

③ Voltage Drop

Assuming train operation of 4-minute headway, at the farthest position from SS, the receiving voltage of electric cars is 22.8 kV which is above the required minimum voltage of 22.5 kV. Refer to calculation in Table 4-6.

Table 4-4: Maximum Allowable SS Interval

Item	SS distance
Maximum distance for feeding	About 50km
Possible one-side feeding system	About 25km

Table 4-5: Location of SSs

Kilometer from Hanoi	Name of SS	Remarks
11km+100	Ngoc Hoi	SS
5km+ 000	Giap Bat	ATP
0km+000	Hanoi	SSP
5km+000	Gia Lam	ATP
10km+850	Yen Vien	ATP

Table 4-6 Calculation result of Voltage Drop

Farthest location from SS	Voltage Drop	Receiving Voltage
Yen Vien Station	2.21kV	22.79kV

(2) Power Receiving System

There are three types of power receiving system under study.

- Dual Line Power Receiving System (Type A)
- Single Line Power Receiving System No.1 (Type B)
- Single Line Power Receiving System No.2 (Type C)

Because Ngoc Hoi SS is the only SS for the route, it is therefore impossible to allow power disruption. Type A was derived to be appropriate in spite of its higher price.

(3) Transformer Facility System

The feeding transformer cąpacity of the SS is calculated using the train operating parameters. Rated overload capacity of the feeding transformer (100% capacity continuously and 300% for 2 minutes) was also taken into account. After value of one-hour maximum load and the monetary maximum load is calculated, the higher value shall determine the feeding capacity of the SS. The result is presented in Table 4-7.

Table 4-7 Load of HURCP Line 1

Location of SS	**Maximum Load between Ngoc Hoi SS and Yen Vien (MVA)**	**Required minimum secondary capacity of Transformer (MVA)**	**Rate Primary Capacity of Transformer (MVA)**
Ngoc Hoi	20.2	21	50 (2×25)

With respect to the type of transformer, the Scott-connected transformer shall be used.

(4) Feeding for directions system and up and down line system

There are two types of feeding system for AC electrification system: the different phase feeding for direction system and the different phase feeding up and down line system (Refer to Figure 3-6 and Figure 3-7 in Concept & Integration Design for Railway Power Substation of JKT Basic Design Report). In the feeding for direction system, simple same phase section can be used. On the other hand, in the feeding for up and down line system, although load balance is better, more complicated different phase section installation is required in station yards. For this reason, the different phase feeding for directions system shall be adopted.

(5) Remote Control System

We recommend referring to SCADA section.

- Control method
- Remote control items
- Centralized Supervision Control devices

(6) SS types

Two types of SS were discussed: Outdoor type and Indoor Type. The SS plants is planned be built inside Ngoc Hoi Complex regarding the fact that required land can be secured and construction of receiving transmission systems by Power Company is expected in the future.

4.3 Overhead Contact System

4.3.1 Basic Design Criteria

(1) Objective of the Basic Design

As traction power change from diesel to electricity, a new overhead contact system is required to transmit electricity to the trains. The new system is designed to ensure the entirety of its specified design life in a safe, economical and technically efficient manner.

(2) Scope of work

The location of the railway power substation and AT post are decided based on the train operation plan of the HURCP Line 1 for the year of 2030. The following tasks were performed.

- Review the basic conditions of the Overhead contact system
- Review the feeding system diagram
- Review the Overhead contact system configuration
- Review the protection system, supports, the Overhead contact system at depot, construction plan and maintenance.

(3) Abbreviation

This part explains the meaning of abbreviations such as ATP, CB, DS

(4) Standards

The design of the Overhead contact system is based on the following standards.

- General

  IEC60850-2007: Railway application-Supply voltage to traction system

  Technical Regulation of Vietnam

  Urban railway standard of Vietnam

- Wire

  JIS E2101-1990: Hard-drawn grooved trolley wire

(5) Location of railway SS and AT posts

The feeding system diagram is prepared with respect to the SS and AT post locations that were approved by RPMU. The railway SS shall be located near Ngoc Hoi station.

(6) Electrified Section

The electrified sections are as follows.

- Phase 1: Ngoc Hoi station, Giap Bat- Gia Lam (2017)
- Phase 2: Ngoc Hoi-Giap Bat, Gia Lam- Yen Vien (2020)

4.3.2 Basic Design Condition

(1) Climate condition

- Table 4-9 shows the standard climate condition for the project area.

Table 4-9 Climate Conditions

Item	Standard Value	
Air temperature	Maximum temperature	45^0C
	Standard temperature	25^0C
	Minimum temperature	0^0C
Wind velocity (Maximum)		40m/s
Wind velocity for train operation		30m/s

(2) Train operation condition

The Basic Design predicted that the Overhead contact system should supply electric power for the HURCP Line 1 and would also supply power for high-speed railway in the future. However, there is high possibility that the power supply for high speed railway shall be separate from the power system of this project. For the time being, it is understood that it is not required to take into consideration of power supply for high speed railway. The major train operation conditions for HURCP Line 1 are as follows.

- Train set: 8 cars (4M4T)
- Number of train sets: 15 trains/hour
- Headway: 4 minutes
- Maximum design speed: 120km/h
- Maximum current: 200A/train set

(3) Rolling stock condition (Pantograph)

Structures, overhead contact line and pantograph are required to insulate from each other. Also, it is necessary to secure efficient space between rolling stock and overhead contact line. The working range of pantograph is introduced in the Table 2-2-2 of the System Design for E&M (Summary) document by JKT

(4) Upper structure gauge

Upper Structure clearance is illustrated in Figure 2-2-1 in the System Design for E&M (Summary) document by JKT.

(5) Electric conditions

The standards for the electrification of the HURCP Line 1 are as follows.

- Nominal voltage: 25.0kV (*1)
- Maximum voltage: 30.0kV (*2)
- Minimum voltage: 22.5kV (*3)

Note *1: IEC Publication 60850-2007

*2: Maximum voltage at SS at no load condition

*3: Voltage of pantograph which is necessarily to be secured at normal operation condition.

(6) Overhead contact system for 3-rail track

After reviewing the distribution of the overhead contact system for 3-rail track, it is concluded that the standard deviation for dual gauge is 100mm, which is not favorable for normal operation. Therefore, the overhead contact system is to be constructed for only 1,435mm gauge. It is also noted in the Report by JKT that this system may be applicable to the future high speed railway. However, as mentioned above, for the time being, it is understood that the future high speed railway is not taken into account.

4.3.3 Feeding System (Feeding System Diagrams)

(1) AT Feeding System

The basic structure of AC feeding circuit is illustrated in the Figure 2-3-1 in the JKT Report. The circuits shall be connected by Scott-connected traction transformers.

(2) Feeding system diagram

In the Report, the feeding system diagram for the section from Ngoc Hoi to Yen Vien, and the section on Ngoc Hoi depot are shown in Figure 3-2 and Figure 3-3 in the JKT Report, respectively.

4.3.4 Overhead Contact Line

In this section of the JKT Report, the comparison between various catenary systems is shown. In conclusion, heavy simple catenary is adopted for main line and simple catenay is used for the depots and side lines at stations.

4.3.5 Electric wire and tension

This part shows the various characteristics of contact wire, messenger wire and their standard tension.

4.3.6 Feeder

This section shows the characteristics of different types of feeder.

4.3.7 Height and Deviation of overhead contact line

In the JKT Report, the height of contact wire and working height of pantograph and the standard deviation of contact line are illustrated in Table 4-5 and Table 4-6 respectively.

4.3.8 Standard span length

Table 4-7 in the JKT Report shows the standard span and standard deviation with the condition of wind velocity at 30m/s.

4.3.9 Tension device

This part shows the differences between balance weight tensioning device and spring tensioning device. Taking into account the little requirement for maintenance, the JKT Report recommend the spring tensioning device.

4.3.10 Insulator

Table 4-8 in the Report shows the commercial frequency housing withstand voltage and lightning impulse withstand voltage of suspension insulator, polymer insulator and stem insulator.

4.3.11 Sectioning device

This part explains the difference between same phase section and different phase section.

4.3.12 Protection System

(1) Protection of feeding circuit

To prevent against short-circuit or ground fault of circuit breakers at the substation, it is required to have the circuit breaker in SS cutting electric current to protect feeding circuits.

(2) Protection system

The protection system consists of protective relays and circuit breakers. Those devices detect fault currents and break power supply to the fault circuit, which prevent spreading of the trouble to the normal sections.

4.3.13 Lightning Protection Cable

To protect the feeding circuit from lightning, a protection cable shall be installed and grounded.

4.3.14 Earthing

To protect humans and animals from danger, all metallic structures adjacent to feeding system are grounded. In station areas, S type horn and protection line are installed in order to detect grounding fault.

4.3.15 Supports

(1) Poles

Concrete pole and/or steel pole are used to support overhead lines.

(2) Support system

- Independent pole

  Fixed cantilever and hinged cantilever are attached to the independent poles to support the overhead lines.

- Portal structure

  Two poles are built on both sides of the track with span wires or beam stretching across the tracks and catenaries are suspended from the beam. This type is used in stations or depots.

- Support structure of HURCP Line 1

  For the main line, it is recommended that concrete pole or steel pipe pole with hinged cantilever structure shall be adopted while concrete pole with steel pipe beam or portal structure will all steel pipes is recommended for the depot.

4.3.16 Overhead Contact Line at a Depot

Simple catenary system is used for overhead contact line in the depot.

4.3.17 Construction Plan

The first phase of the construction project is expected to complete in 2017 and the second phase is planned to complete in 2020.

4.3.18 Maintenance

(1) Method of maintenance

The breakdown of overhead contact lines results in the obstruction of train operation, therefore, preventive maintenance are recommended to detect the symptoms of deterioration in advance.

(2) Inspection of overhead contact lines

This section explains the method for inspecting overhead contact lines.

(3) Inspection instruments

This section explains the overview of catenary inspection car.

(4) Maintenance Unit

This section explains the organization of maintenance unit in 2020

(5) Electric inspection cars

This section explains the overview of Japanese electric inspection cars and inspection items.

4.4 Power Distribution System

4.4.1 Purpose and scope of work

The basic concepts of power distribution system for HURCP Line 1 are as follows.

- The railway company constructs the power grid independently the grid of the power company, operates the electrical equipment itself and structures the strong power grid unaffected by other power consumers.
- The power distribution system supplies essential load for train operations such as signaling, telecommunication and facilities of OCC even in case of maintenance or electricity failure of one system.
- In case there is power failure of both distribution lines, the essential loads can be backed up with power from the standby generator.

With above mentioned basic concepts, the scope of work for basic design of power distribution system consists of the following items.

- Scope of design
- Normal mode power supply
- Maintenance mode power supply
- Accident mode power supply
- Emergency power supply
- Back up of power supply for signaling and telecommunication

- Load-shedding

4.4.2 Codes and standards

The basic design for power distribution system is in accordance with the following codes and standards.

- Japan ministerial ordinance establishing the technical standards for electrical appliances
- Interpretation of Japan ministerial ordinance establishing the technical standards of electrical appliances.
- Japan Industrial Standard
- Japan Electro-technical Standard and codes committee (JESC)
- National electric code: Electrical installation standard in Vietnam
- Vietnam Building Code: Dwelling and Public Building
- Regulation for connecting to the national electric system in Vietnam

4.4.3 Functional requirements for power distribution system

The following functions required for power distribution system are as described.

- Vibration isolation
- Equipment mounting
- Maintainability
- Voltage level
- Location and space
- Other design considerations

4.4.4 Technical requirement for power distribution system

- To prevent impact on the entire power supply system due to failure of any individual equipment
- To prevent against voltage drop below standard level
- To clearly label all equipment
- To ensure required degree of fire assistance for wires passing through elements of building construction.

4.4.5 Review of power distribution system

It is recommended that the load shedding of station and OCC buildings are re-examined in the detail design stage.

4.4.6 Power distribution diagram

The power distribution diagrams are illustrated by Figure 1-7, Figure 1-8, Figure 1-9, and Figure 1-10 in the JKT Report.

4.4.7 Electrical Equipment

(1) Overview

For selection of electrical equipment, the following requirements are defined. ①All assumptions, norms, and support documents shall be provided in detail.② All equipments are subject to be rated for the voltage, capacity and fault duty to which it is exposed. ③ Various calculations such as equipment and component sizing, load flow analysis, earthing and lightning protection system are required.

(2) Switch room and power supply room

The power supply room shall deliver 380/220V power supply to all stations. For maintenance purpose, power outlets shall be installed at the switch rooms and power supply rooms.

(3) Standby Generator

The purpose of installation, applicable regulations and codes, required characteristics, type of motor, the location criteria for the generator itself and fuel tank are described.

(4) Earthing System

- Purpose and scope of work

  The earthing system is required to be installed for stations, depots and buildings.

- Codes and Standards

  The earthing system is designed in accordance with the followings codes and standards.

  - ✧ BS7430 Code of Practice Earthing
  - ✧ BS7671 Wiring regulation for electrical installation for buildings
  - ✧ ANSI/IEEE Guide for safety in AC Substation Grounding Gtd 802000
  - ✧ IEEE 1100 1992: Recommended Practice for powering and grounding of sensitive electronic equipment

4.4.8 Lightning Protection System

(1) Purpose and scope of work

It is required to install lightning protection system for above ground stations, buildings, depots the OCC and aerial structures.

(2) Codes and Standards

The design is in accordance with the following codes and standards.

- BS6551 Code of Practice for Protection of Structures against Lightning
- BS7430 Code of Practice Earthing
- BS7671 Wiring Regulation for Electrical Installation for Buildings

4.4.9 Cable, Conduits and other equipment

(1) General

(2) Wiring and termination: Termination and wiring in equipment room is described. The exact quantity shall be determined in detail design phase.

4.4.10 Preservation of electrical structure

The JKT Report recommends that the electrical structure for one's own use shall be maintained by Railway Company in order to secure the unified preservation.

4.4.11 Agreement with Power Company

The procedure of connection agreement with the power company shall be carried out based on the provision 49 and 50 in the Decision 37/2006/QD-BCN.

4.5 SCADA (Supervisory Control and Data Acquisition)

SCADA system will be equipped for the purpose of operating substation, overhead contact system and power distribution system as well as supervising power supply condition, power consumption. The system can also interchange between remote mode and direct mode to remotely control the on-off of circuit breaker at substation, electrical equipment rooms.

4.6 Signaling System

4.6.1 Introduction

(1) Purpose of Document

The purpose of this document is described as "explanation of the basic design preconditions", "functional requirements of the subsystems", "phased installation, interface schedules", and "issues to be clarified in the detailed design stage".

(2) Scope of Documents

The new signaling system for the UTs, ITs, and NTs is to be designed "to ensure safe train operations in the complicated mixed-train operating environment", "to harmonize with the existing signaling systems if available" and "to interface with other systems, such as telecommunications, rolling stock, and tracks".

(3) Abbreviations

The meanings of abbreviations used in this chapter are defined.

(4) Definitions

(4)-1 Design framework

It is described that the technical specifications will be prepared in the detailed design stage in the manner of performance specifications, so "that the Contractor and manufacturers can prepare detailed specifications for design, manufacture, testing, assembly, installation and operation" and also "that the specification is to comply with the Vietnamese standards, JIS or equivalent international standards".

(4)-2 Design requirements

The requirement to subsystems is defined as proven in revenue and maintenance services for more than 10 years.

(5) Design standards

The design standard are referred.

- The internal technical standards of VNR established in 2006.
- The national technical regulations for railway and the national standards for urban railways drafted in June 2009.

(6) Preconditions of design

Preconditions for the signaling system design are detailed.

(7) Scope of works

Functional requirements to be fulfilled are detailed and also the followings are defined as scope of works.

- Two phased installation works for Phase 1 and Phase 2.
- Removal of existing signalling installations
- Supply of equipments and spare parts necessary for maintenance

(8) Demarcation of works

The installations of "on-board ATP equipment" and "train number input equipment" and also "telecommunication lines among stations and between stations and OCC" are excluded from signaling works but required to be designed in close coordination with signaling works.

4.6.2 Background

(1) Existing infrastructure

(1)-1 Existing railway administration

National railways are governed by the government and administered mainly by VNR pursuant to Law of railway.

(1)-2 Existing train operation

4 segments of existing train operation are explained.

(1)-3 Existing signaling system

(a) Block system

Semi-automatic, automatic and tablet block signalling systems are respectively explained.

(b) Signalling

7 kinds of signals with electric lamps are described.

(c) Interlocking system

Two types of interlocking system (Relay and Electric) are explained.

(d) Train protection system

No ATP system but on-board GPS device on some of locomotives is described.

(e) Point machine

Followings are described.

- #8 and #10 among many kinds of turnouts are employed.
- 38kg/m and 43kg/m rails are used.
- Three types of point machines (Manual, Electric, and Electirc-hydraulic) are described.

(f) Level crossing protection system

Two types of level crossing (Automatic and Manual) are described.

(g) Power supply system

No exclusive cable line but individual and direct supply when needed is installed.

(2) HURCP Line 1 project

(2)-1 New organization for urban railway administration

It is described that, according to Law on Railway, HURCP Line 1 is constructed and managed by RPMU and operated and maintained by a new urban railway company.

(2)-2 Features of signaling system for HURCP Line 1

It is described that all trains of UT, NT and IT under complicated operation in HURCP territory is required to be controlled and supervised by OCC in an integrated fashion and that ATP, TID, CMS and TDS are newly adopted as signaling system.

(3) Other projects

As other projects which HURCP Line 1 design is required to review or closely work with, 5 railway improvement projects are listed.

4.6.3 Functional Design

(1) System design life

20 years durability life except for 5 years for battery is specified.

(2) System assurance design

(2)-1 Availability

Availability of signaling system even in the failure of upper systems is specified.

(2)-2 Safety

Redundant electric interlocking system with fail safe processor configuration is specified.

(2)-3 Maintainability

Continuous monitoring by centralized monitoring system and easy replacement of failure units in its system are specified.

(2)-4 Reliability

"Redundant configuration for major subsystems", "immunity against electromagnetic and electrostatic influence" and "immunity against electric harmonics and noises" are specified.

(2)-5 Environmental conditions

Operating environmental conditions are specified.

(3) Functions

Subsystems and equipment of signalling system for exerting vital functions enabling train control and management of combined UT, NT and IT operation are specified and the block diagram of the configuration is shown.

(4) Functional requirements

Requirements for light signals are specified

(4)-1 ATP

The adoption of ATP class 1 with train speed checking function for UT and ATP class 2 without train speed checking function for NT/IT is specified.

(a) ATP class 1 system

System features and system configuration of ATP class 1 are described.

(b) ATP class 2 system

System features and system configuration of ATP class 2 are described.

(4)-2 Automatic block signallig system (ABS)

System features and system configuration of ABS are described.

(4)-3 Train detection system (TDS)

System features and system configuration of TDS are described.

(4)-4 Train identification system (TIS)

System features and system configuration of TIS are described.

(4)-5 Traffic information display system (TID)

System features and system configuration of TID are described.

(4)-6 Centralized signaling monitoring system (CMS)

System features and system configuration of CMS are described.

(4)-7 Centralized traffic control system (CTC) and Programmed route control system (PRC)

System features and system configuration of CTC and PRC are described. PRC is categorized as Automatic route control, Manual route control and Local route control.

(4)-8 Interlocking system (ILK)

System features and system configuration of ILK are described.

(4)-9 Point machines

System features and system configuration of Point machines are described.

(4)-10 Depot level crossing protection system

System features and system configuration with control unit near a level crossing of Depot level crossing protection system are described.

(5) Signalling system in each phases

Installation is planned to be phased to Phase 1 and Phase 2.

(5)-1 Unification of phased signaling system

Unification centered on central equipment of CTC, PRC and TIS is described.

(5)-2 Consideration of phased installation

It is described that system requirements of each systems for phase 2constituting signaling system 2 is dominated by those of sub-systems for phase 1.

4.6.4 Configuration Design

(1) System diagram of signaling system

System diagram of signaling system is shown.

(2) Signalling system and installations

(2)-1 National train station

Signalling equipment to be installed in National train stations is specified.

(2)-2 Urban train station

Signalling equipment to be installed in Urban train stations is specified.

(3) Signalling system configuration

(3)-1 ATP

"Failure measures", "immunity against railway electrification system" and "location of transponders" for ATP class 1 and class 2 are described.

(3)-2 ABS

"Division of block signal supervision section", "centralized control of block signals at ABS NT station equipment" and "transmission of track occupancy status and signal aspects in the block section" are described.

(3)-3 TDS

Track circuits with double rail type for standard and narrow gauge tracks is specified

(3)-4 TIS

Respective numbering methods of train description numbers to UT and NT/IT are described.

(3)-5 TID

Installation points of TID are described.

(3)-6 CMS

Items to be intensely supervised by "the supervision console located in OCC" and "the workstation located in depot" are described.

(3)-7 CTC and PRC

Train operation control by "CTC, PRC and ILK systems collaboratively" and "CTC territory in phase 1 and phase 2 including control area of signal routes within Ngoc Hoi complex, Giap Bat station, Ha Noi station and Gia Lam station" are described.

(3)-8 ILK(Interlocking system)

"Electronic interlocking system for NT stations for UT, NT, IT train route control" and "relay interlocking system for freight and temporary stations" are specified and also equipment to be equipped with interlocking system are described.

(3)-9 Classification of signal installations

9 kinds of signals as classification of signal installations are described.

(3)-10 Block signaling system

Block signaling on "single line section (NT train section)" and "double line sections (through HURCP Line1) in which existing block signaling system is included" is described.

(3)-11 Point machine

Turnout expected to be used in dual gauge track are described and recommendation of Japanese point machine mainly from viewpoints of functional and operational performance are described.

(3)-12 Depot level crossing protection system

Automatic barriers and alarms with track circuit for the warning control circuitry with back-up by train detector or exclusive track circuit is described.

(3)-13 Signalling cables

"Functional requirements", "main cable core allocation" and "signal cable routes" of signaling cables are described.

(3)-14 Power supply and lighting protection systems

"Power supply equipment configuration with supply capacity", "countermeasures against lightning strikes" and "earth system configuration" are described.

(4) Interface with other systems

(4)-1 Train operation management system in OCC

Requirements of ports for CTC, PRC and TIS to interface with "traffic indication panel" and "EDP for train operation diagram" are described.

(4)-2 Telecommunication system

As cables used by signaling systems, "CTC LAN", "signal-information LAN", "transmission line for centralized signaling monitoring system", "connection with PIS and PAS at NT stations" and "transmission line for block signaling system between stations" are described.

(4)-3 Power distribution and overhead contact system

"Interface with power supply", "pilot power supply for train detector" and "safety clearance against neutral sections" are described.

(4)-4 Electric multiple unit

ATP on-board equipment and TIS on-board equipment are described.

(4)-5 Track

Insulated rail joints and changeover of track alignment upon renewal at the boundaries of Phase 1 and Phase 2 are described.

(4)-6 Architecture

"Signalling equipment room" and "indoor facilities in signaling equipment room" are described.

(4)-7 Civil

"The ducts for signaling cables" and "foundation of signal poles" are referred.

4.6.5 Technical Conditions

(1) Unification of signaling system for urban and international trains

"PRC to control the signal route for intermingled UT, NT and IT operation", "signal indication corresponding to UT, NT and IT operation", "safety of train operation with ATP class 1 equipment for UT and ATP class 2 equipment for NT/IT" are described.

(2) Wayside signal function and aspects

Wayside signals with 5 signal aspects of G, Y and R commonly and YG and YY additionally for NT/IT is described.

(3) Signal block length required to achieve the required operational headways

"Securement of space clearance between consecutive trains by proper block section length", "multi-aspect system coping intermingled train operation" and "proper signal aspect sequence" are described. Meanwhile, "preparation of signal aspect sequence diagram in the detail design stage" is described.

(4) Train detection alternative and optimal method

"Adoption of train detection by track circuits as a result of reviews on various train detection applications", "interference currents to track circuits" and "insulation type of track circuits" is described.

(5) Signalling system on abnormal conditions

Requirement of train operation availability upon failures of CTC/PRC or CTC transmission circuits is described.

(6) Consideration of introducing Automatic Train Operation system (ATO)

Reasons to deny the adoption of ATO system are described.

(7) Future development of signaling system

Provision of proper interface ports enabling easy modifications on planned HURCP Line 1 project to cope with possible future development with ATO function is described.

(8) Depot signaling system

Controls of trains in each territory of the followings in Ngoc Hoi complex from respective signal cabins are described:

Train operation in Passenger Station, PC Depot and DL Depot	:	Interlocking equipment cabin of Passenger Station
EMU operation in EMU depot	:	Interlocking equipment cabin of EMU Depot
Train operation in Freight Station	:	Interlocking equipment cabin of Freight Station
Block signaling operation between Ha Dong Station and Freight Station	:	Interlocking equipment cabin of Freight Station
Block signaling operation with Thuong Tin Station	:	Passenger station
Block signaling operation of incoming route to Freight Station from Thuong Tin Station	:	Individual interlocking equipment on the transit line

(9) Integration with adjoining railway lines

Views for integrations with urban railway line extension to Nhu Quynh Station and other adjoining railway lines are described.

(10) Subject to another railway project

"Necessity of information change between OCC and the integrated CTC Center" and also "coordination with other modernization projects being implemented parallel with HURCP Line1" is described.

4.6.6 Construction plan and schedule

(1) Construction plan

Necessity of temporary signaling installations at border stations between Phase 1 and Phase 2 to cope with step-by-step track alignment construction is described

(1)-1 Phase 1

Phased signaling works by project locations including removal of all existing installations are classified.

(1)-2 Phase 2

Classification of signaling works by project locations is described.

(1)-3 Signalling equipment room

Considerations required for the construction of signaling equipment room to be made by building works are provided.

(1)-4 Signalling control room

Requirements to location and room space are provided.

(1)-5 Temporary stations

Temporary signaling installations provisionally required at the temporary stations are described.

(1)-6 Re-use of signaling equipment

Possible re-use of the signaling installations currently existing in Giap Bai Station at temporary station is suggested.

(2) Construction schedule

12 months for manufacturing and 6 months for integrated test and test run are described. Also indicative construction schedules for Phase 1 and Phase 2 are provided.

4.6.7 Maintenance and spare parts

"Centralized signaling monitoring system", "provision of the specific maintenance organization by O&M team" and "estimate of spare parts in detail design stage" are described.

4.6.8 Summary of signaling system

According to the JKT Report, the summary of the signaling system is as follows.

(1) Signaling: Wayside signaling system (color light signal system)

(2) Block system: Fixed block

(3) Safety equipment: Electronic interlocking system Type-1

(4) Gauge: 1435mm, 1000mm, dual gauge

(5) Train protection: ATP Class 1 (ATS-P), ATP Class 2 (ATS-S)

(6) Switch and lock device: Electronic point machine

(7) System life: System and electronic equipment: 20 years

Battery: 5 years

Wire and cables: 20 years

(8) Environmental conditions:

- Ambient temperature:
  - ✧ 10^0C to 35^0C (equipment rooms)
  - ✧ -10^0C to 60^0C (inside of cubicle)
  - ✧ -10^0C to 60^0C (outdoors)
- Humidity:
  - ✧ 30%- 80% (equipment rooms)
  - ✧ Maximum 90% (inside of cubicle)
  - ✧ Less than 100% (outdoors)
- Vibration:
  - ✧ Less than 9.8m/s^2 (inside of cubicle)
  - ✧ Less than 98.1m/s^2 (outdoors)

  ※Note: vibration acceleration from 10 to 1000Hz

4.6.9 Matters of concern emerged in the review of signaling system basic design report

(1) Mixed operation

According the Basic Design documents, long-distance trains (national trains and international trains) stop at Hanoi station. However, because acceleration and deceleration performance of diesel locomotives is poorer than electric cars, even if the 4-minute headway is possible, the operation efficiency of urban trains will be negatively affected.

Moreover, if operation diagram of long-distance trains is disrupted, it will become uncertain when those trains will enter the urban railway section HURCP Line 1. Therefore, it becomes difficult for urban trains to operate according to predetermined time schedule. This issue has negative impact on both punctuality and functionality of urban trains.

(2) Dual gauges

In order to operate different types of trains, dual gauges are adopted for HURCP Line 1. For this reason, the aim "to build a fast, punctual and safe transport system that can be further developed in the future" may not be easy to achieve under current context. However, the line is expected to serve as a mass rapid urban railway transit system.

Mixed operation of trains with different acceleration/deceleration performance and gauge requires special consideration for safe operation. Especially, since running into wrong track leads to derailment, the absolute requirement is that trains must run on their designed gauge track.

In the Basic Design documents, trains with different wheel width shall be detected by 3-rail track circuit.

4.7 Telecommunication

The summary of Telecommunication system of HURCP Line 1 is as follows.

(1) Applicable Standards

For signal system, International Telecommunication Union, IEC and other international standards are applied. Other domestic regulations and standards on general communication system are also applied for this project.

(2) Existing Telecommunication Systems

Several telecommunication systems exist between Ngoc Hoi- Yen Vien section such as Hanoi-Vinh signal communication optical fiber, telecommunication system for North-South railway line, Western Hanoi ring railway and Hanoi- Dong Dang railway line. Those lines shall be relocated for construction of this project. After the completion of civil work, the new communication will be installed.

(3) Composition of telecommunication system

The Telecommunication system shall consist of the following subsystems.

① Back-bone optical fiber network

② Automatic telephone network

③ Specialized telephone network (Traffic dispatch, Electricity dispatch, Signal dispatch, ways-side telephone)

④ Train radio system

⑤ Talk-back system

⑥ Public Address system

⑦ Passenger information system

⑧ Centralized supervisory system

⑨ ITV

⑩ Lightning protection and grounding system

⑪ Power supply system

(4) Back-bone network

- Two separate optical fiber cables for redundancy purpose
- System configuration: Synchronous Digital Hierarchy (SDH)
- Providing transmission for automatic telephone, dispatch telephone, other specialized telephone network, wayside disaster prevention system, and centralized supervisory system.
- Network control by Network Management System (NMS)

(5) Automatic Telephone System

- Formed by the automatic private branch exchange (PABX) and incorporated with the existing automatic telephone network of VNR.
- Telephone shall be available in all rooms of facilities at all stations, depot, OCC.

(6) Telephone System for Exclusive Use

- Telephones for traffic dispatching and electricity dispatching are Dial Tone Multi Frequency type. Those telephones connect dispatcher with the slave telephones. Any slave telephone can be called as selective call or group call.
- Way-side telephones shall be installed at an interval of 500m along the railway and provide the function of a magnetic telephone. Those telephones can be connected to the PABX via the SDH or metallic telephone cable.
- The dedicated telephone system connecting two adjacent stations directly is formed with magnetic telephones and a metallic telephone cable. This telephone system is used as telecommunication mean when other means of communication fail and as the substitute block system when the CTC fails.

(7) Train radio system

Train radio system provides communication among the OCC, on-board devices and the hand-portable radio sets carried by O&M staff. This system will be the Terrestrial Trunked Radio which is a radio communication system in 400 MHz band permitted to be used by VNR.

(8) Talk-back system

The talk-back system will be installed at five NIT stations: Ngoc Hoi, Giap Bat, Hanoi, Gia Lam and Yen Vien station to ensure the safety of in-yard workers.

(9) Public Address System

The system will be installed at platform, concourse to broadcast announcements and instructions to the passengers. The approach of train shall be automatically announced.

(10) Clock System

- The system distributes a precise time signal which shall be used to synchronize all the other telecommunication systems.
- GPS time signal shall be received at every station. The time signal shall be sent from master clocks to the slave clocks connected to them.

(11) Way-side disaster prevention system

This system comprises devices that collect data such as the amount of rainfall and wind speed along the wayside and devices that display an alarm when the rated value exceeds the permitted level.

(12) Centralized Supervision System

The Centralized Supervision System is used for the concentrated supervision of signaling and telecommunication equipment at the OCC, telecommunication center. When there is any abnormal electricity supply or equipment malfunction, alarms are displayed.

(13) CCTV System: The system uses cameras to monitor safety of passengers in stations.

(14) Lightning Protection Equipment and Grounding System

The system consists of devices to properly ground devices of telecommunication system to protect the telecommunication system from lightning, over current or malfunctions.

(15) Power Supply Equipment

Emergency generator will be provided as backup in case of electricity failure. Uninterruptible Power Supply (UPS) are installed to maintain the telecommunication system at least 10 minutes in case the dual line power fails.

4.8 Train Operation System

Train Operation System has direct impact on train operation. Under normal operation condition, it is expected that the system shall operate smoothly with the proposed basic design. The railway system comprises many smaller sub-systems and those sub-systems further consist of various devices. In order to increase system reliability, most of sub-systems have redundant configuration. However, not all of them have this type of configuration. In case malfunction occurs at any of these subsystems, in order to promptly recover to normal operation, OCC must constantly gathering information and dispatch prompt and precise command to field.

4.9 Rolling Stock

4.9.1 Principal Agreement

(1) FS agreed both Japanese standards and Vietnamese standards

Car design base of Vietnamese and Japanese standards indicated in FS is specified.

(2) Revision of Basic Technical Contents

"Implementation of basic design on the bases of 25kV AC system, instead of DC1500V of FS," and "revised structural and rolling stock envelopes proposed on 21 December 2009" and, further, "recommendation of "22TCN340-05" and "STRASYA" as basic standards with supplementation by MLITT and JIS" are described

4.9.2 Project Major Technical Standards

Principal data provided are consolidated in Sub-chapter 4.9.7.

4.9.3 Car Size

(1) Rolling stock envelope

Rolling stock envelope is provided.

(2) Car size

Car width, car length and distance between coupler surfaces are described except car length of head cars which will be determined consequently after identification of connectors to locomotives.

4.9.4 Passenger Capacity and Load

(1) Conditions

Examination result of the number of seats and standing area is provided.

(2) Car nominal number of passengers

Calculation result of car nominal number of passengers based on a layout example is provided.

(3) Train nominal number of passengers

Train nominal number of passengers is provided.

(4) Car load

(4)-1 Weight of individual passengers

Application of 60kg/person is described.

(4)-2 Kind of load

Definitions of AW0, AW1, AW2 and AW3 are provided.

(4)-3 Load

Load calculation result based on the passenger capacity derived from above results is provided.

4.9.5 Equipment for Cars and Train structure (Verification contents)

(1) System integration

Various system integration with other systems including catenary system, signaling system and communication system is described.

(1)-1 Catenary system

Catenary height and working area of pantograph, pantograph length, limitation for roof equipment are specified.

(1)-2 Signalling system (ATP)

"On-board ATP device which should be compatible with wayside signaling equipment specification", "Dead-man system" and "Communication system" are described. The determination of interface conditions between on-board ATP system and wayside ATP system is left for detail design face.

(2) Traction propulsion system

(2)-1 Main power circuit

The structure of 25kV AC propulsion system is provided.

(2)-2 Structure type of main circuit

Verification of the structure type of main circuit including 1M type and Unit type is described. Also, evaluation result proposing 1M type is provided.

(2)-3 Structure type of Converter and Inverter

The comparison of 1C4M type and 1C2M type and the result proposing 1C2M which is attainable higher availability are described.

(3) Auxiliary power system

(3)-1 Introduction of Auxiliary power system

Provision of AC normal loads in AC train generally from tertiary auxiliary winding (380V AC) in the main transformer in which voltage severely varies is described. In addition, the demand of stabilized power supply such as power of lighting systems is described.

(3)-2 Power supply to individual equipment

(a) Regular load (in relation to controlling)

Demand of 110V DC which is supplied from SIV (in case of failure from SIV, from battery) is described.

(b) Saloon lighting

Supply of 220V AC stabilized power to lighting circuit from battery through inverter even over dead sections is described.

(c) Air-conditioned equipment

Supply of 380V AC from tertiary winding is described.

(d) Compressor

Supply of 380V AC from tertiary winding is described.

(e) Battery

Power supply for 45 minutes to signal lights, radio equipment, train wireless and door closing equipment upon loss of power supply from catenary is described.

(4) Door operating equipment

Comparison between electrically-driven type proposed by FS and air-driven type specified in STRASYA and the result for proposal of electrically-driven type are described.

4.9.6 Car Weight

(1) Train configuration

T-car and M-car configuration with the ratio of 1: not less than 1 is described.

(2) Free-load car weight for various types

The data of empty car weight provided are consolidated in Sub-chapter 4.9.7.

(3) Car weight and maximum axial load

The data of AW, AW1, AW2, AW3 and Maximum axle load are provided to each car type and consolidated in Sub-chapter 4.10.7..

4.9.7 Main Features of Rolling Stock

Table 4-10 Main features of rolling stock

Item	**Main features**			
Train set configuration	3 cars (2M1T)			
Passenger capacity (passengers)	Nominal passengers	Head car: With wheel chair space	Head car: Without wheel chair space	Middle car
	Seating	37	40	50
	Standing	157	152	165
	Total	194	192	215
Empty car weight (ton)	Mc	M	T	
	43.3	40.3	36.6	
Car Specification	Designated maximum speed		120km/h	
	Operation maximum speed		80km/h	
	Acceleration		2.5km/h/s	
	Deceleration	Normal braking	3.5km/h/s	
		Emergency braking	4.5km/h/s	
Car body	Car width	3,380mm		
	Car length	19,500mm		

Car body	Distance between coupler surfaces	20,000mm
	Roof height	3,655mm
	Floor height	1,150mm
	Bogie centers	13,800mm
Cab	Cab with ergonomic comfortable environment	
	Better visibility	
	Non-penetration cab end	
	Cab door in cab side	
	A door separating from passenger saloon	
	Crew seat horizontally and vertically adjustable	
	Laminated safety glass for windows	
	Electric windscreen wipers	
	Train Information System (TIS) screens on train driver's desk	
Passenger saloon	Comfort and safety	
	Longitudinal seating arrangement	
	Seat width of 500mm/person	
	Safe alighting and embanking for passengers	
	4 doors per side of each car	
	Minimization of gap between car floor level and platform level with adjustment function by load weighing apparatus of secondary suspension	
	Enough window strength and openable upon emergency	
	Assurance of safety in seating and standing during car operation	
	Maintainability of cleanness of inside panel	

Passenger saloon	Ventilation provision to inside car		
	Safety and smooth flow capability in gangways		
	Partition sliding door at the car end		
Design for the disabled	Good accessibility for elderly, infirm and disabled		
Ventilation	Emergency ventilation (agenda in detail design stage)		
Side door system	Type	Double type with effective opening width of 1,300mm	
	Power supply	DC110V (DC70V ～ DC110V)	
	Door guiding	Sliding rail type	
	Driving	Electric motor type	
	Control command	Command transferring serial from TIS	
Air conditioning system	AC 380V single phase from the tertiary winding of main transformer		
Lighting system	Power	Saloon lighting	220V AC
		Emergency lighting	110V AC
	Brightness	200 lux or more at 750mm above floor Based on JIS E4016	
	Headlight	200 lux at a distance of 180m	
Main circuit	PWM converter (conversion from AC to DC to AC)		
	Lesser maintenance provision requirement		
Pantograph	Type	Single arm	
	Line voltage	AC25kV	
	Operation type	Air	
	Operating device	Spring push up and air-controlled pull down	
	Operation height	Push up force is depending on catenary design	
		Height at folding, minimum operation, standard operation and strike protection are determined in detail design stage.	

Emergency ground switch	Recommended to be installed to cope with inability of power cutoff by VCB and abnormal drop-off of OCS	
	Type	Magnetically controlled air type
	Voltage	Single phase 30kV
	Operating pressure	780kPa (Minimum pressure: 60%)
	Operating voltage	DC110V ～ 70V
Transformer for instrument	Connected to pantograph and train earth	
VCB	Nominal voltage	AC 30kV
	Operating type	Magnetically controlled air driven for open and closed positions
	Operating voltage	DC 110V (minimum: 60%)
	Operating pressure	780kPa
AC Arrester	Type	Gap less
	Element	ZnO
	Arc voltage	Above 47kV (voltage of DC 1mA flow)
Main transformer	Voltage	Primary: AC 25kV
		Secondary: input voltage of PWM converter
		Tertiary winding output voltage: 380V AC single phase and 220V AC single phase
	Cooling type	Primary: pumped silicon oil thorough radiator
		Air cooling during train movement (fan may be used in case of large transformer)
Converter-Inverter	Main circuit type	1C2M
	Converter type	1-phase-3-level PWM converter
	Inverter type	3-phase-2-level PWM inverter
	Phase factor	1.0

Converter-Inverter	Cooling type	Self cooling with heat pipe	
	Maintenance performance	Easy replacement of power unit	
Traction motor	Type	3-phase VVVF squirrel cage induction motor	
	Number of poles	4	
	Cooling type	Self cooled	
	Strainer	Easy removable mesh type	
	Insulation of coil	Class H	
	Bearings	Insulated bearings	
Auxiliary power supply	Input voltage	380V AC 50Hz single phase	
	Output voltage	2-phase AC 220V, DC 110V	
	Availability	SIV is recommended	
	Main element	IGBT	
	Cooling type	Natural air cooling (fans for large type)	
Power supply for major equipment	Power voltage	Equipment	Remarks
	AC 380V single phase	Compressor Air conditioner Auxiliary power supply	For brakes Cooler with inverter AC220V, DC110V output
	AC 220V	Windscreen demister	Defroster
	AC 220V (SIV output)	Saloon lighting Cross current fan	Measure for crowded saloon condition
	DC 110V (SIV output)	Battery charger Control equipment TIS equipment Emergency lighting Head and tail lights Train radio equipment PA equipment Door operating equipment	

Bogie	Type	Bolsterless light weight type
	Axle box suspension	Axial beam system
	Wheel base	2,100mm
	Primary suspension	Coil spring and anti-vibration rubber
	Secondary suspension	Air spring
	Traction device	Single link
	Damper	Hydraulic horizontal and vertical damper
	Wheel diameter	860mm in new, 780 mm in worn, instead of 840mm and 770mm specified in FS
	Standard for bogie	JIS E4207
	Standard for axle	JIS E4501
Transmission equipment	Driving transmission	Cardan gear unit type
	Flexible coupling connection between motor and gear box.	
	Helical single reduction gear	
Brake gear	M car	Tread brake unit
	T car	Disk brake and tread brake units
	Parking brake	Air-off spring-applied type
	Brake block and lining	Composition material
Brake system	Air brake system	Electrical command type
		Correlation with e3lectrical brake
		Wheel-spin/slide control
		Electro-pneumatic control
	Security brake operable upon breakdown of normal brake.	
	In deadhead operation on section without catenary, supply of electrical power and compressed air from diesel locomotive	

Air compressor	Type	Scrol or screw type	
	Air capacity	1600ℓ/min.	
	Power supply	AC 380V single phase	
	Net working rate	Less than 50% in normal operation	
	Air dryer, oil separator and drain separator are incorporated.		
Coupling equipment	Outer end couplers	Compatible with those of Diesel locomotives	
	Mid couplers	semi-permanent coupler	
	Coupler height	880mm	
Safety equipment system (ATP)	Power input	DC 110V	
	ATP output	Normal brake output	Indication pattern upon over speeding
		Emergency brake output	For emergency or trouble
	Transmitter-receiver equipment	Compatible with wayside equipment specification	
	Car control unit	Pursuant to car specification	
	On-board system	Configuration shown in Fig 7.15.1 of JTK Report	
TIS	Car information controlling equipment	To send commands for driving, braking, door operating, setting and adjusting air conditioner through digital transmission. To collect information from car equipment and indicate it on the cab display and records it.	
	Central equipment & Terminal equipment	Power	DC 110V
		Transmission speed between terminals	Above 2.5 Mbps
		Transmission object	Twisted pair sealed line
	Transmission equipment	RS485 semi double bus	
		HDLC frame format	
		One polling selecting type	

Train Radio	Communication between driver and OCC
	Equipment located in the cab
	Power supply of DC 110V
Public Address system	Communication between driver and conductor
	Broadcasting in the car
	Power supply of DC 110V
Emergency alarm equipment	Call from passenger to conductor in emergency
	Communication between passengers and conductor
	Power supply of 110V

4.9.8 Common Contents

(1) Electro-magnetic compatibility

Protection of leakage of high frequency waves and also protection of affect by outside high frequency waves.

(2) Safety

System: safety and reliability

Head car: collision energy absorbing structure

Car body: materials with fire resistance

Electric cables: fire resistant

Equipment: protection from arcing or heat

Fire resistant structure of car and materials: as per MLITT

Fire extinguisher: 2 set for each car according to “22TCN 347-06”

(3) RAMS

High reliability, performance, maintenance and safety

Mean Distance Between Failure (MDBF): no more service delay beyond 5 minutes per 100,000km for guarantee operation period

(4) Noise & Vibration

Inside car at 600mm away from car end under 80km/h speed: less than 70dB

At the stopping condition: less than 68dB

(5) Ride comfort

Horizontal and vertical vibration: less than 2.8 Sperling ride comfort coefficient

4.9.9 Rolling Stock and Maintenance System

Intervals of periodical maintenance provisions (overhaul, semi-overhaul and monthly check) are provided according to newer Japanese regulation revised in 2009, instead those of FS which were based on old stipulation.

In case of cars other than Japanese, discussion with the manufacture is recommended.

4.9.10 Fundamentals in Basic Design stage

The following items are required to be properly configured in basic design phase.

(1) Car weight

This is essential factor for the review of axle load control (for track design etc.) and for calculation of capacity of power substation.

(2) Train length

It is necessary to determine the passenger capacity and to examine headway.

(3) Acceleration/Deceleration performance

The running performance of electric cars determines the characteristics of train operation plan for the route section. The two major train operation characteristics of route section are number of trains in operation and scheduled speed. The number of trains and scheduled speed largely depend on the acceleration/deceleration of the rolling stock. As number of trains in operation increases, transport capacity and passenger convenience also increase. Number of trains in operation is mainly determined by train acceleration/deceleration performance and signaling system. Scheduled speed, which is the average running speed including stopping time, is largely decided by train acceleration/deceleration performance and maximum operating speed and route conditions (i.e. speed limit at curve and maximum design speed). At the technology level in recent days, it is considered that scheduled speed decreases if number of train in operation increases and vice versa.

Under the assumptions of the above inclination, the following relationship is investigated for various urban railway systems around the world and the results described in the below are derived.

Number of trains in operation (trains/hour) ×Scheduled speed (km/h) = P

The typical range of this P for railway systems with fixed block signal system is from 700 to 800. For example, the Yamanote Line in Tokyo has scheduled speed of 34km/h, number of trains in operation of 24 (trains/hour), therefore, P=816. The Ginza Line in Tokyo has number of trains in operation of 30 (trains/hour), scheduled speed of 25km/h, therefore, P=750. In Washington Subway system, the scheduled speed is 56km/h, number of trains in operation drop to 13 trains/ hour, P=694. Applying the relationship to HURCP Line 1, if number of trains in operation is designed to be 15trains/hour, then the scheduled speed shall be attained to be around 45~50km/h.

Because acceleration/deceleration of most of Japanese rolling stocks is comparatively low, the schedule speed shows also comparatively low. Acceleration/deceleration of other countries rolling stocks is generally about 4km/h/s or higher which is higher than current average level of rolling stocks in Japanese railway system. Moreover, recent improvement of train operation control and protection system enables increase of both number of trains in operation and scheduled speed.

For HURCP Line 1, it is expected to materialize improvement of acceleration/deceleration of rolling stock so that the scheduled speed can attain the international standard level and also to equip the ability of train operation and protection so that the number of trains in operation can be also increased.

4.9.11 Evaluation approach in Rolling Stock Basic Design

The evaluation of technical items described in the JKT report was conducted in accordance with the following approaches. Note that those items are classified to the following three categories by evaluation viewpoints.

(1) Transport capacity of the entire route

From the perspective of transport capacity of the entire route, cost performance of rolling stock should not be considered as the only factor for deciding specification. Especially, acceleration/deceleration and maximum operating speed should be decided from cost performance perspectives considering transport capacity of the entire route.

(2) Relationship with the ground system

The related items are on-board signal devices, train radio on-board devices. Those items should be investigated in association with the ground system. Particularly, from aspect of the evaluation of rolling stock, it is necessary to evaluate the probabilities of occurrence of malfunctions or errors in on-board train operation as exemplified by human errors such as power input negligence and false operation of train operation devices.

(3) On-board system on its own accord

Those items includes on-board devices such as main circuit control system, brake control devices, running device, car body design, auxiliary power supply system, on-board train information management system, lighting device, air-conditioning system. It is judged that there is no significant issue when all technical items are in accordance with STRASYA standard. However, it is necessary to evaluate the items related to reliability and safety of brake control and door control. In addition, taking into account the rapid development of information technology, it is also necessary to evaluate on-boar passenger information and public address system.

Chapter 5: EVALUATION OF THE BASIC DESIGN

5.1 Evaluation Summary

Explanatory note:

- "Agreed" means that Evaluation team agrees with, assents to or affirms the descriptions or explanations stated in JTK's Basic Design Report of which essences are set out in Chapter 4 of this Report and, further, outlined in the column of "Scope of Description" of Table 5-1 hereunder.
- "Acknowledged" means that Evaluation team acknowledges or recognizes the descriptions stated in JTK's Basic Design Report of which essences are set out in Chapter 4 of this Report and, further, outlined in the column of "Scope of Description" of Table 5-1 hereunder.
- "Post basic design" means the timing before entering into the Detail Design stage.

Table 5-1: Summary Sheet of Evaluation on Electrification

No	Index in JKT Report	Scope of Description	Evaluation by Study Team	
			Evaluation	Requirement to response/ complement
1	1. AC ELECTRIFICATION SYSTEM			
	1.1. Type of AC Electrification System	Comparison of different AC electrification system	Agreed	———
	1.2. AT Feeding System	AT Feeding System	Agreed Refer to 5.2.1 (1)	———
	1.3. Operation Principle of AT Feeding System	Operation Principle of AT feeding System	Agreed	———
	1.4. System Voltage	System voltage	Agreed	———
2	2.TRACTION LOAD FOR ELECTRIFICATION SYSTEM			
	2.1.EMU	Specifications of rolling stock	Agreed	———
	2.2.Train Operation	Train Operation	Agreed	———
	2.3.Track Alignment	Track alignment	Agreed	———
	2.4.Traction Load	Traction Load	Agreed	———
3	3. TRANSMISSION LINE SYSTEM			
	3.1 Power Grid	HV Power Grid	Agreed	———
	3.2 Location of Railway Power Substation	Four survey Site , Survey Result and conclusion	Agreed	———
	3.3 Short Circuit Power	Mai Dong and Ha Dong substations	Agreed	———
	3.4 Meeting with Relevant Organization	Matter to be discussed at the meeting	Agreed	———

4	4.ELECTRICAL EFFECTS ON INCOMING TRANSMISSON LINE 4.1 Voltage Unbalance 4.2 Harmonic Current 4.3 Voltage Fluctuation	 Code , assessment and reduction of unbalance and short circuit power at SS Standard and assessment to harmonic current Standard and assessment to fluctuation	 Agreed Agreed Agreed Refer to 5.2.1 .(2)	 —— —— ——
5	5. TRACTION POWER SUPPLY FOR EMUS ON NGOC HOI COMPLEX	Traction Power Supply at Ngoc Hoi complex	Agreed	——
6	6. Feeding Transformer(AT)	Capacity of feeding transformer	Agreed	——
7	7.LOCATION OF AUTO TRANSFORMER(AT) 7.1.Location of Auto Transformer 7.2.Distance Between Auto Transformer 7.3.Evaluation 7.4.Conclusion	 Location of AT：Yen Vien、Gia Lam、Hanoi、Giap bat The interval of 6km between AT with regard to inductive inference to telecommunication and mitigation of rail potential	 Agreed Agreed Agreed Agreed	 —— —— —— ——
8	8. VOLTAGE OF OVERHEAD CONTACT SYSTEM	Calculation for voltage of overhead contact system at furthest position	Agreed Refer to 5.2.1 (3)	——
9	9. EARTH AND BONDING FOR PROTECTION	Rail potential and rail potential control device	Agreed	——
10	10. ELECTROMAGNETIC COMPATIBILITY 10.1.Study Item of EMC	 Induced voltage at normal operation, induced voltage under fault condition, noise voltage and electrostatic voltage and its current	 Agreed	 ——

10	10.2.Mutual Inductance between Railway and Telecommunication Cable	Mutual Inductance between railway and telecommunication cable	Agreed	———
	10.3.Countermsure for EMI	Countermeasure for electromagnetic compatibility	Agreed	———
	10.4.Further Study of EMC	EMC examination, decision on the limit and measurement of harmonics	Agreed	———
11	11.FUTURE ELECTRIFICATION SYSTEM REQUIRED FOR EXTENSION TO NHU QUYNH	Future electrification system regarding the extension to Nhu Quynh	Agreed Refer to 5.2.1 (4)	———

Table 5-2: Summary Sheet of Evaluation on Power Substation

No	Index in JKT Report	Scope of description	Evaluation by Study Team	
			Evaluation	Requirement to response/ complement
1	1.Basic Design Criteria			
	1.1.Purpose of Basic Design	Purpose of Basic Design	Acknowledged	———
	1.2.Design Standards	Design Standards	Acknowledged	———
	1.3.Abbreviations	Abbreviations	Acknowledged	———
	1.4.Traction Power Capacity	Traction Power Capacity	Agreed	———
	1.5.SS Location	SS Location	Agreed Refer to 5.2.2. (1)	———
	1.6.Basic Design Conditions	Basic Design Conditions	Acknowledged	———
2	2.Project Area and Scope of Works	Scope of Work of Phase 1 and Phase2	Acknowledged	———

3	3.Design Concept			
	3.1.Decision of SS Locations	Site conditions of SS, Determination of SS location, Calculation of voltage drop	Agreed Refer to 5.2.2 (2)	——
	3.2.Power Receiving System	Explanation and comparison of power receiving system (Type A, B and C)、Decision for adoption of Type A, Grounding resistance of SS	Agreed Refer to 5.2.2 (3)	——
	3.3.Transformer Facility System	Determination/calculation of Transformer capacity, Transformer type	Need to change the transformer connection	Post basic design
	3.4.Feeding System	Direction system and Up and down line system	Agreed Refer to 5.2.2. (4)	——
	3.5.Remote Control System	Operation mode, Remote operation, Centralized SS control system(CSC)	Agreed	——
	3.6.SS Type	Indoor type and Outdoor type of SS, Required area for SS	Agreed Refer to 5.2.2 (5)	——
4	4.SS System and Equipment	Examples of layouts for Indoor type and outdoor type of SS	Acknowledged	——
5	5. Maintenance	Corrective and preventive maintenance	Agreed	——

Table 5-3: Summary Sheet of Evaluation on Overhead Contact System

No	Index in JKT Report	Scope of description	Evaluation by Study Team	
			Evaluation	Requirement to response/ complement
1	1.Basic Design Criteria			
	1.1. Purpose of Basic Design	Purpose of Basic Design	Acknowledged	――
	1.2. Scope of Work	Basic design under scenario of train operation plan expected in 2030	Acknowledged	――
	1.3. Abbreviation	Explanations of abbreviations	Acknowledged	――
	1.4. Design Standards	Applicable design standards	Agreed	――
	1.5.SS Locations and ATP Locations	SS is located in Ngoc Hoi	Agreed Refer to 5.2.3 (1)	――
	1.6.Project Area	Project areas to be encompassed	Agreed	――
2	2.Basic Design Conditions			
	2.1.Climate Conditions	Specification of climate condition	Acknowledged	――
	2.2.Train Operation Condition	Train operation by 4M4T formation with 15trains per hour(headway of 4 minutes) and with max. operation speed of 120km/h	Agreed Refer to 5.2.3 (2)	――
	2.3.Rolling Stock Conditions (Pantograph)	Working range of pantograph is specified	Agreed Refer to 5.2.3 (3)	――
	2.4.Upper Structure Envelope	Upper structure envelope is specified.	Agreed Refer to 5.2.3 (4)	――

	2.5. Electric Condition	Nominal voltage of 25kV、maximum voltage of 30kV and minimum voltage of 22.5kV are specified.	Agreed	——
	2.6.OCS for Dual Gauge	OCS is designed for only standard gauge due to weakness of OCS adaptable to dual gauge.	Agreed Refer to 5.2.3 (5)	——
3	3. Feeding System (Feeding System Diagrams) 3.1.AT Feeding system (2x25kV Feeding System) and Section	Explanation of AT feeding system and section with Scott connected transformer	Amendment to Roof-delta connected transformer Refer to 5.2.3 (6)	Post basic design
	3.2.Feeding System Diagram	Description of Feeding system diagram for main line	Agreed	
	4.Overhead Contact Line			——
	4.1. Overhead Contact Line Systems	Explanation of characteristics of 5 type contact lines and recommendation of heavy simple catenary system for main line and simple catenary system for depot and side lines	Agreed Refer to 5.2.4 (1)	——
	4.2.Electric Wire and it's Tension	Explanation of characteristics of electric wires for contact line and messenger wires and contact line's tension and catenary structures	Agreed Refer to 5.2.4 (2)	——
	4.3.Feeder	Role of feeder in AT feeding system	Agreed Refer to 5.2.4 (3)	——
	4.4.Height and deviation of Overhead Contact Line	Height of Contact Line (max.:5.500mm,standard: 5,300mm, minimum:5,100mm), deviation in HURCP (max.:±300mm、standard:±200mm、at curved track:±250mm), and gradient (Main line: 3%, side line:15%) are specified	Agreed Refer to 5.2.4 (4)	——

	4.5.Standard Span Length	Standard span (50m) is specified	Agreed Refer to 5.2.4 (5)	―
	4.6.Tensioning Device	Spring type tensioning device is recommended	Agreed	―
	4.7.Insulator	Applied insulators are specified	Agreed Refer to 5.2.4 (6)	―
	4.8.Section	Same phase section in Depot and inside station and different phase section in front of SS are specified with explanations of their structures.	Agreed Refer to 5.2.4 (7)	―
5	5. Protection System 5.1.Protection of Feeding Circuit	Protection of Feeding Circuit is designated	Agreed Refer to 5.2.4 (8)	―
	5.2.Protection System	Protection system (protective wire method, pole ground connecting method) are described	Agreed Refer to 5.2.4 (9)	―
	5.3.Lightning Protection Cable	Lighting protection cable arrangement is described	Agreed Refer to 5.2.4 (10)	―
	5.4.Earthing System	Grounding method and arrangement is described	Agreed Refer to 5.2.4 (11)	―
6	6 Supports 6.1.Poles	Comparison of concrete poles and steel poles is provided.	Agreed	―
	6.2.Support System	Various support systems are described	Agreed	―
7	7.Overhead Contact Line at a Depot	Wires and arrangement of Overhead Contact line at Depot(Simple catenary system) is described	Agreed	―
8	8. Construction Plan	Construction plan of OCS for Phase 1 and Phase 2 is described	Agreed	―

9	9.Maintenance			
	9.1. Method of Maintenance	Breakdown maintenance and preventive maintenance are explained and adoption of preventive maintenance is recommended.	Agreed	——
	9.2.Inspection of Overhead Contact Line	Inspection by patrol and wagon, specific individual inspection and inspection by inspection car are described	Agreed	——
	9.3. Inspection Instruments	Catenary Installation car, Catenary Operation car and Catenary Measurement car are described	Agreed	——
	9.4.Maitenance Section of OCS	Personnel organization of maintenance section is exemplified Measurement items by typical electric inspection car in Japan are described and efficiency of providing OCS maintenance by such electric car is described.	Agreed	——
	9.5.Future Maintenance by Electric Inspection Car		Agreed Refer to 5.2.4 (12)	——

Table 5-4: Summary Sheet of Evaluation on Power Distribution System

No	Index in JKT Report	Scope of description	Evaluation by Study Team	
			Evaluation	Requirement to response/ complement
1	1. General			
	1.1. Purpose and Scope	The power distribution system has the important roles to supply powers to lighting and general machines of stations, OCC, Depot and other facilities.	Acknowledged	――
	1.2. Main Codes and Standards	Applicable codes and standards	Acknowledged	――
	1.3. Functional Requirement for Power Distribution System	Voltage levels are 3-phase 380V and 1-phase220V	Agreed	――
	1.4.Technical Requirements for Power Distribution System	1.Any equipment or supply failure shall not affect the system supply capacity. 2.Voltage drop shall be within allowance. 3.Any equipment shall be labeled. 4.Passing of wirings through building elements such as walls and floors shall be sealed according to fire resistance requirement.	Agreed	――
	1.5.Review of Method for Power Distribution System	Power loads shall be required to be re-examined pursuant to the revelation of station design shape.	Agreed Refer to 5.2.5 (1)	――
	1.6.Distribution Diagram for Power Distribution System	Distribution diagram of Power Distribution System	Agreed Refer to 5.2.5 (2)	――

2	2. Electrical Equipment			
	2.1.General	Descriptions of general matters	Agreed	——
	2.2.Switch Room and Power Supply Room	Switch Room and Power Supply Room	Agreed	——
3	3. Standby Generator			
	3.1.Scope	Power supply to essential loads upon failure of normal power supply	Agreed	——
	3.2.Codes and Standards	Applicable codes and standards	Agreed	——
	3.3.Performance Requirement	Sequence of start and stop	Agreed	——
	3.4.Type of Engine	Recommendation of Diesel type generator	Agreed	——
	3.5.Location	Location of the standby-generator	Agreed	——
	3.6.Fuel Storage Tank	Fuel storage tank	Agreed	——
4	4.Erthing System			
	4.1.Purpose and Scope	Protection of personnel from electric shock, minimization of damage to equipments etc or system failure, prevention of	Agreed	——
	4.2. Codes and Standards	interference to other electrical systems, applicable codes and standards.	Agreed	——
5	5. Lightning Protection System			
	5.1. Purpose and Scope	Protection from direct lighting strike to aboveground facilities/structures, equipment and personnel in protected zones.	Agreed	——
		Applicable codes and standards		
	5.2. Codes and Standards	Definitions of air terminal and bond	Agreed	——
	5.3.Definitions		Agreed	——

6	6 Cables ,Conduit ,etc. 6.1.General 6.2.Wiring and Termination 6.3.Usage of Cables	Wiring shall be placed on ladders or trays. Wiring with entry and termination Usage of F-CV、FP、NH-CE cables	Agreed Agreed Agreed	——— ——— ———
7	7.Preservation of Electrical Structure	Electrical structure for electrical enterprise and one's own use	Agreed	———
8	8. Procedure of Connection Agreement with Power Company	Connection agreement with Power Company	Agreed	———

Table 5-5: Summary Sheet of Evaluation on Signaling System

No	Index in JKT Report	Scope of Description	Evaluation by Study Team	
			Evaluation	Requirement to response/ complement
1	1. INTRODUCTION	Introduction of signaling system		
2	1.1 PURPOSE OF DOCUMENT	Purposes of the document	Acknowledged	———
3	1.2. SCOPE OF DOCUMENT	Scope of the document	Acknowledged	———
4	1.3. ABBREVIATIONS	Explaining abbreviations in the report	Acknowledged	———
5	1.4. DEFINITION	Definition	Acknowledged	———
6	1.5. DESIGN STANDARDS	Design standard	Acknowledged Refer to 5.2.7 (4)	———
7	1.6. PREREQUISITES OF DESIGN	Presenting prerequisites for design work	Acknowledged, See more 5.2.7 (1)	———
8	1.7. SCOPE OF WORKS	Scope of work	Acknowledged See more 52.7 (2)	———

9	1.8. DEMARCATION OF WORKS	Describing the signaling device installations	Agreed	———
10	2. BACKGROUND	Background of the project		
11	2.1. EXISTING INFRASTRUCTURE	Describing existing infrastructure	Refer to 5.3.6 (4)	In detail design
12	2.2. HURCP Line1 project	Describing HURCP Line 1 Project	Refer to 5.3.6 (6)	In detail design
13	3. FUNCTIONAL DESIGN	Functional specifications		
14	3.1. SYSTEM DESIGN LIFE	Describing the system life	Agreed	———
15	3.2. SYSTEM ASSURANCE DESIGN	Describing the availability, maintainability and various environmental conditions	3.2.2 Describing the system safety Refer to 5.3.6 (9) Others Agreed	In detail design
16	3.3. FUNCTIONS	System functions	Agreed	———
17	3.4. FUNCTIONAL REQUIREMENTS	Description of functional requirements 3.4.1 3.4.3 3.4.10 Fig. 1-5, 1-9, 1-10, 1-11, 1-12, 1-14	 5.3.6 (8) 5.3.6 (7) 5.3.6 (5) 5.2.7 (3)	 In detail design In detail design In detail design In detail design
18	3.5. SIGNALING SYSTEMS IN EACH PHASES	Signaling system in each phases	Agreed	———
19	4. CONFIGURATION DESIGN	Configuration of the system	Agreed	———
20	4.1. SYSTEM DIAGRAM OF SIGNALING SYSTEM	Signaling System Diagram Fig. 1-16	 Refer to 5.2.7 (3)	 In detail design
21	4.2. SIGNALING SYSTEM AND INSTALLATIONS	Installation of signaling system	Agreed	———

22	4.3. SIGNALING SYSTEM CONFIGURATION	Description of ATP equipment 4.3.3 Fig.1-24, 1-25, 1-26, 1-27, 1-28, 1-42, 1-43, 1-44, 1-45 Fig.1-25 or/and Gia Lam Station ,Giap Bat Station and Ngoc Hoi Station	Refer to 5.3.6 (7) Refer to 5.2.7 (3) Refer to 5.4.6	In detail design In detail design In detail design
23	4.4. INTERFACE WITH OTHER SYSTEM	Interface with other systems Fig.1-46, 1-47, 1-48	Refer to 5.2.7 (3)	In detail design
24	5. TECHNICAL CONDITIONS	Describing a comprehensive technical content of signaling system	Agreed	———
25	5.1. UNIFICATION OF SIGNALING SYSTEM FOR URBAN AND INTERNATIONAL TRAINS	Descriptions such as train operation safety	Refer to 5.3.6(2)	In detail design
26	5.2. WAYSIDE SIGNAL AND ASPECTS	Description on wayside signal and aspects	Refer to 5.3.6 (1)	In detail design
27	5.3. SIGNAL BLOCK LENGTH REQUIRED TO ACHIEVE THE REQUIRED OPERATIONAL HEADWAYS	Description on operational headway	Agreed	———
28	5.4. TRAIN DETECTION ALTERNATIVE AND OPTIMAL METHOD	Description on train detection method	Refer to 5.3.6 (2)	In detail design
29	5.5. SIGNALING SYSTEM ON ABNORMAL CONDITION	Signaling system on abnormal condition	Refer to 5.3.6 (3)	In detail design
30	5.6. CONSIDERATION OF INTRODUCING AUTOMATIC TRAIN OPERATION SYSTEM (ATO)	Description on automatic train operation system	Agreed	———

31	5.7. FUTURE DEVELOPMENTS OF SIGNALING SYSTEM	Concept for the future of signaling system	Agreed	———
32	5.8. DEPOT SIGNALING SYSTEM	Depot Signaling System	Agreed	———
33	5.9. INTEGRATION WITH ADJOINING RAILWAY LINES	Integration with adjoining railway lines	Agreed	———
34	6. CONSTRUCTION PLAN AND SCHEDULE 6.1. CONSTRUCTION PLAN 6.2. CONSTRUCTION SCHEDULE	Construction plan for signal system	Agreed	———
35	7. MAINTENANCE AND SPARE PARTS	Maintenance and Spare parts	Agreed	———

Table 5-6: Summary Sheet of Evaluation on Telecommunication System

No	Index in JKT Report	Scope of description	Evaluation by Study Team	
			Evaluation	Requirement to response/ complement
1	1. INTRODUCTION	Introduction of telecommunication system		
2	1.1. PURPOSE	Purpose of the document	Acknowledged	———
3	1.2. ABBREVIATIONS	List of abbreviations in the document	Acknowledged	———
4	1.3. DESIGN STANDARDS	Design standards	Refer to 5.2.8 (2)	In detail design
5	1.4. SAFETY, LEGISLATION, AND REGULATIONS	Safety, legislation and regulation related to telecommunication system	Refer to 5.2.8 (4) Refer to 5.2.8 (2)	In detail design In detail design
6	1.5. QUALIFICATION OF MANUFACTURER	Qualification of manufacturer	Agreed	———

7	2. EXISTING TELECOMMUNICATION SYSTEMS	Existing telecommunication system	Acknowledged	———
8	3. DEFINITION OF SCOPE OF WORKS	Scope of works in telecommunication system	Acknowledged	———
9	4. FUNCTIONAL REQUIREMENTS	Functional requirement	Refer to 5.4.7 (2)	In detail design
10	4.1. BACK-BONE NETWORK	The back-bone network 4.1.2	Refer to 5.4.7 (1)	In detail design
11	4.2. AUTOMATIC TELEPHONE SYSTEM	Automatic telephone system	Agreed	———
12	4.3. CABLES	Description about cables for the system 4.3.1, 4.3.3 4.3.2	Refer to 5.2.8 (5) Refer to 5.2.8 (2)	In detail design In detail design
13	4.4. TELEPHONE SYSTEMS FOR EXCLUSIVE USE	Telephone systems for exclusive use 4.4.4	Refer to 5.2.8 (2)	In detail design
14	4.5. TRAIN RADIO SYSTEM	Train radio system 4.5.2.5	Refer to 5.2.8 (2)	In detail design
15	4.6. TALK-BACK SYSTEM	Talk-back system 4.6.1 4.6.2	Refer to 5.2.8 (2) Refer to 5.3.7 (1)	In detail design In detail design
16	4.7. PUBLIC ADDRESS (PA) SYSTEMS	Public address system	Agreed	———
17	4.8. PASSENGER INFORMATION SYSTEMS (PIS)	Passenger Information System	Agreed	———
18	4.9. TIME DISTRIBUTION AND CLOCK SYSTEM	Time distribution and clock system	Agreed	———
19	4.10. WAY-SIDE DISASTER PREVENTION SYSTEM	The system for collecting wayside data such as rainfall and wind speed for disaster prevention purpose	Agreed	———

20	4.11. CENTRALIZED SUPERVISORY SYSTEM	The system for the concentrated supervision of signaling and telecommunication equipment at OCC	Agreed	———
21	4.12. CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM	Closed Circuit Television System		
		4.12.1	Refer to 5.2.8 (2)	In detail design
		4.12.2	Refer to 5.2.8 (2)	In detail design
		4.12.2	Refer to 5.3.8 (1)	In detail design
22	4.13. LIGHTNING PROTECTION AND GROUNDING SYSTEMS	Lightning Protection and Grounding systems		
		4.13.1	Refer to 5.2.8 (2)	In detail design
		4.13.2	Refer to 5.2.8 (2)	In detail design
23	4.14. POWER SUPPLY EQUIPMENTS	Power Supply Equipment	Agreed	———
24	4.15. MAINTENANCE	Maintenance for telecommunication system	Refer to 5.2.8 (3) Refer to 5.4.7 (1)	In detail design In detail design

Table 5-7: Summary Sheet of Evaluation on Train Operation System

No	Index in JKT Report	Scope of description	Evaluation by Study Team	
			Evaluation	Requirement to response/ complement
1	1. OPERATIONS AND MANAGEMENT	Overview of operation and management	Acknowledged	———
2	1.1 ABBREVIATION	Explaining meaning of various abbreviation in the document	Acknowledged	———
3	1.2 SCOPE OF WORK	Scope of work in the document	Acknowledged	———
4	1.3 GENERAL	Description about location, installation plan, environmental conditions, room layout, functional requirements and main equipment	Agreed	———

5	1.4 FUNCTIONAL REQUIREMENTS OF THE OPERATION CONTROL	Functions of the Operation control system, Facility control system, Station control system, Passenger information system, Train timetable scheduling system and Operation training simulator	5.3.8(1) 5.3.8(2)	In detail design In detail design
6	1.5 OPERATION REQUIREMENTS	Operation requirements, dispatcher, organization and number of dispatchers	Agreed	———
7	1.6 CONFERENCE WITH VNR TRAFFIC OPERATION CENTER ON OCC	Conference with VNR Traffic Operation Center on OCC	Agreed	———
8	2. FUNCTIONS OF OCC FACILITIES	Functions of OCC	Agreed	———
9	2.1 PURPOSE AND OBJECTIVES	Objectives of OCC	Agreed	———
10	2.2 DEFINITIONS	Definition of terminology in the document	Agreed	———
11	2.3 DESIGN CRITERIA	Design prerequisites, standard and code and basic design architecture (centralized or distributed)	Agreed	———
12	2.4 OVERVIEW OF THE SYSTEMS	External appearance of the OCC	Agreed	———
13	2.5 DESIGN CONCEPTS	Design concepts	Agreed	———
14	2.6 SYSTEMS PERFORMANCES	System performance	Agreed	———
15	2.7 HUMAN MACHINE INTERFACE	Human Machine Interface	Agreed	———
16	2.8 FUNDAMENTAL REQUIREMENTS FOR THE SYSTEM ON THE OCC	Fundamental requirements for the OCC	Agreed	———
17	2.9 CENTRALIZED TRAFFIC CONTROL SYSTEM WITH PROGRAMMED ROUTE CONTROL	Performance and equipment for CTC and PRC	Agreed	———
18	2.10 MODE OF TRAIN OPERATION	Three difference operating modes for abnormal condition	Agreed	———

19	2.11 CENTRALIZED SUBSTATION CONTROL SYSTEM	Overview of centralized substation control system	Agreed	――
20	2.12 CENTRALIZED MONITORING SYSTEM	Overview of centralized monitoring system	Agreed	――
21	2.13 PASSENGER INFORMATION SYSTEM	Overview of passenger information system	Agreed	――
22	2.14 TRAFFIC INFORMATION DISPLAY SYSTEM	Overview of traffic information display system	Agreed	――
23	2.15 WAYSIDE DISASTER PREVENTION SYSTEM	The system for measuring rainfall, wind speed at wayside for disaster prevention purpose	Agreed	――
24	2.16 OTHER SYSTEM	Interface with other systems such as train radio system, telephone system	Agreed	――
25	2.17 ESSENTIAL CONSIDERATIONS ON THE BASIC DESIGN OF OCC	Considerations such as mixed operation with NT, IT and dual gauge track	5.3.8(2)	In detail design
26	2.18 INTERFACES	Interfaces with telecommunication system and power supply units	Agreed	――
27	2.19 TEST REQUIREMENTS	Descriptions about various required tests	Agreed	――
28	2.20 MAINTENANCE OF OCC FACILITIES	Overview of maintenance for OCC facilities	5.3.8(1)	In detail design

Table 5-8: Summary Sheet of Evaluation on Rolling Stock

No	Index in JKT Report	Scope of Description	Evaluation by Study Team	
			Evaluation	Requirement to response/ complement
1	1. PRINCIPAL AGREEMENT	Vietnamese and Japanese standards and regulations: STRASYA, JIS	Acknowledged	——
2	2. PROJECT MAJOR TECHNICAL STANDARD	Overhead line voltage, gauge, maximum operating speed, minimum curve, etc…	Agreed	——
3	3. CAR SIZE	Train size, rolling stock gauge, etc…	Agreed	——
4	4. PASSENGER CAPACITY AND LORD	Train length, car width, sliding door, No. of seats, passenger capacity, etc…	Agreed	——
5	5. EQUIPMENT FOR CARS AND TRAIN STRUCTURE.	Comparative study on configurations of major on board equipment	Agreed	——
6	5.1 SYSTEM INTEGRATION	Overhead contact line system, pantograph, signaling system, train radio system and other related ground equipment	Agreed	——
7	5.2 TRACTION PROPULSION SYSTEM	Configuration of main circuit control devices and M/T ratio	Refer to 5.3.9(1)-1)	Post basic design
8	5.3 AUXILIARY POWER SYSTEM	Auxiliary power equipment, lighting, air-conditioning equipment, battery, etc…	Agreed	——
9	5.4 DOOR OPERATING EQUIPMENT	Door operation control mechanism	Agreed	——
10	6. CAR WEIGHT	Train formation and cars weight	Agreed	——
11	7. MAIN FEATURE OF ROLLING STOCK	Main devices of rolling stock	Agreed	——

12	7.1 TRAIN FORMATION	Train formation	Refer to 5.3.9(1)-1)	Post basic design
13	7.2 PASSENGER CAPACITY	Passenger Capacity	Agreed	———
14	7.3 EMPTY CAR WEIGHT	Empty car weight	Agreed	———
15	7.4 CAR SPECIFICATION	Maximum operation speed, acceleration, deceleration and other major specifications of rolling stock	Refer to 5.3.9(1)-1) Refer to 5.3.9(1)-3)	Post basic design
16	7.5 CAR BODY	Car width, car height, car length, driving cab, etc…	Agreed	———
17	7.6 PASSENGER SALOON	Seating capacity, standing capacity, priority seats, etc…	Agreed	———
18	7.7 SIDE DOOR SYSTEM	Driving method, open/close dispatch method, etc…	Refer to 5.4.9 Refer to 5.3.9(1)-2)	Post basic design
19	7.8 AIR CONDITIONING SYSTEM	Air conditioning equipment	Refer to 5.3.9(4)	Post basic design
20	7.9 LIGHTING SYSTEM	Lightning system	Agreed	———
21	7.10 MAIN CIRCUIT EQUIPMENT SYSTEM	Summary of main circuit, pantograph, ground switch, main transformer, VCB, converter, inverter, traction motor, auxiliary power supply device, etc…	Agreed	———
22	7.11 AUXILIARY CIRCUIT	Auxiliary power supply device	Agreed	———
23	7.12 BOGIE	Bogie type	Agreed	———
24	7.13 BRAKE SYSTEM	Brake system	Refer to5.4.9	Post basic design
25	7.14 COUPLING EQUIPMENT	Coupling equipment	Agreed	———
26	7.15 SAFETY EQUIPMENT SYSTEM	Safety System (ATP)	Refer to 5.3.9(2)	In detail design
27	7.16 TRAIN INFORMATION SYSTEM	Train information management device	Refer to 5.4.9	Post basic design
28	7.17 TRAIN RADIO EQUIPMENT	Train radio equipment	Refer to 5.3.9(3)	In detail design

29	7.18 PUBLIC ADDRESS SYSTEM	On-board Public Address System	Refer to 5.3.9(3)	In detail design
30	7.19 EMERGENCY ALARM EQUIPMENT	Emergency Alarm Equipment	Agreed	———
31	8. COMMON CONTENTS	Inductive inference, safety, RAMS, passenger convenience, vibration, noise, etc…	Agreed	———

5.2 Examination Result →

Category A : No response/complement is required

As a result of evaluation study and discussions with the design contractor, items that were judged not to require particular response or complement from the design contractor are as described below. The comments provided hereunder are supplement propositions.

5.2.1 Electrification System

(1) AC Electrification System

In Japan, AT Feeding method is used in all recent electrified railways because of its advantages as the same described in the JKT report, the selection of AT feeding method even for the HURCP Line 1 is appropriate.

(2) Electrical effects on receiving substation of Power Company

The basic design does not violate the regulations on voltage unbalance, harmonic current and voltage fluctuation.

(3) Voltage of Contact Overhead System

The standard voltage for the overhead contact system and voltage drop at furthest station is judged to be sufficient for train operation.

(4) Future electrification system required for extension to Nhu Quynh

It is necessary to consider the construction of new SS near Yen Vien Station for the future extension.

5.2.2 Railway Power Substation

(1) Location of SS

Criteria for selecting SS location, maximum allowable SS distance and possible one-side feeding distance are appropriate; therefore, the selection of Ngoc Hoi is reasonable.

(2) Voltage Drop

Assuming train operation of minimum headway, at the farthest position from SS, the receiving voltage of electric cars is above the required minimum voltage.

(3) Power Receiving Facilities

Because Ngoc Hoi is the only SS for the route, although the price is higher, the dual line power receiving system with two main transformers and two feeding transformers (one of the two is used as back-up) is judged to be appropriate.

(4) Feeding Transformer Facilities

The feeding transformer capacity is properly calculated. However, it is advisable to evaluate the use of the other type of transformer rather than the Scott-connected transformer.

(5) Land acquisition for SS

It is difficult to judge whether the location is optimal from general factors for selecting SS location. However, considering availability of land and easy access to receiving substation of Power Company, the selection of Ngoc Hoi Complex is reasonable.

5.2.3 Overhead Contact System

(1) Location of railway SS and AT posts

The feeding diagram was prepared according to the location of railway SS (near Ngoc Hoi station) and two AT posts. This diagram shall be the foundation for detailed design.

(2) Basic design criteria

The climate condition is in accordance with Vietnam Building Code. Train operation conditions are also consistent with other contents.

(3) Rolling stock condition (Pantograph)

At the basic design phase, the working range of pantograph and detailed data are described. It is understood that at detail design phase, further details shall be decided after confirming consistency with rolling stock plan.

(4) Upper Structure Gauge

It is understood that at detail design phase, further details shall be decided after confirming consistency with rolling stock plan.

(5) Overhead Contact System for 3-rail track

For pantograph of 1,000mm gauge and 1,435mm gauge, the possible deviation is 100mm in standard position of center positions, which is not favorable for enabling normal operation of both gauges at a contact position. Therefore, the overhead contact system is to be constructed for only 1,435mm gauge. This choice is appropriate from aspects to avoid unnecessary complication in studying further the measures for compatibility to both gauges at a contact line position and defining applicable standard in the detail design phase.

(6) AT Feeding System

Although the description of "Scott connection" remains in the JKT Report, it is understood that the description is to be revised to "Roof-delta connection".

5.2.4 Overhead Contact Line

(1) Types of Overhead contact line

Heavy simple catenary is adopted for the main line and simple catenary is adopted for sections at depot and side lines at station. Because uplift force and vibration amplitude of pantograph at high-speed section is small, these selections are judged to be appropriate.

(2) Electric wire and tension

It is understood that further investigation should be done in detail design phase.

(3) Feeder

It is understood that further investigation should be done in detail design phase.

(4) Height and deviation of overhead contact line

Although the height of pantograph and the standard deviation of contact line are shown, it is understood that further investigation should be done in detail design phase.

(5) Standard span length

The JKT Report described the standard span and standard deviation under condition of wind velocity at 30m/s. It is understood that, at detail design phase, alignment conditions should also be considered to define detailed specifications.

(6) Insulator

It is understood that further investigation should be undertaken in detail design phase.

(7) Sectioning device

It is understood that the final decision on sectioning device shall be made in detail design phase.

(8) Protection of feeding circuit

It is understood that at basic design stage, the basic policies are described and the more detailed description shall be made available in detail design phase.

(9) Protection System

It is understood that further investigation shall be undertaken in detail design phase.

(10) Lightning Protection Cable

It is understood that at basic design stage, the basic policies are described and the more detailed description shall be made available in detail design phase.

(11) Earthing

Because the measures taken for this item vary depending on the systems and/or equipment/devices, the content in the JKT Report is sufficient as a basic design report.

(12) Maintenance

The recommended maintenance method is appropriate. In respect to maintenance of catenary system, the content is appropriate at the basic design stage, however, further discussions and investigation must be undertaken in the detail design phase and the contents should be reflected to the staff training plan. Inspection equipment, maintenance body, inspection cars should also be subject to further investigation in the detail design phase and staff training plan.

5.2.5 Power Distribution System

(1) Review of power distribution system

The JKT report suggests that the load shedding of stations and OCC building shall be re-examined in the detail design phase, which is judged to be appropriate.

(2) Power distribution diagram

It is understood that the more detailed power distribution diagram shall be developed after the detail of power distribution system is decided in the detail design phase.

5.2.6 SCADA (Supervisory Control and Data Acquisition)

In the basic design stage, the described functional concept including remote supervising and control functions which are part of essential functions of SCADA for efficient supervision and control of power distribution and traction system is appropriate. The detailed system configuration with performance requirements will be developed in detail design stage in accordance with the determination of system configurations of related systems to be made in detail design stage.

5.2.7 Signaling System

(1) Regarding the overview of the signaling system according to the Basic Design Report:

The way-side signal equipment type (colored light signals), fixed blocks, first class electronic interlocking devices, gauges (1435mm, 1,000mm, or 1435mm and 1,000mm three-rail track), safety equipment (ATP Level 1 (ATS-P) and Level 2 (ATS-S)), electric points machines, lifetime and environmental condition numerical values are all common choices and values in recent railway industry, and it is believed that these are appropriate.

(2) The most important point for a railway is that the trains should be operated without confusion. For Hanoi Line 1, it is planned that in addition to the UT, NT and IT trains, and, in the future the case may be, high speed trains will also run over the line. Particularly in the situation where operations are disrupted in any matters, it is anticipated that various complex matters will be involved in managing operation control, and, therefore, the train operation control system will definitely play an important role.

As long as the daily work relating to normal train operations is performed without problems, it will be possible to carry out stable operations at regular schedule. It is presumed that these proposed in the Basic Design will be, under normal train operation condition, operable without problem.

Railway systems are made up from many sub-systems, and these sub-systems in turn consist of various devices each of which has own special kind of functions. Although many of these sub-systems and devices adopt redundancy configurations for improving the system reliability, there are also some sub-systems or devices that basically can not adopt redundancy structures. In order for operations to be restored at the earliest opportunity in the situation where these components have broken down, it will be necessary to instantly collect on-location information at the OCC so that when an abnormality occurs, swift and appropriate measures can be provided to the location to hasten the restoration of train operations and recover the trust of passengers to the train operation.

In the Basic Design Report, not only a management system that arranges train operation controller and also facilities controller (covering facilities, electric power, signaling, and communications) but also system configuration consisting of Centralized Traffic Control system (CTC) and Programmed Route Control system (PRC) in regard to train operation control and Centralized Substation Control system (CSC) and Centralized Signaling Monitoring system (CMS) in regard to management and supervision of electrical power and other electrical systemsare proposed.

These management system and system configuration are well prepared system for taking swift and appropriate measures immediately responding to the occurrence of abnormalities disturbing normal train operation even in on-location points.

(3) Concerning the various diagrams for Signaling system in the Basic Design Report, some of the diagrams, for example Figure 1-9 and 1-12, describe even the detailed parts. Since the basic design is defining only the outline of system configuration and

performance, it will be appropriate to show only the outline configuration illustrating schematic design, or to illustrate them as examples cited from other application cases.

(4) Concerning the standards referenced for Signaling system in the Basic Design Report, many of the standards described there are Vietnamese standards and JIS standards. Due to the move towards international standards and WTO agreements in recent years particularly in this field, there are some concerns about necessity of citing the ISO and IEC standards. In the meantime, this will not be a serious concern as long as Vietnam is not a member of the WTO and as long as no other special circumstances requiring international standard exists in Vietnam. If it is the case, it is judged that the references basically standing on the Vietnamese standards and supplemented by JIS standards or other equivalent standards will basically not be a problem in consideration of the fact that the project is a yen loan and STEP loan subject.

5.2.8 Telecommunication system

(1) Among the telecommunication system, the most important functions are secure the telecommunication links without interruptions and troubles, to allow smooth and safe train operations, between the trains and the OCC, between trains, between various locations and the OCC or between each location necessary for maintenance. The implementing of other general communications should also be possible without impediment.

In particular, for the telecommunications utilizing wireless between the way-side and the trains, it will be important to secure the reliability and processing security for the information regarding the train operations. It will be also necessary to precisely transmit the required details at the required time to the required train.

Although it is relatively easy to use high quality transmission methods such as optical fiber cables for the communications network between the way-side locations and the OCC, only wireless can be used for the communications between the wayside and the trains or between trains because the trains are moving. Particularly for responses in situations when operations are abnormal, large amounts of information will have to be continually transmitted correctly to each individual train, otherwise recovery operations will result in delaying or. in worse cases, a very dangerous situation will be created.

Accordingly, it will be recommended for train radio to use a dedicated frequency band that will always allow precise wireless communications and will enable interference from other sources to be eliminated while enhancing the security.

In the Basic Design Report, there is a description of a digital trunk system as train radio system exemplifying TETRA system which implies the terrestrial trunk radio system similar to multi-channel access radio system, rather positive indication for the radio system standing on dedicated wireless frequency band. There is acute anxiety about the likely possibility of causing problems in the train operations due to nonuse of the dedicated frequency band.

According to the result of the hearing by the evaluation team in this study, it was made known that the design contractor has explained to Vietnam Railways (VNR) that a dedicated frequency band is necessary. The response of securing the dedicated frequency band at an early period would be desirable.

In the basic design of the other communications systems, generally in addition to adequately satisfying the necessary conditions described above, it is believed that it will also be possible to secure a transmission capacity that will provide for the future expansion required by the Vietnamese side.

The combined use of optical communication cable routes and metal communication cable routes, the appropriate use of optical fiber cables according to system applications, and the establishing of a dual route main line network may look like a little bit too much redundancy at first glance, but it is judged to be a system design that also gives consideration to system breakdown responses and maintenance ability.

(2) In the telecommunications systems, the words "safe" and "safety" are used. For example, consideration should be given to the following expressions, among others.

Regarding "1.3 The telecommunication system will be designed, constructed, and tested always with a view to ensuring the safety of persons working on its construction," although the safety of workers is necessary, an expression such as "consideration with a view to avoid danger" would be recommendable.

Regarding "1.4 The telecommunication system listed in this document shall be designed for safe operation and maintenance," it is recommendable that the expression should be limited to "necessity for high reliability."

Regarding "The safety risk and workmanship of each design will be assessed before submitting to RPMU/VNR," it should be understood that the investigation of the risk concept in communications facilities is very difficult.

Regarding "4.3.2 Optical fiber cables are necessary for the transmission of fail-safe control and indications for signaling, and are therefore, part of the safety assurance of the signaling system," because there is no need for optical fiber cables as a requirement for the fail safe, it is recommendable that the expression should be "highly reliable control" or similar.

Regarding "4.4.4 Installation of the way-side telephone system shall take into consideration the geographical features in order to optimize utility and ensure the safety of users," it is recommendable that the expression should be "prevent danger to users" or similar.

Regarding "4.5.2.5 The on-board radio equipment shall be linked to each unit of the on-board radio equipment in order to monitor the soundness of the operating status of such equipment, thus providing assurance of safety and availability," it is recommendable that the expression should be limited to "assure the reliability and availability."

Regarding "4.6.1 This system is essential to ensure the safety of in-yard workers by location," it is recommendable that the expression should be "prevent danger to workers" or similar.

Regarding "4.12.1 In order to support and increase the safety of transportation, CCTV systems are installed at stations," it is recommendable that the expression should be "increase the reliability" or similar.

Regarding "4.12.2 monitoring the safety of passengers, especially disabled passengers, on and in the vicinity of lifts and escalators," it is recommendable that the expression should be limited to "protect passengers from danger."

Regarding "4.13.1 Power sources supplied from a transformer for power distribution shall be insulated to ensure safety and reliability," it is recommendable to omit "safety" and limit the expression to "availability and reliability".

Regarding "4.13.2 To secure the safety and reliability of equipment, a grounding system shall be installed at all stations for equipment and cable lines," it is recommendable to omit "safety."

Because the telecommunications system are one of the sub-systems of the safety-related systems and have few parts that directly relate to safety, it is recommendable to use expressions such as "protect workers from danger" or "increase the reliability" in order not to be mistaken for the strictest meaning of "safety."

(3) Telecommunications sometimes cannot convey information to locations that you wish to reach, and may also reach locations that you do not wish them to reach. While it is believed that responses can be made for many parts by planning the actual propagation characteristics of the radio waves, it is thought that these planning process should be clarified with more concrete time schedule of design development. It is desirable that the fact of the necessity of carrying out on-location transmission testing including measurement of the information error rates in the future should be described in the Detailed Design Report.

(4) In the Basic Design Report it will be desirable to describe the necessity of presenting the testing method and testing results including emissions and immunity relating to the EMC in the Detailed Design Report. In addition, the fact that these must conform to the Vietnamese standards means that it will be necessary to define them clearly.

(5) Although "Cables" are described in 4.3, which comes after 4.2 Automatic Telephone Systems, it was noticed in 4.3.1 and 4.3.3 that descriptions are given only for cables relating to telephone systems, which is liable to cause misunderstanding (4.3.2 is clearly limited to referring to telephone systems). It is believed it would allow easier understanding if "Cables" are described in the final section, which should collect together descriptions of the kinds of cables used in each system.

5.2.9 Train Control system

(1) For the functions of the OCC described in the Basic Design Report, although each of the equipment, sub-system, and system configurations and functions are described, the descriptions from the operations point of view of the methods of responding in the case of abnormalities, the training, and education are given separately. However, even if the equipment of the railway system is excellent, it will not function if the organizations that carry out the maintenance, operations, and management are not clearly organized, and train operations will also not be possible. Unless these are constructed by the system hardware at the same time that the education and training is carried out as the software, the system can not be established. Accordingly, in the Detailed Design it will be necessary to specify the necessity and requirements, from all-around view, relating to the means of constructing these responses in times of abnormalities.

(2) As partly above-described, even if the railway system equipment is excellent, it will not function if the organizations that carry out the maintenance, operations, and management are not organized, and train operations will also not be possible. Unless these are constructed by the system hardware at the same time that the education and training is carried out as the software, the system can not be established.
In the OCC Basic Design Report, the OCC organization and system is clearly described, and the work system is also specifically proposed.
In the meantime, although education and training concerning the new facilities will of course be required, for the reason that the education and training for Line 1 will require implementation in all the fields from driver training to train inspections, electric train lines, signaling and communications, and maintenance, it will be recommendable to investigate the new system education implementation method at the same time that the detailed design is being investigated.

5.2.10 Rolling Stock

Apart from items affecting scheduled speed and passenger convenience such as maximum operating speed and acceleration performance, to which study team has comments as described in later, other items are judged to be appropriate.

5.3. Examination Result

Category B : Comments Low Importance

The following comments are expected to be noted by the design contractor and/or other related organizations and to be incorporated into the design works in Post Basic Design stage and/or Detail Design stage.

5.3.1 Electrification

The JKT Report mentions that the feeding transformer shall be Roof-delta connected. In the detail design phase, it is necessary that the feeding transformer connection is decided and substation system and overhead contact system are more detailed in the detail design report.

5.3.2 Railway Power Substation

As above

5.3.3 Overhead Contact System

(1) Poles

As the poles supporting overhead contact lines in the Basic Design, the following poles with the support system and poles are recommended.

For main tracks: concrete poles or steel poles, both of which are popularly applied in Vietnam, with hinged cantilever

For depot: concrete poles with steel pipe beam, or portal structure with steel pipes.

In consideration of lightweight and quake-resistance of steel poles compared with concrete poles, the poles on the elevated bridges are recommended to be steel pipes. If the manufacturing of steel pipes is available in Vietnam, it will be the best selection.

5.3.4 Power Distribution System

No comments

5.3.5 SCADA

No comments

5.3.6 Signaling System

(1) Concerning the Mixture of Trains

The operation of the urban railway trains (UT) and the locomotive-drawn national trains

(NT) and international trains (IT) on the same line will cause a large reduction in the train operation efficiency. That is, in the situation where locomotives and electric trains which have different acceleration and deceleration performances are all running on the same line, the electric train operations will have to match the locomotives with their inferior operating performance, so that the line's overall train operating efficiency will be reduced. In the Basic Design, the block section of the line is planned pursuant to a 4-minute head. Since both types of UT trains and NT and IT trains are running on the same three-rail track, the block sections must be made the same and consequently will be divided based on the acceleration and deceleration rates of the slowest train. Accordingly, although the time interval will be 4 minutes, none of the trains with higher performance will be able to exert their speed and acceleration performance, and the scheduled speeds will be considerably reduced.

As a method of resolving this problem, one way would be to carry out block sectioning that matches the UT train performance while setting signal aspects that would enable the NT and IT trains to run using these block sections. For the UT trains in this method, the trains would run by uplifting the signal aspects obtained from block sections. However, because this method will complicate the design and control, meticulous care will be required regarding the detailed design and operations. In particular, it is presumed that if education and training relating to the safety investigations and maintenance technology is correctly given but not continuously implemented, the maintenance management will become difficult. Accordingly, as a future investigation issue, it will be necessary to clarify these details in the plans for education, maintenance and training.

(2) Concerning the Three-rail Track

In the situation where the UT, and NT and IT trains run on the three-rail track circuit, the coupling and separation by interlocking for standard gauge and M-gauge will always be required when trains approach and leave the three-rail track. This coupling and separation function basically utilizes information from the standard gauge and M-gauge train detection in the three-rail track circuit to implement the processing response using the interlocking equipment. In the situation where a standard gauge train is detected, the device will be interlocked so that the routing of the train to approach or leave the M-gauge track can not be implemented. In this situation, as long as the equipment operates correctly there will be no particular problem, but in the case of abnormalities or breakdowns there will be a possibility that the train detection will output information stating that trains are present on both the standard gauge and M-gauge outputs. In this kind of situation, it will be acceptable if all trains can be stopped and can wait until the three-rail track circuit equipment restores to normal operation, but in high-density line sections this often cannot be permitted, and an early recovery is expected. Accordingly, the trains will have to be operated through guidance by manual signals, and since this judging is carried out through intervention only by humans, the possibility of making mistakes resulting from human intervention will have to be permitted.

As a means of avoiding these dangers, all of the locomotives and trains should be provided with storage devices that memorize own train number. This number will be received at the way-side, and discrimination between the standard gauge and M-gauge will be carried out. Since the method of carrying out operations by matching the judgment by the person in charge on location with the judging of the train number on board the train to enhance the safety can be considered, it will also be necessary to investigate this method.

In any case, because the possibility of this type of abnormality occurring is not zero, in consideration of how to secure safety in this kind of situation it is recommendable that the importance of constructing a system as an organization including education and training should also be described in the Basic Design Report.

Because trains from many directions will run on Line 1, there will additionally be stations where trains will not stop, depending on the type of train. This means that if train type recognition is not secured, it will cause a major impediment to operations, and it is believed that it will be necessary to clarify the method for recognizing the mixed trains.

(3) Concerning the Train Classification

As described above, because the gauges are different for the long distance trains and the urban railway trains, the trains will run on a three-rail track. However, from a safety viewpoint, the safety must be secured by clearly discriminating the long distance trains from the urban trains at the forefront station of the gauge track section. For this purpose, an operation method should be adopted in which verification of the way-side train scheduling information against the train number memorized in the train number storage device on the train must always be carried out at either the departure station or the forefront station, and only in the case where the settings are correct should the departure signal give the indication to proceed. Accordingly, it is believed that the introduction of this equipment will be necessary. Further, to respond in the case of abnormalities, and from a safety viewpoint, all of the interconnecting stations should be equipped with three-rail tracks so that operation of trains with different gauges can be freely carried out.

(4) Regarding the on-location wayside equipment, although it is assumed that all of the equipment including the installations in rolling stock depot will be newly constructed, depending on the progress conditions of recently constructed and related projects it will be desirable at the detailed design stage to clarify equipment that is to be re-used.

(5) Regarding level crossings, the reason for choosing the point control system is unclear. Rather, it would be recommendable to use the continuous control system. This is for the reason that in the case of the point control system not only will the control circuit require a recording circuit which will make it more complicated, but since the power supply will also need to be made uninterruptible a battery will be required that will be troublesome to maintain. Because many of the locations where the level crossings will be installed are on roads inside the Ngoc Hoi depot and on workers' roadways where there are no track circuits, detection has been determined to be carried out using level crossing detectors. However, for locations where track circuits can be used, these should be used. In addition, it is also believed it will be good to employ continuous type train detection to avoid having to make the control circuits more complicated.

(6) In "2.2.3 Other Projects" of Signaling system of the Basic Design Report, it is unclear how these other projects will affect this plan. Regarding adjacent stations that have different systems, the requirement to exchange information regarding safety will certainly be created. Although the Basic Design Report considers a system construction based on the precondition that the party providing the safety-related information should secure the safety of that information, it is believed that investigations into the safety-related information should be carried out in the Detailed Design Report.

(7) While "3.4.3 Rail Breakage Detection" in Signaling system of the Basic Design Report gives a description using the Train Detection System function, there will be dead sections in the point interlocking sections and rail breakage detection will not be possible in these parts. The parts relating to this should be clarified in the Detailed Design Report.

(8) Concerning the ATP, although the signal aspects will be uplifted to allow high speed responses for UT trains, it is believed that investigations should be carried out together with the detailed design regarding the safety of uplifting the signal aspects on board in the three-rail tracks.

5.3.7 Telecommunications system

(1) Concerning "4.5.2.5 On-board Radio Equipment" of Telecommunication system of the Basic Design Report, the EN standards number is described in this part. it is desirable that more commonly used standards such as ISO or IEC should be cited.

5.3.8 Train Operations Control system

(1) In the Basic Design Report, equipment is described that will not require CCTV image information taken inside the station premises and in other locations to be monitored in the central control room. However, it will be recommendable that the equipment should be capable of adding the function in the future. With respect to the feasibility f this additional function, although CCTV monitoring will not be installed in the central control room when the line is opened, it is believed that this will not be a problem since the capacity of the communications lines is designed with a surplus that will support the additional installation of CCTV monitoring in OCC in the future.

(2) In the train timetable production system, it will also be necessary to investigate the future IT and NT train operating schedules. For example, in the situation where the IT and NT trains have delayed arrivals, situations will be created that will require the alteration of timetables, the display and announcement of train guidance, and departure delay control for the UT trains. In the Basic Design Report, although the proposal of estimated timetables including for UT trains is not planned in the train operation system, guidance regarding delays to IT and NT trains will be required as for UT trains. Further, in the situation that trains are required to deter the departure, the direction is taken of prioritizing the UT train operations the reverse will be the case in which the IT and NT trains will be delayed, and it is presumed that the exchange of instructions and continuous discussions with VNR will become important.

5.3.9 Rolling Stock

(1) It is thought that planning process of the train operation plan presumed from the descriptions of the Basic Design is supposed to be irregular. The planning is to be implemented to study the issues described in ①,②, and ③ below and, then, the more detail studies are to be extended to each of rolling stock, electric power system, signaling system and telecommunication system etc..

① Setup of performances required for rolling stock and substations by simulation

The required performance of rolling stock should be evaluated from perspective of total transport capacity of the line. For that reason, simulation becomes essential. The comments on the simulation results are as follows.

The acceleration of rolling stock was increased from 2.5km/h/s to 3.5km/h/s. Note that 3.5km/h/s is the standard value for acceleration of Japanese subway rolling stock. The world level is much higher. It is known that the acceleration of rolling stock in most urban system around the word is about 4.5km/h/s. Therefore, it is necessary to undertake the review of rolling stock performance with higher acceleration.

Higher acceleration performance of rolling stock results in the increase of peak demand at substation. However, it does not necessarily mean that higher acceleration requires more power consumption. It stands as a matter of course, on the assumptions that both trains runs the same section at same traveling time. For example, a 6M0T train and a 3M3T train operate in the same station to station section; in case that the 3M3T train requires T-min. to travel the whole section, the energy consumption required for 6M0T train running at the same T-min. on the same section was proved not to exceed the energy consumption of 3M3T. It is confirmed in past simulation examples that when a train travel between two stations, the running patter with higher acceleration starting, constant speed running, coasting and higher deceleration stopping is the most economical in term of energy consumption (This was appearing on some of academic dissertations in Japan).

Although higher acceleration results in the increase of peak power demand at substation, reduction in total energy consumption and improvement in transportation efficiency can be expected. Therefore, it is expected that a comprehensive evaluation shall be re-implemented so that train operation can attain the world level.

② Shortening stopping time at stations

The stopping time of 1 minute is exceedingly long. It is heard that this is required by operator. It is advisable to confirm the reasons for such a long stopping time and persuade the operator that, unless there are overflowing passengers by all the four side sliding doors, such a long stopping time is unnecessary. For subway systems in U.S. and Europe, the train stopping time is less than 40 seconds without exception. In Japan, there is also number of stations where train stopping time is less than 40 seconds. If it is the real case that more time is required to handle overflowing passengers, it will be conceivable, as one of solution, to increase the number or width of side sliding doors that will enable shortening of the time for boarding and alighting of passengers with about 10 seconds easily.

Scheduled speed and train frequency are two influential factors on performance of an urban railway system. Increase in train stopping time shall have impact on these both factors. Therefore, it is recommended that train stopping time should be shortened. If the stopping time is shortened, the scheduled speed will increase, travel distance per unit of time will also increase, which means that rolling stock cost will be made comparatively cheaper. In addition, shortening train stopping time also leads to energy-saving in train operation. This energy-saving train operation can be realized by decreasing maximum operating speed while keeping high acceleration and high deceleration.

③ Settlement of maximum operating speed

In the TOR, although the maximum operation speed is stated as 120km/h, other values such as 100km/h and 80km/h are also mentioned. It is necessary to decide the maximum operation speed in early stage by carrying out simulation. It is also noted that, if interval between stations is short and acceleration is poor, higher maximum operating speed can not be attained. It is therefore necessary to study the relationship between acceleration and the attainability of target operating speed. Furthermore, although it is responded that maximum speed of 120km/h is applied to the train operation with rapid service. Since the schedule speed will be able to be improved in rapid service, M/T ratio is thought to be decreased, in such case, corresponding to substation capacity.

(2) Input power interlock of safety device

It is extremely dangerous if the train travels while its on-board ATP device is out of power supply. The operation control circuits must be interlocked so that a train can not run if the ATP device is out of power.

(3) System compatible with information society

It is understood that the on-board passenger service facilities is only for the conventional passenger information provision. In the era of information technology, provision of information about train operation to passengers via media transmission devices should also be considered. Furthermore, if data transmission to ground by highly reliable train radio system is possible, many other applications can be developed.

(4) Air-conditioning device

Although air-condition device is equipped, there is no other information presented. Because in winter, temperature may drop significantly, heating device should also be studied.

5.4. Evaluation Result

Category C : Comments of high importance

Since the following comments are with significance, re-examination of the design contractor and/or related organizations to those are required.

5.4.1 Electrification

No comments

5.4.2 Railway Power Substation

No comments

5.4.3 Overhead Contact System

No comments

5.4.4 Power Distribution System

No comments

5.4.5 SCADA

No comments

5.4.6 Signaling System

In station yards where there are operations of UT, NT, and IT, many facilities such as turnouts and point interlocking exist. Abnormal condition is therefore throne to occur. Even in such a case, train should be freely operated. For this reason, even if there is no platform, the track layout in station yard must be 3-rail track. This must be further investigated in the detail design phase. Currently, it is thought that a part of track in Gia Lam station and Giap Bat station is not planned for 3-rail track.

5.4.7 Telecommunication System

(1) Securing the wireless communication in desired area is not always possible. It is anticipated that unavoidable condition may happen after completion of wave propagation test. The detail design report must mention the necessity to define parameters after implementing essential measurement in construction phase.

(2) The wireless communication system must be designed in consideration of Vietnamese law on wireless communication. Furthermore, in this project reliability and safety are indispensible requirements. Accordingly, public frequency band must be avoided and dedicated frequency band for railway should be secured.

As result of discussion with design contractor JKT, they are also fully aware of this point. They have has already discussed the necessity of securing a dedicated frequency band to technical committee of RPMU/VNR. It is desirable that this dedicated frequency band will be decided in early stage.

5.4.8 Train Operation System

No comments

5.4.9 Rolling Stock

Data transmission and command requiring safety by on-board Train Information System (TIS)

Train Information System (TIS) has redundant configuration which can strictly detect failures. However, it does not have a perfect fail-safe function. Therefore, it is obviously recommend to avoid complete reliance on it in transmission of control date or command which are directly related to human life. In concrete, it is said that this system is not appropriate as ultimate line for transmission for side door command and brake control.

In respect to handling procedure of side door opening command, door can not be opened only by opening command by TIS. It is desirable that cable connection connected in series with actual contacts for transmitting door opening command is provided. It is advisable that TIS will be useful to collect information of door operation status but not to use as the ultimate door control device.

Regarding brake control, it should be avoided to leave the complicated control such as the control which unable to detect by separate system with function detecting the lack of braking force to TIS.

Taking the application of uniform brake control for the entire train set as an example, failures can not be detected by simple brake force detection system. Therefore, TIS is used to detect the failure in its brake control function. However, this is inappropriate as those devices such as TIS are not yet proved to be perfect fail-safe.

Conventionally, service brake command is transmitted by a non fail-safe system. However, in case that the brake control command fails and the command can not be transmitted, the failure is detected by the lack of braking force performed by brake force detection system as separate system.

The response by design contractor to above specified points is that "TIS is adopted by many and big railway companies in Japan and used for such function, and also noting has experienced under the fact that the system has been adopted over 10 years and for about 2000 electric cars".

Nevertheless, according to IEC and RAMS standards (i.e.IEC62279), past records do not ensure safety. In Japan, IEC and RAMS standard will be authenticated by a public agency in the near future. For this project, whether IEC standards are applied to rolling stock or not, it is strongly recommended that the use of TIS should be re-examined in order to ensure high safety requirement.

Chapter 6: COMPREHENSIVE REMARKS

The study team has implemented the study on the validity of basic design for E&M system of HURCP Line 1 in accordance with the TOR specified by JICA.

With respect to the project review, it is understood that the basic study has been completed and works unrelated to E&M system such as route alignment and civil works are out of scope in this study. Therefore, in this section, our study focuses on background and premise configuration of various specifications for E&M system.

In the technical evaluation of E&M system, our team obtained clarifications and additional explanations, through discussions and meetings with the Implementing Agency (RPMU) and the design contractor (JKT), to our initial comments and questions on items mentioned in the Basic Design Report, and assembled our conclusions in the Chapter 5 of this report

In this chapter, we address our remarks and impressions on the overall implementation of this study as well as technical issues about which we are not able to fully present in the descriptions in the Sub-Chapters of each system disciplines provided in the previous Chapter 4 and 5.

(1) Laws and Regulations

We conducted investigation on Vietnam, Japanese and International standards and regulations which provide basis for the basic design by JKT and classified them according to each subsystem of E&M system . However, unlike the situation in Japan in which the railway technical standards related to E&M system are organized in a systematic way, in Vietnam these standards have not been developed. For this reason, it is difficult to judge that all the applicable standards and regulalations are fully included. We understand that this is a bottle neck in the basic design phase.

Nevertheless, in June 2009, a study funded by JICA was implemented to formulate railway regulations and technical standards in Vietnam. The draft report of this study is under review by the authorities concerned. If these regulations and standards are enacted, design work shall follow those firm standards, therefore, the design contractor can conduct their work easier.

(2) Train Operation on Dual gauge of 3-rail track

As mentioned in Chapter 3, we brought up several issues, in the evaluation process of several E&M subsystems, in relation to train operation on dual gauge and hold a series of sessions of questions and answers with the design contractors for manifestation of accompanying challenges, which brought a common understanding about no other alternative solution but dual gauge system. However, the understanding is reached with reservations that in order to achieve efficient train operation for UT, more detailed investigation about conditions of compatibility of train operations of UT with higher running capability and NT/IT with slower acceleration/deceleration capability must be carried out. Therefore, in the detail design phase, it is necessary to exercise further effort for defining more specific requirements and rules about this mixed operation.

(3) Necessity of coordination between functions of different systems

In the Basic Design Report, generally each subsystem becomes the main unit for description. We have impression that the description about functional coordination between these subsystems is not thorough enough.

For instance, when configuring specifications of rolling stock, the study process (such as Configuration of transport capacity →Running simulation→Rolling stock specifications) should be described in the Report. In like fashion, it is recommended that the descriptions about the affects to the determination of specification of a system from the other system such as the dealing of rolling stock specification with the capacity determination of electric system should be added for easier comprehension.

(4) OCC

Emergency response of electric system and telecommunication system is one of critical functions of OCC. According to the individual Basic Design Report for OCC, under 4-minute headway train operation, emergency response is examined to be effected by the method that the prompt recovery is taken on three-shift basis for signal dispatch, telecommunication dispatch and electricity dispatch and during the pause of maintenance (downtime of not only train operation but also maintenance work). However, in respect to emergency response particularly for electric power system and signal system, it is recommended to present, in the Basic Design Report, the optimal measures to emergency cases from comprehensive examination over individual systems which clarify functions, in such emergency case, of both of hardware and software of all role-sharing systems.

(5) Operation, Maintenance and Staff Training

In railway system, operation and maintenance are extremely critical. If a comprehensive plan is not well-prepared, even if modern facilities are equipped, their functions can not reach its full capacity. For this reason, it is essential that, in conceptual and basic design process, a comprehensive consideration and, consequent requirements, to design, manufacturing, setting up, operation, maintenance and disposal should be described.

Particularly, in Vietnam, this project is the first high speed/high density urban railway system. Therefore, it is required to understand how to secure reliability and safety for operation, maintenance and management under high speed/ high density condition. Thus, staffing training is so important that it should be mentioned in the Basic Design Report.

(6) Time Constraint

In this study, the evaluation was carried out in considerably fine detail through meetings and discussions with the design contractor. However, considering the fact that time period in Vietnam was limited to 1 month, it was difficult to say that all related data and materials were fully reviewed. However, this evaluation report was assembled with every effort in the manner reviewing the results of discussions held in Vietnam and information/materials provided subsequent days and also on the basis of technical knowledge obtained from experiences in the railway industries.

(7) Collection and review of data, documentation and reference materials

We have received various data, documentation and reference materials from the design contractor. As mentioned above, due to the time constraint, we could not thoroughly examine all these documentations in details. In order to cover the adversity, we actively conducted direct interviews with the design contractor to verify the data and calculations.

(8) The Implementing Agency (RPMU)

In this project, we had two meeting with RPMU, the Implementing Agency of this project. Particularly, the meeting on December 3, 2010 on E&M system was very meaningful for our study team. We could feel the Vietnamese's enthusiasm to develop the urban railway system in their country.

(9) Minutes of Meeting

For each meeting with the design contractor, we used recorder to record the conversation in order to fully understand ideas of counterpart. After that, we prepared minutes of meeting and emailed to the design contractor to avoid any misunderstanding.

(10) Cooperation from the design contractor (JKT)

As a characteristic of this study, it is difficult to understand the background and basis for basic design just by examining the Basic Design Report. Therefore, additional information is required to be explained by the design contractor.

The design contractor responded in a friendly attitude for keeping open for the evaluation team, though they were pressed by their design work, and providing answers to the wide variety of questions in writing or by e-mail from the evaluation team.

(11) Comprehensive evaluation

As mentioned in Chapter 5, there are some items for which we commented about the further design works to be carried out in the detail design phase to append additional clarifications and directions etc. to the system specifications. However, as a whole, **the Basic Design by the design contractor is judged to be reasonable and proper.**

Concluding remarks

Lastly, our evaluation work benefited greatly from the cooperation of JICA, contractor of this evaluation work, RPMU, the implementation agency of this project and JKT, the design contractor in collection of information, request for explanation/clarification, several-time meetings and deliberations. Taking this opportunity, we wish sincerely to express our gratitude to those who extended their generous support and cooperation to our study work.

LIST OF STANDARDS	
Title or description	Registered Number of Standard
Fire and Explosion Protection	
Vietnamese Standards	
Fire alarm system	TCVN 5738 :2001
Fire extinguishing system - General requirements for design, installation and use	TCVN 5760: 1993
Fire safety - equipment and water tank	TCVN 6379: 1998
Fire protection - Automatic sprinkler systems - Design and installation requirements	TCVN 7336 :2003
Fire warning systems - Technical requirements	TCVN 5788: 1993
Protection of Structures Against Lightning - Guide for design, inspect[on and maintenance	TCXDVN46:2007
Transportation Works and Structures	
Vietnamese Standards	
Technical Railway gradation	22TCN 362-07
Railway gauge 1435mm-Design standard	TCVN 4117:1985
Technical specification for designing railway gauge 1000mm	433/QD-KT4 1976
Regulation on Crossing Road	15/2006/QD-BGTVT
Telecommunication work	
Foreign Standards	
IEC International Electro technical Commission	
IEEE Institute of electrical & Electronics Engineers	
NEMA National electric Manufactures Association	
NEC National electric code, USA	
ICAO International Civil Aviation Organization	
Electrical system	
Vietnamese Standards	
Installation of electric line in building and public structures-Design Standard	20TCN25-91
Installation of electric line in building and public structures-Design Standard	20TCN27-91
Electrical Equipment Code	11TCN18-2006 to 11TCN21-2006
Earthling and aerial connection for electrical equipments	TCVN 4756-1989
Electrical Installation of Buildings- Protection for Safety	TCXD 294: 2007
Foreign Standards	
IEC International Electro technical Commission	
IEEE Institute of electrical & Electronics Engineers	
NEMA National electric Manufactures Association	
NEC National electric code, USA	

LIST OF STANDARDS	
Title or description	Registered Number of Standard
ICAO International Civil Aviation Organization	
Mechanical and Electrical work (Transportation)	
Vietnamese Standards	
Regulation for connecting into National electric system	Decision No.37/2006/QDBCN
Detail regulation and instructions to execute Electricity law about safety and security for high voltage system	Decree No.106/2005/NDCP
Appliance to protect over-voltage, excessive current due to effect from lightening against power transmission line-Technical specifications	TCN 68-167: 1997
Environment for installation of electric equipment	TCVN 2328:1978
Electrical equipment regulation-Part 1: General regulation	11TCN 18-2006
Electrical equipment regulation-Part 2: Transmission system	11TCN 19-2006
Electrical equipment regulation-Part 3: Distribution equipment and transformers	11TCN 20-2006
Electrical equipment regulation-Part 4: Protection and automation	11TCN 21-2006
Technical regulation for ground and aerial connection of electric equipment;	TCVN 4756:1989
Standards for plastic pipe for underground cable line;	TCN 68-144:1995
Foreign Standards	
System voltage, Protection of Electrical Systems, Voltage Unbalance	(Japan)The Ministerial Ordinance Specifying the Technical Standard Concerning on Railway
Supply voltages of traction systems	IEC 60850
Safety voltage secured by electrical earthling system	IEC 62128-1
Induced voltage on telecommunication systems due to power systems	ITU-T K.68
Railway Application-Supply voltages for traction systems	IEC60850-2007
Hard-drawn Grooved Trolley Wire	JIS E2101-1990
Traction Power Transformer	JEC2200 (IEC60076-1~5)
Auto Transformer	JEC2200
Distribution Transformer	JEC2200 (IEC60076-1~5)
Circuit Breaker	JEC2300
Disconnecting Switch	JEC2310 (IEC60129)
Current Transformer	JISC1731-1 JEC1201

LIST OF STANDARDS	
Title or description	Registered Number of Standard
	(IEC60044-1)
Voltage Transformer	JISC1731-2 JEC1201 (I EC600444-2)
Insulation test for control gear	JISC0704 (IEC60064)
Graphical symbols for diagrams-Part 7 : Switchgear control gear and protective devices	JISC0617-7 (IEC60617-7)
(Japan) Ministerial Ordinance establishing the technical standards of electrical appliances	Ministerial Ordinance No.52 of the Ministry of International Trade and Industry , Japan 1997
(Japan) Interpretation of Ministerial Ordinance establishing the technical standards of electrical appliances	Official Instruction of the Ministry of Economy, Trade and Industry METI 2010
(Japan) Ministerial Ordinance providing the technical standards on railways with commentary enacted by the Ministry of Land, Infrastructure, Transportation and Tourism	Ministerial Ordinance of the Ministry of Land, Infrastructure and Transport, No.151, 2001 Ministry of Land, Infrastructure. Transport and Tourism MLIT
Japan Industrial Standard (JIS)	
Japan Electro-technical Standards and Codes Committee (JESC)	
The standard of Japan(Nippon) Engine Generator Association (NEGA)	
(Japan) Interpretation of Ministerial Ordinance Specifying the Technical Standard Concerning on Railways	Ministerial Ordinance of the Ministry of Land, Infrastructure and Transport, Kokutetsugi-No 78,2007 Ministry of Land, Infrastructure, Transport and Tourism MLIT, Japan

LIST OF STANDARDS	
Title or description	Registered Number of Standard
Railway applications Fixed installations Part I : Protective provisions relating to electrical safety and earthling	IEC 62 1 28-1 -2003
Railway applications - Supply voltages of traction systems	IEC60850-2007
Electromagnetic compatibility (EMC) -Part 3-6: Limits -Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems	IEC/TR61000-3-6-2008
Electromagnetic compatibility(EMC) -Part 3-7: Limits -Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems	IEC/TR 61000-3-7-2008
Electromagnetic compatibility (EMC] -Part 3-13: Limits -Assessment of emission limits for the connection of unbalanced installations to MV, HV and EHV power system	IEC/TR61000-3-13-2008
Operator responsibilities in the management of electromagnetic interference by power systems on telecommunication system	ITU-T K.68 (2008)
Signal work	
Vietnamese Standards	
Railway signaling regulations	22TCN 341-05
Technical criteria on railway operation	22TCN 342-05
Foreign Standards	
Glossary of terms of railway signaling	JIS E3013
Parts for railway signal -Vibration test methods	JISE3014
Parts for railway signal - Shock test methods	JISE3015
Parts for railway signal - Water proof test methods	JISE3017
Insulation resistance and withstand voltage testing methods of parts for railway signaling	JISE3021
Testing methods of permissible interference value for track circuit device	JISE3022
Telecommunication work	
Vietnamese Standards	
Multi-pair Metallic Telephone Cables for local networks - Technical requirement	TCVN 6238 :2009
Earthling of Telecommunication Plants - Technical requirement	TCN 68-141 :1999
Telecom. equipment generic climatic environmental requirements -Technical requirement	TCN 68-149 :1995
Optical fiber cables - Technical requirement	TCN 68-1 60:1996
Protection of Telecommunication cables and Radio Stations against harmful effects from electric power lines - Technical	TCN 68-1 61:2006

LIST OF STANDARDS	
Title or description	Registered Number of Standard
requirements	
The devices for protection against over-voltages and over-currents from lighting discharges and electric power lines - Technical requirement	TCN 68-167: 1997
Optical interfaces for equipments and systems relating to the Synchronous Digital Hierarchy - Technical requirement	TCN 68-173 :1998
Optical Fiber and Microwave Transmission Systems based on the Synchronous Digital Hierarchy - Technical requirement	TCN 68-177 :1998
Cade of Practice for the Construction of Optical Fiber Communication Systems	TCN 68-178 :1999
Electro Magnetic Compatibility (EMC) - Telecommunications Terminal Equipment - Electromagnetic immunity Requirements	TCN 68-196 :2001
Electro Magnetic Compatibility (EMC) - Telecommunication Network Equipment - Electro Magnetic Compatibility requirements	TCVN 8235 :2009
Electro Magnetic Compatibility (EMC) Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity	TCVN 8241-4-8-2009
Telecommunication outside plants - Technical regulations	TCN 68-254 :2006
Foreign standards	
Ergonomic design of control centers	JIS Z 8503-1-4,6 (ISO 11064-1~4,6)
Man-machine interface(MMI) - Actuating principles	JIS C 0447 (IEC60447)
Characteristics of a single-mode fiber arid cable	ITU-T G.652
Digital hierarchy bit rate	ITU-T G.702
Network node interface for the synchronous digital hierarchy (SDH)	ITU-T G.707
Pulse code modulation (PCM) of voice frequencies	ITU-T G.711
Transmission performance characteristics of pulse code modulation channels	ITU-T G.712
Terms and definitions for synchronous digital hierarchy (SDH) networks	ITU-T G.780
Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks	ITU-T G.783
The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)	ITU-T G.825
Optical interfaces for equipments and systems relating to the synchronous digital hierarchy	ITU-T G.957
Generic cabling for customer promises	IEC 11801

LIST OF STANDARDS	
Title or description	Registered Number of Standard
Tests on electric and optical fiber cables under fire conditions	IEC 60332
Measurement of smoke density of electric cables burning under defined conditions	IEC 61 034
Fiber optic connector interfaces	IEC 61754
Office Work with Visual Display Terminals (VDTs)	ISO 7243, ISO9241-1~1 7, ISO 13406-1~2, ISO 13407, ISO 14915-1~3, JIS Z 8504, JIS Z 8511 1~27, JIS Z
Railway Rolling stock	
Vietnamese Standards	
Technical specification for operation of Vietnam railway network	22 TCN 340 - 05
Railway transport vehicle - Rolling stock - Specifications In new manufacturing and installation, 6/2006	22 TCN 347 - 06
Railway transport vehicle - passenger ear bogie - Specifications in new manufacturing and installation, 13/01/2007	22 TCN 359 - 06
Pressure vessels -safety engineering requirement of design, construction manufacture	TCVN 6153: 1996
Foreign Standards	
Rolling stock -General requirements of car body for passenger car	JIS E7103
General requirements of ear body structures for passenger car	JIS E7106
Truck frames for railway rolling stock -General rules for design	JIS E4207
Railway rolling - Design methods for strength axels	JIS E4501
Railway operation	
Vietnamese Standards	
Code on technical railway operation	22 TCN 340-05
Foreign Standards	
JICA report- Railway technological guidance for train operation	Jun-2009

Required Data and Questionnaires

Item		Questions and Answers
1		**Electricity System Design**
1-1 Electricfication Planning	①	**Q**: *In respect to voltage drop, it is advantegous to position Substation (SS) nearby the midpoint of the route. In this project, why is the SS positioned at the southernmost end of the route?* **A:** After carefully surveying four sites for power substation, it is concluded that Ngoc Hoi is the optimal location (Refer to ***Basic Design Concept & Integration Design for Electrification.3.2***). The reasons are as follows: ① Possible land acquisition for Outdoor type SS (it is also easy to secure access road for construction and maintenance) ② Stable power sources (Substation of power company) at both sides of Ngoc Hoi SS ③ Construction cost ④Power supply for the Depot ⑤ Consideration of future electrification extension such as East Line. For the present, future electrification system required for extension to Nhu Quynh is mentioned in ***Basic Design Concept & Integration Design for Electrification.11.***
	②	**Q**: *At Ngoc Hoi station, load of feeding transformer is at unbalanced state. From viewpoint of power supply company, is there any related problem?* **A**: Voltage unbalance was designed so as to satisfy the Vietnamese regulation (3%) (Refer to ***Basic Design Concept & Integration Design for Electrification, 4.1***)
	③	**Q**: *What is the short circuit power of the receiving end at Ngoc Hoi SS of power company?* **A**: The three phase short circuit power is 1150MVA in the worst case (Refer to ***Basic Design Concept & Integration Design for Electrification, 4.1.4.3) and 3.3***)
	④	**Q:** *The distance between AT is shorter than typical practice (10km). What are the reasons?* **A**: The distance of 6 km was decided according to calculation of induced voltage on communication system and rail potential (***Refer to Basic Design Concept & Integration Design for Electrification, 7***). Other considerations include location of various stations in the route and route alignment which run through centre of Hanoi (i.e. there are several metallic communication cables adjacent to the route)

1-2 Substation	①	**Q:** *Only one single SS is constructed for the whole line with total length of about 25 km. Regarding the voltage supply for electric cars, is there any problem?* **A:** To avoid any design change even in case of future electrification extension, it is confirmed that minimum voltage of 22.5 kV can be secured. Ngoc Hoi SS is supposed to supply power for a total section of 50 km including 25 km section to Hanoi direction and other 25 km section to Ngoc Hoi direction; power supply and voltage drop was calculated under the assumption of 8 trainsets at 4-minutes headway. Therefore, there is not any problem with one single SS. It is noted that the data for calculation such as train characteristics, track conditions, impedance were provided by specialists in charge.
	②	**Q:** *Building a single SS for the whole line requires high reliability and availability. Was the matter thoroughly investigated?* **A:** Power is received respectively from two 110kV transmission lines connecting to 220kV substations of power company and two set of traction transformer (100% reserve) is installed. We proposed this plan to Vietnamese side and already got the approval.
	③	**Q:** *Power receiving from power supply company is designed at 110kV. Was 66kV power receiving considered?* **A:** As far as scale of SS is concerned, 66 kV is sufficient enough. However, lower voltage supply than 110kV is 22kV, 110kV is, therefore, appropriate.
	④	**Q:** *Is there any plan for land acquisition for Sub-sectioning Post(SSP) and Auto-transformer Post (ATP)?* **A:** As it is difficult to secure land at commercial districts, we are planning indoor type under the elevated track. We have already submitted schematic drawings to the personnel in charge of designing the structures. Although the detail locations are not exactly defined, we have requested for securing a necessary space of about 300 m2.

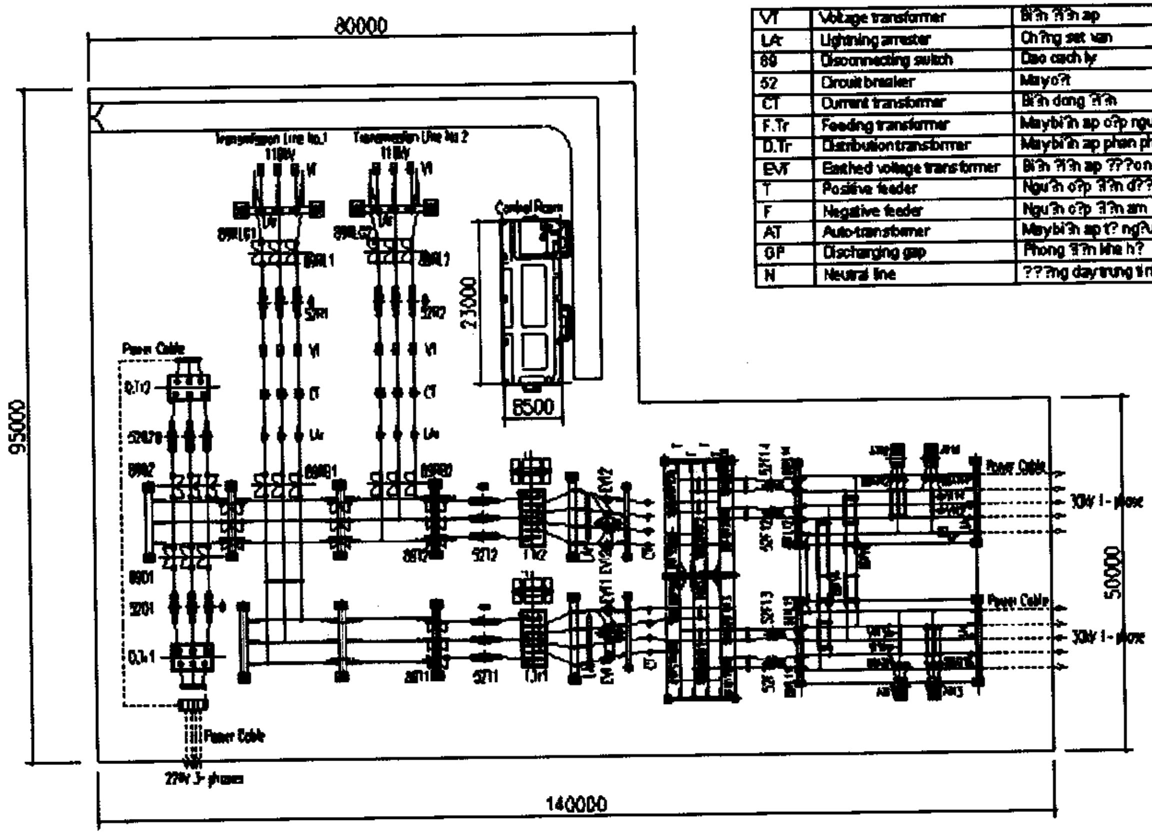
	⑤	**Q:** *Which are standards/regulations of electricity system applied for basic design?* **A:** According to the contract with customer, Vietnamese standards/regulations is adopted. In case, there is no applicable regulation then Japanese standards (JIS,JEC) will be applied.
	⑥	**Q:** *Were Vietnamse standards/regulations related to installation of substation equipments examined?* **A:** To some extent, we grasp understanding by requesting subcontractors and counterparts to conduct study on legal documents and standards on electrical equipments. We are still in progress now. For instance, antinoise standard and fire prevention standard for oil-filled equipments are somehow similar to Japanese ones. Those standards will become basis for detail design.
	⑦	**Q:** *What are the differences between Japanese standards/regulations and Vietnamese ones?* **A:** For power lines over 110kV, it is legally obligated that the neutral point of primary side of the three-phase transformer must directly connect to the earth. Therefore, the standard Scott connected transformer can not be adopted. That is why we proposed loop delta connected transformer and have obtained approval.
	⑧	**Q:** *Is there any special consideration when undertaking the basic design?* **A:** On preparing equipment specification, we plan to set the highest temperature to be 45 C degree. Furthermore, if there is any special condition that we find out in future studies, we will reflect them in equipments specification.
	⑨	**Q:** *What is point of view on area of Substation?* **A:** With reference to 220kV SS of Kyushu Shinkansen, we took careful consideration of the size reduction due to voltage difference between 220kV and 110kV and unusefullness of change-over circuit breaker when preparing Equipment Layout Plan. However, there are so many uncertain elements that we design a larger area (10,000 m2).

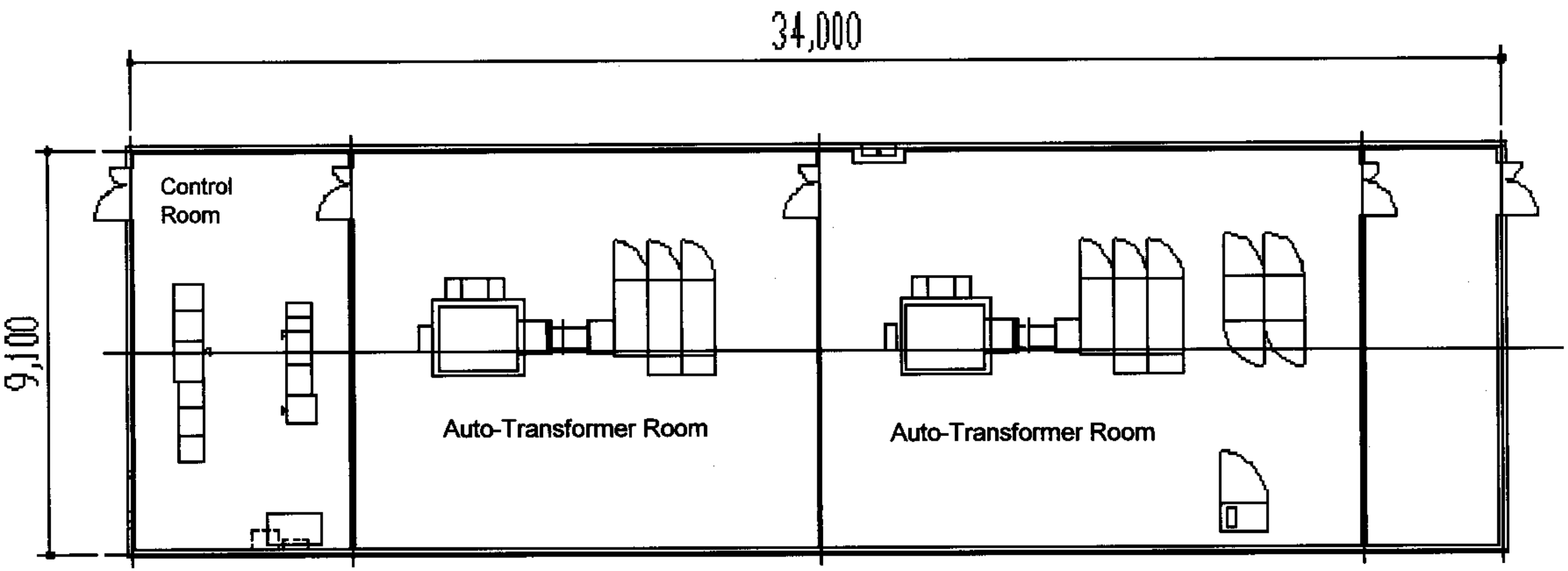
	⑩	**Q:** *Why are two sets of distribution transformer installed?* **A:** Ngoc Hoi is a complex station with various facilities such as electric railcars depot, passenger train depot, freight train depot and train maintenance workshop. Power supply for each depot is received from 22kV distribution line connecting to Ngoc Hoi SS. For this reason, distribution side requires two sets of distribution transformer. However, for economical reason, we are also investigating the plan that temporary power supply source for construction purpose during depot construction period will be utilized as reserve power supply source for those depots (it is necessary to negotiate with power company on this matter) so that the number of distribution transformer shall be reduced to one set.
	⑪	**Q:** *What is feeding system for the depot?* **A:** The depot is adjacent to Ngoc Hoi station; and there is little concern about inductive interference, hence the simple feeding system may be adoptable. However, as 30kV power supply is necessary, depot-dedicated AT or Step-down transformer is required. In the detail design phase, the most economical method will be studied and proposed to Vietnamese side.
	⑫	**Q:** *How was the traction power line and distribution line extracted from SS?* **A:** Both lines shall be pulled out by cables. We have already discussed with specialists in charge of depot electrical equipment about route of cable tunnel inside Ngoc Hoi area.
	⑬	**Q:** *Ngoc Hoi substation is built on reclaimed ground of swampy land. Was this factor taken into consideration?* **A:** As a flood countermeasure, the floor of switchboard room shall be 1 meter higher than ground level (we already requested building engineers in charge). Additionally, it is necessary to examine base bearing pile at the detail design phase. We also want to discuss the matter of design and construction of base and base bearing pile the personnel in charge of civil structures.

2	**Signalling/Telecommunication Design**
2-2 Reference Standards	**Q:** *The technical standards refered in the text are Vietnamese ones and JIS. If the country is a member of WTO, is it possible not to refer to ISO and IEC? Is there any special consideration in case of Vietnam?* **A:** In general, we take Vietnamese standards as basic standards. In case Japanese products are adopted, JIS or equipvalent standards will be the basic standard.
2-3 Mixed Operation	**Q:** *There is operation of different train types on Line 1. Addtionally, there are non-stop stations for certain train type. Hence, it is essential to classify train types. Unless classification of train types is clearly defined, cost estimate and system design will be affected. The reason is that only a portion of trains are installed simple JR-type ATS. At minimum requirement, ATS-P protection system must be intalled on all trains. Otherwise, station check devices and train number transmitters can be adopted, which is the method widely used among private train operators in Japan.* A: Programmed route control and centralized train control is conducted at CTC/PRC. Train operation diagram is stored at PRC. Train number assigned to operating train shall be compared with the number on diagram so as to safely control train routes.About methods for assigning train number, there are two methods according to type of train: UTs (urban electric trains) with train number setting equipment transmit train number to the ground transponders via onboard ATP equipment. As the other types of trains (NT,IT) which use diesel locomotive, are not equipped with on-board train number setting equipment, at the moment of arriving boundary stations (Ngoc Hoi, Gia Lam, Yen Vien), train number shall be compared manually with train diagram at those stations or OCC. Accordingly, train number input devices shall be installed at those boundary stations. Interlocking devices of NT stations (Interlocking stations) perform to set train route . Type of train (standard gauge train, narrow gauge train) approaching the station is detected and discriminated by track circuit on dual gauge track with three rails so that misguiding can be prevented. Moreover, due to intermingled operations of both electric trains and non-electric trains, the train type information, which is transmitted to ground coil via ATP equipment, shall be utilized in order to prevent electric trains running into non-electric track sections. Train detection shall not be used for level crossing control because there are only a few dedicated level crossings for employees inside Ngoc Hoi complex area.

2-4 Technical terms	**Q:** *International technical terms are used in the reports. It is necessary to define the meaning of those technical terms such as ATS, ATP,...* **A:** At the first place, abbreviation of technical terms were confusing due to their different meaning in Japanese. Then all the technical terms are used as international convention. For example, ATP stands for Automatic Train Protection, ATS stands for Automatic Train Supervision.
2-5 Level Crossing	Q: *Why is point control method adopted? Continuous control method is more favorable. (Control circuit is too complicated and battery maintenance is difficult)* A: As level crossings are located at junctions with roads inside Ngoc Hoi area and employee dedicated passages, there are many locations without track circuit. Electronic train detector is adoped wherever track circuit can be used. We also think that AFO may also be good alternative.

VT	Voltage transformer	Bi?n ?i?n ap
LAr	Lightning arrester	Ch?ng set van
89	Disconnecting switch	Dao cach ly
52	Circuit breaker	May c?t
CT	Current transformer	Bi?n dong ?i?n
F.Tr	Feeding transformer	May bi?n ap c?p ngu?n
D.Tr	Distribution transformer	May bi?n ap phan ph?i
EVT	Earthed voltage transformer	Bi?n ?i?n ap ???on? ??
T	Positive feeder	Ngu?n c?p ?i?n d??ng
F	Negative feeder	Ngu?n c?p ?i?n am
AT	Auto-transformer	May bi?n ap t? ng?u
GP	Discharging gap	Phong ?i?n khe h?
N	Neutral line	???ng day trung tinh




34,000
9,100
Control Room
Auto-Transformer Room
Auto-Transformer Room

SSP,ATP

Questions and Requests from VNR/ RPMU

No.	Questions and requests	Answers
1 .	**E& M** (1) According to the JKT report, assuming train operation of 8-car train set and 4-minute headway, voltage drop at Yen Vien- the furthest position from substation- is 22.5KV. While it is stated in DF/R that if interval between AT posts is installed at 6km, the voltage drop is 22.79KV. In the special case with the voltage drop like that, what is possible number of trains in operation per hour?	(1) The following descriptions are presented in the basic design Report: ① It is stipulated in IEC60850 that AC 22.5kV is the lowest permanent voltage for power feeding system with highest permanent voltage of 30KV and nominal voltage of 25kV. From the stipulation, the power feeding system in this project is required to secure the prevention of the continuous occurrence of voltage beyond 22.5kV at the furthest position from substation 22.5kV under the condition of train operation with 8-car set (4M4T) at 4-minute headway. In the other word, the maximum allowable voltage drop is 2.5kV. ② On the assumption of train current value for typical commuter trains (4M4T) in Japan, 4-minute headway and other fixed values of feeding line similar to this project, the voltage drop at the farthest position from substation with 25kV output is calculated as 2.21kV (or voltage after voltage drop is 22.79kV) DF/R has noted that the above descriptions were reasonable. Also, under the condition of current proposed system, it will be available to increase the maximum number of train per hour 17 trains/hour (110% of 15 trains/hour). Provided a better alternative design for the arrangement of substations, capacity of transformer equipments and performance of signaling equipment and train control system, it is presumable, from practical experience,

		that train operation of 3-minute headway and 20 trains/hour is feasible.
	(2) More details about overhead contact line system should be described.	(2) In the DF/R, we stated that "the details should be further investigated in detail design phase", which means that "the descriptions in the basic design Report are adequate for the basic design phase". It is comprehended that because the selection of elements of overhead contact line and selection criteria are already determined in FSR, the configuration of overhead contact line system (as represented by overhead contact line configuration diagram) and their specifications shall be precisely determined in the detail design report.
	(3) Why is 5 signal aspects adopted for signal system? Why less aspects is not appropriate?	(3) Based on operation conditions such as 4-minute headway, scheduled speed, train acceleration/deceleration, route alignment and acquaintances from various experience, it is concluded that the 5 signal aspects system is adequate.
	(4) Which equipments are used for detecting standard gauge and 1000mm gauge in dual gauge section?	(4) In AC electrified section, in general the direct track circuit is adopted for train detection. However, in this project, because train detections on both of standard gauge and 1000mm gauge are necessary, AF track circuit is recommended. This method is already adopted for dual gauge section in Akita Shinkansen in Japan.
	(5) Train detection by telecommunication system should be	(5) Train detection in signal system is as above-described. If there are on-board

	investigated.	devices able to recognize own position, train detection by telecommunication could be possible by using data transmission function of train radio system. However, this method differs from the category of train detection for train safety. If it is more related to CBTC system, we are not recommending the adoption of CBTC system for this HUR project as described in a separated submission. Especially for mixed operation of NT and IT with UT, expensive CBTC on-board devices are required even for NT and IT, which presents economical challenge.
	(6) It is required to evaluate whether station location and 4-minute headway proposed by JKT is optimal or not.	(6) The decision is to be made with a comprehensive consideration of various criteria such as route alignment, train acceleration/deceleration, train length and climate conditions. There are some criteria that are out of scope in this appraisal study (e.g. conditions of infrastructure and requirements from passenger convenience etc.), such comprehensive evaluation is not available. However, in consideration of criteria only related E&M basic design, there are not any problem with station location and 4-minute headway. In the meantime, the comprehensive evaluation will be made available after related conditions and details of systems are shaped.
	(7) For telecommunication and other items in DF/R, the evaluation should not be "No comment" or "No opinion", more clear expression such as "agree/disagree" (If disagree, study team must explain reason why disagree) is desirable.	(7) More comprehensible expression will be applied in the F/R.

2.	**Rolling stock** (1) Brake distance should be described for not only UT but also NT and IT. (2) In the basic design report, the two values of rolling speed are 120km/h and 100km/h. It is necessary to clarify this point.	(1)Since any performance data of NT, IT were not obtainable in basic design report, we are not in a position to describe it in this part. (2) Our relevant comment is provided in the DF/R 5.2.9(1)-3). In case of short station interval and poor acceleration/deceleration performance, there is possibility that the maximum speed of 120km/h could not be attained. Therefore, it is recommended to conduct simulations for comparing the scheduled speeds of train operation conditions for both maximum speed of 120km/h and 100km/h. If scheduled speed can attain effective level even in maximum speed of 120km/h, it will be worthwhile to set the maximum speed of 120km/h. Nonetheless, it is recommended that for rapid service with less stopping stations, the maximum speed of 120km/h is presumed to be effective, simulation should also be done to confirm that effectiveness quantitatively.
3.	**Overall** (1) It is necessary to indicate whether the applied regulations and standards are sufficient or not.	(1) As presented in Chapter 6 (1) of DF/R, the design contractor JKT has been investigating the issue of regulations and standards from various directions and ranged to the list those extensively in basic design report. However, we are in recognition that most of the described regulations and standards do not specify the details sufficient for practical application in minute technical points in design work. For this reason, in Japan, "Railway

		Technical standards" which is practice standards in the design and construction of rail infrastructure and systems was determined as Japanese ministerial ordinance. As mentioned in the DF/R, Vietnamese authority is now investigating to establish railway technical standards of which purpose is said to be similar with Japanese. It will become the solution to current problem if it becomes effective in early stage.
	(2) It can be found the technical term "CSC" at several places in the basic design report. The word "SCADA" is used in VNR. It is essential to clarify these technical terms.	(2) To prevent misunderstanding, it is recommended that the question about the definition of CSC is to be addressed to JKT via RPMU.
4.	**Request by Mr. Duy (on behalf of VNR/RPMU)** (1) As an independent consultant, study team is requested to have clear and precise expression of opinion, judgment and evaluation. (2) During preparation of Basic Design, all concerned agencies in VNR/RPMU have engaged in vigorous exchange of views on basic design. Therefore, VNR/RPMU expects that the Study team shall appraise from other points of views and provide its opinions and comments etc on the items mentioned in JKT report with clear and extensive manner. (3) For easier understanding for VNR/RPMU, consultant's opinions	 (1) We will make every effort to express our comments judgment and appraisal with more comprehensible and clear expressions in F/R (2) We will make effort to have clearer expression. (3) For easier understanding of appraisal result, we will add the suggested

	and comments are suggested to provide with the tabular form. For example, descriptions by JKT are arranged on the left side and study team's comments are shown parallel on the right side.	tabular format in Chapter 5.
	(4) For this complicated project, prospect for practical implementation of E&M and EMU should be studied?	(4) Because we have only 2 months to conduct this appraisal study, it is unfortunately difficult to study practical implementation of all E&M subsystems.
	(5) Cost evaluation should also be included?	(5) We always bear in mind the issue of equipment cost when conducting this evaluation study. We confirmed that there is no equipment of which cost is unnecessarily expensive.
	(6) The evaluation report must be prepared objectively from an independent standpoint.	(6) Every member of our team has studied a large number of JKT materials and conducted the evaluation after thoroughly reviewing them. We prepared the report from an independent viewpoint.
	(7) F/R in English and Vietnamese are required	(7) Binding F/R in both English and Vietnamese will be submitted at the end of study period.

Configuration of Power Supply (Distribution) System and Reliability

1. Configuration of Power Supply System and Reliability

Case 1: Regular power supply system

(Reliability of electrical source and reliability of line are arranged in series)

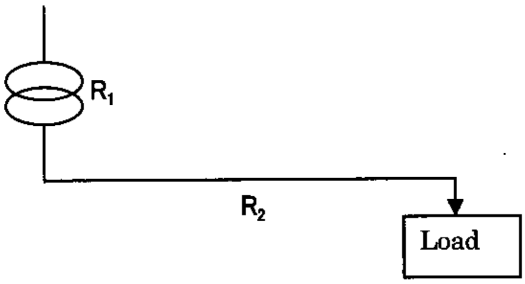


Fig. 1

In Fig. 1,

R_1 : Reliability of electrical source

R_2: Reliability of line

Then, synthetic reliability (R) is given by:.

$R=R_1\times R_2$

When $R_1=0.9$、$R_2=0.9$:

$R=0.9\times0.9=\underline{0.81}$

Case 2: Above power supply source stands in parallel

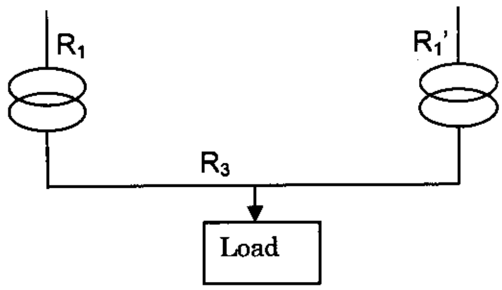


Fig. 2

In Fig.2,

R_1、R_1': Reliability of each power source

R_3: Reliability of line

$R=R_{11}\times R_3$

(Where, R_{11}: Reliability of electrical sources)

$R_{11}=1-(1-R_1)(1-R_1')$

$=1-(1-R_1-R_1'+R_1\cdot R_1')$

$=1-1+R_1+R_1'-R_1\cdot R_1'=R_1+R_1'-R_1\cdot R_1'$

Then, synthetic reliability (R) is given by:

$R=R_1R_3+R_1'\cdot R_3-R_1\cdot R_1'\cdot R_3$

When reliability of electrical source $R_1=R_1'=R_S=0.9$, reliability of line $R_3=R_L=0.9$

$R=2R_S\cdot R_L-R_S^2\cdot R_L$

$=2\times0.9\times0.9-0.9^2\times0.9=\underline{0.891}$

Case 3: Electrical source and line of above Case 1 stands in parallel

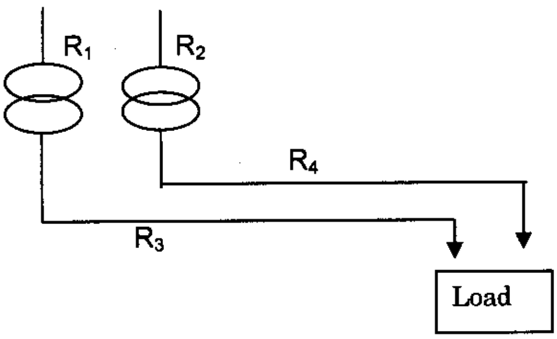


Fig. 3

In Fig. 3, where reliabilities of electrical sources and lines are replaced:

$R=1-(1-R_A)(1-R_B)$

Where, $R_A=R_1\times R_3$、$R_B=R_2\times R_4$

$R=1-(1-R_1\cdot R_3)(1-R_2\cdot R_4)$

$=1-(1-R_1\cdot R_3-R_2\cdot R_4+R_1\cdot R_2\cdot R_3\cdot R_4)$

$=R_1\cdot R_3+R_2\cdot R_4-R_1\cdot R_2\cdot R_3\cdot R_4$

When reliability of electrical source $R_1=R_2=R_S=0.9$、reliability of line $R_3=R_4=R_L=0.9$ とすると、

$R=2R_S\cdot R_L-R_S^2\cdot R_L^2$

$=2\times0.9\times0.9-0.9^2\times0.9^2=\underline{0.9639}$

Case 4： Electrical sources and lines of above Case 2 stand in parallel（This configuration corresponds to the normal power supply system of HURCP Line 1）

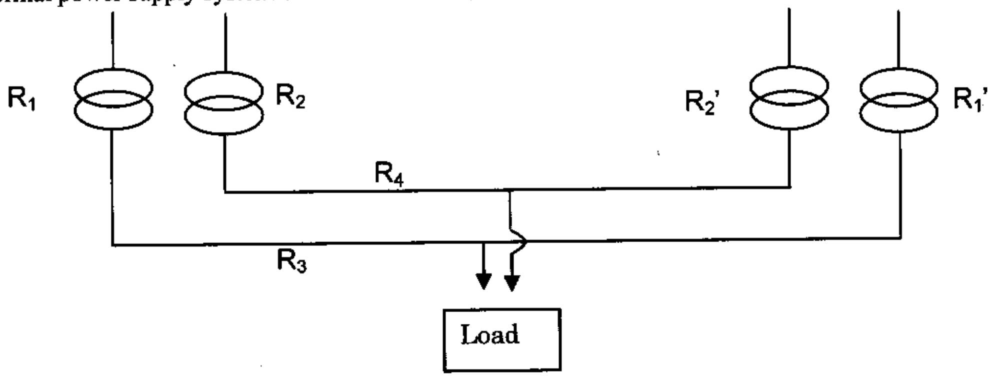
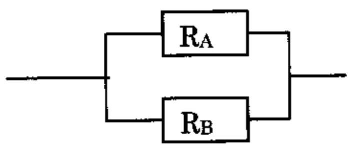


Fig.4

Reliability calculation of the configuration shown in Fig. 4 is equivalent to the calculation of parallel placement of R_A and R_B .

Where, R_A : reliability of left side of above Fig. 3, and R_B : reliability of right side of above Fig. 3



Then, synthetic reliability (R) is:

$R=1-(1-R_A)(1-R_B)$

$=1-(1-(R_1R_3+R_1'\cdot R_3-R_1\cdot R_1'\cdot R_3))(1-(R_2R_4+R_2'\cdot R_4-R_2\cdot R_2'\cdot R_4))$

When, reliability of electrical source $R_1=R_2=R_1'=R_2'=R_S=0.9$, reliability of line $R_3=R_4=R_L=0.9$,

$R=1-(1-(2R_S\cdot R_L-R_S^2\cdot R_L))(1-(2R_S\cdot R_L-R_S^2\cdot R_L))$

$=1-(1-(2\times0.9\times0.9-0.9^2\times0.9))(1-(2\times0.9\times0.9-0.9^2\times0.9))$

$=1-(1-1.1\times0.9\times0.9)(1-1.1\times0.9\times0.9)$

$=1-1+1.1\times0.9\times0.9+1.1\times0.9\times0.9-1.1^2\times0.9^2\times0.9^2$

$=2\times1.1\times0.9\times0.9-1.1^2\times0.9^2\times0.9^2$

$=1.782-0.793881$

$=\underline{0.988119}$

2. Reliability and Failure rate of Power Supply system

Case 1： Single line supply under arborescens configuration

Case 4： Power receiving in dual lines, reciprocal backup by the other electrical source, Power supply in dual lines

Calculation result of reliability and failure rate

	Reliability	Failure Rate	Remarks
Case 1	0.81	0.19	(1-0.81)
Case 4	0.988119	0.011881	(1-0.988119)

Failure rate in Case 1 is 0.19, by contrast, failure rate in Case 4 is 0.0119. The ratio is, therefore, 0.0119／0.19 ＝ 0.0626, or 0. 19／0. 0119 ＝ 15.97.

Accordingly, the possibility of electrical shutdown in Case 4 is expected to be reduced to 1/16 of that of Case 1.

Therefore, it is determined that the power supply (distribution) system for HURCP Line 1 with the configuration of above Case 4 is appropriate in consideration of its importance.

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