

## **ANNEXURE-C**

### **ERECTION, WORK FORCE, MEANS & GENERAL TOOLS**

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## **ANNEX 1**

### **ESTIMATED WORKFORCE FOR INSTALLATION & HV TEST OF GIS**

#### **1.1 Extent of Service**

The following pages describe the responsibilities of the ETC Contractor at site. They also define the requirements in terms of workforce and qualification to make sure that the equipment can be installed according to the manufacturer standards and estimated time schedule.

#### **1.2 Responsibilities of the ETC Contractor**

The ETC Contractor's responsibilities shall be as follows:

- To provide a suitably qualified erection team as specified in corresponding paragraph.
- To provide general tools and on site facilities as per corresponding paragraph.
- To ensure of the permanent cleanliness of the GIS area.
- To ensure that the erection team placed at the disposal of BHEL/GIS manufacturer representative is following its instructions and advices.
- Provide the BHEL/GIS manufacturer representative with a safe working environment.

#### **1.3 General tools to be available (To be provided by ETC Contractor)**

The General tools must be available and operational on site prior to and during the whole duration of the works. Detailed requirements shall be specified 1 month prior to start of Supervision Service. Typical list of general tools required is presented in Annex 2.

#### **1.4 Estimated Schedule**

The estimated minimum duration of the service is given in the following table.

#### **Erection Team – Availability and Qualification**

Responsibility	Resources	Team 1		Team 2	
		No. of people	Duration on site (Estimated Working Days)	No. of people	Duration on site (Estimated Working Days)
GIS MANUFACTURER	Areva Supervisor	1	133	1	52
<b>Civil Work</b>					
ETC CONTRACTOR	Land Surveyor	1	4	-	-
ETC CONTRACTOR	Surveyor	2	4	-	-
<b>Unpacking and handling</b>					
ETC CONTRACTOR	Helper	4	53	-	-
<b>GIS erection and testing</b>					
ETC CONTRACTOR	Team leader for HV equipment	1	112	1	39
ETC CONTRACTOR	Electromechanical fitter	8	112	4	39

ETC CONTRACTOR	Helper	2	112	2	39
ETC CONTRACTOR	Technician for gas treatment	1	124	-	-
ETC CONTRACTOR	Team leader for LV cabling	1	77	-	-
ETC CONTRACTOR	Wireman	6	77	-	-
ETC CONTRACTOR	Helpers for wiring	1	77	-	-
ETC CONTRACTOR	Test technician	1	49	-	-

### 1.5 Erection team - Availability and Qualification

The erection team is placed under the technical authority of BHEL/GIS manufacturer supervisor and under the hierarchical authority of Erection company site manager. Detailed requirements regarding qualification of erection team shall be given at contract stage.

As a resume:

- **Team Leader for HV equipment (foreman)** should be able to manage the team, read all drawings, identify equipment and tools, supervise gas treatment equipment operation, supervise heavy pieces handling by crane or otherwise. He should also be able to understand the inspection instructions, interlocking functions as well as all LV HV safety instructions. He should be able to carry out the tasks assigned to the fitters and be qualified to check the equipment prior to the erection, check the civil work with Theodolite, erect the equipment, handle gas treatment operations such as measurement of vacuum, pressure, humidity, correction according to temperature

- **Electromechanical fitters** should be able to carry out the installation work and the inspections during the erection under the supervision of the HV team leader/foreman. They should be able to read drawings. They would be responsible for unpacking, identifying equipment, organise the storage, erect supporting frames according to drawings, prepare and install the GIS equipment according to drawings and instructions.

- **Team leader for LV cabling** should manage wiremen and be able to carry out all activities assigned to them (cabling work and inspection, reading of electrical drawings and other electrical documentation) check connections and detect possible faults.

- **Wiremen** should be suitably qualified to read electrical drawings and be able to do proper cabling of CTs, VTs, pressure switches, driving mechanism ... according to drawings and instructions.

- **Test technician** should carry out all testing prior to energisation of the equipment. He should have extensive technical knowledge to carry out all testing and commissioning work, record test values. As examples, he would be responsible for testing the operating time of circuit-breaker, test driving-rods mechanism for disconnectors and earthing switches, test CTs and VTs for ratios, polarity, insulation a.s.o and test local control panel including interlocking functions

Team leaders and test technician should be correctly fluent in English language in order to assure proper understanding of GIS manufacturer supervisor's instruction. It is recommended that fitters, wiremen and helpers also have some basic knowledge of English language.

LIST OF CONTRACTOR TOOLS

ANNEX 2

	ENGLISH	PICTURE REFERENCE **	RECOMMENDED MINIMUM QUANTITY *
1 PRELIMINARIES TO ERECTION			
1.1 INSTALLATION			
	OFFICE, CLOAKROOMS, STORE	N°18	1
	TELEPHONE LINE (possibility internet access)	F443246001	1
	SHELF FOR TOOLS STORAGE	F443248001	1
	TEMPORARY SUPPLY TYPE A (380V / 100A)	F341154001	1
	TEMPORARY SUPPLY TYPE B (380V / 40A)	F341154002	1
	ELECTRICAL EXTENSION 220V 15m	F443110001	6
	MOBILE TABLE 1000x700	H4718469201	3
	COLLAPSIBLE WORKBENCH 1200x550	F443249001	2
	REVOLVING VICE (open 180mm x 125mm)	F443250001	2
	PRY BAR	F443255001	2
	INDUSTRIAL ASPRATOR	F441072001	1
	WELDING EQUIPMENT	N°19	1 (as per site needs)
	SPOTLIGHT 1000W	F443253001	2 (as per site needs)
	PLASTIC SHEET	F443254001	2 (as per site needs)
	SHELTER FOR OUTSIDE	N°20	1 (as per site needs)
1.2 SAFETY			
	POWDER FIRE EXTINGUISHER (6kg)	F443256001	2
	FIRST AID KIT - FOR 8 PERSONS	F443266001	1
1.3 CIVIL WORKS			
	THEODOLITE	F443124001	1
	ALIGNEMENT RULER 2.5m	H4718487501	2
	SPIRIT LEVEL 300mm	F440388001	2
	INDUSTRIAL CONCRETE DRILLING MACHINE	F440417001	1
	CONCRETE DRILL 25mm	F440417002	Type and quantity of concrete drills will be defined with GIS manufacturer civil works guide
	CONCRETE DRILL 28mm	F440417003	
	CONCRETE DRILL 18mm	F440417004	
	CONCRETE DRILL 14mm	F440417005	
	CONCRETE DRILL 12mm	F440417006	
	CONCRETE DRILL 16mm	F440417007	
	CONCRETE DRILL 20mm	F440417008	
	CONCRETE DRILL 24mm	F440417009	
	CHEMICAL STUD INSTALLATION TOOL M20	F440852001	
	CHEMICAL STUD INSTALLATION TOOL M24	F440852002	
1.4 HEIGHT WORKING			
	INDIVIDUAL EQUIPMENT FOR WORKING AT ELEVATION	F443031001	2
	STEPLADDER (7 Steps)	F443115007	4
	EXTENDABLE LADDER 5m	F443116001	2
	EXTENDABLE LADDER 7m	F443116004	2 (as per site needs)
	SCAFFOLDING FLOOR LEVEL 3m	F443269001	2
	SCAFFOLDING FLOOR LEVEL 5m	F443269002	2 (as per site needs)
	SCAFFOLDING FLOOR LEVEL 7m	F443269003	2 (as per site needs)
	MOBILE PLATFORM		1 (as per site needs)
	TELESCOPIC PLATFORM FOR EXTERNAL WORK	N°80	1 (as per site needs) For external erection
2 GENERAL ASSEMBLY			
2.1 GENERAL TOOLS			

LIST OF CONTRACTOR TOOLS

	ENGLISH	PICTURE REFERENCE **	RECOMMENDED MINIMUM QUANTITY *
	MECHANIC'S TOOL BOX	F441 054001 N°35 a 39	1
	LIGHT MECHANIC'S TOOL BOX	F441 055001 N°40 a 44	3
	GREASE GUN	F440387001 N°34	4
	GREASE BRUSH	H47184718001 N°57	10
	ALUMINIUM PLATE BENDER	F441 066001 N°45	1
	DRILLING MACHINE (Drills 13mm MAX.)	F443112001 N°48	1
	4 to 13mm DRILLS ( FOR DRILLING MACHINE )	F443113001 N°49	1
	DRILLING MACHINE WITH COLUMN	F443114001 N°50	1
	THERMAL STRIPPER	F443189001 N°51	1
	DISC GRINDER 220V 2100W	F443252001 N°53	1
	PORTABLE ASPIRATOR	F967574001 N°55	2
	ASPIRATOR ACCESSORY (SET OF 10 BAGS)	F967574002 N°56	2
	NYLON CORD	F440740001 N°58	20 M
	3 HANDLING		
	3.1 GENERAL HANDLING TOOLS		
	SHACKLE 2T	F443068002 N°62	4
	TUBULAR SLING 1T DEVELOPED LENGTH L=2m	F443290101 N°63	2
	TUBULAR SLING 3T DEVELOPED LENGTH L=2m	F443290301 N°63	2
	TUBULAR SLING 3T DEVELOPED LENGTH L=4m	F443290302 N°63	2
	TUBULAR SLING 6T DEVELOPED LENGTH L=4m	F443290303 N°63	2
	TUBULAR SLING 6T DEVELOPED LENGTH L=6m	F443290602 N°63	4
	TUBULAR SLING 6T DEVELOPED LENGTH L=10m	F443290605 N°63	4
	CHAIN PULLEY BLOCK 1T	F446156001 N064	2
	LUG ALL 1T	F975218002 N°66	2
	EYELET SCREW M12	H419021011 N°67	6
	TUBULAR SLING 1.5m	H4718457301 N°68	2
	LIFT TRUCK 2T, L=1140 / l=520	H4718470401 N°69	1
	FORKLIFT	N°70	1
	HYDRAULIC JACK WITH FEET 5T	F972252001 N°60	4 (as per site needs)
	CABLE LUG-ALL, UNLIMITED RUN (3.2T A 5T)	F440164001 N°61	2 (as per site needs)
	CRANE 30T	N°71	2 (as per site needs)
	REMOVABLE GANTRY IN LOAD WITH ELECTRICAL HOIST (1.5t)	N°81	1 (as per site needs)
	4 GAS TREATMENT		
	NITROGEN BOTTLE U 50Kg 50ppm MAXI	N°73	4 (as per site needs)
	5 INSPECTION		
	INSULATION TESTING STATION 2000 V AC	F440386001 N°74	1
	MULTIMETER	F440414001 N°75	2
	ELECTRICAL ALIMENTATION IN 205 Vdc WITH VARIABLE AMPLITUDE	F443 688 001 N°76	1
	VARIABLE ELECTRICAL ALIMENTATION AC/DC	F443 612 001 N°77	1
	LOW VOLTAGE TOOLS		
	ELECTRICIAN'S TOOL BOX	F441 056001 N°78	2
	MANUAL WIRE CUTTER	F443244001 N°79	2
	CRIMPING PLIERS SET		Details of LV tools to be obtained from GIS manufacturer.
	TOOLS FOR OPTICAL FIBER INSTALLATION AND TEST		Detalles de las herramientas de baja tension a obtener del fabricante.
	7 HIGH VOLTAGE TEST		
	ELECTRICAL SUPPLY FOR HV TEST 150A380V 2Ph		1

LIST OF CONTRACTOR TOOLS

ENGLISH	PICTURE REFERENCE **	RECOMMENDED MINIMUM QUANTITY *
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*\*Quantities are required for a standard installation. They need to be adjusted for the specific site conditions or schedule constraints*

*\*\*The pictures of the various tools are given for example only.*

## Important Note:

The Bidders are required to contact following BHEL officials for obtaining **Contractor Tools Catalogue:**

1. Sh. Prem Prakash (AGM/TBSM)  
Landline: 011-41793314  
Mobile : 09310588971  
email : premprakash@bhelindustry.com
2. Sh. Sandip Daipuriya (Dy. Manager/TBSM)  
Landline: 011-41793485  
Mobile : 09999191232  
email : sandipd@bhelindustry.com

### **ANNEX 3**

#### **PRELIMINARY PACKING LIST**

The estimated packing list is the following:

<b>Complete equipment:</b>	
Total volume (m3)	1500
Total weight (tons)	200
Total nb of shipping units	200

<b>Biggest shipping unit:</b>	
Length (meter)	5.7
Width (meter)	1.4
Height (meter)	2.75
Weight per unit (tons)	3.6
Number	21

## **ANNEX 4**

### **CONDITIONS REQUIRED TO OPEN AND USE THE SITE FOR ERECTION OF GIS\***

\* "GIS" stands for all gas insulated equipment such as GIS, GIB, Module, .....

***The conditions to be fulfilled are as follows: -***

**- Storage area correctly prepared**

Equipment waiting to be erected and that may be stored outdoors should be stored in consolidated areas that are protected from flooding and impacts and are accessible to lifting and handling equipment under any weather conditions.

**- Satisfactory cleanliness of the GIS erection areas**

The installation of GIS must be performed with protection from all types of pollution, so as to avoid the penetration of particles harmful to the dielectric withstand of the equipment. Openings in the building, if any, must be closed. Temporary protections against dust, rain, ..., must be provided, if required, for the outdoor erection works.

**- Building equipped (when the equipment is indoor)**

The building where the GIS is to be installed must be equipped with the necessary means for assembly and tests:

- lighting installed
- handling equipment operational
- doors, windows installed
- necessary power supplies available

**- Erection means available at site**

All tools and other equipment required for erection must be available on site.


A report of the actual conditions shall be established jointly with M/s Areva (GIS manufacturer), BHEL, NHPC and ETC contractor representatives. Their observations are recorded in the document "State of site before beginning GIS assembly".

The GIS factory representative gives the authorization to begin work if the required conditions have been met. If not, he specifies the measures that must be taken before erection can be authorized. The Contractor specifies the time required to perform these corrective actions.

During the work, the cleanliness conditions required must be maintained. The GIS factory representative may suspend the work if these conditions are unsatisfactory. If such is the case, the GIS factory representative submits a written request for the suspension of work specifying the corrective actions required. The authorisation to resume work will only be given once the required cleanliness conditions have been restored.

The report on the opening conditions at the site shall be signed by the GIS factory representative, BHEL, NHPC and the ETC contractor.



	<b>SITE INSPECTION RECORD</b> <b>RAPPORT DE CONTRÔLE SUR SITE</b>	Client: #REF! Customer: #REF!
	STATE OF SITE BEFORE BEGINNING GIS ERECTION ACCORDING TO FAQ 011 ETAT DES LIEUX AVANT OUVERTURE DU CHANTIER DE MONTAGE SUIVANT FAQ 011	Poste: #REF! Substation: #REF! BHT N° : #REF!

Layout drawing:  
Plan d'implantation

Erection Contractor:  
Installateur

Civil works guide drawing:  
Plan guide génie-civil

Mr.

GIS factory representing  
représentant constructeur

Mr.

representing the Client  
représentant le Client

Mr.

representing the erection Contractor  
représentant l'Installateur

constatent la situation suivante :

report the following conditions:

**CHECKS PERFORMED/VERIFICATIONS EFFECTUEES**

**REMARKS/REMARQUES**

**1 - CIVIL WORKS**  
**GENIE-CIVIL**

1.1 - Reference pins at correct position  
Présence et position des pions de référence

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1.2 - Carry out a flatness survey of the  
GIS slab and outdoor foundations  
Faire un relevé de la planéité de la dalle et des  
massifs en béton

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1.3 - Location and dimensions of openings for:  
Position et dimensions des ouvertures pour

- Passage of the GIB  
Passage des liaisons blindées

☐

- Passage of high voltage cables  
Passage des câbles HT

☐

- Passage of low voltage cables  
Passage des câbles BT

☐

1.4 - Location of civil works expansion joints  
Position des joints de dilatation du génie civil

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1.5 - Location and dimensions of cable trenches for  
LV cables, HV cables and HV SF6 busducts.  
Position et dimensions des caniveaux pour câbles BT,  
câbles HT et liaisons SF6 HT.

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	<b>RAPPORT DE CONTRÔLE SUR SITE - POSTE .....</b> <b>SITE INSPECTION RECORD</b>	<b>Client:</b> #REF! <b>Customer:</b>
	<b>CONTRÔLE DU GENIE CIVIL</b> <b>INSPECTION OF CIVIL ENGINEERING WORK</b>	<b>Poste:</b> #REF! <b>Substation:</b> <b>BHT N° :</b> #REF!

CHECKS PERFORMED/VERIFICATIONS EFFECTUEES	REMARKS/REMARQUES
<b>1.6 - Location of connecting points to earthing grid</b> <input type="checkbox"/> <i>Position des points de raccordement au réseau général de terre</i>	
<b>1.7- Installation of anchor rods, if Halfen rails not installed (if applicable)</b> <input type="checkbox"/> <i>Implantation des tiges d'ancrage si rails Halfen non installés (si applicable)</i>	
<b>1.8 - Location and level of Halfen rails (if applicable)</b> <input type="checkbox"/> <i>Position et niveau des rails Halfen (si applicable)</i>	
<b>1.9 - Prestressed anchoring rods for circuit-breakers (if applicable)</b> - Proper seating of the distribution plates <input type="checkbox"/> - Locking (weld point) of the nuts of the Halfen rails <input type="checkbox"/> - Tightening torque <input type="checkbox"/> <i>Tiges d'ancrage précontraintes pour disjoncteurs (si applicable)</i> - Surface d'appui des plaques de réparation - Pointage des écrous de platine support rail Halfen - Couple de serrage	
<b>1.10 Location, dimensions and level of foundations for transformers, overhead bushings, surge arresters and switchgear supports.</b> <input checked="" type="checkbox"/> <i>Position, dimensions et niveaux des massifs pour transformateurs, traversées aériennes, parafoudres et liaisons blindées.</i>	

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RAPPORT DE CONTRÔLE SUR SITE - POSTE .....  
SITE INSPECTION RECORD

Client: #REF!  
Customer:

CONTRÔLE DU GENIE CIVIL  
INSPECTION OF CIVIL ENGINEERING WORK

Poste: #REF!  
Substation:  
BHT N° : #REF!

CHECKS PERFORMED/VERIFICATIONS EFFECTUEES	REMARKS/REMARQUES
<b>2- STORAGE AREA</b> <b>ZONE DE STOCKAGE</b>  <b>2.1 - Consolidated areas, protected from flooding and impacts and accessible to lifting and handling equipments under any weather conditions</b> <input type="checkbox"/> <i>Zones stabilisées, non inondables, à l'abri des chocs et accessibles aux engins de levage et manutention par tout temps</i>  <b>2.2 - Site security</b> <input type="checkbox"/> <i>Gardiennage</i>  <b>3- CLEANLINESS</b> <b>PROPRETE</b>  <b>3.1 - Erection areas cleared by contractors</b> <input type="checkbox"/> <i>Zone de montage rendue libre par les entreprises</i>  <b>3.2 - Anti-dust treatment on floors</b> <input type="checkbox"/> <i>Traitement anti-poussière des sols</i>  <b>3.3 - Thorough cleaning and dusting of floors, foundations, walls, partitions, Halfen rails and travelling crane</b> <input type="checkbox"/> <i>Nettoyage et dépoussiérage complet des sols, massifs, murs, cloisons, rails Halfen et pont roulant</i>  <b>4 - GIS ROOM EQUIPMENT</b> <b>AMENAGEMENT DU LOCAL</b>  <b>4.1 - Lighting installed</b> <input type="checkbox"/> <i>Eclairage réalisé</i>  <b>4.2 - Handling equipment operational</b> <input type="checkbox"/> <i>Moyens de manutention opérationnels</i>  <b>4.3 - Doors, windows installed</b> <input type="checkbox"/> <i>Portes, fenêtres posées</i>  <b>4.4 - Necessary power supplies available</b> <input type="checkbox"/> <i>Alimentations électriques BT requises disponibles</i>  <b>5- CHECK OF THE SITE FACILITIES</b> <b>VERIFICATION DE L'EQUIPEMENT DU SITE</b>  <b>5.1 - Necessary power supplies available</b> <input type="checkbox"/> <i>Alimentations électriques BT requises disponibles</i>  <b>5.2 - Access road for crane and forklift available.</b> <input type="checkbox"/> <i>Route d'accès pour grue et chariot élévateur disponible.</i>  <b>5.3 - Preassembly workshop available.</b> <input type="checkbox"/> <i>Local de préassemblage disponible.</i>	

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RAPPORT DE CONTRÔLE SUR SITE - POSTE .....  
SITE INSPECTION RECORD

CONTRÔLE DU GENIE CIVIL  
INSPECTION OF CIVIL ENGINEERING WORK

Client: #REF!  
Customer:

Poste: #REF!  
Substation:

BHT N° : #REF!

CHECKS PERFORMED/VERIFICATIONS EFFECTUEES	REMARKS/REMARQUES
<p><b>6- ERECTION MEANS</b> <b>MOYENS DE MONTAGE</b></p> <p><b>6.1 - Means on site according to the list</b> <input type="checkbox"/> <b>recommended by GIS manufacturer</b> <i>Moyens de chantier recommandés par le fabricant</i></p> <p><b>6-2 - General erection tools according to the list</b> <input type="checkbox"/> <b>recommended by GIS manufacturer</b> <i>Outillages généraux de montage recommandés par le fabricant</i></p> <p><b>6-3 - Specific erection tools according to</b> <input type="checkbox"/> <b>GIS manufacturer's list</b> <i>Outillages spécifiques de montage selon liste</i> <i>du fabricant</i></p>	



RAPPORT DE CONTRÔLE SUR SITE - POSTE .....  
SITE INSPECTION RECORD

CONTRÔLE DU GENIE CIVIL  
INSPECTION OF CIVIL ENGINEERING WORK

Client: #REF!  
Customer:

Poste: #REF!  
Substation:

BHT N° : #REF!

The GIS factory representative  
*Le représentant Constructeur*

- authorises the starting of the erection  
*autorise l'ouverture du chantier*

☐

- authorises the starting of the erection with the following reservations:  
item numbers of above check-list:

☐

others:

*autorise l'ouverture du chantier avec les réserves suivantes :*  
*numéro des points de la check-list ci-dessus :*

*autres :*

- does not authorise the starting of the erection as long as the conditions  
mentioned on the following page are not met:  
*n'autorise pas l'ouverture du chantier tant que les conditions mentionnées dans  
le document page suivante ne sont pas remplies*

☐

Signature of GIS factory representative:  
*Signature du représentant Constructeur*

date:

Signature of CLIENT representative:  
*Signature du représentant du CLIENT*

date:

Signature of Contractor representative:  
*Signature du représentant de l'Installateur*

date:

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RAPPORT DE CONTRÔLE SUR SITE - POSTE .....  
SITE INSPECTION RECORD

CONTRÔLE DU GENIE CIVIL  
INSPECTION OF CIVIL ENGINEERING WORK

Client: #REF!  
Customer:

Poste: #REF!  
Substation:

BHT N°: #REF!

### SUSPENSION OF GIS ERECTION WORKS

#### SUSPENSION DE TRAVAUX DE MONTAGE DU POSTE

**Request of suspension of following erection works:**  
*Demande de suspension des travaux de montage suivants*

**as long as the following conditions are not met:**  
*tant que les conditions ci-après ne sont pas remplies*

**Date:** **Visa of GIS factory Representative:**  
*Visa du Représentant Constructeur*

**Corrective actions taken and anticipated completion dates:**  
*Actions correctives entreprises et dates prévisionnelles d'achèvement*

**Date:** **Visa of Erection Contractor or client Representative:**  
*Visa du Représentant de l'Entreprise ou du Client*

**Authorisation of resumption of following erection works:**  
*Autorisation de reprise des travaux suivants*

**Date:** **Visa of GIS factory Representative:**  
*Visa du Représentant Constructeur*