

Electrification Design – Generic Scope Of Work

Electrification Design – Scope Of Work v10.0

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Table of Content

Chapter 20. Electrification Design.....	1
Work flow chart	1
20.1 Longitudinal Electrification Infrastructure	2
20.1.1. Initial design	2
20.1.2. Primary Design	8
20.1.3. Tender for Design-Build Contractor (OCS)	21
20.1.4. Design Reviwe	23
20.1.5. Design-Build Construction Overseeing	24
20.2 Traction Power Supply	25
20.2.1. Statutorical zoning plan for TS	25
20.2.2. Detailed design	27
20.3 Power Study	28

Electrification Designing - Scope Of Work

Chapter 20. Electrification Design

This document contains planning and design tasks for railway electrification systems.

The document cannot cover the all detailed issues of electrification design. Therefore, without detracting from the requirements herein, the designer should act and design accordingly to the best practice in the field of electrification whether the task appears in this document or not.

The electrification designer outcome will include, inter alia, all the infrastructure design needed for OCS, ECC, SCADA, TS and feeding lines.

Technical details and other specifications are explained in the guideline ISR-EL 01 - 08.

All design products should be approved by ISR

ISR work method assume that multidisciplinary design should be led by principal designer that integrate all sub-designers/consultants and responsible for the whole design

The principal designer determined according to main objectives of the project.

ISR is entitled to order tasks from the electrification designer either as sub-designer or principal designer subject to ISR decision

Electrification designer as sub- designer

This situation is mostly for new lines and stations

The electrification designer will work under the principal designer which may be the alignment designer for tracks or the architect for passenger's stations and other buildings respectively.

The principal designer prepares the basic documents including, inter alia, the track alignment layout drawings.

The principal designer shall coordinate the other participants/disciplines in the design process.

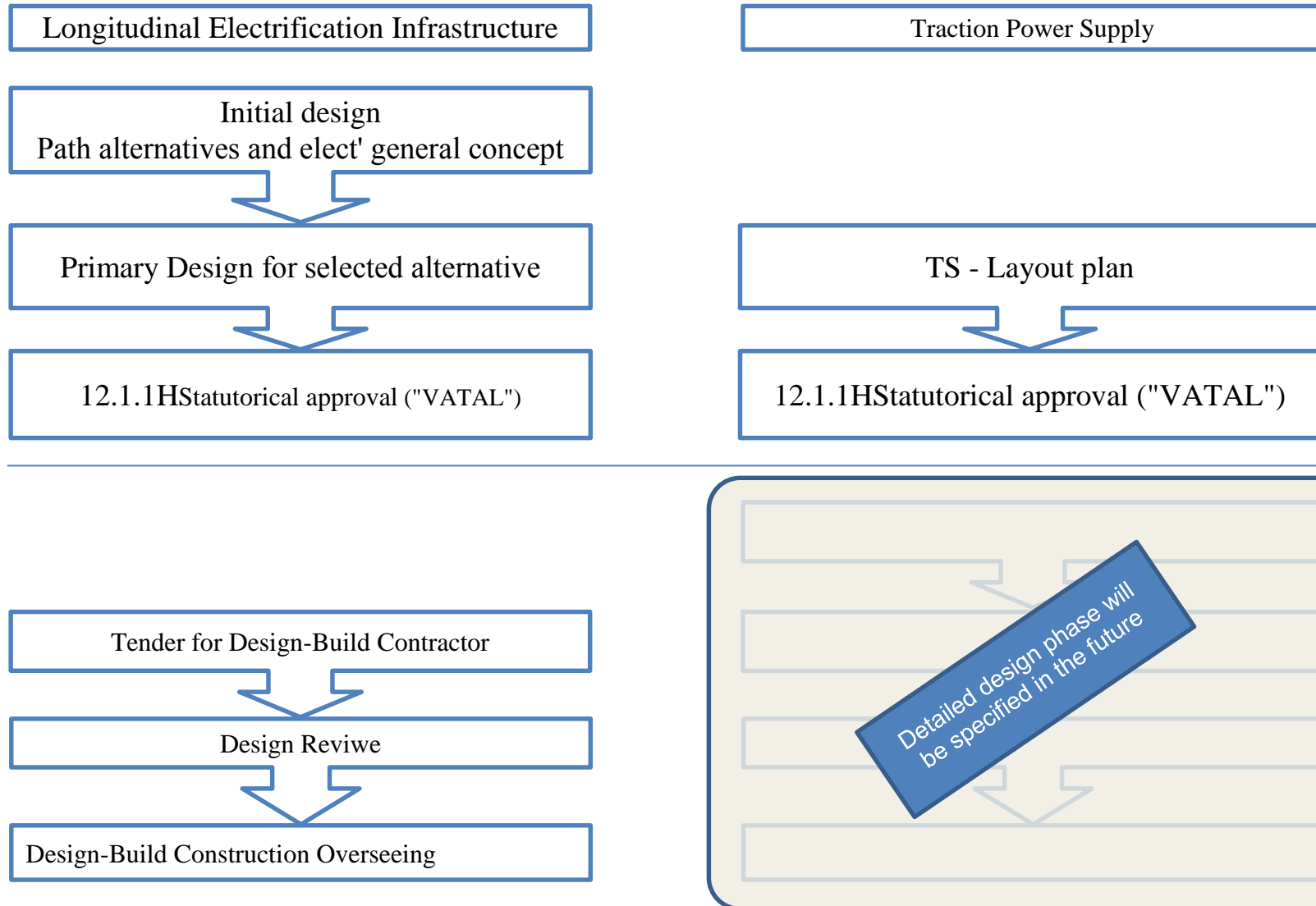
The electrification designer should specify to the principal designer all background documents required for the electrification design, including, inter alia, statutory plans, approvals and survey results. The electrification designer is required to check the background documents and ask for any completion or correction needed.

Electrification designer as principal designer

The electrification designer will hire and integrate all the designers and consultants at all disciplines.

The fee of the sub designers\consultants (for others tasks than mention in this catalog) shall be calculated according to ISR tariffs and with the addition of wages for the management of subcontractor contracts (as detailed in section b. 5 in ISR tariffs

Work flow chart



20.1 Longitudinal Electrification Infrastructure

20.1.1. Initial design

A. General Basics (Initial Design)

Initial design phase, in new lines, is carried out concurrently with "Tichnun Rishoni" of tracks.

At this phase, there are several alignment alternatives to the project.

The electrification designer will refer to all of them

No.	Task	Result / Product(Document)	Description of contents
1.	Clarification of the project objectives with the client and the principal designer	The result of the clarification shall be systematically documented.	The framework conditions to meet the project goals shall be detailed and documented by the electrification designer considering: Matters of railway operation, Aspects of Statutorical issues, Influence on neighbours etc.
2.	Obtaining preliminary instructions from the electrification division/ design department	Documentation of all framework conditions and dependency from other projects.	The electrification designer shall inform the client in case of discrepancies between the task definition and the framework conditions and shall suggest solutions.
3.	Compilation of the applicable standards and norms	List of the applicable standards and norms. (as an appendix to the explanation report)	Clarification of the applicable Israeli national standards and norms as well as the applicable EN-standards and other international standards and norms, including clarification of the hierarchy of interfering rules and regulations, if this might be the case.
4.	Site visit/site survey	Minute thr protocol with observations and fixings accompanied by photographs and sketches. Photographic documentation	In this context the electrification designer shall visually check, whether the available data (as built drawings etc.) comply with the situation on site. When inconsistencies or gaps become obvious, the electrification designer shall inform the client ISR that it can initiate updating the basic documents.
5.	<i>Compilation and evaluation of basic data.</i> Determining of the existing state of the railway facilities.	<i>Systematic compilation of basic documentation (part of the explanation report)</i> List of the checked documents.	The electrification designer shall reconcile the compilation with the client. The electrification designer shall incorporate resulting additional or complementary information, relevant findings and further documents relevant for the design into the documentation.
6.	Explanation and Comment of basic design data.	As part of the explanation report	The electrification designer shall discuss and agree with ISR about the data, which shall become the basis for the design. Thereby The electrification designer

			shall document in writing the identified and mutually agreed data base and decisions.
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B. OCS – Overhead Contact System (Initial Design)

No.	Task	Result / Product(Document)	Description of contents
1.	Analysis of basic data	Data analysis report	The electrification designer shall analyze and evaluate the basic design data regarding quality and completeness. All available documents, parameters and results and requirements of the client are to be considered. The electrification designer shall document gaps and shortcomings.
2.	Development of a planning concept with an approximate interpretation of the main systems and components including the investigation of alternative solutions according to the same requirements with a sketchy representation of the integration of the object planning, including preliminary economic feasibility study.	Concept Design Report	Elaboration of alternative solutions (variants) which equally meet the requirements and integrate the results of other disciplines and involved parties (e.g. ground survey expert, landscape architect, other divisions or business units of the client regarding traction power supply, SCADA, utility providers). Representation incl. Drawings of the alternative solutions, estimation of bill of quantities and cost based on experience. Analyzing of the alternative variants regarding their effects on functionality, on aesthetic design, convenience, economic viability, life cycle cost, environmental compatibility, aspects of railway operation and viability regarding approvals and permits.
3.	Concept design drawings	Drawings upon alignment plans and longitudinal sections as background	The electrification designer shall elaborate the design documents with drawings and explanatory notes in order to enable the client, to realize the suggested solutions and to evaluate the alternatives.
4.	Discussion of alternative solutions	Comparison Table	The electrification designer shall compile a comparison the advantages and disadvantages of the suggested alternative solutions.

C. TS - Traction Power Supply (Initial Design)

No.	Task	Result / Product(Document)	Description of contents
1.	Examination of the existing Power study	Conclusion whether the power study is sufficient or need re-run a new one	Examination of the existing Power study according to the project requirements.
2.	Power supply concept	Concept design power supply	Power supply concept design with rough dimensioning of major systems components including study of alternatives fulfilling the requirements. <ul style="list-style-type: none"> ▪ Evaluation and documentation of alternatives ▪ Rough positioning of TS ▪ Optional points of connections to IECo net

D. ECC - Communication and SCADA infrastructures (Initial Design)

No.	Task	Result / Product(Document)	Description of contents
1.	Clarifying the existing Communication system	System configuration plan	Clarifying the existing communication system and the possibilities to amend and update the system for the purpose of operating the electrification system
2.	Clarify the existing SCADA system	System configuration plan	Clarifying the existing SCADA system Review of available system components Determining the necessary additional new stations to be added to the existing system, regarding location and capacity Determining the new SCADA system
3.	Elaboration of the concept design. development a solution in drawings with taking into account all technical requirements with integration of all disciplines technical designs.	Drawings Calculations Compilation of special conditions and requirements for the OCS design Calculation and preliminary dimensioning Design report including construction stages	The electrification designer shall elaborate the preferred variant resulting from the concept design stage towards a complete preliminary design documentation. The preliminary design shall include drawings and calculations. The electrification designer shall incorporate all technical requirements into the design (e.g. requirements of railway operation, telecommunication, structures). The results from other disciplines' design shall be incorporated as well (e.g. general designer, structural design, ground and soil expert, surveyor, landscape architect, technical equipment designer and other third party design, as applicable).
4.	LOPs concept design		<ul style="list-style-type: none"> ▪ Rough positioning of LOPs ▪ Coordinate LOPs location with signaling control rooms

E. EMC – Electromagnetic compatibility (Initial Design)

Electromagnetic interference may cause disturbance, distorting and destruction in technical and biological systems, endanger health and safety, and may be responsible for environmental damage as well as IT security breaches. The engineering discipline has to look at all these effects and has to provide adequate protective measures.

Electromagnetic compatibility is the ability of an electrical system to function correctly within its electromagnetic environment and not emit intolerant electromagnetic disturbance into that environment. Electromagnetic interference is when an electrical system malfunctions when subjected to an electromagnetic disturbance caused by the normal operation of electrical equipment caused by intentional transmitter or natural phenomena

No.	Task	Result / Product(Document)	Description of contents
1.	EMC Study	EMC Control Plan EMC Management Plan EMD Design Activities Report	<p>The following documents/task have to be elaborated during design: The EMC study comprise the following reports:</p> <ul style="list-style-type: none"> ▪ EMC Control Plan The EMC Control Plan contains potential EMC related physical influences and interactions including risks and hazards. Furthermore, it contains the associated technical and technological measures to ensure functionality and to avoid risks and hazards. ▪ EMC Management Plan The EMC management plan contains the way of realization of the identified EMC measures, a related time schedule, the inclusion of third parties, inspection and testing regime and interface activities. ▪ EMC Design Activities Report The EMC design activities report contains the measures taken to ensure EMC conformity, analyses of relevant sources and sensible equipment, hazard and risk analysis, measures taken to avoid disturbances and hazards, measures taken to ensure the functionality and measures taken for clarification of interfaces. <p>The EMC related documents/tasks have to be continually updated during the design phases.</p>
2.	Third party's infrastructures and facilities	Report of all	<p>For each alignment alternative, locate known parallel and crossing infrastructure and facilities.</p> <p>For each found element elaborate the needed treatment (Shifting, shielding etc.) and rough cost estimate</p> <p>Risk management for report for the ability of making those treatments</p>
3.	Earthing and bonding	Earthing and bonding plan.	In addition, the electrification designer has to plan and establish a cohesive electrical earthing and bonding strategy.

No.	Task	Result / Product(Document)	Description of contents
			The electrification designer shall coordinate that details how earthing and bonding systems across the railway system shall interfere to protect humans, equipment and to provide lightning protection.

F. Deliverables Initial Design Stage (For each alignment alternative)

No.	Task	Result / Product(Document)	Description of contents
1.	Selection and justification of the preferred solution / variant	Initial design report	The electrification designer shall elaborate the preferred variant up to the completion of the planning stage, based on the client's target definition (e.g. cost, milestones, technical solutions, may be employment of certain companies)
2.	Deliverables in Initial design stage	System Parameters	<p>General</p> <ul style="list-style-type: none"> ▪ Principle Interfaces drawings ▪ RAMS study ▪ Single line diagram of the whole system (section supply plan). ▪ Power Study-remarks and discussions. ▪ Calculation of touch-voltages and proof of compliance with the limits ▪ Document management and computer files management system during the design phase. ▪ Cost estimation ▪ Preferred alternative from the electrification point of view
3.	Deliverables in Initial design stage		<p>For the OCS:</p> <ul style="list-style-type: none"> ▪ Sectioning diagrams for the whole project with the maximum flexibility for the train operation of ISR ▪ Basic design drawings ▪ System description ▪ Basic parameters ▪ Calculation of the current carrying capacity of the OCS ▪ Operation requirements ▪ Mechanical requirements ▪ Electrical requirements ▪ Environmental requirements ▪ Gauge and clearance profile requirements ▪ Basic cross sections (tunnel, open track, restricted areas)

No.	Task	Result / Product(Document)	Description of contents
4.	Deliverables in Initial design stage		<p>For the Traction Power Substations</p> <ul style="list-style-type: none"> ▪ Main single line diagram of typical TPS. ▪ typical switching post single line diagram ▪ typical bulk power substation (if any) single line diagram ▪ Interfaces ▪ General arrangement of each TPS/BPS including location, footprint and site layout. ▪ technical description and description of design principles ▪ design report <p>For the SCADA</p> <ul style="list-style-type: none"> ▪ System configuration plan – preliminary ▪ Interface definition and clarification with the telecommunication discipline and the OCC ▪ System configuration plan – preliminary
5.			<p>For the EMC</p> <p>EMC Control Plan EMC Management Plan EMD Design Activities Report</p> <p>Third party's infrastructures and facilities Earthing and bonding plan</p>
4.	Cost estimate	Initial design level cost estimate.	<p>The electrification designer shall define a cost estimate for each alternative. The cost estimate shall be established according to the client's requirements. The allocation of the costs to various budgets (e.g. design, execution, maintenance) shall be reconciled with the client. The basis of the cost estimate (scope and reference year) shall be documented.</p> <p>The cost estimate shall pertain to</p> <ul style="list-style-type: none"> ▪ OCS ▪ TS ▪ SCADA ▪ Third parties' infrastructures and facilities treatments ▪ Auxiliary works

20.1.2. Primary Design

A. General Basics (Primary Design)

Primary design phase, in new lines, is carried out concurrently with "Tichnun Mukdam" of tracks.

The primary design has to be based on the approved concept design and will be reviewed against it.

In case The electrification designer must deviate from approved concept document he has to implement the change into the concept design and to renew it. The changed concept design document needs basically always a review and renewed approval.

The electrification designer has to implement his design into the drawings of the principal designer, inter alia, longitudinal section, all cross sections, bridges, stations' tunnels, walls etc.

The electrification designer has to coordinate his design with the other disciplines and the principal designer.

The preliminary design is the base for Statutorial approval (VATAL)

No.	Task	Result / Product(Document)	Description of contents
1.	Clarification of the project objectives with the client and the principal designer	Define a basic program for the project's design phase. The result of the clarification shall be systematically documented. List with design-stages	By means of a project manual or a project requirements catalogue and available as-built documents The electrification designer shall scrutinize and clarify the client's expectations and the project goals in consultation with the client. The framework conditions to meet the project goals shall be detailed and documented by the electrification designer considering: Aspects of statutory approval, Influence on neighbours' rights and interests Matters of railway operation Quality standards Coordination of involved disciplines
2.	Determine the framework conditions Study of the program and its understanding with the various railway divisions/departments Obtaining preliminary instructions from the electrification division and design department	Documentation of all framework conditions and dependency from other projects.	Identify, evaluate and define all framework conditions resulting from the situation on site, from the design task, the area of authority of the division of the client and other divisions of ISR, intended plans, rights etc. of third parties. The electrification designer shall inform the client in case of discrepancies between the task definition and the framework conditions and shall suggest solutions. Verification of compliance of the as-built documents with the situation on site. Evaluation of dependency from other projects
3.	Compilation of the applicable standards and	List of the applicable standards and norms. (as an appendix to the explanation report)	Clarification of the applicable Israeli national standards and norms as well as the applicable EN-standards and other international standards and norms, including

No.	Task	Result / Product(Document)	Description of contents
	norms as well as ISR's design instructions		clarification of the hierarchy of interfering rules and regulations, if this might be the case.
4.	Site visit/site survey	Minute of the protocol with observations and fixings accompanied by photographs and sketches. Record of site visits Photographic documentation	Documentation of site visits. Estimation potential problems of realization the project (Risk analysis) Notation of the framework conditions and obstacles In this context the electrification designer shall visually check, whether the available data (as built drawings etc.) comply with the situation on site. When inconsistencies or gaps become obvious, the electrification designer shall update the basic documents and inform ISR.
5.	Compilation of near by projects and understanding the impact on the current project.	Documentation and conclusion of other ISR divisions and third parties plans and projects	Contacting infrastructure companies and receiving data on existing and planned infrastructures in the project area. This pertains especially to the plans and intentions that can be derived from framework plans and plans of third parties. The electrification designer shall compile systematic lists of planned measures from other disciplines and utility providers as well as from other divisions of ISR pertaining to the planning section and project site.
6.	Compilation and evaluation of basic data.	Systematic compilation of basic documentation (part of the explanation report) List of the checked documents.	The electrification designer shall compile the documents systematically, check their consistency and examine their usability, applicability and utilization pertaining to the design task. The electrification designer shall reconcile the compilation with the client. The electrification designer shall incorporate resulting additional or complementary information, relevant findings and further documents relevant for the design into the documentation.
7.	Completion of background data and documentation	List of the missing documents.	The electrification designer , based on the findings, shall define the necessary scope of further surveys and and background materials.
8.	Explanation and Comment of basic design data.	As part of the explanation report	The electrification designer shall discuss and agree with ISR about the data, which shall become the basis for the design. Thereby The electrification designer shall document in writing the identified and mutually agreed data base and decisions.
9.	Specification of the scope of work for the further design stages including the necessary preparations and investigations (e.g. soil	Specification of the scope of work	The electrification designer shall define the scope and depths of required studies and contributions of related disciplines. The scope shall be defined in writing. This pertains to, for example, ground and soil investigations, hydrological studies, surveys on existing utilities, geodetically surveys, ascertainment of basic maps, studies on noise emission, studies on electromagnetic compatibility etc.

No.	Task	Result / Product(Document)	Description of contents
	investigations, geodetic surveys, electromagnetic compatibility studies)		The electrification designer shall be responsible for adjustment of the disciplines' studies scopes are relevant and appropriate to the planning task.
10.	Summary of the Results of basic document review, site review and framework conditions	Inception Report	<p>Compilation of all working results in an explanatory report in order to allow a clear evaluation of all relevant aspects and framework conditions.</p> <p>The electrification designer shall elaborate a recommendation for the further procedure.</p>

B. OCS – Overhead Contact System (Primary Design)

No.	Task	Result / Product(Document)	Description of contents
1.	General	Preliminary design	<ul style="list-style-type: none"> ▪ definition of a technically sound solution with low life cycle cost and environmentally compatible ▪ document the result ▪ determine the time frame for execution ▪ cost estimation ▪ confirm the economic efficiency of the technical solution ▪ define the construction stages and sequence
2.	OCS design	Drawings and reports	<ul style="list-style-type: none"> ▪ Sectioning of final state, taking into account train operating possibilities and electrical supply conditions ▪ Longitudinal division of the OCS masts and support points, taking into account the load and the foundation (also in the future, additional loads and forces) as well for other constructions (e.g., bridges, platforms, tunnels) ▪ Determination of the turnout wiring by "lacing" ▪ Overhead layout plans and circuit diagrams for states of the construction time (if required) ▪ Longitudinal profiles for all additional wires (return feeder, reinforcement- and feeding wires) ▪ Cross-section profiles at every 100 m' and at critical and special points (Against the background of the cross-section of the railway designer) ▪ Check the dimensioning of the portals and multi-track cantilevers as well as the arrangement of the suspension beams for feasibility ▪ Determine catenary and wire/cable lengths for construction and final conditions ▪ Design of catenary and contact-wire height reductions under overcrossing structures (check feasibility / safety distances) ▪ Graphical solutions for special constructions (e.g. signal visibility)

No.	Task	Result / Product(Document)	Description of contents
			<ul style="list-style-type: none"> ▪ Planning the location of all masts The design shall be coordinated with the principal designer Planning the location of the masts shall be used for masts foundations preliminary design In the case of implementation the masts foundations along with the structure of the tracks, for masts foundations detailed design, will be based on this preliminary design
3.	Mast foundation	Specification of soil exploration (preliminary)	<p>Mast-foundation: The electrification designer shall specify and organize ground exploration for the mast fundaments.</p> <p>The soil exploration and evaluation will be carried out by specialized subcontractor firm.</p> <ul style="list-style-type: none"> ▪ Exploration ▪ Evaluation ▪ Documentation of soil conditions relevant for designing the mast fundaments
4.	Signal visibility	Signal visibility proof plan	<ul style="list-style-type: none"> ▪ The electrification designer must design and proof the visibility of signals for all tracks in conformity with the other disciplines
5.	Cable planning	<p>Cable overview plan</p> <p>Schematic cable-route diagrams of Control and power-supply cables</p> <p>Layout plans to cable trenching or cable duct system of the control and power-supply cables</p> <p>cable list/table of control and power-supply cables</p> <p>Graphic solutions</p>	<ul style="list-style-type: none"> ▪ The electrification designer shall elaborate cable overview plans and cable plans for the entire planning area ▪ Design and dimensioning of cables must be unspecific regarding manufacturers. ▪ Check for existing cable routes ▪ Check for existing cables ▪ Calculation of the influence of existing and future cables ▪ Dimensioning the new cables according to their load or function ▪ Determination of additional cable routes including dimensioning
6.	Structural design	Preliminary design for all structural elements	Masts, portals, poles, anchors, Foundations etc.
7.	Special planning tasks	Preparatory documents	<p>Preparation for the implementation of the concept design of the preferred variant into preliminary design, including, inter alia –</p> <ul style="list-style-type: none"> ▪ Create a processing concept and system configuration ▪ Cooperation with ISR regarding basic plan documents ▪ Calculate the time schedule for design

No.	Task	Result / Product(Document)	Description of contents
			<ul style="list-style-type: none"> Plan resource deployment
8.	Site visit	Site visit report	Inspection of essential locations (e.g. OCS mast positions) regarding feasibility of design Not required if tracks are not installed (yet), e.g. newly build lines.
9.	Design Meetings	Minutes of meeting	Participate in regular design meetings with the other disciplines
10.	Preliminary Design Documentation	Complete documentation	Step by step development of the design concept into a complete documentation and preliminary design of the power supply and SCADA PRCS system, considering all technical requirements and contributions of other disciplines: <ul style="list-style-type: none"> Comprehensive technical documentation for indoor power supply equipment Comprehensive technical documentation for outdoor power supply equipment

C. Power Study (Primary Design)

No.	Task	Result / Product(Document)	Description of contents
1.	Review Power Study	Confirmation	Review of Power study (result from concept design phase) regarding possible changes of design concept or input until/during the preliminary design phase.
2.	Update Power Study	Conclusion whether the power study is sufficient or need re-run a new one	Recommendation for updating the power study (result from concept design phase) in case of design changes and significant modification of input data until the preliminary design.

D. ECC - Communication and SCADA (Primary Design)

No.	Task	Result / Product(Document)	Description of contents
1.	SCADA and Communication Infrastructure design	Ducts, chambers, crossings and all the necessary infrastructure for end fittings LOPs building layout	Layout drawings of SCADA and Communication cable routing from the terminals (e.g. OCS poles) to the RTUs, LOPs or subunits including their power supply, scaled 1:500 With an emphasis on problematic places such as bridges, interchanges, stations, etc. Coordinating all the SCADA and Communication infrastructure with the alignment designer. The electrification designer will implant SCADA and Communication infrastructure in ,at least, all alignment designer's cross-sections and plans.

No.	Task	Result / Product(Document)	Description of contents
			<p>LOPs Location and positioning. The location of the site should take into account other plans that apply to it, aspects of the environment, infrastructure and any subject that may prevent the establishment of the LOP.</p> <p>LOPs building layout</p> <p>The LOPs plans Should be coordinated with all others disciplins</p> <p>Planning and design infrastructures, connections and entrances to existing LOPs</p>
2.	SCADA Design- Electrification control system		<p>System description document</p> <ul style="list-style-type: none"> ▪ Main items manufacturers and model data ▪ RTU's type ▪ Voltage detectors ▪ UPS units ▪ DC chargers and batteries ▪ Control center preliminary layout requirements document ▪ LOP Location and positioning. The location of the site should take into account other plans that apply to it, aspects of the environment, infrastructure and any subject that may prevent the establishment of the LOP ▪ LOP building layout ▪ The LOP plans Should be coordinated with all others disceplis ▪ Workplace description and layout of work places ▪ Typical preliminary installations ▪ Preliminary description of the system and its operation. ▪ Documents regarding specific lines (or execution packages) have to be connectedly submitted as package containing: ▪ Documents regarding protection, switching and detection equipment (e.g. disconnectors, voltage detectors) ▪ Documents regarding the location and housing of RTUs ▪ Layout drawings of SCADA cable routing from the terminals (e.g. OCS poles) to the RTUs or subunits including their power supply, scaled 1:500. ▪ Software adoption packages for every station, depot or TS or within the ▪ Preliminary installation details.
3.	Communication Design		<p>Main items preliminary description and complete data sheets</p> <ul style="list-style-type: none"> ▪ System configuration plan. ▪ System operating plan. ▪ System description document. ▪ Main items manufacturers & model data:

No.	Task	Result / Product(Document)	Description of contents
			<ul style="list-style-type: none"> ▪ Optical plant ▪ Optical cables ▪ ADSS cable ▪ Buried cable ▪ Optical Distribution Frame (ODF) ▪ Closures of the used areas / rooms / buildings ▪ Installation equipment and materials ▪ Active equipment ▪ Switch/Router ▪ Auxiliary equipment ▪ Equipment racks ▪ Main Distribution Frame (MDF) ▪ Local cables ▪ Control center preliminary layout requirements document to architect drawings. (for a new build or an increased control center) ▪ Typical preliminary installation details. ▪ Preliminary document for description of operation.

E. EMC – Electromagnetic compatibility (Primary Design)

Electromagnetic interference may cause disturbance, distorting and destruction in technical and biological systems, endanger health and safety, and may be responsible for environmental damage as well as IT security breaches. The engineering discipline has to look at all these effects and has to provide adequate protective measures.

Electromagnetic compatibility is the ability of an electrical system to function correctly within its electromagnetic environment and not emit intolerant electromagnetic disturbance into that environment. Electromagnetic interference is when an electrical system malfunctions when subjected to an electromagnetic disturbance caused by the normal operation of electrical equipment caused by intentional transmitter or natural phenomena

No.	Task	Result / Product(Document)	Description of contents
1.	EMC assessment	<p>EMC effects on third parties and third party equipment</p> <p>A systematic report that covers all the infrastructure and facilities that may be affected by the project</p>	<p>Details of the EMC/EMI effects on third parties and third party equipment in regard of the standards, regulations and guidelines as well as the measures to be taken to mitigate possible impacts.</p> <p>Typical effects of EMC/EMI usually include the following:</p> <ul style="list-style-type: none"> ▪ Effects on signalling cables /systems/ devices ▪ Effects on telecommunication cables ▪ Effects on any other cable in the vicinity

No.	Task	Result / Product(Document)	Description of contents
			<ul style="list-style-type: none"> ▪ Effects on adjacent buildings ▪ Effects on pipelines ▪ Effects on structures ▪ Effects on stations ▪ Effects on water pipes ▪ Effects on gas pipes ▪ Effects on any sensitive equipment in the vicinity of the railway or assets
2.	Third parties infrastructures	Documentation of all meetings	<p>Holding meetings with companies with an infrastructure or facilities that may be affected by the project.</p> <p>Presenting the project and conflicts, and holding discussions on possible solutions.</p> <p>The designer will take detailed documentation of all meetings and deliver it to ISR.</p> <p>It is important to note that all the meetings will be coordinated and approved in writing by the electrification devisin</p>

F. Cost Estimate (Primary Design)

No.	Task	Result / Product(Document)	Description of contents
1.	OCS cost	Cost estimate	<p>OCS cost</p> <ul style="list-style-type: none"> ▪ Define asset categories (units) ▪ Quantities (estimated) ▪ Unit cost
2.	Power Supply and SCADA PRCS cost	Cost estimate	<p>Power Supply and SCADA PRCS</p> <ul style="list-style-type: none"> ▪ Determination of asset categories ▪ Asset classification matrix ▪ Data input for budget schedule ▪ Construction time and cost schedule ▪ Data sheet per component ▪ Cost compilation
3.	Calculation of the life-cycle-costs	Overview table of the variants with comparison of costs related to the usage-times.	<p>The life cycle cost for the alternative and the preferred variant shall be prepared in a cost plan and integrate the contributions of the other disciplines.</p> <p>The life cycle cost shall take into account construction and installation cost as well as maintenance cost. In addition to the construction cost.</p>

G. Deliverables Primary Design Stage

No.	Task	Result / Product(Document)	Description of contents
1.	General results from the preliminary design stage	Primary design report incl. drawings	<p>The Primary design shall result in:</p> <ul style="list-style-type: none"> ▪ Definition of a technically sound solution with low life cycle cost and environmentally compatible ▪ Documentation of the chosen solution in regards of third party interests including a justification of the chosen solution ▪ Documentation of the exemptions and exceptions from guidelines, standards and regulations including a justification ▪ Determine the time frame for execution ▪ Cost estimation ▪ Confirm the economic efficiency of the technical solution ▪ Define the construction stages and sequence
2.	Analysis of the impact of the schedules and costs for relocating infrastructures (solutions offered by the infrastructure owners) on the possibility of dividing the project into stages.	Phasing plan	<p>Recommendations document about stages of project implementation and their influence on the content of the project (temporary structures, changes in the route, speeds design changes, etc.)</p>
3.	Deliverables in Primary design stage for OCS		<p>Documents regarding the general type of OCS:</p> <ul style="list-style-type: none"> ▪ Foundations (preliminary drawings, calculation, use) ▪ Masts / gantry (preliminary drawings, calculation, use) ▪ Components of the catenary: cantilevers, droppers, stitch wires (preliminary drawings, types, calculation, use) ▪ Feeding equipment, feeding points, feeder lines (Sectioning and Feeding diagrams drawings) ▪ Earthing and bonding, preliminary drawings ▪ Bird protection (preliminary drawings, use) ▪ Insulation coordination, preliminary drawings ▪ Tensioning devices ▪ Overlap - insulated and non-insulated (preliminary drawings, design related to the spans and track radii) ▪ Insulators (types, use, installation)

No.	Task	Result / Product(Document)	Description of contents
			<ul style="list-style-type: none"> ▪ Disconnecting equipment, fault detection equipment and process description, current and voltage transformers. ▪ Regular OCS feeding and protection arrangement for tunnels and open track catenary ▪ Tunnel protection sectioning ▪ Fixed poles anchors (preliminary drawings, use) ▪ APC tracks magnets, ▪ Neutral Sections – full set including devices ▪ Electrification signs (specification and use) ▪ Turnouts preliminary drawings (kinds of wiring, conditions for the use) ▪ Section insulators preliminary drawings (types, test results for use in other projects) ▪ In-field cross section drawings ▪ OCS Geometry drawings ▪ CW height (restrictions, calculation) ▪ Catenary System Height (systems with limited system height) ▪ Stagger in straight / curve / overlaps / turnouts ▪ Span length in straight / curve / slope ▪ Dropper arrangement / Dropper table ▪ Stitch wire: type, length and mechanical tension (if any) ▪ Regular wiring of insulated overlaps, overlaps, level crossings, bridges with reduced CW height ▪ Soil characteristics classification and specification for the project ▪ Foundation calculation, types / table and combining with the poles ▪ Anchorage foundation: calculation, types and use ▪ Pole calculation, types / table and support application ▪ Gantry calculation, types / table and gantry – pole – cross-span – load arrangement ▪ Cantilever calculation, selection table ▪ Feeders / return wire: supports, anchorage, alignment, laying chart calculation. ▪ Earthing and bonding calculation , specification and accessible voltage levels ▪ Types of Insulators: types, specification and implementation. ▪ Automatic tensioning devices: range, implementation, types and description. Tensioning length including mid-point ▪ Mid-point anchor: implementation, types and description. ▪ Protection description: live accessible parts / 3rd party protection / lighting / overvoltage drawings.

No.	Task	Result / Product(Document)	Description of contents
			<ul style="list-style-type: none"> ▪ OCS procurement: procedures and tests (FAT) ▪ Signaling including proof signal visibility by train driver ▪ External state agencies (roads / buildings / IECo lines / water / pipelines ...) ▪ Utilities that can affect OCS (power lines, overcrossing structures) ▪ OCS Performances development calculation. Static and dynamic behavior compliance. ▪ Poles layout and types for sensitive areas. ▪ Interface between OCS design and overcrossing structures. ▪ EMI preliminary Study ▪ Methods of installation. ▪ Level crossing and access roads drawings for installation
4.	Deliverables in preliminary design stage for TS	Single line diagrams Preliminary Design Report Drawings Data sheets (specification of technical parameters of equipment)	<p>For the Traction Power Substations and SCADA PRCS</p> <ul style="list-style-type: none"> ▪ Single line diagrams ▪ Report containing the description of the power supply and SCADA PRCS equipment, design criteria and dimensions. ▪ Consideration of requirements resulting from other studies and surveys, especially requirements resulting from the EMC study. ▪ Provision of plans and layouts ▪ Principle Interfaces drawings between TS and other subsystems.
5.	ECC-Communication and SCADA Infrastructure	Drawing for all ducts, manholes and crossings	<ul style="list-style-type: none"> ▪ Cross section drawings for every cross section of the geometrical designer showing the SCADA and communication infrastructures ▪ Drawing of all crossings

H. Statutory approval ("VATAL")

Based on the preliminary design the electrification designer will validate the design all the way through the Statutory process (usually the VATAL committee) until published in the official government gazette

The approval design includes:

Compilation and provision of the documents necessary for legally defined public approval procedures including application documents for exceptions and exemptions as well as negotiations with authorities

In case the electrification designer must deviate from approved concept document he has to implement the change into the concept design and to renew it. The changed concept design document needs basically always a review and renewed approval.

All contacts with the Statutory committee will be fully coordinate with the ISR Statutory department

No.	Task	Result / Product(Document)	Description of contents
1.	Documentation preparation	Documentation ready for delivery approved by ISR Statutory department	Arranging all the documents, drawing, etc. according to the regulations
2.	Environmental annex	Environmental annex approved by the committee.	Writing the electrification part of the environmental annex Inter alia: <ul style="list-style-type: none"> ▪ Visibility of the OCS ▪ Noise emission ▪ EM effect on land use in the railway area ▪ Conflicts with building limitations ▪ Impact on adjacent infrastructure ▪ EM interference on equipment ▪ Conflicts with building limitations (existings and planed) ▪ Measures to reduce radiation ▪ All the committee requests
3.	Statutory process	Approved plan	Participate in the committee meetings Making presentations to explain and clarify the design Making any changes in the design needed by the committee until it's approval
4.	Statutory approval	Plan published in the official government gazette	

No.	Task	Result / Product(Document)	Description of contents
5.	Clarification and explanation of the relevant technical context, processes and conditions	Technical description and explanation of main system-specific interdependencies for power supply: <ul style="list-style-type: none"> ▪ Records of clarification results ▪ Technical description and specifications ▪ Description of alternatives ▪ Evaluation matrix 	Clarification of technical context, of processes and functional and organizational conditions including sequence and time schedule of execution. <ul style="list-style-type: none"> ▪ Written compilation of the results and explanation to the approval authorities, the concerned parties and the public in statutory committee meetings. ▪ Reconciliation with the infrastructure designers. ▪ Assessment of best solution
6.	Cooperation with the Client in explanation of the design concept to the public, political committees and authorities.	Support and participation in statutory approval process, including Presentations, Drawings, explanatory reports.	The electrification designer shall prepare presentation material (e.g. power point, enlarged drawings) based on the planning results of the preferred solution. The electrification designer shall explain the concept design of the preferred solution towards the public, committees and the authorities. The connection of the traction or bulk power substations has to be clarified between The electrification designer and the power supply utilities under consideration of the local grid codes and connection requirements: Results to be considered in the report
7.	Participation in revision of the design concept in reaction to concerns and suggestions.	Revised design concept.	Suggestions and comments from citizens and committees respectively shall be evaluated and integrated into the design concept, subject to client's approval.

20.1.3. Tender for Design-Build Contractor (OCS)

The documents will be according to ISR design instructions (Known as volume B) .

The electrification designer is responsible for preparing all technical documents for the tender

No.	Task	Result / Product (Document)	Description of contents
1.	Detailed performance description	Specification of the works	<p>The complete and precise description of the works, that bidders are enabled on the same basis/conditions to calculate their bid prices.</p> <ul style="list-style-type: none"> ▪ Purpose of the project ▪ Description of the works ▪ Scope of work specification ▪ Conditions (construction site, time frame, track possession etc.)
2.	Interface Management (types of Interfaces, responsibilities)	Interface management Plan	<p>Since various disciplines may be involved in an electrification project, technical interfaces between system components and contractual interfaces will occur. Further interfaces to existing, as well as planned and approved structures, buildings, installations and facilities could be affected by the electrification project.</p> <p>To ensure the coordination of all disciplines and the interoperability of the systems and to prevent conflicts, it is necessary to identify the interfaces and influences of neighboring systems, disciplines and projects at the earliest stage.</p> <p>In order to handle identified interfaces, every electrification designer shall be requested to establish an interface management procedure and to name a responsible person (e.g. an Interface Management Director).</p> <p>Typical Interfaces to be taken into consideration:</p> <ul style="list-style-type: none"> ▪ Interfaces within the design build Agreement and therefore within all subsystems and infrastructure that will be newly erected for the Project ▪ Interfaces with existing and planned infrastructure that will be affected by the Project ▪ Interfaces with - <ul style="list-style-type: none"> - neighboring Projects - Organization and Operation - ISR Organization - Railway Operation - 3rd parties
1.	Detailed description of the works to be conducted by the construction company	General description	<ul style="list-style-type: none"> ▪ General description of the scope of work. ▪ The scope of work has to detail the tasks and deliverables to be elaborated during the detailed design stage

No.	Task	Result / Product (Document)	Description of contents
2.	Preparation of general tender documents	General conditions and interfaces	Determination of quantities required for the bill of quantities. Coordination and integration of contributions by other disciplines. General parts/requirements of the tender.
3.	Tender documents	Requirements	Technical requirements, specifications and explanations for OCS and SCADA PRCS including bill of quantities on the basis of the preliminary design results/deliverables and functional specifications.
3.	Component and equipment specification	Specification	Technical specifications and equipment/component description from preliminary design stage to be included in the tender. Functional specifications for the power supply equipment independent from any supplier.
4.	Plans and drawings		<ul style="list-style-type: none"> ▪ Set of approved Primary design ▪ Approved "VATAL" zoning plan and construction instruction and restrictions ▪ Contracts and agreements with third parties ▪ Approvals from an electrical company
5.	Procurement and litigation		<ul style="list-style-type: none"> ▪ Participate in procurement and litigation ▪ Assistance in the formulation of commercial issues and preparation of contractor contract
6.	Review contractors' proposals	Rating contractors' proposals and recommending a contractor is recommended	<ul style="list-style-type: none"> ▪ Detailed examination of contractors' proposals ▪ Examination of the proposals in terms of matching the proposal to the requirements and notice of deviations from the requirement to prepare a clarification document for the contractors ▪ Pointing on unreasonable prices ▪ Preparing a detailed report on the proposals, advantages and disadvantages ▪ Recommendation for Preferred Offer
7.	Negotiation assistance		<ul style="list-style-type: none"> ▪ Assistance in technical matters during negotiations with the contractor

20.1.4. Design Review

The designer will be a member of the team on behalf of the train headed by the electrification CTO that review contractor's design

Specific requirements for review shall be given to the designer by the train electrification division after the Contractor has been chosen

No.	Task	Result / Product(Document)	Description of contents
1.	Participating in meetings as part of the reviewing process		
2.	Reviewing and approving the contractor's design submitted to the train.	<ul style="list-style-type: none"> • Approved concept & preliminary design • Approved detailed design phase 1 • Approved detailed design phase 2 • Approved For Construcion plans (AFC) • Approved AS-MADE plans 	Reviewing and approving that the design and calculations are done in accordance with the standards, regulations, train design guidelines and requirements of the tender
3.	Any specific requirements for review given by the train electrification division		

20.1.5. Design-Build Construction Overseeing

The electrification designer act as a professional consultant to ISR and his main role in the execution stage is to ensure that the contractor supplies a system that meets the requirements of the tender and the approved detailed design.

No.	Task	Result / Product(Document)	Description of contents
1.	Participation in the kick-off sessions	A report that summarizes the problematic issues in the contractor's work plan and the possible solutions	Examine the contractor's work plan and indicate weaknesses and possible risks in execution. Assistance to the client and the project manager in formulating solutions with the contractor for the problems raised
2.	<i>Participation in supervisory meetings on site. At least twice a month or at the request of the project manager</i>	Detailed Construction Overseeing reports. The reports will be prepared in a format as instructed by the customer	Confirmation that the execution was done in accordance with the approved design version.
3.	<i>Quality assurance</i>	Detailed reports	Confirmation that the supplied products comply with the specifications. Instruct the project manager's supervisor to perform tests or to require documents confirming the quality of the supplied products
4.	"VATAL" team		Assistance the project manager with the VATAL team
5.	Contractor's issues		Assistance the project manager negotiating with the contractor due to raised problems

20.2 Traction Power Supply

20.2.1. Statutorial zoning plan for TS

A. TS - Layout plan

The general location of the TS and the required electrical characteristics will be based on an existing power stadey

No.	Task	Result / Product(Document)	Description of contents
1.	Examination of the existing Power study	Conclusion whether the power study is sufficient or need re-run a new one	Examination of the existing Power study according to the project requirements.
2.	TS location	Locate suitable site for the TS approved by ISR	Examining locations alternatives (Unlimited) All locations will be examined against the requirements of the program, IECo requirements, statutory limitations, third party restrictions, etc. The location of the site should take into account other plans that apply to it, aspects of the environment, infrastructure and any subject that may prevent the establishment of the TS The site should be close as possible to the feeding point and to IECo connection Preparing a comparison table between the different locations. The comparison will include, inter alia, costs, impact on schdules, availability of connection to IECo and more.
3.	IECo connection	IECo Feasibility Study	Coordination with IECo planned connection to the network and integration of the planning into the drawings including the manner of connection and the route
4.	Analysis of IECo feasibility study	Report approved by ISR	Presentation of the effects of the feasibility study on: <ul style="list-style-type: none"> ▪ TS location ▪ Costs ▪ Schedules ▪ Analysis of other risks
5.	Feeding point and feeding line	Determine the exact feeding point to the OCS system	Coordinating with the geometric designer the exact feeding point point taking in conideration al the other elements as communication ducts, drain system, signaling etc. Design the feeding line from the TS and the feeding point. The design sould include cross sections every 100 m'.

No.	Task	Result / Product(Document)	Description of contents
			The plans must be coordinate with the geometric designer and appear in his drawings. Design all communication and control ducts pits and crossings
6.	161 KVM line design	IECo approval for the line	Design according to IECo requirements
7.	Power supply schematic design	Design report	<ul style="list-style-type: none"> ▪ Main single line diagram of typical TPS. ▪ typical switching post single line diagram ▪ typical bulk power substation (if any) single line diagram ▪ Interfaces ▪ General arrangement of each TPS/BPS including print foot and site layout. ▪ technical description and description of design principles ▪ Communication and control system
8.	Plans and layouts	Preparation areas-functions program for the TS building	<p>A description of each component in terms of its functional function.</p> <p>Description of dimensions and location of each component inside the building</p> <p>Description safety margins around the various components</p> <p>Assessment of heat loads and requirements for air conditioning systems</p> <p>Special requirements that affect the size of the building</p> <p>Design Gantry feeding system</p>
9.	Coordinatin with IECo	IECo approval for TS layout plan	<p>Coordination of planning with IECo ("AMOT MIDA" document)</p> <p>Receiving their comments and updating the planning, in coordination with the principal designer until receipt of the approval of the IECo</p> <p>All coordination work with IECo will be done in full coordination and consent of the ISR Elecrification division</p>
10.	Cost estimate	Report approved by ISR	Cost estimation for all components of the TS

B. Statutorial approval ("VATAL")

Based on the Layout plan, the electrification designer will validate the design all the way through the Statutorial process (usually the VATAL committee) until published in the official government gazette

All contacts with the Statutorial committee will be fully coordinate with the ISR Statutorial department and the ISR electrification division

No.	Task	Result / Product(Document)	Description of contents
1.	Documentation preparation	Documentation ready for delivery approved by ISR Statutorial department	Arranging all the documents, drawing, etc. according to the regulations
2.	Environmental annex	Environmental annex approved by the committee.	Writing the electrification part of the environmental annex Inter alia: <ul style="list-style-type: none"> ▪ Visibility of the Gantry feeding system, Feeding points and feeding lines ▪ TS footprint and visibility ▪ Noise emission ▪ EM effect on land use in the TS area ▪ Conflicts with building limitations ▪ Impact on adjacent infrastructure ▪ EM interference on equipment ▪ Conflicts with building limitations ▪ Measures to reduce radiation ▪ All the committee requests
3.	Statutorial process	Approved plan	Participate in the committee meetings Making presentations to explain and clarify the design Making any changes in the design needed by the committee until it's approval
4.	Statutorial approval	Plan published in the official government gazette	

20.2.2. Detailed design

Detailed design phase will be specified in the future

20.3 Power Study

No.	Task	Result / Product(Document)	Description of contents
1.	Power Study	Operational load scenario If necessary, Adjustments in feeding & sectioning as a result of the power study.	<p>A power simulation has to consider the following scenarios:</p> <ul style="list-style-type: none"> ▪ Network simulation in normal feeding condition of entire network; ▪ Network simulation in emergency feeding conditions for each traction substation/critical equipment; ▪ Defining of potential scenarios of emergency feeding levels within the distribution network, e.g. failure of one substation; ▪ Network simulation in emergency feeding condition of Bulk Power Substations (if any), i.e. considering the developed failure scenarios for each Bulk Power Substation; ▪ Short-circuit study MV/HV distribution network for all feeding conditions; ▪ Study of harmonics and power quality at connection points of distribution network to EHV or HV grid and ▪ Estimation of MTBF (mean time between failure) of main components of the power network; ▪ Definition of credible MTTR (mean time to repair) for the main components and ▪ Calculation of availability of the power network using reliability block diagrams and the availability of the main constituents (1-MTTR/MTBF). <p>The design of the electrical equipment will be based on the loads for a worst case scenario that has to be elaborated in cooperation with the operations. The system has to be engineered so that it is the most economical solution where the technical requirements and specifications are fulfilled.</p>
2.	Power Study	Power Study input data	<p>Power Study input data:</p> <ul style="list-style-type: none"> ▪ Train data, e.g. power consumption, acceleration, deceleration, electrical resistance of the vehicle ▪ Operational data, i.e. timetable, number and speed of the trains in the respective feeding section ▪ Track data, e.g. alignment gradients, curves ▪ Data of the electrical network as substation total resistance and feeding arrangements (length and resistance of the feeder cables) ▪ Data of the power transmission to the vehicles (i.e. catenary or third rail) as length and resistance of the catenary/third rail section, length and resistance of line feeders ▪ Data of the traction return path as length and resistance of return cables and running rails

No.	Task	Result / Product(Document)	Description of contents
3.	Power Study output	Report incl. tables and graphical representation of the results	<p>Power Study Output:</p> <ul style="list-style-type: none"> ▪ Validation of the proposed feeding arrangements, i.e. number and diameter of the feeding cables and return cables ▪ Number of substations ▪ Assessment of the need of additional line feeders ▪ Touch voltages along the line and measures to reduce the touch voltages (e.g. short circuit devices and additional line feeders) ▪ Feeding distances, i.e. distance between adjacent substations ▪ Substation ratings, i.e. rating of the transformers and the related equipment as switchgears and bus bar ▪ Power characteristics, i.e. maximum and minimum short circuit currents, maximum and minimum currents in normal and degraded operation ▪ Setting of the protection devices, i.e. setting of the switches and over temperature measurement ▪ Location-dependent minimum voltage level at train current collector position (pantograph voltage), ▪ Power consumption of the network ▪ Energy and power losses balances. ▪ Power demand at the insert point (i.e. at the connection to the public grid) ▪ Harmonics and power quality
4.	Sectioning and neutral sections	Feeding and sectioning Scheme	Determining the locations and type of neutral sections according to the overall power supply principle and in coordination with the power utilities. The position of neutral sections and of OCL switches has to be coordinated with the signaling discipline.