



## **REQUEST FOR EXPRESSION OF INTEREST (EOI)**

**Title of the EOI:**

Construction of maintenance facilities for high speed trains.

**Date of this EOI:**

13/11/2014

**Closing date for receipt of EOI:**

18/12/2014

**Address EOI response:**

Alameer Sultan Street North,

Alnaeem District (4)

Ahmed Al-Hamoodi Street Building N° 8

PO BOX 51656, Jeddah 21553, Saudi Arabia

GPS Coordinates: 21.626329, 39.136721

**For the attention of:**

Armando Fombella Cuesta

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## BACKGROUND

The Kingdom of Saudi Arabia (KSA) is developing a new world-class, railway network which includes a new passenger railway line from Makkah to Madinah, via Jeddah. The railway will be known as the Haramain High Speed Railway (HHR), it will be approximately 444 km length. The Railway will be a high speed electrified passenger line (up to 320 Km/h), with double track between Makkah and Madinah and standard gauge line (1435 mm). Also the Railway is designed with facilities to run in the up and down directions on both tracks. Furthermore, two workshops are designed for high speed rolling stock maintenance, one in Makkah and another one in Madinah.

Renfe (inside which forms part of Al-Shoula Consortium awarded of the HHR2) is responsible, among other tasks, responsible for the design and construction of these maintenance facilities.

## DESCRIPTION OF REQUIREMENTS

Renfe invites qualified firms to submit their Expression of Interest to participate in the upcoming competitive bidding exercise for the construction of maintenance facilities in the frame of the Haramain high speed project. Detailed specifications and requirements shall be communicated in due course in the tender documents but for the purpose of this EOI, an **executive summary** is attached.

Renfe will conduct pre-qualification exercise to identify eligible Contractors and then they must be approved by Saudi Railway Organization. Contractors that are deemed prequalified will be considered for receiving the tender documents that will be issued after both approvals are completed.

To be considered for pre-qualification evaluation, Contractors must submit:

- A letter expressing their expression of interest for this process
- Sufficiently detailed information according to the attached document “**Civil Works subcontractors. Instructions for pre-qualification**”

**Civil works subcontractors.  
Instructions for  
pre-qualification**

## ***Civil Works subcontractors. Instructions for pre-qualification.***

### **1 Introduction and object.**

Within the framework of the Makkah-Madinah High-Speed Line's Construction Project in Saudi Arabia (Haramain Project), RENFE, as a member of the Saudi-Spanish Al-Shoula Consortium, is responsible, among other activities, for the construction of the rolling stock maintenance workshops of the Line, located in Makkah and Madinah.

Those companies aimed for the Civil Works related to this construction within the framework of the Project, once the relevant contracting proceedings have started, they shall previously pre-qualify as subcontractors according to the instructions specified in this document and the annexes thereof.

### **2 Required documents.**

The required documents to be submitted are as follows:

- Check list (file "1.Check list template\_Rev01.xlsx") duly completed, ticking in the column entitled "Included" those documents which, for whatever reason, are not submitted. The structure of the check list herein shall not be in any case modified by adding or deleting any row or column. Likewise, every observation that might be deemed appropriate will be included under the column entitled "Comments".
- A cover letter in the file format included in "2 Letter template (2).docx". This letter shall be one extension page and it will be structured in two paragraphs: the first one will be a brief description of the company, and the second one will state the reasons for which the company wants to participate in the Haramain Project.
- Documents specified in the Check list, in the same order as set out in the Excel file.

Generally, all the documentation shall be written in English. Official documents issued in a different language shall be complemented by their relevant translation (sworn translations are not required).

### **3 Options for pre-qualification.**

With regard to the subcontractor pre-qualification, the following cases shall be identified:

- Local companies. In this case, the only documents to be submitted will be those included in file "1.Check template\_Rev01.xlsx list" under the section entitled "For Local Companies or registered companies in KSA".
- Joint Ventures between local and international companies: In this case, the local partners will submit the same documents as in the situation mentioned above and, additionally the documentation contained in section "For Joint Ventures (Local / International) companies to work as Subcontractors".
- Local branches from international companies: In this case, the local branch will submit the same documents as in the situation mentioned above and, additionally the documentation contained in section "For International Companies to work as subcontractors".

## **4 Clarification on documents to be submitted by suppliers.**

The abovementioned documents refer to those listed under the section "Suppliers" in file "1. Check list template\_Rev01.xlsx".

1. General information (company overview). Presentation including general information and a global vision of the company.
2. Registration certificate. Registration in the Commercial Register.
3. Ranking certificate:
4. Commercial Registration/ Chamber of Commerce Certificate. Registration Certificate issued by the Chamber of Commerce, which shall necessarily include the term or expiration date.
5. Zakat certificate. Only compulsory for those companies based in Saudi Arabia.
6. Range of products. Description of the various product ranges manufactured and/or supplied by the company.
7. Organization Chart. General organization chart of the company.
8. Industrial License when applicable. Industrial License, if available.
9. Financial data/Audited statement. Company's Financial Statements for the last two financial years, and duly audited.
10. Total no. of manpower List. General description of human resources.
11. Total no. of Personnel deployed for the project. Description of human resources to be applied on the project.
12. QA/QC plan. Quality Certificates currently in force (ISO 9001, ISO 14001, etc.) and the company's Quality Plan, if available.
13. Safety plan. Documentation regarding Health and Safety.
14. Equipment List & its total no. List and general description of available equipment.
15. Completed Major Projects and its total cost. Main projects, specifying the total cost for each of them.
16. Ongoing Projects. Main ongoing projects, specifying the total cost foreseen or the contract value for each of them.
17. Accreditations if any. Certificates of satisfactory execution issued by the clients for projects referred to in section 15.
18. Reference to the BoQ item (approx. %) and a clear reference to the Scope of works and Geographical location. Description of the activity to be performed (for instance: earthworks, construction, etc..) and its location (ex: Madinah, Makkah, etc...).
19. Transparency and evidence of being in possession of the Licenses associated with the Scope of Works or the current status of the administrative process.

## **5 Presentation format.**

The documents to be submitted shall be necessarily structured as follows:

- First, the check list completed according to the instructions detailed in the previous sections.
- Second, the cover letter.
- Third, an index of the documents submitted.
- And finally, the documents submitted in the same order as they are mentioned in the check list, and each of them preceded by a cover indicating the name of the document submitted.

Two printed copies (hardcopies) and one computer copy (softcopy) will be submitted according to the following formats:

- Hardcopies: Two A4 size double-sided and spiral bound printed copies. There shall be no difference between them (e.g. it will not be possible to print one in color and the other one in black and White).
- Softcopy: A single pdf file containing all the documents. Under no circumstances may the documentation be submitted in several files. There shall be no difference, neither in form or content, between the information contained in hardcopies or in the softcopy.

## **6 Delivery instructions.**

Hardcopies can be delivered by hand or sent by courier to the following address:

RENFE – KSA Branch  
Armando Fombella Cuesta  
Alameer Sultan Street North,  
Alnaeem dist. (4),  
Ahmed Al-Hamoodi Street Building no. (8).  
Jeddah, Saudi Arabia.  
GPS Coordinates: 21.626329, 39.136721  
e-mail: [administration\\_renfeksa@renfe.es](mailto:administration_renfeksa@renfe.es)

If, instead of hand delivery or courier, the documentation is sent by ordinary mail, the post office box details are as follows:

P.O. Box 51656 Jeddah 21553

The softcopy may be submitted in two ways:

- On physical media (CD, DVD or pen-drive) accompanying hardcopies.
- Providing an internet link in order to download it.



**EXECUTIVE SUMMARY  
MAKKAH DEPOT**



**HARAMAIN HIGH SPEED RAILWAY.  
PHASE 2**

**EXECUTIVE SUMMARY  
MAKKAH DEPOT**

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## 0.

### 0.1. Purpose

The purpose of this document is to describe to the Saudi Railways Organization the Al-Shoula Consortium Detailed Design drafted to detail the activities that will be developed in order to implement the Makkah Depot of the Haramain High-speed Railway Phase 2 Project.

### 0.2. Document Scope

This document is prepared according to Saudi Railways Organization General Specifications Section 4 Management of the Project Clause 4.3 Quality Management Program.

According to the general project management organization of the Consortium, the Quality Management Plan is subsidiary to the Consortium's Project Management Plan. Therefore all requirements and obligations established in this document must be in accordance with PMP.

The following issues will be addressed in the present document:

- HHR Phase 2 Project Quality Assurance Program Activities.

### 0.3. Input Data

Additionally, to those regulations included in the "List of Standards during Design Stages" the following has been considered specifically for the preparation of this document:

- ISO 9000 and 14000 Standards.

Additionally to Master Agreement Clause 1.1 Contract Documents, the following project deliverables have been considered specifically for the preparation of this document:

- Consortium members Quality Assurance Systems procedures.

This document must be considered as an input data for the preparation of, at least, the following project deliverables:

- Design Deliverables.

The "Interface Revision Table" included in the Document Approval section reflects, if required, validation according to the mentioned input analysis.

## 0.4. Terms & Acronyms

Additionally to those stated in Section 2 Glossary of the General Specifications the following has to be considered:

### Acronyms

SRO	Saudi Railways Organization
ASC	Al-Shoula Consortium
PMP	Project Management Plan
QMP	Quality Management Plan
VTA	Verification, Tests and Acceptance
QCP	Quality Control Plan
DVE	Design Verification Engineer
SVE	Safety Verification Engineer
APM	Consortium Project Manager
AAM	Consortium Area Manager
ADM	Consortium Design Manager
ACM	Consortium Construction Manager
AQM	Consortium Quality Manager
ADC	Consortium Document Controller
AQG	Consortium Assurance Engineer
CPM	Consortium Company Project Manager
CQM	Consortium Company Quality and Environmental Manager
CPG	Consortium Company Production Engineer
CQG	Consortium Company Quality Engineer
HST	High Speed Train
HHR	Haramain High Speed Railway
SBC	Saudi Building Code

## 0.5. Standards and regulations

### ROADS

Standards and regulations taken into account for the design of Makkah depot roads are:

- AASHTO Guide for Design of Pavement Structures.
- Kingdom Of Saudi Arabia, Ministry Of Transport. General Directorate for Materials and Research. Hot Asphalt Mix Design System.
- Kingdom Of Saudi Arabia, Ministry Of Communications. General Directorate for Road and Bridge Construction.
- Kingdom Of Saudi Arabia, Ministry Of Communications. Highway Design Manual.
- American Concrete Pavement Association, Subgrade Resilient Modulus Calculator.
- Utah Department of transportation (UDOT). Pavement Management and Pavement Design Manual.
- California Department of transportation. Truck Weight Limitations.

- Ministry of Communications (MOC) Circular 01-45512 dated 1427 Hijri, for traffic volumes ranging from 0.3 to 3 million ESALs the corresponding layer thicknesses are 5 cm bituminous wearing course, 8 cm bituminous base course and 15 cm aggregate base course.

## **STRUCTURES**

The structures have been calculated according to the following standards:

- Reference Standards. Eurocode 1, Eurocode 2, Eurocode 3 and Eurocode 8.
- Ultimate Limit States. Eurocode EN1990 – Basis of Structural Design.
- Partial Factor for Actions and Combinations of Actions. EN1991.
- Clear Cover. Eurocode 2, chart 4.1. “Exposure class related to environmental conditions”.
- Saudi Building Code Requirements. (SBC-301). 2. Loading and Forces:
  - 2.1.2. Live Loads. The live loads considered for roof, according to section 4.9 of Saudi Building Code (301 Loading and Forces).
  - 2.1.4. Rain Loads. According to section 8.3 of SBC 301.
  - 2.1.5. Wind Loads. Sections 7.1.1.1. and 7.1.1.2. of the Saudi Building Code (301 Loading and Forces).
  - 2.1.7.1. Occupancy importance. According to table 1.6.-1 (SBC 301).
  - 2.1.7.2. Site Class Definitions. Saudi Building Code in section 9.4.2.
  - 2.1.7.7. Design Response Spectrum. Section 9.5 of SBC.
  - 2.1.7.7. Design Response Spectrum. Table 10.2 of SBC.

## **TRACK**

The following European or international standards have been considered for track design:

- Technical Specification for Interoperability. Control and command Subsystem ERTMS.
- Technical Specification for Interoperability. Rolling stock Subsystem.
- Technical Specification for Interoperability. Infrastructure Subsystem.
- Technical Specification for Interoperability. Operation Subsystem.
- Technical Specification for Interoperability. Maintenance Subsystem.
- Technical Specification for Interoperability. Energy Subsystem.
- UIC-719. Earthworks and track bed for railway lines.
- EN 13146-5. Railway applications. Track. Test methods for fastening systems. Part 5: Determination of electrical resistance.
- EN 13232-1. Railway applications - Track - Switches and crossings - Part 1: Definitions.
- EN 13232-2, Railway applications — Track — Switches and crossings — Part 2: Requirements for geometric design.
- EN 13232-9. Railway applications - Track - Switches and crossings - Part 9: Layouts
- EN 13450 (2002/2004). Railway applications. Aggregates for railway ballast.
- EN 13674-1. Railway applications - Track - Rail - Part 1: Vignole railway rails 46 kg/m and above.
- EN 13674-2. Railway applications — Track — Rail — Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above.

- EN 13674-3: 2006+A1:2010 Railway applications - Track - Rail - Part 3: Check rails.
- EN 13803-1. Railway applications. Track. Track alignment design parameters. Track gauges 1435 mm and wider. Part 1: Plain line.
- EN 13803-2. Railway applications. Track. Track alignment design parameters. Track gauges 1435 mm and wider. Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature.
- EN 14730-1. Railway applications - Track - Aluminothermic welding of rails - Part 1: Approval of Welding processes.
- EN 14730-2. Railway applications - Track - Aluminothermic welding of rails - Part 2: Qualification of aluminothermic welders, approval of contractors and acceptance of welds.
- EN 15273-2: 2009. Railway applications - Gauges - Part 2: Rolling stock gauge.
- EN 15273-3: 2009. Railway applications - Gauges - Part 3: Structure gauges.
- Standards for sleepers and fastenings:
  - EN 13230-1 and EN 13230-2. Railway applications. Track. Concrete sleepers and bearers. Part 1: General requirements and Part 2: Prestressed concrete monoblock sleepers.
  - EN 13481-3, Railway applications - Track - Performance requirements for fastening systems - Part 3: Fastening systems for wood sleepers.
  - EN 13481-7, Railway applications - Track - Performance requirements for fastening systems - Part 7: Special fastening systems for switches and crossings and check rails.
  - EN 13146, Railway applications. Track-Test methods for fastening systems.

## UTILITIES

- SANITARY
  - The SBC 701 and all the ANSI, ARI, ASME, ASSE, ASTM, AWWA, CISPI, CSA, FS, ICC, ISEA NFPA, NFS and UL standards included in SBC 701.
- WATER SUPPLY
  - ANSI, American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
  - ARI, Air-Conditioning & Refrigeration Institute, 4100 North Fairfax Drive, Suite 200, Arlington, VA22203.
  - ASME, American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.
  - ASSE, American Society of Sanitary Engineering, 901 Canterbury Road, Suite A, Westlake, OH 44145.
  - ASTM, ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
  - AWS, American Welding Society, 550 N.W. Le Jeune Road, Miami, FL 33126.
  - AWWA, American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235.
  - CSA, Canadian Standards Association, 178 Rexdale Blvd., Rexdale (Toronto), Ontario, Canada M9W 1R3.
  - FS, Federal Specification, 1941 Jefferson Davis Highway, Suite 104, Arlington, VA 22202.
  - ICC, International Code Council, 5203Leesburg Pike, Suite 600, Falls Church, VA 22041.

- ISEA, Industry Safety Equipment Association, 1901 N. Moore Street, Suite 808, Arlington, VA 22209.
  - NFPA, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
  - NFS National Sanitation Foundation, 789 Dixboro Road, Ann Arbor, MI 48105.
- ELECTRICAL
    - SBC 401 and all the SASO STANDARDS, IEC STANDARDS, BS EN STANDARDS, CENELEC STANDARDS, ISO STANDARDS and NFPA STANDARDS included in SBC 401.
    - Furthermore, the latest issues of the listed Codes and Standards will also be complied: Saudi Building Code (SBC) and Saudi Arabian Standard Organization (SASO) Codes and Standards; however, items/systems not covered in SASO Standards will conform to the latest version of the following:
      - Standards/Regulations issued by Saudi Electric Company (SEC), Ministry of Public Building and Works, Civil Aviation Authority, etc., as applicable.
      - (IEE) Seventeenth edition of IEE wiring Regulations. (BS 7671: 2008).
      - (IEC) International Electro-Technical Committee codes/standards.
      - (NFPA) National Fire Protection Association.
      - (NEC) National Electrical Code - U.S.A.
      - (CIBSE) British "Code of Interior Lighting "issued by the "Chartered Institution of Building Services".
      - Illuminating Engineering Society (IES) Code.
      - British standard for Earthing (BS 7430)
      - British Standards for Protection of Structures against lightning (BSEN 62305).
      - ISO Standards.
- FIRE FIGHTING
    - The main standards considered are Saudi Building Code (SBC) and the international NFPA. In particular the Saudi Building Code 801 (Fire Protection). SBC 801 and all the ANSI. API. ASME. ASTM. DOTn. ICC. NEMA. NFPA and UL standards included in SBC 801 are the reference standards to be complied.
    - Furthermore, the latest issues of the listed Codes and Standards shall also be complied:
      - SASO: Saudi Arabian Standards Organization.
      - Local Codes and Ordinances. Civil Defense & Authorities having Jurisdiction.
      - NFPA 10: Standard for Portable Fire Extinguishers
      - NFPA 11: Standard for Low-, Medium-, and High-Expansion Foam
      - NFPA 1142: Standard on Water Supplies for Suburban and Rural Fire Fighting
      - NFPA 12: Standard on Carbon Dioxide Extinguishing Systems
      - NFPA 13: Standards for the Installation of Sprinkler Systems.
      - NFPA 13 E : Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems
      - NFPA 14 : Standard for the Installation of Standpipes and Hose Systems
      - NFPA 20 : Standard for the Installation of Stationary Pumps for Fire Protection
      - NFPA 22 : Standard for Water Tanks for Private Fire Protection
      - NFPA 24 : Standard for the Installation of Private Fire Service Mains and Their Appurtenances

- NFPA 70 : National Electrical Code
  - NFPA 72 : National Fire Alarm Code
  - NFPA 75 : Standard for the Protection of Information Technology Equipment
  - NFPA 76 : Standard for the Fire Protection of Telecommunications Facilities
  - NFPA 2001 : Standard on Clean Agent Fire Extinguishing Systems
- HVAC
    - Furthermore, the latest issues of the listed Codes and Standards shall also be complied:
      - SASO Saudi Arabian Standards Organization.
      - ARI 210 Unitary Air Conditioning Equipment.
      - ARI 270 Sound Rating of Outdoor Unitary Equipment.
      - ARI 360 Commercial Industrial Air Conditioning Equipment.
      - American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
      - Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
      - IEC 328-ANSI Safety Requirements for the Electrical Equipment Room Air Conditioners.
      - NEC Article 44 Air Conditioning and Refrigerating Equipment.
      - National Fire Protection Association (NFPA).
      - ISO R 859 Testing and Rating Room Air Conditioners.
      - UL 465 Central Cooling Air Conditioners.
      - UL 484 Room Air Conditioners.
      - UL 586 Test Performance of High Efficiency Air Filters.
      - Gulf Life Safety Code.
      - Uniform Building Code (UBC).
- COMPRESSED AIR
    - ISO 8573 Compressed air. International Organization for Standardization (ISO). 1. rue de Varembe. Case Postale 56. CH-1211 Geneve 20.Switzerland.
    - ISO 12500 Filters for compressed air. International Organization for Standardization (ISO). 1. rue de Varembe. Case Postale 56. CH-1211 Geneve 20.Switzerland.
    - ISO 6953 Pneumatic fluid power -- Compressed air pressure regulators and filter-regulators. International Organization for Standardization (ISO). 1. rue de Varembe. Case Postale 56. CH-1211 Geneve 20.Switzerland.
    - ISO 10094 Pneumatic fluid power -- Electro-pneumatic pressure control valves. International Organization for Standardization (ISO). 1. rue de Varembe. Case Postale 56. CH-1211 Geneve 20.Switzerland.
    - ISO 11148 Hand-held non-electric power tools -- Safety requirements. International Organization for Standardization (ISO). 1. rue de Varembe. Case Postale 56. CH-1211 Geneve 20.Switzerland.

## 1.

The Makkah Depot has been designed in order to perform the maintenance works that should be carried out to preserve HST in order to enable its continued use and function, over a minimum acceptable level of performance along its design service life and without unforeseen renewal or major repair activities.

Rolling Stock maintenance serves to protect system operation in different ways:

- **Physical Integrity:** To keep HST in good working condition so as to minimize disruptions and downtimes.
- **Risk Management:** To keep the HST in a state of good repair for the users' health and safety.
- **Aesthetic Preservation:** To keep HST from deteriorating in appearance and becoming unsightly.
- **Responsible Stewardship:** To ensure that HST achieve their full potential service life.
- **Duty to Mitigate.** To prevent unnecessary damage to HST that may result in their premature failure.

The object of the Makkah Depot is to develop the quick and light maintenance: Maintenance activities 1 (day stabling), 2 (overnight stabling) and 3 (quick maintenance) are foreseen to be performed at this location as a part of the maintenance program. Additionally some of the activities type 4 (periodic inspection) are foreseen as well.

Therefore the following facilities are included in the depot:

### **Type 1+type2+type3**

- A Stabling area with
  - Roof covered stabling tracks
  - Accesses for cleaning and inspection team
  - Electricity and water supply
  - Catenary
  - Fuel dispensers
- Exterior washing machine
- Toilet filling and emptying systems (automatic)
- Wheel-Set monitoring equipment
- A Quick Maintenance Building which includes:
  - Offices area for maintenance staff
  - A storage area for spare parts
  - Covered tracks system equipped with:
    - Catenary
    - Inspection pits
    - Inspection platforms
    - Toilet filling and emptying systems (automatic)
    - Sand and water refilling systems
    - Accesses for cleaning and inspection team everywhere
    - Electricity and water supply

#### Type 4

- Specific indoor tracks:
  - Simultaneous lifting track
  - Dropping table track
  - Wheel-set truing lathe track
- A workshop area for specialized shops (Electrical, Mechanical, Pneumatical, Body fitting) equipped with:
  - Area for maintenance workers
  - Various facilities to test HST functions
  - Various facilities to exchange components



## 2.

The justification of the solution adopted for the Makkah Depot is based on the following determining factors:

Location (premise of reducing the earthworks and also to maximize land compensations, the connexion with the high speed line must be situated on a straight alignment with constant gradient, adequate drainage, etc)

Environment

Platform geometry

Line operation

Quality road accesses

Occupied Facilities

Functionality

Logistics supply

The main reason for locating the depot has been for Makkah line functionality because of the proximity to the Makkah station.

### 3.

#### 3.1 Sizing facilities

Makkah depot has been designed taking into account the approved concept design (HHR2- ASC- DEW- DEP-001-DES-CON-00001-R00) about maintenance operational characteristics of the Haramain High Speed Railway (HHR).

Makkah Depot and Workshops are designed considering their implementation in two periods depending on the railway system capacity. The HHR passenger services are initially foreseen to be operated with 35 to 55 high speed train (HST) units in the first period (Phase I: 2016 – 2027) and with up to 100 train units during the second period (Phase II).

To have an effective and efficient maintenance railway system it is required:

- Enough parking tracks length to place the maximum number of trains which the system is designed to accommodate
- Enough tracks to carry out maintenance activities in the most demanding scenario
- Proper W&D locations in order to minimize non-commercial rolling stock movements

For each of the likely scenarios, the most difficult situation has been estimated and an operation schedule has been developed.

These data refer to the total line HHR:

First period with 55 trains:	75,564 km/day
First period with 55 trains and Hajj Terminal station:	79,783 km/day
Second period with 100 trains and Hajj Terminal station:	177,441 km/day

Therefore, according to operational plan shown in “WORKSHOPS AND DEPOTS CONCEPT DESIGN”, 79,783km per day are run. Considering that there are 55 trains, every single unit mileage per year is 526,927km. However a maximum of 85% of this amount is realistic, so the maintenance strategy can be based in 447,888km per year and train.

For a correct Makkah depot design it has been taken into account a different maintenance cycles according to the existing rolling stock, as well as the estimated time per maintenance activity.

These data are included in the following charts:

Activity	IR	IS	IB	IM1	IM2	IM3	IM4	IM5	IM6	R
Minimum Km	4,000	8,000	33,600	100,800	201,600	403,200	806,400	1,612,800	3,225,600	6,451,200
Medium km	5,000	10,000	42,000	126,000	252,000	504,000	1,008,000	2,016,000	4,032,000	8,064,000
Maximum km	6,000	12,000	50,400	151,200	302,400	604,800	1,209,600	2,419,200	4,838,400	9,676,800

Activity	IR	IS	IB	IM1	IM2	IM3	IM4	IM5 (est)	IM6 (est)	R (est)
Time	4 hours	8 hours	16 hours	24 hours	48 hours	72 hours	96 hours	21 days	36 days	60 days

Abbreviations used in the maintenance operation cycle:

- IR: Inspection intervention
- IS: Service intervention
- IB: Basic intervention
- IM1: First step maintenance intervention
- IM2: Second step maintenance intervention
- IM3: Third step maintenance intervention
- IM4: Fourth step maintenance intervention
- IM5: Fifth step maintenance intervention
- IM6: Sixth step maintenance intervention
- R: General repair

In the chart below a summary of the proposed maintenance system and parking position is shown. The maintenance system is divided between Makkah and Madinah Depots.

	UP TO 55 TRAINS			UP TO 100 TRAINS		
	Initially		SYSTEM	Additionally		SYSTEM
	Makkah	Madinah		Makkah	Madinah	
Maintenance positions 1-4	8	8	<b>16</b>	8	8	<b>32</b>
Heavy workshop tracks	0	7	<b>7</b>	0	7	<b>14</b>
Parking positions	10	10	<b>20</b>	8	10	<b>38</b>
Pit wheel-lathe	2	2	<b>4</b>	1+1*	1+1*	<b>6+2*</b>
Bogie drop system	1	1	<b>2</b>	1	1	<b>4</b>
Train washing area	1	1	<b>2</b>	1	1	<b>4</b>
Blowing cabin	1	1	<b>2</b>	0	0	<b>1+1</b>
Wheel parameters measurement	1	1	<b>2</b>	0	0	<b>2</b>
Track lowering benches	6	14	<b>20</b>	6	14	<b>40</b>
Test track	0	1	<b>1</b>	0	0	<b>1</b>
Painting booth	0	1	<b>1</b>	0	1	<b>2</b>

An additional document “Workshops and depots. Report of functionality” (HHR2-ASC-DEW-GEN-GEN-REP-DET-00005-R00) has been drafted where the whole maintenance of the HHR Rolling Stock is described.

### 3.2 Location

Makkah depot is located on the left side of the line, approximately between Sta. 5+400 and Sta. 7+100, and occupying an approximately area of 24.60 hectares (a 1,800 long x 135 m width rectangle parallel to main line).

The land where the Depot will be located is just outside the city of Makkah, in an area of urban and industrial development. The depot will be delimited to the north by the High Speed Line and to the south by the Bus Road. This site has rocky mountains which have been smoothed by local requirements.

Railway access is granted by a third track coming from Makkah station, so that the line capacity remains unchanged despite maintenance movements to and from the depot.

Road traffic access is granted by an existing road (Bus Road) which is affected by the implantation of the High Speed Line and by the location of the Depot.

### 3.3 General Characteristics

In the first phase there are 8 tracks at the quick maintenance area, 4 of them are inside the workshop building (WT5, WT6, WT7, WT8), and the other (WT1, WT2, WT3, WT4) are outside and around the quick maintenance building. Two of the four external tracks (WT3, WT4) are located on the wheel-lathes pit, there is a by-pass track (WT2) that provides access to the stabling area, and there is a final track (WT1) where the wheel profile parameters measuring system, blowing booth, and automatic side washing plant are located.

Additionally there is a stabling area with 6 tracks, 5 of them (DT1-DT5) are foreseen for parking the train units, while the last one (DT6) is a manoeuvre track. The automatic front and rear washing plant and the fuel filling are located on this track (DT6).

There are 4 more tracks: The secondary access for trains (T4); 2 side protection tracks at both train accesses (T1, T3), which can be used as manoeuvre tracks as an alternative use; and the last track with a shed for the rescue train (T2).

The depot has two different areas:

- Quick Maintenance building with a net floor area of (450m x 40.90m) 18,405 m<sup>2</sup> approximately where maintenance activities 1, 2, 3 and 4 (some of them) are able to be performed.
- Stabling area with five 435 m long covered tracks resulting in 10 parking positions for individual train set.

Apart from the main areas and buildings described, there are also some other special facilities:

- Access Control Building, to the custody and control of the access to the premises.
- Two wheel-lathes in a pit, equipped with shunting cars and sward removal systems.
- Wheel-set parameter control
- Blowing and vacuuming cabin.
- Pass-through lateral train washing area.
- Pass-through frontal train washing area.
- Shed for the rescue train
- Temporary waste storage, or waste collection area, where waste generated is temporarily stored for later collection and recycling.
- WC treatment area. Facility and extraction for the WCs and toilets treatment.
- Sewage treatment plant.

- Silo equipped with sand dispensers. Sand dispensers to be located at end of the building.
- OCS booth. For the connection with the catenary of the main line.
- Multiple service supply room, where the installations for the various providers (water, gas, power supply, telephone) will be located.
- Transformation centre, with the necessary installations for proper operation.
- Emergency generators with their corresponding fuel tanks.
- Deposits for dispensation and removal of fuel.

## 3.4 Buildings

### 3.4.1 Quick Maintenance Workshop

The layout comes from the need of establishing a shed 450.00 m long and 40.90 m wide, which hosts a total of 4 tracks (WT5 to WT8) with axe to axe distance of 7.25 m to provide maintenance service to 8 trains, and hosts all the necessary dependencies (offices, storage, warehouses, etc...).

Attached to the northwest façade there are two tracks (WT3 and WT4) where the pits for the wheel-lathes are located in the middle, with access through the workshop. It is 15.64.00 m long and 15.30 m wide.

The main building is structured into three areas as well:

- Workshop: It is organized in ground floor with access to level  $\pm 0.00$ , and work areas at level -1.40.
  - Tracks area (WT5 to WT8)
  - Technical rooms. There are some technical rooms that have a raised flooring system and the levels of these rooms are -1.10.
  - Boxes
- Supporting area: It is located at the southeast façade and it is organized in ground floor with access to level  $\pm 0.00$ , and work areas at level -1.40; and in first floor at level +4.45.

Level  $\pm 0.00$

- Bogie drop system
- Storage
- Technical rooms (some of them)
- Operation Control Room
- Nursing room
- Toilets

Level +4.45

- Offices

Level +4.23

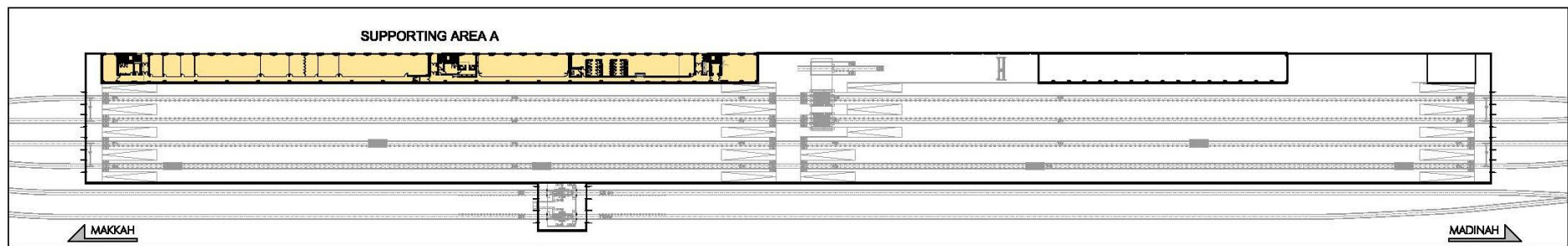
- Praying room

- Canteen room, locker room, toilets
- Pit wheel-lathe: It is located at the northwest façade, and it is organized in ground floor with access through the Quick Maintenance Building, at level  $\pm 0.00$  through steel stairs from level -1.40. It is placed on two tracks (WT3 and WT4). There is a pit at level -1.81

The following drawing defines the different areas of the Quick Maintenance Building.



GROUND FLOOR



FIRST FLOOR

	SURFACE m <sup>2</sup>
<b>1. GROUND FLOOR</b>	
<b>1.1. MAIN BUILDING</b>	
PLATEAUS	432.85
WORKSHOP	14042.85
PASSAGEWAY	399.50
<b>TOTAL WORKSHOP</b>	<b>14875.20</b>
<b>1.2 SUPPORTING AREA A</b>	
OPERATION CONTROL'S ROOM	84.25
LOCKER ROOM	10.75
<b>1.3. SUPPORTING AREA B</b>	
TECHNICAL ROOMS	
RAILWAY SIGNALING	69.65
TELECOMMUNICATION/PAS/GSMR ROOM	55.65
BATTERY ROOM	31.65
TELECOMMUNICATION/PAS/GSMR ROOM	28.90
BOXES	780.10
TECHNICAL ROOMS	
ELECTRICAL ROOM	43.20
FIRE PROTECTION ROOM	43.20
WATER SUPPLY	43.40
<b>1.4. SUPPORTING AREA C</b>	
TECHNICAL ROOMS	
OFFICE WATER TECHNICAL ROOM	43.40
COMPRESSOR ROOM	43.20
UTILITIES TECHNICAL ROOM	32.45
WC	14.20
NURSING ROOM AND TOILET	29.75
BOGIE DROP AREA	845.00
STORAGE	723.20
<b>1.5. SUPPORTING AREA C</b>	
BOXES	291.10
<b>1.6. SUPPORTING AREA D</b>	
TECHNICAL ROOMS	



	SURFACE m <sup>2</sup>
ELECTRICAL ROOM	86.85
WC	22.80
CLEANNING ROOM	11.85
<b>TOTAL SUPPORTING AREAS</b>	<b>3334.55</b>
<b>TOTAL GROUND FLOOR</b>	<b>18209.75</b>

	SURFACE m <sup>2</sup>
<b>2. FIRST FLOOR</b>	
OFFICE	
DIRECTOR	42.70
FLET TRACKING/HELP DESK	30.70
HUMAN RESOURCES AND TRANSLATORS	39.70
MAINTENANCE OF CENTRE	30.70
PLANNING, QUALITY, PURCHASING	150.00
TRAINING ROOM	65.00
MEETING ROOM	65.00
WARRANTY	46.65
MAINTENANCE ENGINEERING	203.00
FEMALE LOCKER ROOM	58.45
MALE LOCKER ROOM	262.55
CANTEEN ROOM	208.60
PRAYER ROOM	108.25
FOOT BATH	11.60
WC MALE	19.45
CLEANNING ROOM	3.85
CLEANNING ROOM	7.95
PLUMBING ROOM	7.95
ELECTRICAL ROOM	7.95
PASSAGEWAY	364.00
<b>TOTAL</b>	<b>1733.80</b>

	SURFACE m <sup>2</sup>
<b>2. FLAT ROOF FLOOR</b>	
TECHNICAL ROOM 1	84.25
TECHNICAL ROOM 2	138.55
TECHNICAL ROOM 3	56.15
FLAT ROOF	1477.10
<b>TOTAL</b>	<b>1756.05</b>

	SURFACE m <sup>2</sup>
<b>3. WHEELS LATHE</b>	
WHEELS LATHE	228.90
<b>TOTAL</b>	<b>228.90</b>

The structure of the Quick Maintenance Building and the Wheels Lathe is made by metal frames every 5.00 m. The Quick Maintenance Building is made with metal pillars and a metal truss that spans 31.75 m, with the upper chord of the truss gabled. The supporting area, which is located at the southeast façade, is made with metal pillars and metal beams that span 9.15 m and decking flat. The supporting area has a zone with two levels. The structure extends 7.00 m of the southeast façade to form a canopy to cover a space for parking. The Wheels Lathe is made with metal pillars, metal beams and a sloping roof, in accordance with the Quick Maintenance Building gable.

The façades are made 1.00 m high (over ±0.00 level) concrete perimeter baseboard and sandwich panels anchored to the structure. In the Quick Maintenance Building and the Wheels Lathe the gable roof is finished with sandwich panels anchored to ceiling structure and the deck of the supporting area is a flat roof.

Natural lightning is guaranteed by means of skylights of translucent panels along the gable roof and vertical glazing along longitudinal façades

### 3.4.2 Stabling Area

It is a shed of 435.50 m long, 25.19 m wide, and 7.86 m height, which hosts a total of 5 tracks (DT1 to DT5). The structure is made of metal frames with metal pillars and a metal truss that form a gabled roof. The shed is covered with simple sheet and has not envelope system. The trains maintenance is performed by metal walkways arranged on the side of the tracks, at +0.50 m height from the rail head, located between tracks DT2-DT3, DT4-DT5, and the northwest side of track DT1.

### 3.4.3 Other special facilities

#### Temporary Waste storage

It is a shed of 14.60 m long and 6.70 m wide, and 4.00 m height. The structure is made of metal frames formed by pillars and beams that form a sloped roof. The cover and the envelope system are made with a concrete perimeter baseboard 1.00 m height, and a sandwich panel.

#### Parking canopies

In the parking area canopies are made of metal structure and covered with galvanized trapezoidal steel sheet attached to steel frame. The structure is made by metal frames with metal pillars and a metal beam that form a sloping roof.

#### OCS Booth

It is a building has a net floor area of 21.00 m<sup>2</sup> (6.00 x 3.5 m) indoor, and 3.70 m height. It's an area at level -1.00 to permit a raised flooring system. The structure is made by metal pillars and a concrete slab form a flat roof.

#### Access control

The access control has a net floor area of 43.20 m<sup>2</sup> (9.00 x 4.80 m) and, the main room is destined to the checkpoint, it has two workstations, looking to the entrance way and each one to his side. There are two entries to this room, one in each side, so the staff can easily go outside in case they need to get closer to vehicles. In the back there are distributed a data room, a small storage room and the restroom.

	SURFACE m <sup>2</sup>
<b>ACCESS CONTROL</b>	
CHECPOINT	16.10
DATA ROOM	10.75
STORAGE ROOM	2.45
WC	2.45
<b>TOTAL</b>	<b>31.75</b>

The structural system consists in a rectangular concrete slab supported on steel columns with a sliding roof.

## 3.5 Equipment

### 3.5.1 Indoor quick Maintenance equipment

This section describes the main equipment which shall be installed in the workshop in order to perform the maintenance activities. This equipment is installed inside the main building.

Lifting means: They are listed in the following table with a proposal for the location on the layout:

Description	Capacity(t)	Length (m)	Units	Location
Chain hoist	2,5		16	2 units (at each train job)
Crane	3	7,25	4	2 units (at each track header)
Crane	15+5	9,0	1	Bogie drop system

Bogie drop system: It has three working positions:

- Two positions where the bogie can be assembled/disassembled.
- One position where the bogie can be moved inside/outside the working area.

XYZ maintenance platforms: 16 units of this kind of platforms shall be installed in order to enable access to the train on both sides. The loading capacity is 250 kg approximately (enough for two workers and tools).

Working platforms systems, side and roof access: 16 units of this kind of platforms shall be installed in order to enable access to the locomotive and to the roof.

Rail Drop and Wheelset Extractor: 6 units shall be installed in order to enable the extraction train elements or wheel-sets, if necessary while maintenance activities are being performed.

Lifelines: 8 units shall be installed in order to enable workers to climb onto the roof of the train, to join and avoid accidents.

Toilet emptying/cleaning vehicle: Specific equipment shall be installed in order to empty and clean HST toilets during the performance of maintenance activities. This facility is also to include: suction points, storage tanks, vacuum pumps and control room.

### 3.5.2 Outdoor Equipment Facilities

Pit lathes: Two units shall be installed in order to enable wheel reprofiling without removing wheelsets from HST.

Wheel profile parameters measuring system: This equipment shall be able to measure and register all wheel profile parameters, detecting also surface damages/cracks defects, while HST passes over the equipment, with no stops and in a completely automatic way.

Automatic side washing system: This equipment shall be able to wash completely the lateral HST while it passes through the equipment, with no stops and in an automatic way.

Automatic front and rear washing system: This equipment shall be able to wash front and rear HST while it stops in the stabling area to change conductor.

Blowing booth: It shall be installed before the automatic side washing plant, in order to perform this activity before the washing process.

Waste-water treatment plant: Equipment needed for the treatment of waste-water shall be installed, ensuring the discharge to the municipal sewer network within established legal limits.

Temporary waste storage: This facility is intended for the sorting and temporary storage of waste generated by the activities of the workshop/Depot.

Sand filling: Specific equipment shall be installed in order to enable sand filling during the performance of maintenance activities.

Fuel filling: Specific equipment shall be installed in order to enable fuel filling during the performance of maintenance activities.

Shunting locotractor for road/track: This vehicle will be included to move the train or other machines without traction.

Diesel forklift (3 t): This forklift shall be used for unloading material from lorries at the warehouse entrance and making materials available in the different areas.

Diesel forklift (5t): This forklift shall occasionally be used for maneuvering warehouse materials and primarily used for production operation.

## 3.6 Utilities

### 3.6.1 External Utilities

#### Affected utilities

By the end of the drafting of this document, information from previous work phases has been gathered and the network supply companies and Official organizations have been contacted. By now, several companies have responded. Their letters are included in the document "HHR\_2C\_272\_MFA\_DP1\_000008UTI\_A01. Affected Utilities Report". It is likely that supply systems will be modified by requirements of this project.

The identified companies with supply systems in the project area are:

SEC (Electric Energy: High Voltage, Medium Voltage, Low voltage)

Zain (Mobile Telecommunications Company)

STC (Saudi Telecom)

Mobily Telephone

ITC Company (Telecom)

SCEC (water system)

Sewer system

Gas (if there is any)

#### Connections with company's systems

The connection design of water supply, sewage, electricity and communications systems are under consultation and analysis of alternatives with Saudi companies and agencies responsible for them.

### 3.6.2 Workshop and Depot Utilities

Utilities design is based on the existing set of legal, administrative and technical regulations and requirements in Saudi Arabia, compiled in the Saudi Building Code (SBC). The SBC specifies the minimum standards related to the building construction in order to ensure public safety and health.

The most relevant utilities planned in this project are the following ones:

Sanitary: The sanitary system has been determined under the Saudi Building Code Sanitary Requirements (SBC 701) based on the International Plumbing Code (IPC). Moreover, this system will be coordinated with the local water Directorate, as required by SBC 701.

As a first outline, the sanitary installation has been divided in four different and separated networks: a storm water network, two industrial networks and, finally, a sewage one.

The storm water network will collect rainwater and discharge it directly to the ground.

On the other hand, the first industrial network will collect waste from the depot building, including washing and blowing waste. This network will be connected to the sewage treatment plant where a biological treatment and also hydrocarbon liquids separation will be carried out independently. Then, this first industrial network will be connected to the urban sanitary one.

Furthermore, there is a second industrial network, which collects waste from the locomotives washing front machine, next to the Stabling area. In this case, a hydrocarbon separator has been proposed. After the separation, the remaining water will be directly thrown to the general drainage network.

Related to the last sanitary network, the sewage from the WC-s of the locomotives as well as sewage generated in the depot building (WCs, kitchens...) and in the checkpoint will be led to the sewage treatment plant.

A portion of the treated water generated in the sewage treatment plant will be stored in a tank and it will be used to clean the trains' WC-s. The treated water surplus generated will be poured to the urban sanitary network. If this is not possible, some septic tanks will be installed for treated water storage. They will be emptied periodically by truck.

Finally, on the stabling area there is a WC-s facility for the emergency emptying of trains' WC-s. This facility will be used only occasionally, so an independent septic tank will be installed to catch the possible spills.

The internal sanitary networks of the buildings will discharge to the external networks described above.

For the showers, in the second floor of depot building, a compact station for grey and treated water reuse will be installed.

Water supply: The water distribution system shall comply with Chapter 3 of SBC 701, Water Supply and Distribution Systems.

The materials, design and installation of water supply systems, both hot and cold water systems, for buildings which people will use are described below. The installation of individual water supply systems is also included in the description.

As a first outline, the water supply installation will consist of the following elements:

- Underground water tanks, to be refilled by the connection to the urban water supply network or by trucks.
- A pressure group, to pump the water to each water demand point

- A distribution manifold, for the distribution of water
- Auxiliary water tank for office's changing room.
- Auxiliary water tank for Stabling area.
- Auxiliary water tank for treated water (see report HHR-2C-272-MFA-DP1-000001UTI-A01).

The installation will work as follows: the water tanks, which will cover the installation demand for seven days, will be connected to the urban water supply network. As aforementioned, these water tanks, whose characteristics will be explained in section 4.10, will be underground tanks. After them, a pressure group will be installed to pump the water to the demand points. Finally, a distribution manifold will distribute water by the required pipes to each consumption point.

For the office's changing room will be installed an auxiliary water tank with capacity for one day maximum punctual estimated consumption (10,000l). In addition the greywater from showers will be treated and reused to fill the tanks of water closets in the second floor.

For the stabling area and locomotive front washing machines, an auxiliary water tank connected to the distribution water pipeline it is proposed. This auxiliary water tank is proposed because the stabling area is far away from the main water tanks and it will have an occasionally high consumption of water.

On the other hand, as it is mentioned before, it is proposed to reuse the waste water treated in the sewage treatment plant for the cleaning of trains' WC-s. Because of this, it will install an auxiliary water tank for treated water.

Electrical supply: the electrical system has been determined under the Saudi Building Code Electrical Requirements (SBC 401), developed based on the standards of the Saudi Arabian Standards Organization (SASO) which are partially based on the International Electrotechnical Standards Series of IEC 60364 (Electrical Installations of Buildings).

The private electrical network will be connected to electric company supply (SEC) with a generator in case of fault of SEC supply, in such a way in main switchboard it's projected installing an interlocking system to make its supply from electrical company supply (SEC) or the electrical fuel oil generators.

For covering the electrical loads of each outbuilding, and individual network will be installed, connected to the private main one. All these individual indoor installations will comply with the aforementioned standards.

Based on SBC 401, the main characteristics of the available supplies are the following ones:

- Nature of current: a.c. current
- Nature and number of conductors: three conductors

All electrical equipment, accessories and fittings will be to operate continuously in the electricity supply considering the following typical Electric Company supply characteristics:

- Medium Voltage: 33 kV, 60 Hz, 3 phases, 3 wires.
- Type: Three-phase
- Phase to phase voltage: 400/480 V
- Phase to neutral voltage: 230/277 V
- Short-circuit power (transformer input): 500 MVA at 33 kV side of transformer.

Lighting: the lighting system has been determined under the Saudi Building Code Electrical Requirements (SBC 401).

This lighting system has been considered to be used for both day and night works. The outdoor lighting installation comprises luminaries, the wiring system and accessories located outside the buildings.

Otherwise, buildings have their own indoor lighting, properly adapted for each area.

The lighting levels considered to design the indoor lighting installation for each outbuilding of the Makkah depot are summarized below:

- Workshop: 400 lux. with an uniformity coefficient not lower than 0.7
- Offices: 500 lux.
- Boxes: 400 lux. with an uniformity coefficient not lower than 0.7
- Connecting areas. staircases: 150 lux.
- Changing rooms: 200 lux.
- Warehouse. storages: 200 lux.
- Kitchen: 500 lux.
- Corridors: 100 lux.
- Mechanical Equipment Rooms: 200 lux.
- Electrical rooms (low voltage rooms): 300 lux.

The following outdoor lighting system has been proposed for the depot area:

- Yard area: high pressure sodium lamps of 250W each mounted on 9 meter high in façade.
- Road Floodlight: high pressure sodium lamps of 150W each mounted on 8 meter column.
- Marquee Parking: fluorescence 2x18W each, mounted in surface of beam.

Fire protection: This point is developed according to the content of chapter 7 of SBC 801 explaining the depot considerations for wide facilities. Fire protection systems required by these code requirements or the SBC 201 shall be installed, repaired, operated, tested and maintained in accordance with these code requirements.

Any fire protection system or portion thereof not required by these code requirements or the SBC 201 shall be allowed to be furnished for partial or complete protection provided such installed system meets these code requirements and the SBC 201.

In occupancies of a hazardous nature, where special hazards exist in addition to the normal hazards of the occupancy, or where the Building official determines that access for fire apparatus is unduly difficult, the Building official shall have the authority to require additional safeguards. Such safeguards will include, but shall not be limited to, the following:

- Automatic fire detection systems
- Fire alarm systems
- Automatic fire-extinguishing systems
- Standpipe systems,



- Portable or fixed extinguishers

Fire protection equipment required under this section shall be installed in accordance with these code requirements and the applicable referenced standards.

Any device that has the physical appearance of life safety or fire protection equipment but does not perform that life safety or fire protection function shall be prohibited.

These fire installations shall be developed according to the sections 7.1.5 to 7.1.13 of the SBC 801.

**HVAC:** Heating, ventilating and air-conditioning systems of all structures shall be designed and installed for efficient utilization of energy in accordance with the Saudi Building Code Energy Conservation and Mechanical Requirements (SBC 601 and 501, respectively).

The Quick Maintenance Building is divided in different zones: industrial area, office area, storage area, canteen prayer room, changing rooms and toilets area. Given the size and characteristics of the building, this Project considers different ways of treating from HVAC or ventilating facilities for the different parts of building.

Rooms with special requirements will be treated with the special equipment, that are required in each case.

**Compressed Air:** The Makkah depot will have a compressed air pipes network, with fast fit hose connections distributed throughout the depot. This net will supply also compressed air to the lathe for wheels pits area.

### 3.7 Earthworks

Please see below the summary of the quantities of the earthworks required for the construction of the depot phase I, which can be seen in detail in the Earthworks Report (HHR-2C-272-MFA-DP1-000001EAW-A01) as well:

Summary of quantities			
Material		Partial Volumes (m <sup>3</sup> )	Total Volume (m <sup>3</sup> )
Cutting	Esplanade	535,225.080	591,157.055
	Workshop foundation	22,921.875	
	Tracks	23,094.900	
	Road	9,702.600	
	Roundabout	212.600	
Fill	Esplanade	217,268.320	221,429.920
	Tracks	65.600	
	Road	4,096.000	
	Roundabout	0,000	
Track Ballast		12,105.100	12,105.100
Track Sub ballast		10,163.500	10,163.500
Track Subgrade		18,005.500	18,005.500
Roads Subgrade	Road	5,956.200	6,135.700
	Roundabout	179,5	

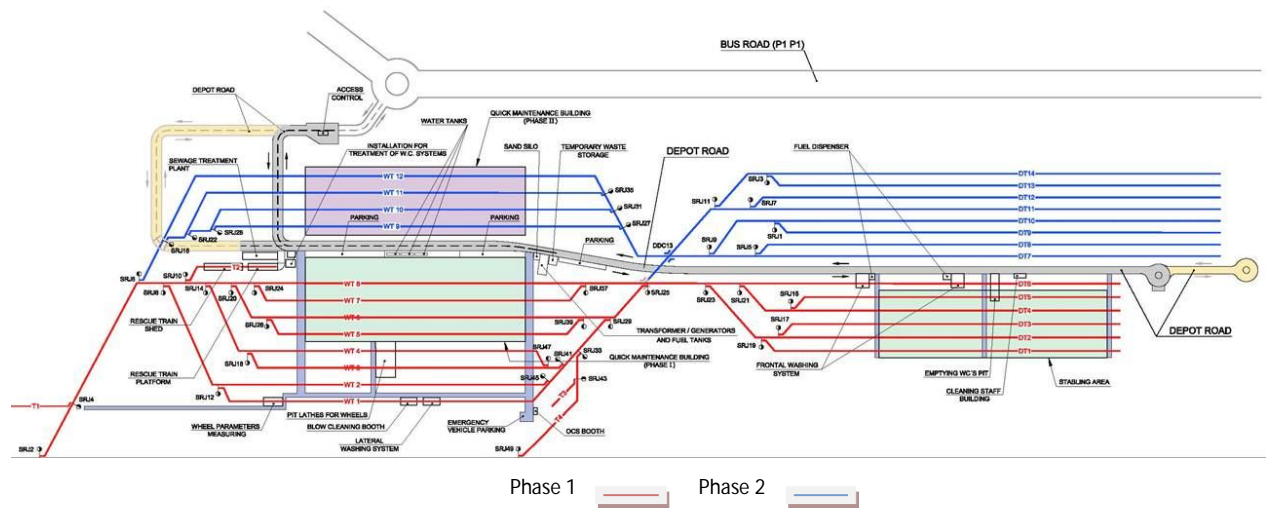
A **perimeter fencing** has been considered with the aim of closing the Depot area in order to prevent the access of people not related to the installation.

The design of the 3,663 meter perimeter fence has also taken into account the possible Phase 2 development.

### 3.8 Tracks

#### Functionality

The following diagram shows the different considered areas, along with the necessary tracks that must give service to them.



Depot diagram.

Makkah Depot has been designed so that its construction is carried out in two phases:

- Phase 1: This period is between 2016 and 2027 and it is planned to be operated with 35 to 55 trains.
- Phase 2: This period starts in 2028 and aims to increase the railway system capacity to cope with a maximum of 100 trains.

Even though Phase 2 is named in this project, only Phase 1 design is developed within it. This is based on the purpose of showing the future Depot as a whole design to ensure the feasibility of the second construction phase for the future.

Two accesses to Makkah Depot are implemented from the third track of the general line coming from Makkah Station. The main one corresponding to track WT8 and the secondary one is track T4. Both accesses link the whole Depot parallel to the Main Line.

With the aim of fulfilling the functionality requirements in both phases, a track layout inside the Makkah Depot has been designed, with the following sets of tracks:

## PHASE 1

### **Access set of tracks**

- The first and main access of the Depot is track WT8. Its Stock Rail Joint (SRJ-2) is located at sta 5+354 of the Main Line Third track, and diverted to its left.
- T1 is the first access side protection track, located closer to Makkah side, from the sta 5+472 to the sta 5+340 of the main line third track, counter-clockwise track WT8, where it starts from. This track can serve as a manoeuvre track as an alternative use.
- T4 is the second access to the Depot. Its SRJ-49 starting point is located in the sta 6+055 of the third track diverting to its left and it leads directly to the stabling area.
- T2 is the track where the rescue train shed is located and also has a platform that enables an access by road.
- T3 is the second side protection track located in the second access to the Depot, in the sta 6+319 of the third track aforementioned. This track can serve as a manoeuvre track as an alternative use, the same way as T1, making more flexible the operation in the depot stabling area.

### **Workshop tracks**

- Tracks WT1 and WT2 diverge directly from WT8 main access track. WT1 has three different facilities on it:
  - An equipment to measure the parameters and wheel defects.
  - A blow cleaning booth.
  - An automatic train washing system.WT2 is considered a by-pass track, permitting the train circulations from the access area to the stabling zone avoiding the workshop.
- Tracks WT3 and WT4 diverge directly from the main access track as well, and run parallel to the workshop building heading towards the pit lathes for wheels. Both of them finish before the second entrance to the Depot.
- Quick Maintenance Area is formed by four tracks (WT5, WT6, WT7 and WT8), most of them located inside the workshop building.

### **Stabling area tracks**

Once the Quick Maintenance Area is overtaken, the Stabling Area is composed by six tracks:

- DT1-DT5 consist of a set of five roof-covered tracks, which serve as train parking and service area with a minimum length of 435 m, enough for a double 216 m long train composition.
- DT6 open air track has two facilities for automatic train washing system equipment for the front of locomotives, and it is close to two deposits of dispensation and removal of fuel.

## PHASE 2

- Quick Maintenance Area is composed by four tracks (WT9 to WT12), great part of them inside the phase 2 Workshop Area building.
- The Stabling Area is formed by eight tracks (DT7 to DT14), all of them serving as train parking area. This area is connected to Phase 1 by means of DT11 track through a double diamond crossing.

## Superstructure

There are three different kinds of tracks at the depot:

- Ballasted track.** Most of the outside tracks in the depot. The cross section is:
  - 5H/4V slope on both sides of the ballast border.
  - 1 m width of ballast shoulder.
  - 20 cm minimum ballast thickness under sleeper.
  - 20 cm sub-ballast layer
  - 35 cm subgrade layer
  - 2% platform cross slope (except for tracks DT3 and left half of DT2, with 4%)
- Embedded track.** In the boundaries of the workshop building and at the crossings with the service ways.
 

Embedded track is made up of a grid formed by steel plate sleepers and the rails of the track with the sleepers placed every 1 m. This grid is finally embedded in a reinforced concrete slab.
- Pit track.** Tracks WT5 to WT8 located inside the Phase 1 Quick Maintenance Building. The superstructure consists of fixed rails held up by slab anchored metal pillars with Gantrex type or similar fastening system. The spacing between the pillars is 1.5 m.
 

Additional pit tracks at the accesses of the wheel lathe.

## Alignment

Functional and geometric parameters considered for the design are shown in the following figures:

FUNCTIONAL PARAMETERS	
Cant	0.00 mm
Cant deficiency	53.10 mm
Uncompensated acceleration	0.35 m/s <sup>2</sup>
Cant excess	0.00 mm
Cant rate of change	No clothoids
Cant deficiency rate of change	No clothoids
Uncompensated acceleration rate of change	No clothoids
GEOMETRIC PARAMETERS	
Minimum curve radius	200 m (Turnout radii not considered)
Cant rate of change (Cant ramp)	No clothoids
Minimum length of circular curve	10 m
Minimum length of straight between turnouts (same turn)	6 m
Minimum length of straight between turnouts (turn & reverse)	7 m

The following table summarizes the main features of the track alignment:

MAIN FEATURES OF THE LAYOUT
MAX. DESIGN SPEED: 30 Kmph
TRACK GAUGE: 1,435 mm
WORKSHOP & STABLING AREA GRADIENT: 0.00 ‰
DESIGN CANT: 0.00 mm
DEFICIENCY CANT: 53.10 mm / STANDARD DEFICIENCY CANT (Speed <160 Kmph): 160 mm

The figures shown in the previous chart follow the TSI Infrastructure HS Requirements.

### 3.9 Roads

It is essential to consider the existing road system, since the depot must be easily accessible by road. The main existing road link is the "Bus Road", a highway whose alignment is next to that of the railway at the Workshop area. Its layout has been modified to avoid interferences with the Depot area.

There is a highway (Makkah - Jeddah Expressway) located 1.5 km north from the Makkah Depot that provides access to the Makkah Station.

Moreover, there is another road (Old Makkah-Jeddah Road) located 3.5 km north from the Makkah Depot that connects with the Makkah Station by the 3rd Ring Road.

The access to Makkah Depot by road will be from Bus Road by means of a new roundabout. The project stretch between Bus Road and Access Control of the Depot will be implemented by P1P1. From the outer access road that leads to the workshop, you get to the Depot access control.

Once passed the access control, the interior road system links all the facilities areas, buildings and equipment of the Depot. It is designed as follows:

- Depot Road. It distributes the traffic from the access control to the quick maintenance building. This road connects the access control with the quick maintenance building and with the maneuver track (DT6) at the trains stabling area.  
It provides access to the front washing equipment and fuel tanks.  
It also allows the traffic to the stabling area.
- Service paths. The depot road is the connection with the service paved paths to the quick maintenance building, wheel parameters measuring, lateral washing system, blowing booth and wheel lathes.

From the results obtained in the multilayer analysis carried out in the Roads Report (HHR-2C-272-MFA-DP1-000001ROA-A01), the layer distribution proposed for the road construction sections are shown in the figure below:

Road construction section

PAVEMENT	BITUMINOUS WEARING COURSE	5 cm	HMA WC PG 76-10 Nominal Maximum Size (NMS) 19 mm
	BITUMINOUS BASE COURSE	8 cm	HMA BC PG 76-10 Nominal Maximum Size (NMS) 25 mm
	AGGREGATE BASE COURSE	15 cm	Aggregate base course, grading III (Table 3.03-1, section 3.03 MOC General Specifications)
SUBGRADE	Untreated Granular Material	30 cm	Untreated subgrade material A-1-a(O), A-1-b(O) or A-2-4(O) (MRDTM 210)
EMBANKMENT / NATURAL GROUND (CUT) / CLEARING AND GRUBBING			

The typical cross sections of the different stretches of road can be shown in drawing HHR-2C-272-MFB-DP1-000004ROA-A01.

For **services ways** and parking areas rigid pavements made of reinforced concrete are considered. The design and calculation of this pavement are included in Structures Report (HHR-2C-272-MFA-DP1-000001STR-A01).

The layer distribution proposed for the service ways sections are shown in the figures below:

Fillings sections.

Subgrade in embankment sections

REINFORCE CONCRETE SLAB (e = 20 cm)
LEAN CONCRETE (e = 10 cm)
UNTREATED SUBGRADE <i>Granular material A-1-a(O), A-1-b(O) or A-2-4(O) according to MRDTM 210 30 cm</i>
EMBANKMENT <i>Material A-1-a(O), A-1-b(O) or A-2-4(O) (MRDTM 210) Variable height</i>
ORIGINAL GROUND (CLEARING AND GRUBBING)

Cuttings sections.

Subgrade for the Depot ways

REINFORCE CONCRETE SLAB (e = 20 cm)	Original ground
LEAN CONCRETE (e = 10 cm)	
SUBGRADE	Natural material with values of CBR ≥ 25
Untreated subgrade material A-1-a(O), A-1-b(O) or A-2-4(O) (MRDTM 210) having no rock fragments larger than 10 cm (Section 2.06.3.6 MOC General Specifications)	30 cm

Pedestrian movement has been considered for the design of the depot, therefore **sidewalks** have been designed for the circulation of pedestrians in safe conditions.

**Road signs and markings** have been designed in order to inform and control road users' behavior in an effort to make the roads as safe as possible for everyone. They are shown in the drawing HHR-2C-272-MFB-DP1-000007ROA-A01.

A total of 144 **parking spaces** have been designed distributed in the different areas of depot. The dimensions of parking spaces are 2.50 m of width and 5.0 m of length.

In addition, there are several **parking areas exclusive for emergencies** use only, for fire trucks between tracks WT1 and WT2. These emergency parking spaces have 12.0 m of length and 5.50 m of width.

### 3.10 Drainage

#### Longitudinal drainage

To ensure correct operation of the depot, drainage elements are arranged to ensure the evacuation of potential runoff on roads, tracks, as well as facilities and work areas. The longitudinal drainage network has been designed for a 25 years return period, which is considered to be enough to keep the depot in working order.

According to the hydraulic capacity shown below for each of the drainage elements, the type of ditches or pipes will be chosen according to the depth and the peak discharge for each watershed calculated in section 2.3. Watersheds of report HHR\_2C\_272\_MFA\_DP1\_000001DRA\_A01

Rip-rap slope protection is designed at the exit of the pipes wherever the outfall flows into the natural ground. The rip-rap protects the embankments at the pipes exits, reducing the water velocity and its subsequent downward erosion.

The minimum slope of the drainage elements is set at 0.25% so the proper water flow is ensured; avoiding potential sedimentation that would block water evacuation to occur. However, it is necessary to perform regular maintenance in order to keep the drainage system in working order.

A 15% free depth is considered in pipes hydraulic capacity calculations, so as to take into account potential sedimentation inside the pipe that would block water discharge.

In order to avoid high depth values in some cases the concrete ditches or perforated drains will have a concrete pipe below, increasing the hydraulic capacity of the drainage lines. Concrete ditches will flow into these concrete pipes through precast manholes set every 100 meters, in turns, and wherever it is necessary to connect two or more drainage elements. A 40 cm deep sand trap is designed at the bottom of every manhole in order to keep concrete pipes free of potential sedimentation.

The drainage elements used for the design of the drainage network are summarized in the following list:

- Trapezoidal concrete ditch type 1: 0.30 m bottom width, 1:1 side slopes, and variable height.
- Trapezoidal concrete ditch type 2: 0.50 m bottom width, 1:1 side slopes, and variable height.
- Rectangular concrete ditches: 0.30 m bottom width, distinguishing whether it is necessary to place grate upon it or not.
- Ø300 PVC perforated drains.
- Ø200 PVC pipes.
- Concrete gutters and storm sewers in the depot road.
- Concrete stepped chutes.
- Ø400 and Ø600 concrete pipes.

- Precast concrete manholes, in order to connect the drainage elements between them.

Dimensions and cross sections of these elements can be found in Details Drawing (HHR-2C-272-MFB-DP1-000003DRA-A01)

The whole drainage system is connected both to natural water streams or existing drainage networks in the nearby of the Makkah Depot.

### Transverse drainage

The construction of Makkah Depot does require the construction of a new culvert, which is designed in order to cross under the whole depot area from the north side towards the south side. The existing culverts of the platform C0061 and C0063 must be adapted, so that proper evacuation of water flow is ensured.

For the eventual phase II, in order to avoid floods on the nearby Bus Road and in the depot itself, a canal to pour away the drainage water of the extended culvert C0063 has been considered.

Once the box culvert has crossed the depot area, it will be extended with a rectangular concrete canal (6 m x 1.5 m). This canal collects water flow directly from C0063 as well as the two box culverts designed in its sides (6 box culverts in total).

## 3.11 Systems

All the necessary systems for the safe and proper operation of the depot have been designed within this project:

- Signalling System
- Overhead Catenary System
- Railway systems Low Voltage Power Supply
- Fixed Telecom
- GSM-R Telecom
- Security system
- Energy Remote Control System
- Public Address System

## 3.12 Fire fighting

A specific study for the fire fighting has been performed considering all the relevant issues regarding prevention, detection, extinguishment, evacuation, etc.

All this information is included in the Fire Safety Design report (HHR-2C-272-MFA-DP1-000001FSD-A01)





EXECUTIVE SUMMARY  
MAKKAH DEPOT



HARAMAIN HIGH SPEED RAILWAY.  
PHASE 2