



**REPUBLIC OF IRAQ  
MINISTRY OF ELECTRICITY  
GENERAL DIRECTORATE OF ELECTRICAL  
TRANSMISSION PROJECTS**

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**TENDER DOCUMENTS**

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NO:T.L /NT/2015**

**Volume 3/3  
TECHNICAL SPECIFICATION**

**DESIGN,MANUFACTURE, TEST, SUPPLY,AND SHIPPMENT MATERIALS OF  
HTLS (ACSS/TW) CONDUCTORS AND HARDWARE FITTINGS FOR 132KV  
OVERHEAD TRANSMISSION LINE**

**Issued in Oct. 2015**

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# TECHNICAL SPECIFICATION

## 1. INTRODUCTION:

### Electrical design criteria

The following are the general particulars governing the design and working of the complete system of which the Works will form a part

- a. Electrical energy is generated at interconnected power stations as three-phase current at a frequency of 50 Hz, and transmitted there from by means of overhead lines.
- b. The existing transmission in Iraq consists of overhead lines operating at 50 Hz .
- c. The system will be in continuous operation during the varying atmospheric and climatic conditions occurring at all seasons.

	400 kV	132 kV	33 kV	11 kV
Maximum system voltage (kV)	420	145	36	12
Nominal system voltage(kV)	400	132	33	11
System frequency(Hz)	50	50	50	50
Switching impulse withstand voltage (kV)	1050	-	-	-
Lightning impulse withstand voltage (kV)	1425	650	170	75

## 2. GENERAL

### 2.1 Definitions

In addition to the terms referred to in General and Particular Conditions of Contract, the following, where used in this Specification, shall have the meanings listed below:

- a. The word "specified" shall mean specified herein or in the attached Schedules.
- b. The expression "Commencement Date" hereafter used in connection with the time from which the various periods are to run shall mean the date specified in the Schedules.

## **2.2 Scope of work**

Design, test, supply & shipment HTLS ACSS/TW conductors and their hardware.

## **2.3 Extent of work**

The Contract Works to be supplied shall include all work incidental thereto whether specified in detail or not and shall be carried out by the Contractor in accordance with the Specification and Conditions of Contract and shall comprise the following:-

### **2.3.1 Definite work**

The design, manufacture, supply, delivery to and off-loading at Site, erection, testing, starting to work, completion based on turn key project and the remedy of all defects during the Defect Notification Period of the following plant and materials and of the other work incidental thereto included in the Specification.

- a. The three-phase overhead transmission lines having the technical particulars set out in the Technical Schedules and Drawings attached to the Specification, the lines being complete with the survey, route clearance, line conductors, fittings, and all fittings at the total price for the estimated quantities stated under the Price Schedules. Estimated quantities are for tender purposes only; final payment shall be made on the basis of quantities as finally erected and confirmed by measurement.
- b. Work at Time and Material rates:  
If and when required to do so by the written instructions of the Engineer any work not covered by the Price Schedules, Labour and Equipment Rates for Extra Field Work.

### **2.3.2 Work at the option of the Engineer**

#### **2.3.2.1 Spare materials**

This shall include but not be limited to:

The design, manufacture, supply, testing and delivery to such store or stores provided by the Engineer of such apparatus, spares and tools specified in the Technical Schedules, as the Engineer shall order from the Contractor at any time or times before the expiration of the Defect Notification Period of the Definite Work, at the total for quantities stated under the Price Schedules.

## 2.4 Terminal points

The slack span connections of conductors from the terminal towers to the substation gantry structures and the down-droppers from the slack spans to the substation plant are included in this Specification.

Connection of the down-droppers to substation plant is not included in this Specification.

OPGW earthwire slack spans will be terminated in the junction boxes to be mounted on the substation gantry structures.

Connections from the junction boxes towards the substations are not included.

Connection of the counterpoise to the substation grounding grid is not included.

The program for work and work at all the terminal points are required to be coordinated with others at no additional cost.

## 2.5 Standards and codes

Except where otherwise specified or implied, the works shall comply with the latest applicable Standards or Recommendations of the International Electro technical Commission (IEC) and ISO (International Standards Organization). If relevant IEC and ISO standards and recommendations are not available in any case or cases then relevant British Standards or National Standards shall apply if available.

When IEC, ISO, BSI or National Standards are referred to the edition used shall be that current at the Date of Tender, together with any amendments issued to that date.

Further to that above, the standard order of preference is listed below,

IEC	International Electro technical Commission
ISO	International Standards Organization BSI British Standards Institution
NS	National Standards (where available)
ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
ASCE	American Society of Civil Engineers
NEMA	National Electrical Manufacturers Association
ASTM	American Society for Testing and Materials
UL	Standards of the Underwriters Laboratories of USA
IPCEA	Insulated Power Cable Engineers Association of USA
ASME	American Society of Mechanical Engineers
AWS	American Welding Society

Where the use of a standard other than IEC, ISO or BS is agreed then this standard shall be used, where applicable, throughout the work. Where other standards are proposed in place of IEC, ISO or BS standards, confirmation shall be provided that the provisions of the standards are equivalent to or exceed those of equivalent IEC, ISO or BS standards.

Copies of any standards proposed in substitution for IEC, ISO or BS standards must be submitted with the Tender accompanied where necessary by English translations of the appropriate sections.

Notwithstanding any descriptions, drawings or illustrations which may have been submitted with the Tender, 'Deviations from the Technical Specification' and approved by the Engineer shall be deemed to be in accordance with the Specification and the standard specifications and codes referred to therein.

No departures from the Specification except those shown in the Schedule, 'Deviations from the Technical Specification' and approved by the Engineer, are to be made without the written approval of the Engineer.

## **2.6 Abbreviations**

The following abbreviations have been used in addition to those listed in Clause 2.5, Standards and Codes.

m	meter
nm	nanometer
mm	millimeter
km	kilometer
m <sup>3</sup>	cubic meter
°	degree
g	gram
kg	kilogram
kg/km	kilogram per kilometer
kg/m <sup>3</sup>	kilogram per cubic meter
N	Newton
kN	kilo Newton
N/mm <sup>2</sup>	Newton per square millimeter
KNm	kilo Newton x meter
s	second
µs	micro second
m/s	meter per second
kph	kilometer per hour
m <sup>3</sup> /s	cubic meters per second
dc	direct current
A	ampere
kA	kilo ampere

V	volt
kV	kilovolt
kA <sup>2</sup> s	kilo ampere squared x seconds
mW	milliwatt
kW	kilowatt
MW	megawatt
Mb/s	megabits per second
°C	degrees centigrade
rh	relative humidity
Hz	hertz (cycles per second)
MHz	megahertz
rms	root mean square
ps/nm.km	pico second per nanometer x kilometer
dB	decibel
μV	micro volt
%	per cent
ACSR	aluminium conductor steel reinforced
Alum	aluminium
ATOL	air traffic obstruction lights
AWM	aircraft warning markers
BER	bit error rate
D	depth
DFB	distributed feedback
H	height
HF	high frequency
ICAO	International Civil Aviation Organization
LED	light emitting diode
LH	left hand
MFL	mechanical failure load
MOE	Ministry of Energy
MTBF	mean time between failures
MTTR	mean time to repair
No	number
NDT	non destructive testing
OPGW	optical fibre conductor
OTDR	optical time domain reflectometer
PDH	Plesiochronous digital hierarchy
RTS	rated tensile strength
RH	right hand
SI	International System of Units
SML	specified mechanical load
SMWT	specified maximum working tension
UTS	ultimate tensile strength
W	width

## **2.7 Details of transmission line routes**

Where available details of the type of overhead line and its general routing, including some description of the terrain along the route, are given in the Solicitation, Offer and Award (SOW) documentation.

## **2.8 Transport**

The Contractor shall inform himself fully as to all available transport facilities, road width, and axle load limitations, loading gauges and any other requirements and shall ensure that equipment as packed for transport shall conform to the relevant limitations. Any cost arising from the use of roads or tracks, including tolls, shall be borne by the Contractor.

The Contractor shall ensure by his own inquiries that the facilities available for unloading and bearing capacity of wharfs at the port of entry are adequate for his proposed plant and equipment.

The Contractor shall take reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute load so that the risk of damage shall be limited as far as is reasonably possible. The Contractor shall immediately report to the Engineer any claims made against him arising out of alleged damage to a highway or bridge.

The Contractor shall be responsible for all costs including those incurred by the Engineer, arising from repair or replacement due to damage to equipment or materials during transport, off-loading or erection on site, until take-over.

The Contractor shall be responsible for obtaining from the relevant authorities all permissions necessary to use docking, off-loading, highway, and bridge facilities required for the transportation of contract materials and plant.

## **2.9 Safety of personnel**

The maximum safety, consistent with good erection practice, must be afforded to personnel directly engaged on this Contract, or who in the normal course of their occupation find it necessary to utilize temporary works erected by the Contractor or frequent the working area. Reasonable measures shall be taken to afford adequate protection against material falling from a higher level onto personnel below.

Particular care shall be taken during work at places where the line runs parallel to other lines which may be energized.



The Contractor and his representatives shall in all ways comply with the Ministry of Electricity's Safety Rules regarding electrical apparatus and the safety of men working thereon.

No testing or other work on apparatus which has been delivered to Site and which is liable to be electrically charged from any source shall be permitted except under a "Permit to Work" which will be issued for the purpose by the Ministry of Electricity's Operating Engineer.

At the completion of the Contract Works the Engineer shall undertake an inspection to ensure the operational safety of the overhead electricity transmission lines. For this purpose the Contractor shall jointly undertake with the Engineer an inspection of the Contract Works. The cost of any re-inspection occasioned by non-compliance with the Specification by the Contractor shall be borne by the Contractor.

## **2.10 Compliance with regulations**

All apparatus and materials supplied and all work carried out shall comply in all respects with such of the requirements of the Regulations and Acts in force in Iraq as are applicable to the Contract Works and with other applicable Regulations to which the Ministry of Electricity is subject.

## **2.11 General particulars and guarantees**

The Works shall comply with the general particulars and guarantees stated in the Schedules.

All working methods employed and all plant and apparatus supplied under this Contract shall be to approval.

The Contractor shall be responsible for any discrepancies, errors or omissions in the particulars and guarantees, whether such particulars and guarantees have been approved by the Engineer or not.

## **2.12 Variations from Conditions of Contract**

In the event of there being any inconsistency between the provisions of this Specification and the Conditions of Contract, the provisions of the Conditions of Contract shall prevail.

### **2.13 Places of manufacture**

The manufacturers and the places of manufacture, testing and inspection of the various portions of the Works shall be as stated in Schedule C.

### **2.14 Subcontracted plant, materials and labour**

Triplicate copies of all subcontracted plant and material orders shall be submitted to the Engineer for review at the time any such order is placed. Copies submitted shall be clearly marked on the first page with the Project title and a statement that the plant and material are to be inspected by the Engineer.

The Contractor shall ensure that sufficient information is to be given on each sub-order to identify the material or equipment to which the sub-order applies and to notify the sub-contractor that the conditions of the Specification apply.

The Contractor shall also provide the Engineer with names and details of local subcontractors before such subcontracts are placed. The Engineer reserves the right to withdraw his consent to local subcontract arrangements if such are considered unsuitable, but consent will not be unreasonably withheld.

### **2.15 Dates for completion**

The dates of readiness for design, manufacture, inspection and testing, delivery and completion of the various sections of the Works shall be as stated in Schedule B which also states the dates by which the Contractor will require access to the Site.

### **2.16 Access to manufacturers' works**

Access to the Contractor's and Subcontractors' works shall be granted to the representative of the Engineer for the purpose of inspection, testing and ascertaining progress.

### **2.17 Planning and progress reports**

The Contractor shall submit for review, within 4 weeks of the starting date of the Contract, an outline design, manufacture, delivery and construction and erection chart. Within a further period of 4 weeks the Contractor shall provide a detailed program in a format to be agreed by the Engineer; this program shall also include details of drawing submissions.

Reporting requirements shall be as specified from time to time by the party that has entered into the Contract with the Contractor or shall be otherwise, as follows.

The Contractor shall submit to the Engineer at monthly intervals, not later than the seventh day of the following month, and in such formats as may be required by the Engineer, detailed progress reports of the status of design, material procurement, manufacture, works tests, delivery to Site, erection of all plant and materials included in the Contract, testing and commissioning with regard to the agreed contract program.

Reports shall include a chart detailing plant manufacture, delivery and erection. The chart shall indicate all phases of the work with provision for modification if found necessary during execution of the Works.

The design aspect of the progress report shall include a comprehensive statement on drawings and calculations submitted for review.

The details on material procurement shall give the dates and details of orders placed, indicating delivery dates and expected inspection dates quoted by the manufacturer. If any delivery date has an adverse affect on the contract program the Contractor shall state the remedial action taken to ensure that delays do not occur.

The section on manufacture shall indicate dates of arrival of material, the progress of manufacture and testing and shall state the date on which the material will be ready for transport. Any events which may adversely affect completion in the manufacturer's works shall also be reported.

All works tests and the test results shall be listed and a commentary provided. Any test failures shall be explained and the Contractor shall state his proposed actions to prevent delay to the project completion.

The shipping or transport of each order shall be monitored in the progress report and shall give the date when equipment is available for transport, the expected time of delivery to site and the dates actually achieved.

The monthly report on the site works shall be subdivided into each of the activities included in the detailed construction program and each activity shall be monitored giving work achieved, the percentage completion and estimated completion dates for each activity, in accordance with the contract program. The number of men working on site, both labour and supervisory staff, shall be reported together with any incidents or events that may affect the progress of site works. The progress reports shall include photographs of work items of interest and any unusual form of construction.

A site weekly program of work shall be provided each week during the previous week.

Any delays which may affect any milestone or completion date shall be detailed by the Contractor who shall state the action taken to effect contract completion in accordance with the contract program.

The Contractor shall forward two copies of each progress report to the Engineer. If during the execution of the Contract the Engineer considers the progress position of any section of the work to be unsatisfactory the Engineer shall be at liberty to call progress meetings at site or in his office with a responsible representative of the Contractor.

## **2.18 Quality assurance**

To ensure that the supply and services under the Scope of this Contract, whether manufactured or performed within the Contractor's works or at his subcontractors' premises or at Site or at any other place of work are in accordance with the Specification, with the Regulations and with relevant authorized standards, the Contractor shall adopt suitable quality assurance programs and procedures to ensure that all activities are being controlled as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001.

The systems and procedures which the Contractor will use to ensure that the Works comply with the Contract requirements shall be defined in the Contractor's Quality Plan for the Works.

The Contractor shall operate systems which implement the following:

**Hold point** - "A stage in material procurement or workmanship process beyond which work shall not proceed without the documented agreement of designated individuals or organizations."

The Engineer's written agreement is required to authorize work to progress beyond the hold points indicated in reviewed quality plans.

**Notification point** – "A stage in material procurement or workmanship process for which advance notice of the activity is required to facilitate witness".

If the Engineer does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice then work may proceed.

### **2.18.1 Quality assurance requirements**

The Contractor and subcontractors shall, for all phases of work to be performed under the Contract, establish and implement quality assurance arrangements which, as a minimum, meet the requirements of ISO 9001, "Model for quality assurance in design, development, production, installation and servicing".

The Contractor shall ensure that all work carried out under the Contract is performed by suitably qualified and skilled personnel and that good quality materials, which meet relevant international standard specifications, where such exist, are used.

### **2.18.2 Quality assurance arrangements – quality plan**

The Contractor shall submit a comprehensive contract specific Quality Plan for review and comment, within two weeks of award of contract.

The Quality Plan shall identify as a minimum:

- a. the Contractor's organization and responsibilities of key management including quality assurance personnel;
- c. the duties and responsibilities assigned to staff ensuring quality of work for the Contract;
- d. the prime project documents, specifications, codes of practice, standards;
- e. the correspondence and reporting interfaces, and liaison between the Engineer and the Contractor;
- d. the procedures the Contractor intends to use to manage and control the Contract, including:
  - i. the duties and responsibilities assigned to staff ensuring quality of work for the Contract;
  - ii. hold and notification points;
  - iii. submission of engineering documents required by the Specification;
  - iv. the inspection of materials and components on receipt;
  - v. reference to the Contractor's work procedures appropriate to each activity;
  - vi. inspection during fabrication/construction;
  - vii. final inspection and test.

It is recommended that separate Quality Plans be submitted for the design/manufacture and construction/installation phases.

The Contractor shall review, amend and re-submit quality plans as necessary during the Contract.

### **2.18.3 Monitoring by the Engineer**

During the course of the Contract the Engineer reserves the right to monitor the implementation of the Contractor's quality assurance arrangements.

The Contractor's compliance with equipment, documentation, drawing, delivery, construction, installation and commissioning schedules shall be monitored by the Engineer.

Monitoring may be by means of a program of formal audits and/or surveillance of activities at the work locations. Where deficiencies requiring corrective actions are identified the Contractor shall implement an agreed corrective action program. The Engineer shall be afforded unrestricted access at all reasonable times to review the implementation of such corrective actions.

For site work the Engineer may monitor all aspects of the Contractor's daily work including that of subcontractors and assess the achievement of milestones as detailed by schedule deliverables.

The Engineer reserves the right to monitor the subcontractors and the Contractor shall ensure that all subcontracts include, and subcontractors are aware of, this requirement.

#### **2.18.4 Contractor quality audits**

The Contractor shall carry out a formal program of project quality audits. These shall include audits of the design, manufacture, assembly, erection, installation, test and commissioning functions of the Contractor's organization and those of its subcontractors and suppliers. The Engineer reserves the right to accompany the Contractor on such audits.

The Contractor shall formulate a 2 month project specific audit program, covering 6 month periods, which shall be submitted to the Engineer for review within 4 weeks of the commencement date of the Contract and thereafter every 2 months. Any revision to the audit program shall be forwarded to the Engineer.

#### **2.18.5 Control of subcontractors**

The Contractor shall be responsible for specifying the quality assurance requirements applicable to subcontractors and suppliers, for reviewing the implementation of subcontractors' quality assurance arrangements and for ensuring compliance with the requirements.

The Contractor shall ensure that all appropriate technical information is provided to subcontractors and suppliers. The Contractor shall, for the supply of items, plant or equipment (including those subcontracted), arrange for suitable protection for the product at all stages including delivery and installation at the site.

The Contractor shall submit, for information, a detailed program defining the basis of control to be applied to each subcontract or supply order.

## 2.18.6 Inspection and tests

Inspection and test plans shall be prepared for all major items of equipment/plant, defining the quality control and inspection activities to be performed to ensure that the manufacture and completion of the plant complies with the specified requirements. Inspection and test plans shall be submitted for review.

The Contractor shall submit for review, within 30 days of the Contract Award, a schedule defining the plant/equipment/systems/services which are to be subcontracted, identifying all items for which inspection and test plans will be submitted.

The Contractor shall review all inspection and test plans and associated control documents, of any subcontractors and suppliers, to ensure their adequacy prior to submission.

The Contractor shall be responsible for identifying and arranging any statutory verification activities in the country of manufacture.

Inspection and test plans may be of any form to suit the Contractor's system, but shall as a minimum:

- a. indicate each inspection and test point and its relative location in the production cycle including incoming goods, packing and site inspections,
- b. indicate where subcontract services will be employed (e.g. subcontractor NDT or heat treatment),
- c. identify the characteristics to be inspected, examined, and tested at each point and specify procedures, acceptance criteria to be used and the applicable verifying document,
- d. indicate mandatory hold points established by the Engineer which require verification of selected characteristics of an item of process before this work can proceed,
- e. define or refer to sampling plans if proposed and where they will be used,
- f. where applicable, specify where lots or batches will be used.

The Contractor shall include in all orders to subcontractors, a note advising that all materials and equipment may be subject to inspection by the Engineer as determined by the inspection and test plan. Copies of such purchase orders shall be forwarded to the Engineer.

In order to verify compliance with engineering, procurement, manufacturing requirements and programs, the Engineer shall have access, at all times, to all places where materials or equipment are being prepared or manufactured, including the works of the Contractor's, subcontractors or supplies of raw materials.

The Contractor shall advise the Engineer of the readiness of inspection at least 3 weeks prior to a notification point or hold point. Work shall not proceed beyond a hold point without the written agreement of the Engineer or his nominated representative.

Inspection of the plant/equipment may be made by the Engineer and could include the following activities:

- i. Periodic monitoring to confirm the effectiveness of, and the Contractor's compliance with, the established quality plan, system procedures and inspection and test plan.
- ii. Witnessing of inspections and tests and/or verification of inspection records to be carried out at the Engineer's discretion covering:
  - a. compliance of raw material with specified requirements
  - b. compliance of manufactured parts, assemblies and final items with specifications, drawings, standards and good engineering practice
  - c. witnessing of inspection and tests
  - d. packing for shipment including check for completeness, handling requirements, and case markings and identification.

Raw materials, components, shop assemblies, and the installation thereof, shall be subject to inspection and test by the Engineer as required by the Specification and to the extent practicable at all times and places, during the period of manufacture.

The Contractor shall keep the Engineer informed in advance of the time of starting and of the progress of the work in its various stages so that arrangements can be made for inspection and for test. The Contractor shall also provide, without additional charge, all reasonable facilities and assistance for the safety and convenience of the Engineer in the performance of his duties. All of the required tests shall be made at the Contractor's expense, including the cost of all samples used.

The Contractor shall not offer, unless otherwise agreed, any item of equipment or system for inspection to the Engineer until all planned inspections and tests to date have been completed to the satisfaction of the Contractor.

The Engineer shall endeavor to schedule the performance of inspection and tests so as to avoid undue risk of delaying the work. In the event of postponement, by the Contractor, of tests previously scheduled, or the necessity to make additional tests due to unsatisfactory results of the original tests, or other reasons attributable to the Contractor, the Contractor shall bear all costs for new tests and the costs incurred by the Engineer or his nominated representative in re-inspecting the non-conforming item or its replacement.

The inspection and tests by the Engineer of any equipment/component or lots thereof does not relieve the Contractor of any responsibility whatever regarding defects or other failures which may be found before the end of the defects liability period.



The Contractor shall provide a quality release certificate confirming compliance with the Contract requirements and a data book, comprising the inspection, test, qualification and material records required by the pertaining specifications.

No material shall be shipped to the Site or put to work until all tests, analysis and inspections have been made and certified copies of reports of test and analysis or Contractor's certificates have been accepted and released by the Engineer or by a waiver in writing.

### **2.18.7 Construction/installation phase**

Within 30 days of mobilization of works, inspection and test plan(s), similar in form and content to that described in 2.18.6 above, shall be submitted defining relevant inspection and test points for all stages of construction/erection, installation and commissioning. The inspection and test plans shall identify activities for which method statements shall be prepared

Method statements shall be submitted to the Engineer for review.

Programs of site construction works shall be submitted to the Engineer, giving notification of forthcoming test/inspections on a weekly basis.

### **2.18.8 Non-conformances**

All items or services not in accordance with the Contract Specification, or deviating from a previously reviewed document, shall be considered non-conforming.

All such items shall be clearly identified and isolated where practical, and reported to the Engineer via a non-conformance report. Information to be provided with non-conformance notifications shall include:

- a. identification of the item(s),
- b. reference to relevant specification/drawings, including applicable revisions,
- c. reference to the application inspection and test plan stage,
- d. description of the non-conformance, with sketch where appropriate,
- e. method by which the non-conformance was detected,
- f. cause,
- g. proposed corrective action, with technical justification, where necessary,
- h. for significant non-conformances, proposed action to prevent recurrence,
- i. applicable procedures.

The Engineer shall have complete authority to accept or reject any equipment or part thereof considered not to be in accordance with the specified requirements.

Approval of any concession applications is the prerogative of the Engineer, and approval of a particular case shall not set a precedent.

Any non-conformances identified by the Engineer shall be notified by issue of the Engineer's nonconformance report to the Contractor. Notification of re-inspection shall not be made until the completed non-conformance report, together with any applicable concession applications have been accepted by the Engineer.

Acceptance or rejection of the equipment and/or components will be made as promptly as practicable following any inspection or test involvement by the Engineer. However, failure to inspect and accept or reject equipment and/or components shall neither relieve the Contractor from responsibility for such items, which may not be in accordance with the specified requirements, nor impose liability for them on the Engineer.

### **2.18.9 Records**

Records packages to be delivered shall be agreed with the Engineer prior to setting-to-work of each phase, i.e. design, manufacture, construction, installation and commissioning.

### **2.18.10 Method statements**

Prior to commencing work, the Contractor shall submit method statements setting out full details of his methods of working. This is a hold point.

## **2.19 Design and standardization**

Corresponding parts of all material shall be made to gauge and shall be interchangeable. When required by the Engineer the Contractor shall demonstrate this quality by actually interchanging parts.

As far as possible fittings and conductor joints and clamps should be interchangeable with the equivalent items of the existing transmission system, details of which are obtainable from the Engineer.

The Works shall be designed to facilitate inspection, cleaning and repairs, and for operation where continuity of supply is the first consideration. All apparatus shall also be designed to ensure satisfactory operation under the atmospheric conditions prevailing at the Site, and

under such sudden variations of load and voltage as may be met with under working conditions on the system, including those due to faulty synchronizing and short circuit.

The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the Works and of associated works supplied under other contracts.

## **2.20 Quality of material**

All material used under this Contract shall be new and of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions arising under working conditions without distortion or deterioration or the setting up of undue stresses in any part and without affecting the strength and suitability of the various parts for the work which they have to perform. No repair of defective parts including welding, filling and plugging will be permitted without the sanction in writing of the Engineer.

## **2.21 Language, weights and measures**

The English language shall be used in all written communications between the Engineer and the Contractor with respect to the services to be rendered and with respect to all documents and drawings procured or prepared by the Contractor pertaining to the work. Whenever anything is required under the terms of the Contract to be marked, printed or engraved, the English language shall be used except where otherwise provided in the Specification.

The design features of all equipment, all quantities and values which are required to be stated in the Technical Schedules and all dimensions on drawings whether prepared by the Contractor or not shall be stated in the International System of Units (SI).

## **2.22 Testing and inspection**

All materials used in the Contract Works shall be made available for inspection and test by the Engineer during manufacture and it is the Contractor's responsibility to advise the Engineer when equipment and materials are available for inspection.

The Contractor shall carry out the tests stated in Clause 5 in accordance with the conditions thereof and the latest applicable Standards or Recommendations and such additional tests as in the opinion of the Engineer are necessary to determine that the Works comply with the conditions of this Specification either under test conditions (in the Manufacturer's Works, on the Site, or elsewhere), or in ordinary working. Type tests may be omitted at the discretion

of the Engineer if satisfactory evidence is given of such tests already made on identical equipment.

All materials used shall also be subjected to and shall withstand satisfactorily such routine tests as are customary in the manufacture of the types of plant or material included in the Works.

All tests shall be carried out to the satisfaction of the Engineer and in his presence, at such reasonable times as he may require, unless agreed otherwise.

Not less than 3 weeks notice of all tests shall be given to the Engineer in order that he may be represented if he so desires. As many tests as in the opinion of the Engineer are possible shall be arranged together.

The original and 5 copies of test records whether or not they have been witnessed by the Engineer shall be supplied to the Engineer.

Measuring apparatus shall be approved by the Engineer and if required shall be calibrated at the expense of the Contractor at an approved laboratory.

The Contractor shall be responsible for the proper testing of work completed or plant or materials supplied by a sub-Contractor to the same extent as if the work, plant or materials were completed or supplied by the Contractor himself.

The Contractor shall supply suitable test pieces of all materials as required by the Engineer. If required by the Engineer test specimens shall be prepared for check testing and forwarded at the expense of the Contractor to an independent testing authority selected by the Engineer.

No inspection or passing by the Engineer of work, plant or materials whether carried out by the Contractor or sub-Contractor, shall relieve the Contractor from his liability to complete the Contract works in accordance with the Contract or exonerate him from any of his guarantees.

## **2.23 Erection, supervision and checking of work on site**

The carrying out of all work on the Site included in this Contract shall be supervised throughout by a sufficient number of qualified representatives of the Contractor who have had thorough experience of the erection and commissioning of similar Works.

The Contractor shall ascertain from time to time what portions of the work on the Site the Engineer desires to check, but such checking shall not relieve the Contractor from the liability to complete the Works in accordance with the Contract or exonerate him from any of his guarantees.

If at any time it appears to the Engineer that the Contractor will be unable to complete any Section of the Works in the time stipulated, then the Contractor shall, if required by the Engineer, carry on such work outside normal working hours and shall not make any claims

for any extra expense thereby incurred unless, in the opinion of the Engineer, the delay is due to causes for which the Contractor would be entitled to an extension of time under the Conditions of Contract.

The Contractor shall satisfy himself as to the correctness of all connections made between the apparatus supplied under the Works and apparatus supplied under any other contract before any of the former is put into operation.

If the Engineer shall certify that defects have shown themselves in the Works, the Contractor shall, for the purpose of the maintenance after the completion of the Works provided for by the Conditions of Contract, keep on Site supervisory staff of such numbers and for such periods as the Engineer may require.

The Contractor is to keep the site, on which he erects or stores plant, reasonably clean removing all waste material resulting from the Works as it accumulates and as reasonably directed. On completion of the Works the Site is to be left clean and tidy to the satisfaction of the Engineer. Any damage done to buildings, structures and plant or property belonging to the Ministry of Electricity is to be made good at the Contractor's expense.

## **2.24 Drawings, models and samples**

A list of the drawings attached to the Specification is given in Schedule E – 'Drawings, Documentation and Samples'.

A list of the drawings which are to be submitted by the Contractor with his Tender and a list of drawings to be submitted after the Commencement Date are also given in Schedule E. The Contractor shall provide free of charge any additional drawings and/or copies of any reviewed drawings required by the Engineer.

The Contractor shall submit samples of materials as required from time to time by the Engineer.

The Contractor shall submit all drawings or samples of materials for review in sufficient time to permit modifications to be made and the drawings or samples resubmitted without delaying the initial deliveries or the completion of the Contract Works. The time allowed for the Engineer to review and comment on drawings, samples and models shall be agreed.

If the Contractor requires early review of any drawing in order to avoid delay in the completion of the Contract Works, he shall advise the Engineer to such effect when submitting the drawing.

Four copies of each drawing and four copies of any subsequent revision shall be submitted to the Engineer for review. Following final review, four further copies of the reviewed

drawing shall be marked "Issued for Construction" and shall be supplied to the Engineer for distribution and to Site.

Drawings for review shall be submitted as paper prints or electronic copies as shall be agreed and shall bear the authorized Contract reference.

All drawings shall be drawn to one of the preferred scales quoted in Table 7 of BS Publication PD6031 and on paper of the appropriate size from the International Series of A sizes.

All detail drawings submitted for review shall be to scale and of a size not less than 1/25 full size. All important dimensions shall be given and the material of which each part is to be constructed shall be indicated.

Except as otherwise specifically approved, all drawings shall be of size not greater than A0 (normally 841 mm x 1189 mm) nor smaller than A4 (normally 210 mm x 297 mm).

All dimensions marked on the drawings shall be considered correct although measurement by scale may differ therefrom. Detailed drawings shall be acted on where they differ from general arrangement drawings.

The Engineer reserves the right to request any further additional information that may be considered necessary in order fully to review the Contractor's drawings.

Any drawing modified from a previously submitted drawing shall bear a new version number. Revised drawings reissued for review shall have at least one copy clearly marked indicating the amendments to the drawing. Revision boxes must be provided giving the date, revision letter and brief description of each drawing.

Any drawing or document submitted for information only shall be indicated as such by the Contractor.

Drawings submitted for information only will not be returned to the Contractor unless the Engineer considers that such drawings do need to be reviewed, in which case they will be returned suitably stamped with comments.

All drawings submitted by the Contractor shall have the following particulars in the lower right hand corner in addition to the Contractor's name, date, scale, number and title of the drawing, contract number, overhead line title and equipment description.

**Ministry of Electricity**  
**Baghdad**  
**Iraq**

The Contractor shall when submitting drawings provide an indexing system for all the drawings divided for each type of equipment.

The drawing format and the indexing system, as detailed in Schedule E, will be agreed at the first Contract meeting between the Contractor and the Engineer.

All prints shall be folded to A4 size and the title, drawing number and revision suffix shall remain visible.

Drawings, samples and models already submitted by the Contractor and reviewed by the Engineer (and such drawings, samples and models as shall be thereafter submitted by the Contractor and reviewed by the Engineer) shall not be departed from without the instruction in writing of the Engineer.

The drawing shall be provided in both Hard format and soft format in PDF or AutoCAD as required by the engineer.

All drawings, samples and models shall be submitted in accordance with the provisions in the Schedules and shall become the property of the Ministry of Electricity.

The requirements for Final Record drawings are given in Clause 2.29 of this Specification.

- Drawings after awarded for approval:

The contract shall provide the drawings & data requirement sheets document for all materials for approval by our engineer.

All final drawings shall become the property of the owner, who shall have full rights to reproduce drawings and use them as the owner sees fit, including submitting them to other vendors for the purpose of obtaining bids on future.

## **2.25 Spares**

All spare material shall comply with the requirements of this Specification including compliance with the specified tests and interchangeability. Spares ordered within 6 months of placing of the Contract shall be available at the time of completion of the Works.

All spare apparatus or materials containing electrical insulation shall be delivered in approved cases suitable for storing such parts or material over a period of years without deterioration. The cases will remain the property of the Ministry of Electricity.

The Contractor shall ensure that sufficient spare parts and consumable items are available for his own use during construction and commissioning of the works. Spares ordered by the Engineer shall not be used by the Contractor without the written consent of the Engineer.

## **2.26 Responsibility of Contractor**

Until each Section of the Works has been taken over or deemed to have been taken over under the Conditions of Contract, the Contractor shall be entirely responsible (save as is provided in the Conditions of Contract) for such sections of the Works, whether under construction, during tests or in use by the Ministry of Electricity.

During the period of maintenance, the Contractor shall make such arrangements as to ensure the attendance on the Site, within a reasonable time of his being called upon to do so, of a competent representative for the purpose of carrying out any work of maintenance for which the Contractor shall be liable and during such part or parts of the said period as the Engineer shall deem it necessary, the said representative shall be continuously available on the Site.

Any work which may be necessary for the Contractor to carry out in pursuance of his obligations under the Conditions of Contract shall be carried out so as to interfere as little as practicable with the normal operation of the generating station or substations. Work on the Site shall be carried out at such time and during such hours as the Engineer may require.

The Contract is to include the whole of the Works which are described in or implied in the Contract Document. All matters omitted from the Specification which may be inferred to be obviously necessary for the efficiency, stability and completion of the Works, shall be deemed to be included in the Contract Price. Works shown upon the drawings, and not mentioned or described in the Specification and Works described in the Specification and not shown on the drawings will nevertheless be held to be included in the Contract and their execution is to be covered by Contract Price in the same manner as if they had been expressly shown upon the drawings or described in the Specification.

## **2.27 Contractor's employees**

The Contractor shall fulfill all his obligations in respect of accommodation, feeding and medical facilities for all personnel in his employ, in accordance with the responsibilities imposed on him by the Specification or as necessary to ensure satisfactory execution of the Contract. He is also to comply with the requirements of all local Statutory Employment Regulations.

The Contractor shall be responsible for the behavior on site of all personnel employed by him.

## **2.28 Installation and maintenance instructions**

The Contract Price shall be deemed to include illustrated installation and maintenance instructions written in English.



Before commencement of conductor stringing the Contractor shall submit to the Engineer for review, fully detailed operating and maintenance instructions for compressors and any other working equipment. Also to be included are instructions on the method of making compression joints and the methods to be used for the erection of all fittings on the line together with the necessary tests and checks to ensure fitting has been successfully effected. The instructions are to be as simple and clear as possible, fully illustrated with drawings and diagrams as necessary and detailed with part numbers for ordering of replacements. Two copies are required for use of the Engineer during erection work .

A further 6 copies are to be reproduced as a book or books of approximately A4 size and bound into strong black durable imitation leather covers inscribed upon the front generally in the form of the title page to this document except that the references to Specification, Conditions of Contract, drawings, etc, will be replaced by "Installation and Maintenance Instructions".

The name of the main Contractor, but not that of any subcontractor, may also be inscribed upon the cover after the description of the plant. The name of the Ministry of Electricity shall be inscribed upon the spine.

The finished books are to be handed to the Engineer not later than 1 month before the Taking-Over Certificate is issued.

## **2.29 Final records**

After completion of work on Site all Contract drawings shall be revised where necessary to show the equipment as installed and two copies of revised drawings shall be submitted for review. A complete set of reviewed records shall be provided comprising, one full size reproducible copy and one full size print. Record drawings shall be endorsed "As Constructed" and shall be correctly titled and carry the Engineer's review number, Contractor's drawing number and where appropriate the Ministry of Electricity's number allocated to the item.

After final review of the "As Constructed" record drawings the Contractor shall submit two complete sets of records on compact discs, one of which is for the Ministry of Electricity. Electronic copies of the drawings shall be in CADD vector format suitable for reproduction on paper using the Engineer's preferred software packages. Each disc shall provide a comprehensive drawing list containing the drawing number, sheet, revision and title of every drawing. Each single file drawing record shall be self-supporting, complete with unique title and drawing number, without referencing other files. Nonstandard items such as fonts, line types, etc should not be used. If compression techniques are applied to files then any software necessary to decompress the files shall be included on the discs.

The Contractor shall ensure that all information contained on the discs has been checked for virus contamination. Each compact disc shall be supplied suitably encased and accompanied with printed documentation describing the contents of the compact discs, the formats and software used to compile the discs and the print hardware required to reproduce the record drawings.

The list of drawings required for final record purposes is given in Schedule E. Final record copies shall be handed over before the issue of the Taking Over Certificate.

### **2.30 Packing and shipment**

All materials shall be carefully packed for transport by sea, rail and road and in such a manner that the packing provides adequate protection against corrosion, physical damage, contamination or damage from water or dust or from any other source in all climatic conditions experienced in transit and during storage on site during the construction period.

The whole of the materials shall be packed where necessary in non-returnable cases or on nonreturnable drums or otherwise prepared for overseas shipment in a manner suitable to withstand rough handling without sustaining damage.

The Contractor shall prepare a method statement covering all aspects of packaging, marking, colour coding, documentation, lifting, transporting and stacking of etc., that will be used by all manufacturers, suppliers and shippers and will be applicable for all stages from manufacture/supply via transport and storage to use. This method statement shall be subject to the approval of the Engineer and it is a requirement that this approval is received before any materials are packed.

The line conductors shall be packed on hybrid drums (made of steel structure and furnished by HDPE sheets ) which are constructed in accordance with an approved national standard so as to enable the conductor to be run out smoothly and in lengths as long as can be conveniently handled and erected. Drums shall be marked with type, size and length of conductor and also with an arrow to show the correct direction of rotation for rolling and shall have attached a metallic label showing a serial number, the conductor type, size and length and also the gross and tare weight of the drum and its cubic measure.

The inner end of the length of conductor must be passed through the flange and be secured external to the barrel. The preservative shall not react with aluminum and the barrel and the drums covering shall be made of wooden lagging chemically treated against fungal and termite attack of min. thickness 33mm sealed by 3 metallic straps around it so as to ensure no damage to the conductors. The upper layer of wrapped conductor shall be covered by PP sheet of appropriate thickness sealed by 3 plastic polyester straps of size 30 x 2.5mm.

All nails to be countersunk and the drum construction must be proved adequate to transport the conductor weight.

Drums shall be lifted by means of a bar through the hub to which are attached slings or chains, which shall have a spreader bar above the drum if a single lift point is used. Where a drum is moved by fork lift trucks, the drum shall be set with the hub axis parallel to the direction of travel; care shall be taken to ensure that the drum battens are not damaged by the lifting forks. Drums shall not be lifted by threading a chain through the hubs or by slinging around the drum battens. Drums shall remain upright on their flanges during handling and storage. Drums shall not be stored or rolled on rough surfaces. Drums shall be rolled as little as possible and always the rotation of the drum shall be in the direction of the arrow on the drum. Drums shall be stored only in single or in double rows and there must be sufficient loading space between each single or double row. Drums shall be rotated by a quarter revolution each six months while they are in storage. Suitable blocks shall be used to keep drums off the ground during site storage.

Suppliers' standard cardboard boxes shall be left intact and shall be over-packed using wooden boxes designed to suit.

Packing crates where used shall be strongly constructed and the contents shall be securely bolted or fastened in position with struts or cross battens. Cross battens supporting weight in any direction are not to rely for their support on nails or screws driven lengthwise into the grain of the wood, but are to be supported by cleats secured from the inside. Drain holes shall be provided in crate bottoms where necessary.

Crating together of components of dissimilar metals is not acceptable.

All parts shall be clearly marked to facilitate easy sorting and erection.

Particular attention shall be given to strutting before packing crates are fastened down. Cases shall be upended after packing to prove that there is no movement of the contents.

Timber wedges or chocks shall be firmly fastened in place to prevent their displacement when the timber shrinks.

Where bolts are used, large washers shall be fitted under the head and nut to distribute the pressure and the timber shall be strengthened by means of a pad.

Woodwool shall be avoided as far as possible.

Waterproof paper and felt linings are to overlap at seams by at least 12 mm and seams shall be secured together in an approved manner but the enclosure is to be provided with screened openings to provide ventilation.

Each crate or package shall contain a packing list in a waterproof envelope. All cases, packages, etc should be clearly marked on the outside to indicate the total weight, show

where the weight is bearing, the correct position of the slings and shall be marked with the contract number and port of destination.

They shall also bear an identification mark relating to the appropriate shipping documents. Material intended for different locations in Iraq shall be packed separately and packages shall clearly identify the destination.

The Engineer may require to inspect and review the packing before items are despatched but the Contractor is to be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not exonerate the Contractor from any loss or damage due to faulty packing.

All arrangements shall be made for all forms of transport used, to ensure that all items are transported safely and on time to their destination.

Only reputable carriers, which have regular schedules to the required destination shall be used. All the facilities, reliability and record of carriers, ports and other depots shall be investigated and arrangements shall be made to supplement any deficiencies in handling equipment and other facilities. The number of carriers shall be kept to a minimum and double handling at ports and depots shall be avoided as far as possible. The contractor shall ensure that all warehouses used en route, are suitable and that all items can be stored without any deterioration or damage from water, sunlight dust or any other cause. When possible the sending of partial consignments is to be avoided.

The Contractor shall make all the necessary arrangements for customs clearance in Iraq, the country of origin, and any countries through which goods pass.

The Contractor shall obtain all the necessary export and import permits and any other documents required for the transport of goods. Copies of all forms and documents relating to customs, permits, packing lists, bills of lading and insurance, etc. shall be forwarded to the Engineer. Packing cases and packing material shall remain the property of the Contractor.

All labels, markings and colour coding on crates, packages, conductor drums, etc., shall be legible, waterproof, not affected by sunlight and are securely fixed or painted on the item. The standard project shipping mark shall be applied to all items and shall be visible at a distance from different viewpoints. In addition to a packing list included in a waterproof envelope, each item shall be marked on the outside providing details of contents, order number, shipper, shipping contract numbers case numbers, etc. Packages contained within a larger crate shall be marked with full details of their contents and any other relevant information. Oil, paint and other hazardous or inflammable materials are to be marked accordingly, including the wording "Flash Point °C" and the recommended storage temperature

## 2.31 Site storage and accommodation

**Storage facilities.** The Contractor shall make his own arrangements for storage areas and camp sites. The Contractor shall in all instances obtain the approval of the Engineer for the places along the route of the lines where he intends to store materials. In no case will this be outside the authorized area unless special arrangements are made with the owners of adjacent property, at the Contractor's own expense. The Contractor is to provide any necessary protection and watchmen to safeguard materials in the areas allocated to him. As a minimum the Contractor shall provide a security fence 2 m high, topped with barbed wire, all round the area, with suitable gates and with provision for floodlighting the area at night. The handling and storage of any equipment at the site or storage areas is to be at the risk of the Contractor and without responsibility to the Ministry of Electricity. The Contractor is to arrange, to the satisfaction of the Engineer, for the protection of these materials against vermin attack, corrosion and mechanical damage during storage and erection at site.

The site storage areas shall be prepared with adequate hard standing for the orderly delivery, storage and subsequent removal of conductor drums, tower steel, insulators and fittings so that the material will not be damaged by the effects of adverse weather during storage. The areas shall be graded to provide an even, firm surface, sloped to permit drainage. All items shall be blocked clear of the ground at all times. Covered areas within the security compound shall be provided for storage of all items that have to be protected against rain, dust, sand and strong sunlight. Items packed in flammable crates or drums shall be stored in such a manner as to limit the extent of any damage arising from fire.

The stores compound shall be efficiently laid out and shall be maintained in an efficient manner so that when required the Engineer may check the contents of the store. Store records such as bin cards shall be kept up to date to show incoming and outgoing material and present stocks.

**Compressed air.** The Contractor is to make his own arrangements for a supply of compressed air if required for the execution of the contract work.

**Lifting facilities.** The Contractor is to make his own arrangements with regard to lifting facilities required for transport or on site.

**Living accommodation.** The Contractor shall make his own arrangements with regard to accommodation for his expatriate and locally recruited staff during the construction period. All dwellings and buildings existing or erected for the purpose by the Contractors shall comply with local regulations with regard to construction, water supply, sanitation and other requirements. Temporary construction camps shall be provided with proper sanitation and other necessary facilities. All accommodation shall be removed by the Contractor when no longer required and before the granting of the final certificate.

After the removal of accommodation the ground shall be left in a clean and tidy condition.

**Medical facilities.** These will not be provided by the Engineer and the Contractor shall be required to make his own arrangements where these services may be required for his expatriate or locally engaged staff.

**Staff transport.** The Contractor shall provide, at his own expense all necessary transport for his own men and materials.

**General.** Without prejudice to the generality of the several clauses of the Contract and except for the facilities referred to in this Clause, particular attention is drawn to the obligation of the Contractor to make his own arrangements at his own expense for supply and furnishing of offices, workshops, stores and store compounds and the watching and guarding of such.

### 3. CONDUCTOR

#### 3.1. Line Conductor Type and Details

##### 3.1.1. General

The line conductor shall be of High Temperature Low Sag conductors (HTLS) of aluminum conductor steel supported (Oswego/ACSS/TW) constructed of fully annealed aluminum wire formed into trapezoidal shape. The aluminum wire are stranded around a steel core of seven wires as described in ASTM B857. The improved conductor can operate continuously at temperatures up to 250 °C without loss of strength, its sag is less than that of traditional ACSR Teal conductors. The conductor characteristic shall comply with schedule D. The conductor shall meet or exceed ASTM Specification (B609, B958-08) and shall comply in all respects with the requirement of IEC, EN, and BS other approved standard.

The conductor characteristics (see also Schedule D) comprise or equivalent the following:-

Stranding details	Aluminium	20 x 2 Layers
	Steel	7 x 3.16
Conductor diameter		23.55 mm
Total cross-sectional area		391.7 mm <sup>2</sup>
Mass of conductor without grease		1359 kg/km
Rated ultimate tensile strength		121 kN
DC Resistance		0.0827 ohm/km at 20 °C
Final modulus of elasticity		207 Gpa
Coefficient of linear expansion		11.5 x 10 <sup>-6</sup> per °C

Rated impedance (X1, X0, R1, R0) and voltage drop should be equal to or less than that for ACSR Teal conductors.

The conductor shall comply in all respects with the requirements of (IEC 61089 and EN 50540) or other approved standard. The outer layer wires and the steel core wires shall be pre-formed so that they remain inert when the conductor is cut.

Each layer of conductor except the outer layer shall be covered with an approved grease of applied mass per unit length determined in accordance with IEC 61089 and as stated in Schedule D. The extent of grease to be applied shall be Case 2 as described in IEC 61089. After application of grease and before the outer layer of wires is stranded the penultimate layer of wires shall be thoroughly wiped so that all remaining visible grease on the conductor is between the wires of the penultimate layer. The grease shall conform to the requirements of BS EN 50326. It shall be compatible with any wire drawing lubricant present on the conductor wires and shall not flow within, nor exude from, the conductor below the drop point stated in Schedule D. It shall exhibit adequate resistance to oxidation and shall conform to the test requirements stated in BS EN 50326 and as given in Clauses 5.

The stranding of each layer of the conductor shall be as close and even as possible. The lay of the outermost layer shall be right-hand.

The aluminium shall be of the highest purity commercially obtainable, but the aluminum content shall not be less than 99.5 %, and the Contractor shall submit certificates of analyses giving the percentage and nature of any impurities in the metal of which the wires are made. Precautions shall be taken during manufacture, storage and erection of conductors to prevent the possibility of contamination by copper or other materials which may adversely affect the aluminium.

The line conductor shall be supplied on hybrid drums (made of steel structure and furnished by HDPE sheets ) which are constructed in accordance with an approved national standard so as to enable the conductor to be run out smoothly and in lengths as long as can be conveniently handled and erected. Drums shall be marked with type, size and length of conductor and also with an arrow to show the correct direction of rotation for rolling and shall have attached a metallic label showing a serial number, the conductor type, size and length and also the gross and tare weight of the drum and its cubic measure.

The inner end of the length of conductor must be passed through the flange and be secured external to the barrel. The preservative shall not react with aluminum and the barrel and the drums covering shall be made of wooden lagging chemically treated against fungal and termite attack of min. thickness 33mm sealed by 3 metallic straps around it so as to ensure no damage to the conductors. The upper layer of wrapped conductor shall be covered by PP sheet of appropriate thickness sealed by 3 plastic polyester straps of size 30 x 2.5mm.

All nails to be countersunk and the drum construction must be proved adequate to transport the conductor weight.

### **3.1.2 Phase conductor Loading Parameters:**

Maximum allowable conductor tension

- a) Temperature 0 °C, bare conductor, maximum gust 40 m/s @ 10m high: Final tension should not exceed 40 % RTS (*rated Tensile Strength*)
- b) Temperature -15 °C No load: Final tension not to exceed 25 % RTS.
- c) Temperature +25 °C No load: Final tension not to exceed 20 % RTS.
- d) Temperature -10 °C No load: Initial tension not to exceed 30 % RTS.

### **The contractor have to submit the followings for Oswego/ACSS/TW conductor :-**

\* Sag-Tension calculations for ruling spans (200-250),(250-300),(300-350),(350-400),(400-450).

\* A DVD contains videos about the procedures for all stringing stages and detailed methods of making the dead end joints, mid-span joints, and repair sleeves.



## **FITTINGS**

### **4.2.1 For ACSS/TW conductor:**

#### **4.2.1.1 Clamps and fittings**

The suspension clamps and insulator fittings for line conductors shall be suitable for “1” suspension insulator sets. Single strings shall be used for the general run of the line but double string suspension sets shall be provided on poles immediately on each side of main road, river, railway, telephone or pipeline crossings or on each side of a long span. Single or twin string tension insulator sets as stated in schedule D shall be provided for tension poles and single string tension insulator sets for light duty use, the latter being for slack span connections to substations. Double string tension sets shall be provided with a single attachment at the tower crossarm. Single string auxiliary (jumper) insulator sets may be used where approved.

Suspension and tension clamps for line conductors shall be of approved types and shall be as light as possible. All clamps shall be designed to avoid any possibility of deforming the stranded conductor or of separating the individual strands.

All connecting fittings between the conductor and the pole steelwork which are subject to a tensile load in service shall comply with IEC 61284, except that the nut of each fixing bolt shall be secured by a split pin. A backing washer is not required. The unthreaded shank of the fixing bolt shall extend 3 mm through the clevis or shackle. The nut shall, during erection, be tightened to the end of the thread and be backed by a phosphor bronze or austenitic stainless steel split pin. A clevis or shackle opening shall not exceed the thickness of the corresponding tongue, plate or link by more than 3 mm. Adequate bearing area between fittings shall be provided and point contacts shall be avoided wherever this is possible without adversely affecting the flexibility of the fitting.

Fittings made of steel or malleable iron shall be galvanized in accordance with the Specification. All bolts and nuts shall be of (8.8) grade according to ISO 898. The mechanical strength of the fittings shall be as stated in Schedule D and the minimum failure load of each fitting shall be stated on the drawings.

- All fittings shall be designed for high temperature applications (min. 250°C).
- All fittings made of Aluminium or Aluminium Alloy shall be designed to dissipate the heat to protect the annealed aluminium strands of conductor.
- All fittings shall be designed to withstand a short circuit current of (70KA).

Insulator sets shall be fitted with shouldered extension links, at each end of the insulator strings, suitable for standard strain carrier yokes of live line maintenance equipment and for bundled line conductor, an attachment plate behind the tension clamp to enable the load on the tension set to be relieved when making adjustment to the sag-adjusting links.

Tension insulator sets shall be equipped with sag-adjusting devices to provide a total range of longitudinal adjustment for each separate conductor from plus to minus 200 mm in steps not greater than 30 mm.

Parallel tension insulator strings shall be provided with links of a length necessary to ensure insulators lie opposite each other when erected.

Suspension clamps for line conductors ACSS/TW shall be free to pivot in the vertical plane about a horizontal axis passing through and transverse to the centre line of the conductor. The overall length of the suspension clamp for line conductor shall not be less than 320 mm. Suspension clamps slippage shall not occur at 25% UTS of conductor, but the conductor shall be mechanically clamped in an approved manner. Unless otherwise approved, the outermost point of clamping pressure shall not be less than two conductor diameters inside the outermost point of contact between the conductor and its supporting groove (the conductor being assumed to be horizontal). (Where armour rods are used, the design shall consider the diameter of the armour rods over the conductor.) The supporting groove beyond the latter point shall be curved in the vertical plane to a minimum radius of 150 mm and for a sufficient distance to allow for the conductor leaving the clamp at the maximum inclination to be obtained in service. The mouth of the supporting groove shall also be slightly flared in plan. The grooves in the clamping piece or pieces shall be bell-mouthed at each end to a minimum radius of 25 mm for a distance of 12.5 mm, unless otherwise approved. All conductor grooves and bell-mouths in ferrous clamps shall, after galvanizing, be smooth and free from waves, ridges or other irregularities.

Bundled line conductors shall be supported on suspension sets with a yoke plate which provides a conductor centre to centre separation as specified in Schedule D. All yoke plates shall be rigidly constructed and shall withstand the maximum vertical, transverse and longitudinal forces applied simultaneously or separately without sign of deformation. Yoke plates shall be designed to permit swings of the conductor clamps to angles at least 60° from the vertical. Attachment of a yoke plate to a vertical string of suspension insulators shall be by means of a single bolt allowing the conductors to swing transversely. Each string comprising an insulator set shall be separately bolted to a yoke plate. Jumper suspension set shall be supplied with 200 kg suspension counterweights for each jumper string.

Tension clamps for line conductors shall be of the compression type and shall comply in all respects with the provision of the Specification for line conductor joints. The design of the clamps for conductors shall be such as to make it impossible to position the steel sleeve incorrectly. Overall length of the clamp for line conductors before compression shall not be less than 525 mm, with the outside diameter of the clamp not less than 42 mm. The mechanical efficiency of such tension clamps shall not be affected by methods of erection involving the use of auxiliary erection clamps before, during or after assembly and erection of the tension clamp itself.

Where mating surfaces and jumper terminals are to be bolted together they are to be protected at the manufacturer's Works by a strippable plastic coating or other approved means.

Tension insulator sets and clamps shall be arranged to give a minimum clearance of 150 mm between the jumper conductor and the rim of the live end insulator units.

Conductor fittings shall not employ screw threads loaded in tension. Hooks shall not be used for attaching insulator sets to pole crossarms.

#### **4.2.2 Arcing devices**

Arcing horns, formed from galvanized mild steel and of approved types, shall be attached in an approved manner to both the live and the earthed end on all suspension and tension insulator sets.

The horns shall be attached to the insulator fittings, but not directly to conductor clamps or to the caps of insulator units. The design of the arcing horns shall be such as to reduce, as far as reasonably possible, damage to the line conductors, clamps, insulator strings and arcing horns themselves under all flashover conditions. The general shape and method of attachment of the live end arcing horn shall also not restrict the replacement of insulators under live line conditions. The mechanical strength of arcing horns at the live end of the suspension insulator sets shall be such as safely to withstand a force of 1000 N (assumed to be the weight of a man and tools) applied at the tip.

#### **4.2.3 Joints**

Tension joints for ACSS/TW line conductor shall be of the compression type. The design of the joint for ACSS/TW conductors shall be such as to make it impossible to position the steel sleeve incorrectly. Before compression the overall length of the joint of ACSS/TW conductor shall not be less than 730 mm with the outside diameter of the joint not less than 42 mm. The electrical resistance of each joint shall not exceed 75 per cent of the measured resistance of the equivalent length of reference conductor. Tension joints shall not permit slipping of or cause damage to or failure of the complete conductor or any part thereof at a load less than 95 per cent of the ultimate strength of the conductor and when tested in accordance with the test conditions specified in Clause 5.

#### **4.2.4 Vibration dampers, spacers and spacer-dampers**

The Stockbridge type vibration dampers shall be designed to:

a. introduce an additional damping effect to that of the conductor and to control Aeolian vibration to ensure that the strain level in the conductors at the clamps, both suspension and tension is below the fatigue limit of the conductor strands,

b. guarantee that conductor bending strain at suspension and tension clamps shall not exceed the limit of 150 microstrains.

The approval of vibration dampers shall be conditional on the provision of evidence in respect of fatigue resistance, clamp to conductor grip, damping of aeolian vibration with disposition along the span as recommended by the manufacturers. An adequate clamping surface with a radius at the clamping mouth shall be provided. The grip of the conductor clamp to conductor strands and the satisfactory properties related to the damping of aeolian vibrations shall be demonstrated. All bolts shall be locked in an approved manner.

In order to evaluate the efficiency of the damping system the supplier must have developed suitable computer programs which have been verified against experimental investigations and behavior of actual transmission lines, so that he is able to simulate the behavior of the bundle when subjected to wind-excited vibrations, either at low frequency (subspan oscillations) or at higher frequency Aeolian vibration. Based on the type of conductor and its tensile load the supplier shall submit a damping study, with calculations of vibration amplitude and strain on conductors with and without spacers and dampers.

All spacers (and spacer dampers) shall be designed to maintain or restore the specified geometric configuration of the conductor bundle, even when the latter is subjected to different actions (eg wind, short-circuit, etc). They shall also be designed to prevent any damage to conductor arising from clamp slip occurring after conductor creep or long-term vibration.

Spacer dampers shall be designed, in addition to maintaining the correct spacing of sub conductors in the bundle and to restoring their tensional stability after unfavorable conditions, to:

i. Introduce an additional damping effect to that of the conductor and to control Aeolian vibration and sub span oscillation to ensure that the strain level in the conductor at the suspension clamp and at the clamp of the spacer dampers is below the fatigue limit of the conductor strands,

ii. Prevent damage to each subconductor from vertical and horizontal vibration and oscillation,

iii. prevent physical contact between subconductors arising from wind and electro-magnetic forces (except short-circuit current),

iv. guarantee that conductor bending strain at suspension and tension clamps shall not exceed the limit of 150 microstrain,

v. guarantee that conductor bending strain at spacer damper clamps shall not exceed the limit of 100 microstrain.

The approval of dampers, spacers and spacer dampers shall be conditional on the provision of evidence of satisfactory service life and performance. Evidence must be provided in respect of fatigue resistance, clamp to conductor grip, damping of Aeolian vibration and control of subspan oscillation with disposition along the span as recommended by the manufacturers. Evidence shall be provided of resistance to ozone and ultraviolet light as well as to aging in the case of hardware employing elastomers.

The metallic material of spacer and spacer dampers shall be aluminium alloy. The clamps shall be provided with an adequate clamping surface secured by not less than two bolts and with a radius at the clamp mouth to prevent damage to the conductor. Alternative designs of clamp and bolt arrangements can be considered on evidence of satisfactory service experience. All screws and nuts on spacers and spacer dampers shall be locked in an approved manner.

The elastic material (elastomer) used for the damping component of the spacer dampers shall withstand a temperature range between  $-40^{\circ}\text{C}$  to  $+250^{\circ}\text{C}$  with a semi-conductive property.

Each jumper connection shall be provided with at least two spacers (spacing as specified in schedule D), fitted symmetrically, which may be of rigid design and which may incorporate jumper weights if the latter are necessary to limit jumper swing. Additional spacers shall be provided where necessary to ensure that the maximum distance between spacers is 5m. Spacers, spacer-dampers and vibration dampers shall satisfy the requirements specified in clause 5 of this Specification and IEC 61854, 61897.

#### **4.2.5 Armour rods**

Approved pre-formed helical armour rods shall be fitted to the line conductor and earthwire conductor or each subconductor, at all tangent poles, in accordance with the schedule of technical information.

Armour rods shall be fabricated from aluminium alloy, shall be 'ball-ended'. For ACSS/TW conductor the overall length shall be 2540 mm.

The armour rods shall be of a material that is compatible with the material of the line conductor earthwire or subconductor to which they are attached such as to eliminate any effects arising from dissimilar metals corrosion.

Armour rods shall have an end form appropriate to the application and operating voltage. The lay of the armour rods shall be right handed.

Identification marking shall be provided on a durable label attached to each set of armour rods. This label shall include details of the material and diameter range of the conductor on which the rods are to be fitted. In addition each armour rod shall be provided with a discrete painted colour coding and a marking indicating the conductor size and starting point for application respectively.

## **5- Inspection and Testing**

### **5-1General:**

- 1- All materials furnished under this Contract shall be inspected and tested. Any material shall not be shipped until all required inspections and tests have been completed, and all deficiencies have been corrected to comply with this Specification and approved for shipment by the Employer.
- 2- Unless specifically directed otherwise, make adequate tests and inspections to determine whether the material furnished under this specification is strictly in accordance with it. In addition, the engineer may inspect the material made under this specification at the plant, at the point of the delivery.
- 3- Be advised that all material furnished and all work performed is subject to inspection unless waived in writing by the engineer or his authorized representative. Do not ship any material until inspection at the plant has been made or waive by the engineer or his authorized representative, certified copies of reports of tests and analysis have been accepted and final shop drawing have been furnished and reviewed.
- 4- The engineer reserves the right to obtain from any lot of material being fabricated sample coupons for independent testing by a laboratory approved by the authority issuing the standards and to reject any lot of material for which such tests fail to meet specification requirements.
- 5- Do not construe any omission or failure on the part of the engineer to approve or reject any work or materials at the time of inspection as an acceptance of any defective work or materials. If any work or materials shall be condemned by the engineer as defective or improperly done, remove or rebuild such work or otherwise remedy the defects in a manner satisfactory to the engineer and consistent with the intent of these specifications.
- 6- Furnish certified reports in three (3) copies showing the results of all of the tests required by this specification and applicable reference specifications.
- 7- Ensure that the all instruments are approved and, if required by the engineer, are calibrated by an approved authority.

## **5-2 Drawings:**

### **5.2.1 Drawings with tender:**

- All drawings submitted by the Bidder shall indicate the type, size, arrangement, dimensions, material description, Bill of Materials, weight of each component, break-up for packing and shipment, shipping arrangement required, the dimensions required for installation and any other information specifically requested in the Specifications. Each drawing submitted by the Bidder shall be clearly marked with the Employer name, the unit designation, the specification title, the specification number and the name of the Project. All titles, notes, markings and writings on the drawing shall be in English. All the dimensions should be to the scale and in metric units. The drawing revision level/ issue no, issue date shall be marked on each drawing and the drawing shall carry issue history information and appropriate signatures (e.g.: originator, checker and approving authority).

### **5.2.2 Drawings after awarded for approval:**

- The contractor shall submit the drawings & data requirement sheets document for all materials for approval by our engineer.
- All final drawings shall become the property of the owner, who shall have full rights to reproduce drawings and use them as the owner sees fit, including submitting them to other vendors for the purpose of obtaining bids on future.

### **5.3 Tests On Conductors :-**

Tests on conductors must be according to IEC 61089 and EN 50540 and as show in the following table:

<b>Item</b>	<b>Category</b>	<b>Tests Required</b>	<b>Type Test</b>	<b>Sample Test</b>
1	Conductor	Surface condition	X	X
		Overall diameter	X	X
		Lay ratio and direction of lay	X	X
		Number and type of wire	X	X
		Aluminium cross - section	X	X
		Mass per unit length	X	X
		Mass of grease per unit length	X	X
		Grease drop point Temperature	X	X
		DC electrical resistance	X	X
		Stress – strain curve	X	-
		Tensile breaking strength	X	-
		Stringing test	X	-
		AC Electrical resistance	X	-
		Joints in aluminium wires	X	-
2	Aluminium wires	Tensile strength	X	X
		Elongation	X	X
		Resistivity	X	X
		Cross - section	X	X
3	Steel wires (Zn95Al5) (MM-MA5)	Diameter	X	X
		Tensile strength	X	X
		Stress at 1% extension	X	X
		Elongation or torsion test	X	X
		Mass of Zn coating	X	X
		Zinc dip test	X	X
Adhesion of zinc coating	X	X		

Note: Properties of wires after stranding shall be according to a/m standards.



## **5.4 HARDWARE AND ACCESSORIES:**

### **5.4.1 Tests on fitting:**

Test on fitting must be according to IEC 61284 and IEC 61897 and as show in the following tables:

## Requirements and tests for fitting

NO.	Test	Earth wire fitting			Suspension clamps			Tension joints and tension clamps			Partial tension fitting			Repair sleeve		
		Type test	Sample test	Routine test	Type test	Sample test	Routine test	Type test	Sample test	Routine test	Type test	Sample test	Routine test	Type test	Sample test	Routine test
1	Visual examination	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	Dimension and material	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	Hot dip galvanizing	X	X		X	X		X	X		X	X		X		
4	Non-destructive	X	X	X	X	X	X	X	X	X	X	X	X			
5	Damage and failure load	X	X	X	X	X	X	X	X	X	X					
6	Slip test				X	X										
7	Clamp bolt tightening test				X	X		X	X							
8	Tensile test.							X	X		X			X	X	
9	Damage and failure load test of the attachment point used during erection		X	X				X	X	X						
10	Magnetic losses test				X			X								
11	Heat cycle test							X			X					

#### **5.4.2 Test on vibration dampers:**

Test on vibration dampers must be according to IEC 61897 and as show below:-

NO.	TEST	vibration dampers		
		Type test	Sample test	Routine test
1	Visual examination	X	X	
2	Verifications of dimensions , material and mass	X	X	
3	Corrosion protection test	X	X	
4	Non-destructive tests			
5	Clamp slip test	X		
6	Breakaway bolt test	X	X	
7	clamp bolt lighting test	X	X	
8	Attachment of weights to messenger cable	X	X	
9	Attachment of clamp to messenger cable test	X	X	
10	Corona and radio interference voltage(RIV) test	X		
11	Damper performance tests:			
11.1	-Damper characteristic test	X		
11.2	-Damper effectiveness evaluation	X		
12	Damper fatigue test	X		

### **5.4.3 Test on Spacer dampers:-**

Number of samples for test shall be according to BS 3288. Test on spacer dampers shall be according to IEC 61854 and as shown below :-

NO.	TEST	spacer dampers		
		Type test	Sample test	Routine Test
1	Visual examination	X	X	
2	Verifications of dimensions , material and mass	X	X	
3	Corrosion protection test	X	X	
4	Mechanical tests: -clamp slip test -break way bolt test -clamp bolt lighting test -simulated short –circuit current and compression-tension test -characterization of the elastic and damping properties -flexibility test -fatigue test	X X X X X X X	X X	
5	Tests to characterize elastomers	X		
6	Electrical tests -corona and radio interference voltage (RIV) tests -electrical resistance test	X X		
7	Verification of vibration behavior of the bundle- spacer system -aeolian vibration -sub span oscillation	X X		

## **6- Packing and Shipments**

### **6-1 Packing**

#### **6-1-1 Scope**

Included in this section are minimum requirements to ensure that all materials pertaining to the works are packed and transported to their destination without sustaining any damage or deterioration. Also included all details of being provided and requirements labeling and marking of containers. Write and submit to the Engineer before manufacturing a comprehensive specification covering packaging, marking, color coding, documentation ...etc, to be used by all manufacturers, suppliers and shippers ...etc. Include, but not be limited to, any methods or procedures described herein.

#### **6-1-2 General**

Ensure that all materials are adequately packed to provide protection against corrosion, physical damage contamination or damage from water, dust, or from any other source during handling and all necessary transport. Handle all crates, boxes, bundles, etc. carefully at all times and do not drop , dump , throw or push items from , onto or into any from of transport , during storage or at any other time .

#### **6-1-4-Hardware**

Pack in wooden boxes made of lumber a minimum of 25 thick with reinforced edges, corners and end. Use nails that are ringed or spiraled. Line boxes with water roof paper and double strap in both directions. Limit the weight of boxes to approximately 100kg. Levee suppliers standard cardboard and over pack with wooden boxes size designed to suit.

### **6-2 Shipping**

Make all arrangements for all forms of transport used to ensure that all items are transport safely and on time to their destination. Use only reputable carriers which have regular schedules to the required destination.

Investigate the facilities, reliability and record of carriers, ports and other depots. Make arrangements to supplement any deficiencies that may be expected.

Investigate the possibility of through transport by road or rail to Iraq, and check for problem such as delays shortage of rolling stock or suitable road vehicles and the acquisition of permits.

Keep the number of carriers to a minimum, and avoid transshipments or double handling at ports and depots as far as possible. Ensure that all warehouses used in route are suitable

and that all items can be stored without any deterioration or damage. From water, sunlight, dust or any other cause.

When possible avoid sending partial consignments.

### **6-3 Marking and Color Coding**

-Ensure that all labels, markings and color codes...etc. on all bundles, crates and boxes ... etc. Is clear, legible, waterproof, not affected by sunlight and are securely fixed or painted thereon. Use the standard project shipping mark in all cases. Apply this and any mark authorized by the Employer to several surfaces of the packages and ensure that the marks are visible at a distance. Apply any special decals required by the exporting country onto all packages.

-Establish a standard form of address for use on all packages. Include in the information on the outside of each package details of contents , size , weight, order Number, shipper, shipping contract number, case numbers ...etc. Apply standard markings such as lift here. No hooks, Fragile ...etc. as appropriate. Ensure that oil, paint and other hazardous or inflammable materials are marked accordingly, including, Flash point and recommended storage temperatures. Mark all bundles, boxes, bags ...etc and package inside larger containers with full details of contents.

**SCHEDULES OF TECHNICAL  
INFORMATIONS**

**General: PARAMETERS GUARANTEED TECHNICAL PARAMETERS**

The following schedules are required to be filled up by the Bidders to aid in the evaluation process. The response shall be brief and to the point and shall be supported by the printed product description and other literature. The same DRS format duly filled and the relevant drawings shall also be submitted during the detailed engineering along with the relevant technical brochures. The DRS forms have been included for the major items, however, the DRS or each item along with sufficient details shall be submitte

**SCHEDULE A  
GENERAL DESCRIPTION OF WORK**

<b>Section for purposes of payment and taking over</b>	<b>Line conductors</b>	<b>Earthwires</b>	<b>Type of construction</b>



## SCHEDULE B

### DATES FOR MANUFACTURE, INSPECTION, COMPLETION AND TESTING

Commencement Date:

Completion Date:

Total period of Contract: 120 calendar days

Description	DAYS			
	Start (DAYS)		Complete (DAYS)	
	required	offered	required	offered
Submit of all technical documentation for approval	0		15	
Test of fittings	15		30	
Shipment of fitting				
First Shipment : - (50%) of all quantity (fittings )	30		75	
Second Shipment : - (50%) of all quantity (fittings )	75		120	

**SCHEDULE C**

**MANUFACTURERS AND PLACES OF MANUFACTURE, TESTING AND INSPECTION**

<b>Item</b>	<b>Manufacturer</b>		<b>Place of manufacture</b>	<b>Place of testing And inspection</b>
	<b>Required</b>	<b>Offered</b>		

**SCHEDULE D**  
**GENERAL PARTICULARS AND GUARANTEES**

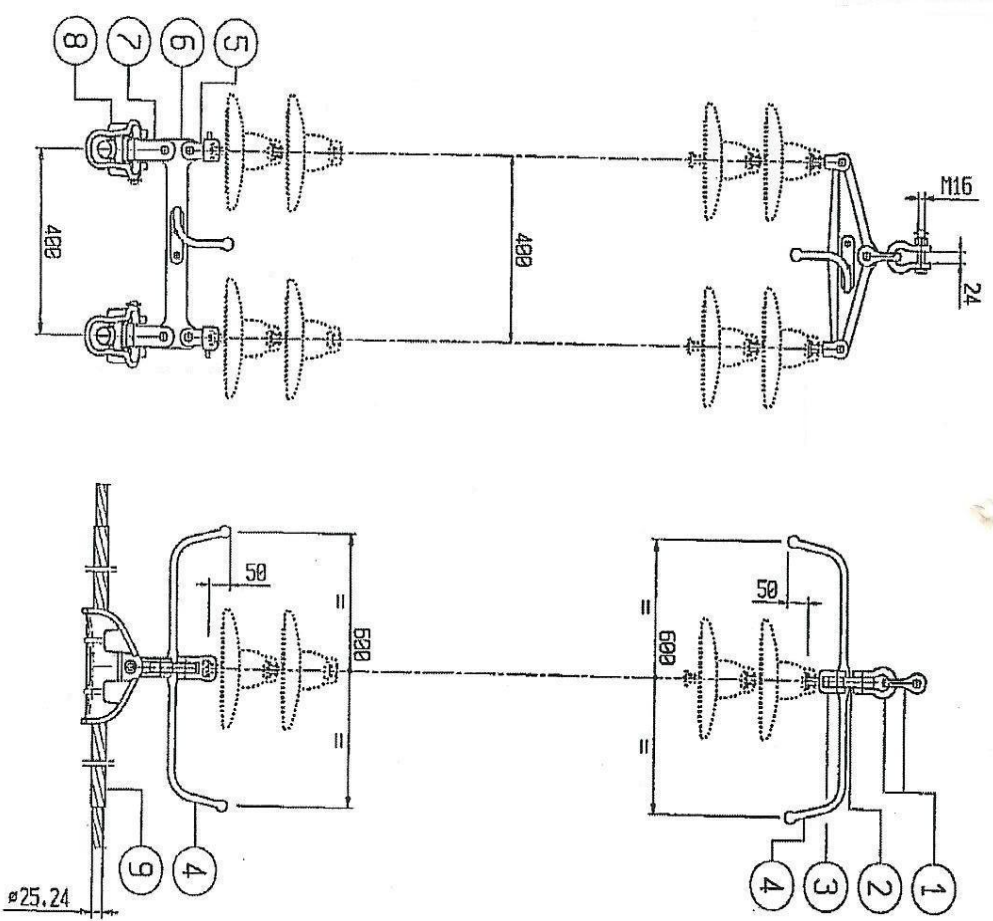
<b>LINE CONDUCTOR</b>		
<b>Description</b>	<b>Required</b>	<b>Offered</b>
<b>Phase conductor:</b>		
Code name	Oswego/ACSS/TW	
International Standard	IEC 61089 , EN50540	
National Standard	ASTM B857	
Material of conductor	ACSS/TW	
Number and diameter of wires		
a. aluminium	No/Layer	20x2
b. steel	No/mm	7x3.16
Total area of conductor	mm <sup>2</sup>	391.7
Overall diameter of stranded conductor	mm	23.55
Resistance of conductor (dc) at 20°C	ohm/km	0.0827
Mass of conductor (without grease)	kg/km	1359
Total mass of greased conductor (greased to Case 2 of IEC 61089)	kg/km	1399
Ultimate rated strength of conductor	KN	121
Assumed equivalent modulus of elasticity of conductor	GPa	207
Assumed equivalent coefficient of linear expansion of Conductor	per °C	11.5x10 <sup>-6</sup>
minimum length of conductor on drum	km	2.5-3

## LINE CONDUCTOR

Description	Required	Offered
<b>Individual wires before stranding:</b>		
Aluminium (ASTM B609 and EN50540) :-		
a. tensile breaking stress	N/mm <sup>2</sup>	60 - 95
b. minimum elongation on 250 mm gauge length at break	%	20
c. Electrical resistivity (max.)	Ω.mm <sup>2</sup> /m	0.027899
Steel (ASTM B958 and EN 50540) :-		
a. grade of steel ultra high strength-MM		MA5
b. tensile breaking stress	N/mm <sup>2</sup>	1860
c. minimum stress of steel at 1% elongation	N/mm <sup>2</sup>	1515
d. minimum elongation on 250 mm gauge length at break	%	3.5
e. mass of MM (ZN95Al5) coating (min.)	g/m <sup>2</sup>	259
<b>Conductor grease:</b>		
Type	“ “	
Minimum drop-point temperature	°C	250
Mass of grease per kilometer of conductor (all inner layers greased – case 2 to IEC 61089)	kg	40

**SCHEDULE E**  
**DRAWINGS OF FITTINGS FOR 132 K.V**

FOR TENDERING  
PURPOSE ONLY

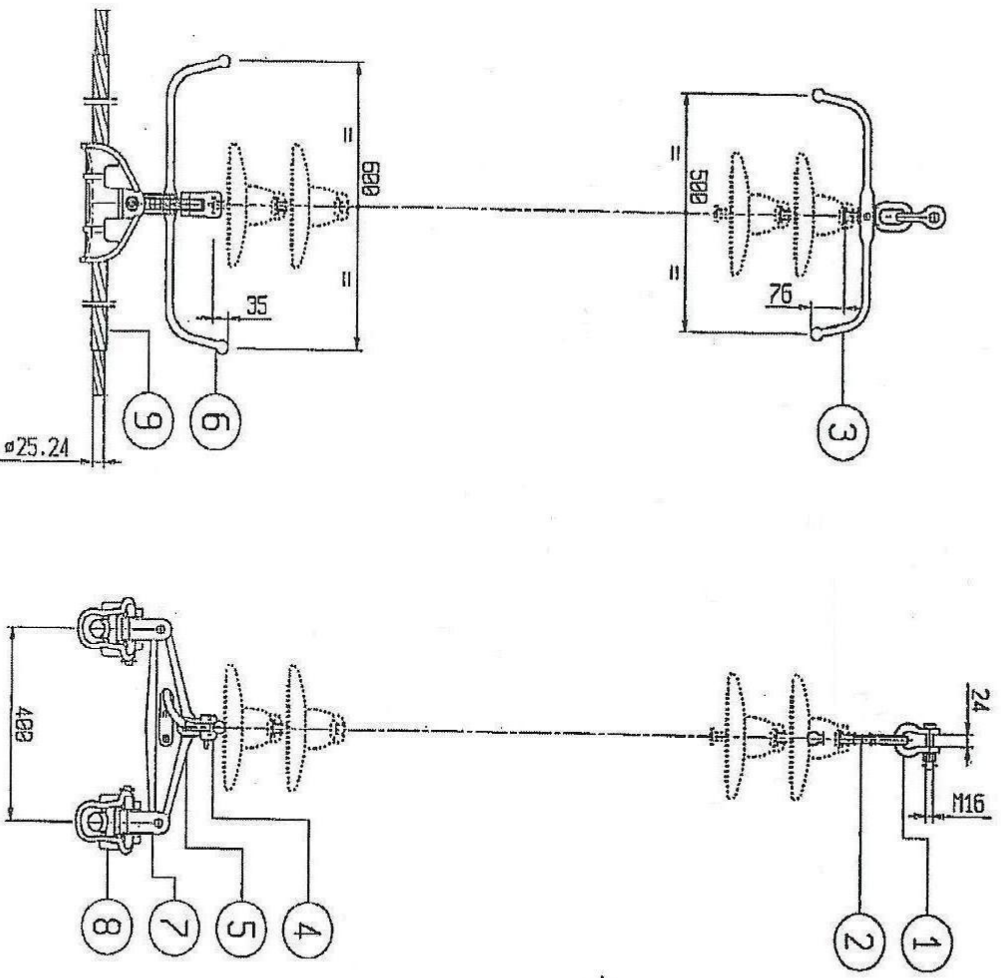


-Minimum breaking strength of suspension insulator set 120 kN

ITEM	DESCRIPTION	N°	MATERIAL
1	shackle	2	galvanized steel
2	spacing yoke	1	galvanized steel
3	ball clevis	2	galvanized steel
4	arcing horn	4	galvanized steel
5	socket clevis	2	galvanized steel
6	spacing yoke	1	galvanized steel
7	U-clevis	2	galvanized steel
8	suspension clamp	2	aluminum alloy/steel
9	line guard	2	aluminum alloy

Republic of Iraq Ministry of Electricity Directorate General of Electrical Transmission Projects	Double Suspension set for ACSR Teal
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FOR TENDERING  
PURPOSE ONLY

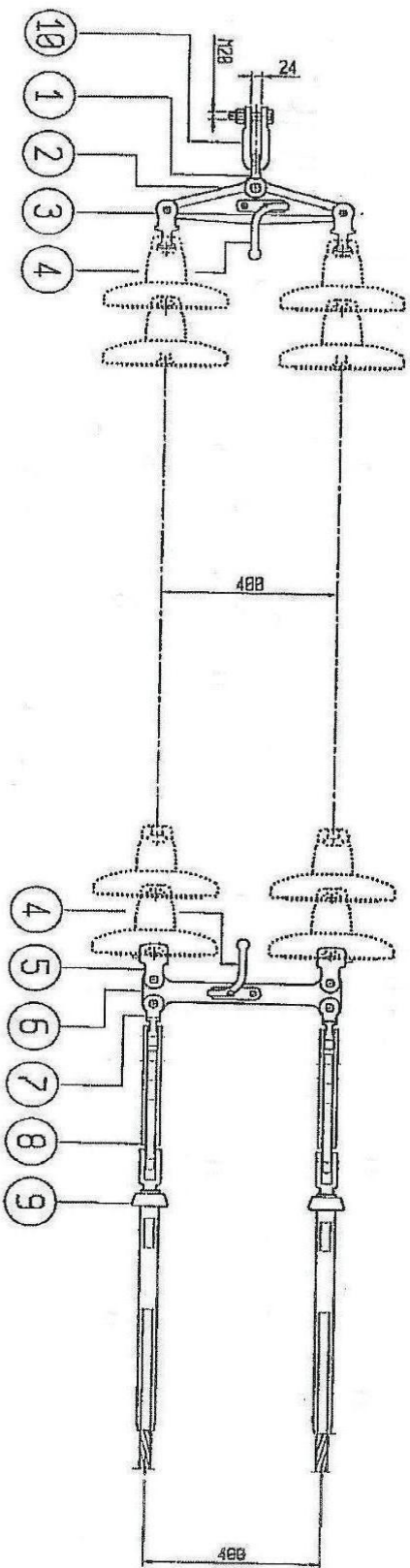
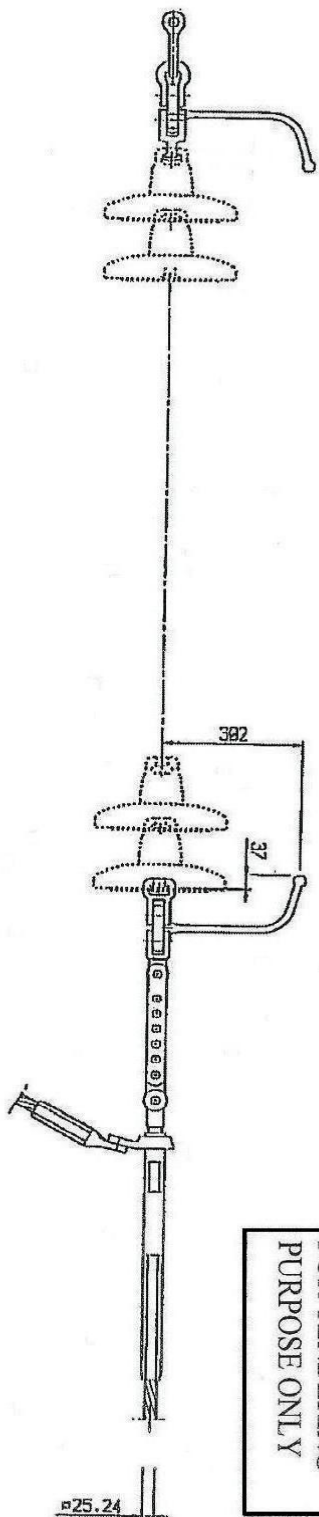


-MINIMUM BREAKING STRENGTH OF SUSPENSION INSULATOR SET 120 KN

ITEM	DESCRIPTION	QTY	MATERIAL
1	shackle	1	galvanized steel
2	long ball eye	1	galvanized steel
3	arcing horn	1	galvanized steel
4	socket clevis	1	galvanized steel
5	spacing yoke	1	galvanized steel
6	arcing horn	2	galvanized steel
7	U clevis	2	galvanized steel
8	suspension clamp	2	alum.alloy/galv. steel
9	line guard	2	aluminium alloy

Republic of Iraq  
Ministry of Electricity  
Directorate General of Electrical  
Transmission Projects

Single Suspension set for  
ACSR Teal



shackle	1	galvanized steel
compression dead end	2	alum.alloy/galv.steel
adjustable extension link	2	galvanized steel
90° clevis tongue	2	galvanized steel
spacing yoke	1	galvanized steel
socket clevis	2	galvanized steel
anchoring horn	2	galvanized steel

-MINIMUM BREAKING STRENGTH OF TENSION INSULATOR SET  
(EXCLUDED DEAD END) 150 KN

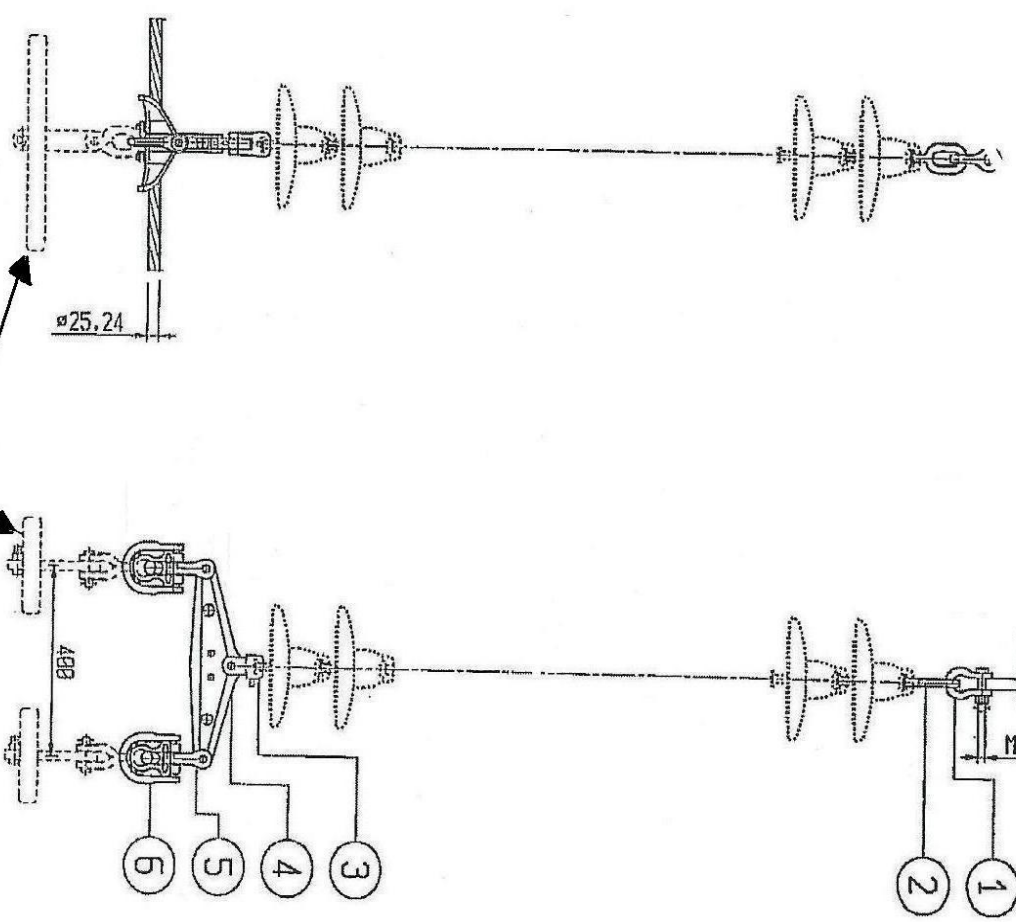
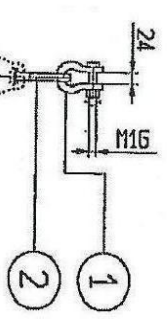
FOR TENDERING  
PURPOSE ONLY

Republic of Iraq  
Ministry of Electricity  
Directorate General of Electrical  
Transmission Projects

Tension set for  
ACSR Teal



FOR TENDERING  
PURPOSE ONLY



(50% of all quantity with counterweights)

-Minimum breaking strength of suspension insulator set 120 kN

ITEM	DESCRIPTION	N°	MATERIAL
1	shackle	1	galvanized steel
2	ball eye	1	galvanized steel
3	socket clevis	1	galvanized steel
4	spacing yoke	1	galvanized steel
5	U clevis	2	galvanized steel
6	suspension clamp	2	alum. alloy/galv. steel

Republic of Iraq  
Ministry of Electricity  
Directorate General of Electrical  
Transmission Projects

Jumper Suspension set for  
ACSR Teal