【添付資料】

A-1　調査団員・氏名

A-1 調査団員・氏名

第一次現地調査（概略設計調査）

No.	氏名	担当業務	所属
1	大嶋　一成	総括	JICA 国際協力専門員
2	桝谷　有希	計画管理	JICA 産業開発・公共政策部 資源・エネルギーグループ第二チーム
3	小宮　雅嗣	業務主任／電力計画	八千代エンジニヤリング株式会社
4	阿部　真	副業務主任／電力計画 ／変電設備－１	八千代エンジニヤリング株式会社
5	佐藤　広人	変電設備－２	八千代エンジニヤリング株式会社
6	田中　宇祐	設備計画	八千代エンジニヤリング株式会社
7	近藤　和晃	調達計画/積算	八千代エンジニヤリング株式会社

第二次現地調査（準備調査報告書（案）説明調査）

No.	氏名	担当業務	所属
1	大嶋　一成	総括	JICA 国際協力専門員
2	桝谷　有希	計画管理	JICA 産業開発・公共政策部 資源・エネルギーグループ第二チーム
3	阿部　真	副業務主任／電力計画 ／変電設備－１	八千代エンジニヤリング株式会社
4	近藤　和晃	調達計画/積算	八千代エンジニヤリング株式会社

A-2　調査行程

A-2 調査行程

第一次現地調査（概略設計調査）

番号	月	日	曜日	調査内容						滞在地
				官団員	コンサルタント団員					
				大嶋、桝谷	小宮	阿部	佐藤	田中	近藤	
1	11	2	日				・移動 {東京 10:50 → パリ（フランス） 15:40 （JL045）}			パリ
2	11	3	月				・移動 {パリ (フランス) 11:00 → アブジャ (ナイジェリア) 17:00 （AF514）}			アブジャ
3	11	4	火	・対処方針会議（8:00 JICA ナイジェリア事務所）			・対処方針会議（8:00 JICA ナイジェリア事務所） ・表敬訪問及び調査説明（9:00 JICAナイジェリア事務所） ・表敬訪問及び調査説明（10:00 ナイジェリア送電公社(TCN)） ・サイト調査（13:30 アポ変電所： 現状の問題認識、設備確認） ・表敬訪問および調査説明（16:00 TCN）			アブジャ
4	11	5	水				・サイト調査（9:30 ケフィ変電所：現状の問題認識、設備確認） ・技術協議（16:00 TCN: 質問状について）			アブジャ
5	11	6	木				・サイト調査（9:00 カタンペ変電所：既設設備の確認） ・団内協議（15:00）			アブジャ
6	11	7	金				・サイト調査（9:00 アポ変電所：既設設備の確認） ・団内協議（15:00）			アブジャ
7	11	8	土				・サイト調査（9:00 グワグワラダ変電所：既設設備の確認） ・団内協議（17:00）			アブジャ
8	11	9	日				・団内協議（9:00） ・移動 {アブジャ (ナイジェリア) 23:55 → パリ（フランス） 06:05+1 (AF513)}	・団内協議（9:00） ・データ分析（13:00）		アブジャ
9	11	10	月				・移動 {パリ (フランス) 18:55 → 東京 14:55+1 (JL046)}	・団内協議（9:00） ・技術協議（14:00 TCN：質問票）		アブジャ
10	11	11	火		・移動 {東京 10:50 → パリ（フランス） 15:40 （JL045）}		移動 {→ 東京 14:55 (JL046)}	・団内協議（9:00） ・技術協議（14:00 アポ変電所：送電系統確認）		アブジャ
11	11	12	水		・移動 {パリ (フランス) 11:00 → アブジャ (ナイジェリア) 17:00 （AF514）} ・団内協議（18:30 プロジェクトコンポーネント）			・情報整理 ・技術協議（15:00 TCN：優先付） ・団内協議（18:30 プロジェクトコンポーネント方針の策定）		アブジャ
12	11	13	木		・田中、近藤と同じ			・表敬訪問（8:00 JICAナイジェリア事務所） ・表敬訪問（11:00 連邦電力省） ・サイト調査（12:30 カタンペ変電所） ・表敬訪問（14:30 TCN） ・表敬訪問（16:00 NPC）		アブジャ
13	11	14	金		・田中、近藤と同じ			・サイト調査（10:00 アポ変電所：現状確認） ・技術協議（14:00 TCN：コンポーネントの優先付） ・団内協議（17:00）		アブジャ
14	11	15	土	・移動{東京→パリ}	・田中、近藤と同じ			・サイト調査（8:00 ケフィ変電所） ・サイト調査（12:00 グワグワラダ変電所） ・団内協議（17:00）		アブジャ
15	11	16	日	・移動	・団内協議とデータ分析			・団内協議とデータ分析		アブジャ
16	11	17	月	・移動{パリ→アブジャ} ・団内協議（19:00）	・田中、近藤と同じ			・協議（8:00 JICAナイジェリア事務所） ・表敬訪問（9:30 NPC） ・表敬訪問（11:00 連邦電力省） ・表敬訪問（14:00 TCN） ・団内協議（19:00）		アブジャ
17	11	18	火	・協議（8:00 JICAナイジェリア事務所） ・ミニッツ協議（11:00 連邦電力省） ・サイト視察（14:00 アポ変電所） ・サイト視察（16:00 グワグワラダ変電所）				・小宮と同じ		アブジャ

番号	月	日	曜日	調査内容						滞在地
				官団員	コンサルタント団員					
				大嶋、桝谷	小宮	阿部	佐藤	田中	近藤	
18	11	19	水	・サイト視察（9:00 ケフィ変電所） ・ミニッツ締結（15:00 連邦電力省） ・ミニッツ締結（16:00 TCN） ・ミニッツ締結（17:00 NPC）				・小宮と同じ		アブジャ
19	11	20	木	・サイト視察（9:00 カタンペ変電所） ・帰国報告（10:30 連邦電力省） ・帰国報告（11:00 JICAナイジェリア事務所） ・帰国報告（15:00 日本大使館） ・移動{アブジャ→パリ}				・小宮と同じ		アブジャ
20	11	21	金	・移動 {パリ（フランス）→ 東京}	・移動 {パリ（フランス） 18:55 → 東京 14:55+1 (JL046)}			・データ分析（9:00） ・サイト視察（13:00 アポ変電所） ・市場調査（15:00）		アブジャ
21	11	22	土	・移動 {→ 東京}	・移動 {→ 東京 14:55 (JL046)}			・団内協議		アブジャ
22	11	23	日			・移動 {東京 10:50 → パリ（フランス） 15:40 （JL045）}		・団内協議とデータ分析		アブジャ
23	11	24	月			・移動 {パリ (フランス) 18:20 → ロンドン（イギリス） 18:30 （BA323）} ・移動 {ロンドン（イギリス）22:40→ アブジャ (ナイジェリア)6:00 （BA83）}		・団内協議（9:00） ・技術協議（14:00 TCN：配電区域）		アブジャ
24	11	25	火			・移動 {→ アブジャ (ナイジェリア) 6:00} [阿部、佐藤] ・団内協議（10:00） ・サイト調査（13:00 ケフィ変電所）				アブジャ
25	11	26	水			・表敬訪問（9:00 JICAナイジェリア事務所） ・サイト視察（10:00 グワグワラダ変電所） ・サイト視察（15:00 アポ変電所） ・団内協議（17:00）				アブジャ
26	11	27	木			・データ分析（9:00） ・技術協議（14:00 TCN）				アブジャ
27	11	28	金			・サイト視察（ケフィ変電所 ・団内協議		・協議（測量会社）	・阿部、佐藤と同じ	アブジャ
28	11	29	土			・データ分析				アブジャ
29	11	30	日			・団内協議とデータ分析				アブジャ
30	12	1	月			・技術協議（10:00 TCN） ・技術協議（15:00 AFD）	・サイト視察、測量監督（9:00 ケフィ変電所）		・阿部と同じ	アブジャ
31	12	2	火			・技術協議（11:00 TCN） ・サイト調査（14:00 アポ変電所） ・市場調査（16:00）	・サイト視察、測量監督（9:00 アポ変電所） ・市場調査（16:00）		・サイト調査（10:00 アポ変電所）	アブジャ
32	12	3	水			・データ分析（9:00） ・技術協議（13:00 TCN）	・団内協議（10:00）	・情報分析（9:00） ・市場調査（13:00）	・団内協議（10:00）	アブジャ
33	12	4	木			・技術協議（TCN:フィールドレポート） ・現地調査結果概要作成				アブジャ
34	12	5	金			・技術協議（TCN:フィールドレポート署名） ・現地調査結果概要作成				アブジャ
35	12	6	土			・現地調査結果概要作成				アブジャ
36	12	7	日			・団内協議とデータ分析				アブジャ
37	12	8	月			・技術協議（TCN:フィールドレポート） ・現地調査結果概要作成				アブジャ
38	12	9	火			・技術協議（TCN:フィールドレポート） ・技術協議（14:30 アブジャ配電会社） ・現地調査結果概要作成				アブジャ
39	12	10	水			・現地調査結果概要作成				アブジャ
40	12	11	木			・現地調査結果概要作成				アブジャ
41	12	12	金			・団内協議（10:00） ・フィールドレポート署名（12:00 TCN） ・フィールドレポート協議・署名（15:00 連邦電力省）				アブジャ
42	12	13	土			・現地調査結果概要作成				アブジャ
43	12	14	日			・現地調査結果概要作成				アブジャ
44	12	15	月			・帰国報告（9:00 JICAナイジェリア事務所） ・移動 {アブジャ (ナイジェリア) 23:55 → パリ (フランス) 06:05+1 (AF513)}				機内
45	12	16	火			・移動 {パリ (フランス) 18:55 → 東京 14:55+1 (JL046)}				機内
46	12	17	水			・移動 {→ 東京 14:55 (JL046)}				

第二次現地調査（準備調査報告書（案）説明調査）

番号	月	日	曜日	調査内容		滞在地
				官団員 大嶋、桝谷	コンサルタント団員 阿部、近藤	
1	6	18	木		・移動 〔東京 11:20 → ロンドン（英国）15:50（JL043）〕 ・移動 〔ロンドン（英国） 22:40 → アブジャ 04:40+1（BA083）〕	機内泊
2	6	19	金		・09:00～10:00：JICAナイジェリア事務所への表敬訪問及び調査内容の説明 ・10:00～11:00：連邦電力省（FMP）への表敬訪問、調査内容の説明 ・11:00～12:00：ナイジェリア送電公社（TCN）への表敬訪問、調査内容の説明 ・12:30～16:00:　サイト状況調査（アポ変電所）	アブジャ
3	6	20	土	・移動	・09:00～12:00：サイト状況調査（ケフィ変電所） ・13:00～18:00：サイト状況調査及び情報収集（カタンペ変電所）	アブジャ
4	6	21	日	・移動	・資料整理・団内協議	アブジャ
5	6	22	月	・09:00～10:00：団内協議（JICAナイジェリア事務所） ・10:00～1100：国家計画委員会（NPC）への表敬訪問、DFR、ミニッツ（案）の説明 ・14:00～16:00：ミニッツ（案）の協議（FMP、NPC、TCN）		アブジャ
6	6	23	火	・09:00～12:00：DFRの補足説明（TCN） ・12:00～16:00：ミニッツ（案）の協議及び締結（FMP、NPC、TCN）		アブジャ
7	6	24	水	・09:00～12:00：データ整理 ・13:30：JICAナイジェリア事務所への報告 ・15:00：日本大使館表敬訪問と報告		アブジャ
8	6	25	木	・移動	・移動 〔アブジャ 08:00 → ロンドン（英国） 14:30 （BA082）〕 ・移動 〔ロンドン（英国） 19:15 → 東京／羽田 15:00+1 （JL044）〕	機内泊
9	6	26	金	・移動	・移動	帰国

A-3　相手国関係者（面会者）リスト

A-3 相手国関係者(面談者)リスト

所属及び氏名	職位
国家計画委員会	
National Planning Commission (NPC)	
Mr. Oladimeji Tajudeen Shogbuyi	Director (IC)
Mr. Ibraheem Rafiu Oyegbade	Director (EG)
MR. Ileuma S. A.	AD (BEC)
Mr. M. Y. Abdulraheem	AD (BEC)
Mr. N. A. Lawal	Acting Director (Infrastructure)
Mr. Adeosun David	Assistant Director
Mr. Nwozuzu U. S	Chief Planning Officer, Commission Secretariat
Mr. Adeosun David T.	Macroeconomist (Infrastructure)
Dr. Chika Nwodo	PPO
Mrs. Eweioie Binbo	Senior Legal Officer (Asia Region)
Mr. Alfa Muhammad	SPO
Mr. Anyadiegwu Emmanuel	PO II
Mr. Oluwakemi Ogunjabi	PO I
連邦電力省	
Federal Ministry of Power (FMP)	
Amb. Godknows Boladei Igali	Permanent Secretary
Mr. Genjamin Neuge	Special Assistant, PS Office
Engr. A. Adebisi	Director, Renewable Energy and Rural Access Department
Mr. Afolabi John Oladele	Acting Director (TSD)
Engr. Ibhugora O. E.	Deputy Director (TS)
Engr. O. E. Ibhugom	Deputy Director
Mr. S. I. Anekwe	Deputy Director (INV) ISO
Engr. Briskilla Sapke	Deputy Director (Power)
Engr. A. E. Uwueiyen	Assistant Director
Engr. Faruk Yusuf Yabo	Assistant Director
Engr. A. D. Abubakar	Assistant Director
Engr. Philip Okpanafe	ACEE (Power)
Engr. D. B. Madu	Chief Engineer
Mr.Enang Moses	SEE(Power)
Mr. Nasira Muhammad Dange	SEE
Mr. Onwuama Victor C.	SEE

Mrs. Nwanus Theresa A.	PCS (TSD)
Mr. Abel Philip	RRP
Engr. Ominiyi A.	Electrical Engineer I
Mr. Arinze M. Osbuso	Electrical Engineer I
Mr. Abimbola Ominiyi	Electrical Engineer I
Engr. Onu Ogbonnaya Moutell	Mechanical Engineer 1 (Power)
Mr. Umoru S. Solomon	Higher Technical Officer
Mr Audi Bitrus Simon	Assistant Technical Officer

ナイジェリア送電公社

Transmission Company of Nigeria

Mr. Shahid Mohammad	Executive Director (TSP)
Mr. Tom Uwah	Director (TSP)
Engr. Musa M. Gumel	Director (System Operations)
Engr. F. K. Oluwafemi Zaccheaus	General Manager (PSP+R&D)
Engr. M. J. Lawal	General Manager (SO)
Engr. M. C. Ezeudenna	General Manager (D&C)
Engr. Olisa M. Okoli	General Manager (Chem, Resset and Environ)
Mr. Afolabi F. Ademora	General Manager (DS and Spec)
Engr. Aribaba Peter Adebisi	Assistant General Manager (Generation Planning & Data Control)
Engr. Shehu Abba Aliyu	Assistant General Manager (PSP)
Engr. L. C. Okalla	Assistant General Manager (T)
Engr. M. A. O. Dada	Assistant General Manager (Regulation)
Mr. E. O. Efiong	Assistant General Manager (Civil Substation)
Engr. Mohammad M. Sheik	Assistant General Manager (Substation Designs)
Engr. Abdulkadir Nazif	Senior Manager (PSPD)
Engr. M. K. Abdullahi	Senior Manager (Planning)
Engr. M. A. Ajibade	Senior Manager (PSP+R&D)
Mr. L.C. Ogwu	Senior Manager (Lines)
Engr. O. Osarenren	Senior Manager(Civil)
Mr. Umar Faruk Tahayc	Senior Manager (Substation Designs)
Engr. Dahiru A. I.	Principal Manager (Substation Designs)
Engr. Sulaiman Mahmud	Principal Manager (Transmission)
Mr. G. O. Aliyu	Principal Manager (Project)
Engr. Bassay I. H.	Principal Manager (SE)
Engr. Bukan Musa Tzab	Principal Manager (DS and IPP)

Engr. Ikeli Ndubuisi H.	Manager (PSP)
Mr. Vincent A. Chukwi	AM (Projects)
Engr. Nongo V. T.	Electrical Engineer (PC&M)
Mr. Ashipa James	Senior Manager (SO), Gwagwalada Substation
Mr. Akamagwuna George	Manager (SO), Gwagwalada Substation
Mr. Obasi Kingsley	Contract Operator (SO), Gwagwalada Substation
Ms. Nina Ikwan	Assistant Manager (SO), KACC[1]
Engr. Emmanuel Osikwemhe	Senior Manager (SO), KACC
Mr. Alhaji Yusuf Sanusi	Assistant Manager (Electrical SO)
Engr. RespectA. Aluya	Assistant Manager (SO), Shift head, KACC
Mr. Davies Kolawole N.	Principal Manager
Mr. John Newton	Station Manager, Keffi Substation
Mr. B. A. S. Umar	Assistant Manager (SO), Keffi Substation
Mr. Maduga Musa Sammuel	System Operator, Keffi Substation

ナイジャデルタ電力持株会社

Niger Delta Power Holding Company Limited

Engr. C. A. Ogunrinde	DGM (Civil Field Operations)

アブジャ配電会社

Abuja Electricity Distribution Company

Mr. Joe Chiyassa	Executive Director (Technical Services)
Mr. A. Bello	Principal Manager (O&M)
Mr. M. S. Dauda	Principal Manager (Planning & Construction)

フランス開発庁

French Development Agency

Mr.Adesoji Ademola	Senior Program Officer

在ナイジェリア国日本大使館

Embassy of Japan in Nigeria

草桶 左信	特命全権大使
庄司 隆一	特命全権大使
吉村 力	一等書記官（経済協力班長）
木花 和仁	一等書記官

[1] KACC: Katampe Area Control Center

JICA ナイジェリア事務所

JICA Nigeria Office

中村 浩孝	所長
関 徹男	所長
大石 健介	所員
鹿野 正明	企画調査員
Mr. Agidani Gabriel O.	Consultant

A-4　協議議事録（M/D）

A-4 協議議事録（M/D）
1．第1次現地調査

Minutes of Discussions
on the Preparatory Survey
for the Project for Emergency Improvement of Electricity Supply Facilities in Abuja
in the Federal Republic of Nigeria
(First Field Survey)

In response to the request from the Government of the Federal Republic of Nigeria (hereinafter referred to as "Nigeria"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Emergency Improvement of Electricity Supply Facilities in Abuja (hereinafter referred to as "the Project")

JICA sent to Nigeria the Preparatory Survey Team (hereinafter referred to as "the Team") headed by Mr. Kazunari Oshima, the Senior Advisor in the field of Energy and Mining, JICA, to conduct the first field survey and the Team is scheduled to stay in the country from 3rd November to 15th December, 2014.

The Team held discussions with the concerned officials of Nigeria; Federal Ministry of Power (FMP), Transmission Company of Nigeria (TCN), and National Planning Commission (NPC); and conducted a field survey in Nigeria.

In the series of the discussions, all parties have confirmed the main items described in the attached sheets hereto. Both sides have also noted that at the stage of the Survey no commitment is made from the Japanese side concerning the realization of the Project. The Team will proceed with further study and prepare the preparatory survey report.

Abuja, Nigeria
19th November, 2014

Mr. Kazunari Oshima
Leader, Preparatory Survey Team
Japan International Cooperation Agency
(JICA)

Engr. Afolabi John Oladele
Ag. Director, Transmission Services
Federal Ministry of Power (FMP)

Mr. Shahid Mohammad 19/11/2014
Executive Director, TSP
Transmission Company of Nigeria (TCN)

Witness

19/11/14
Mr. Oladimeji Tajudeen Shogbuyi
Ag. Director, International Cooperation
National Planning Commission (NPC)

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve and reinforce the power supply in Federal Capital Territory (FCT) in Nigeria.

2. Project Site

The Project sites are located as shown in Annex-1.

3. Responsible and Implementing Organizations

(1) The responsible sector ministry is the Federal Ministry of Power (FMP)
(2) The implementing agency is Transmission Company of Nigeria (TCN)
(3) The witness agency is National Planning Commission (NPC)
(4) The organization structures of FMP and TCN are shown in Annex-2 and 3.

4. Items Targeted in the Project

(1) The Nigerian side and the Team discussed the final requested components of the Project and their priority. The rating of the priority shown in the following table is higher in the following manner; A, B and C.

Table Final requested components of the Project and their priority

Component	Location	Specification	Priority
Installation of capacitor bank	Apo 132/33 kV Substation	60MVar, 132kV	A
Installation of capacitor bank	Keffi 132/33 kV Substation	25MVar, 132kV	A
Installation of Static Var Compensator (SVC)	Katampe 330/132/33kV Substation	50MVar, 330kV	C
Installation of shunt reactor	Gwagwalada 330/132/33kV Substation	75MVar	B

(2) The Team will study further the appropriateness of each component and technical specifications from the viewpoint of necessity and relevance as Japan's Grant Aid scheme, and will compile the findings into the preparatory survey report for the project appraisal process of the Government of Japan.

5. Japan's Grant Aid Scheme

(1) The Nigerian side has understood Japan's Grant Aid Scheme explained by the Team as described in Annex-4 and Annex-5.
(2) The Nigerian side will take the necessary measures, as described in Annex-6, for smooth implementation of the Project.

7. Schedule of the Study

(1) The Team will continue the first field survey in Nigeria until 15th December, 2014.
(2) The Team will prepare the draft report of the Preparatory Survey and dispatch a team to Nigeria in order to explain its contents to the Nigerian side in April 2015.

8. Other Relevant Issues

(1) The Nigerian side should submit answers to the terms to be confirmed, including as-built drawings especially layout drawings, TCN financial statements and data from Abuja Electricity Distribution Company, which the Team handed to the Nigerian side, by the beginning of December 2014.
(2) The Team informed that topographic and geological surveys at the Project sites will be

started from the week of 24 November, 2014 and requested to secure the sites.

(3) Nigerian side explained that, in Apo 132/33 kV substation, the damaged equipment by lightning such as transformer, switchgears, gantry structure, lightning rod, etc., will be replaced with new ones by Nigerian side. Also Nigeria side informed that the damaged parts of control building will be repaired by Nigerian side not to disturb the installation of equipment in the room before December, 2015.

(4) Nigerian side explained that, in Keffi 132/33 kV substation, proper maintenance works such as the repairing of the existing cooling fan of transformer, calibration of MW and MVar meters of 132kV control panel, etc. will be made by Nigerian side before December, 2015.

(5) Nigerian side explained that, in Katampe 330/132/33 kV substation, TCN has been installing Capacitor Banks (330 kV, 50 MVar x 2 sets) and a transformer (330/132 kV, 150 MVA) and they will be commissioned in 2015.

(6) Nigerian side explained that, in Gwagwalada 330/132/33 kV substation, the existing Shunt Reactor (330 kV, 75 MVar) placed at the site will be installed by TCN, however JICA should include Gwagwalada substation in the study.

(7) Nigerian side requested to carry out the capacity building in the field of substation management for the Project.

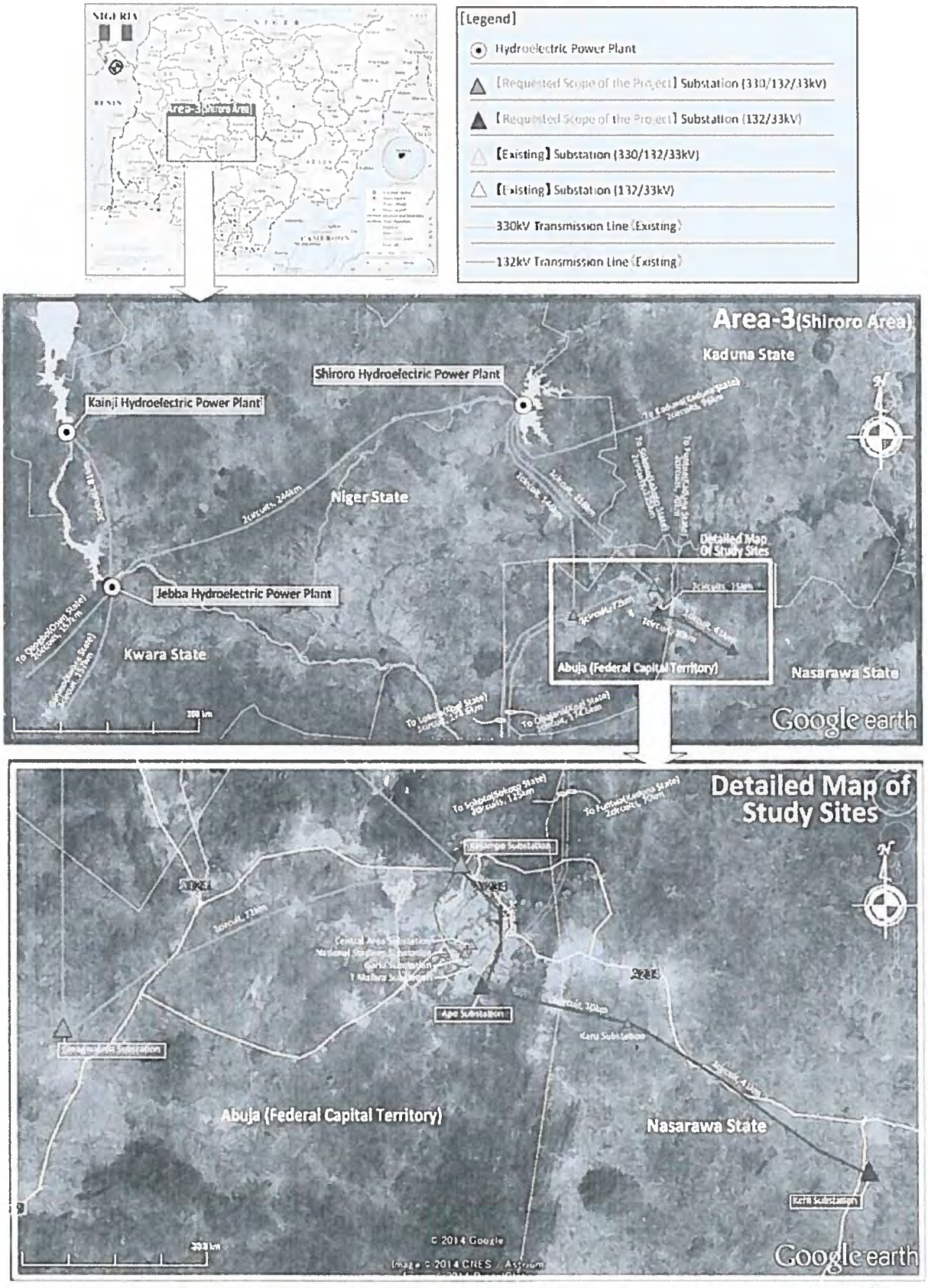
(End)

<List of Annex>

Annex-1	Location of the Project Sites
Annex-2	Organization Structure of Federal Ministry of Power (FMP)
Annex-3	Organization Structure of Transmission Company of Nigeria (TCN)
Annex-4	Japan's Grant Aid
Annex-5	Flow Chart of Japan's Grant Aid Procedures
Annex-6	Major Undertakings to be taken by Each Government

Annex - 1

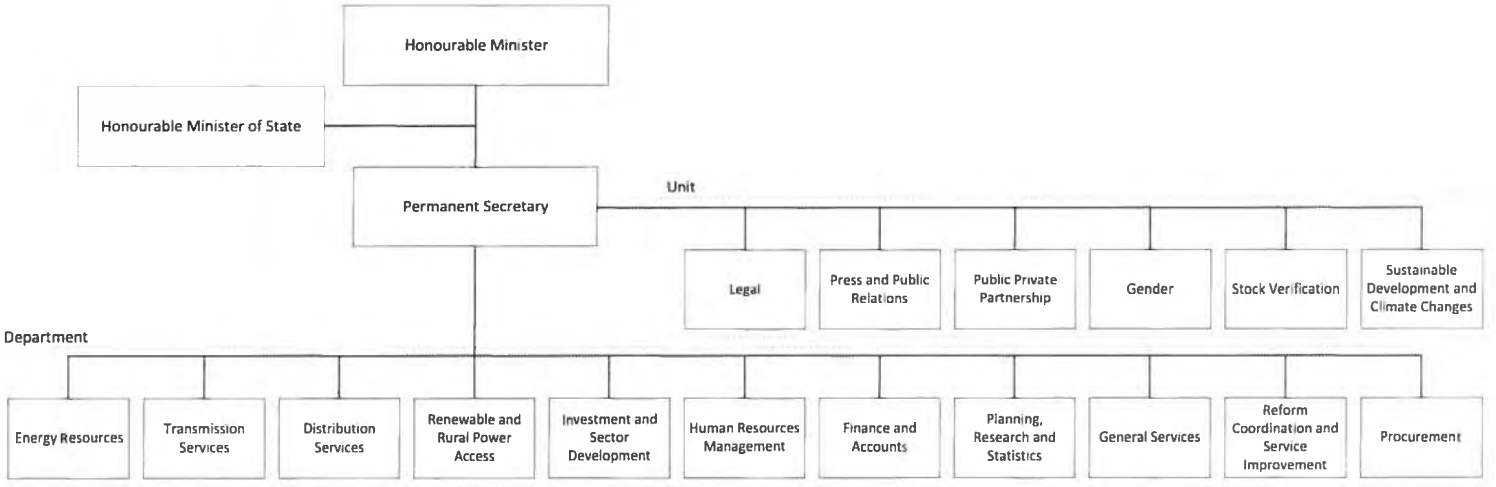
LOCATION OF THE PROJECT SITES



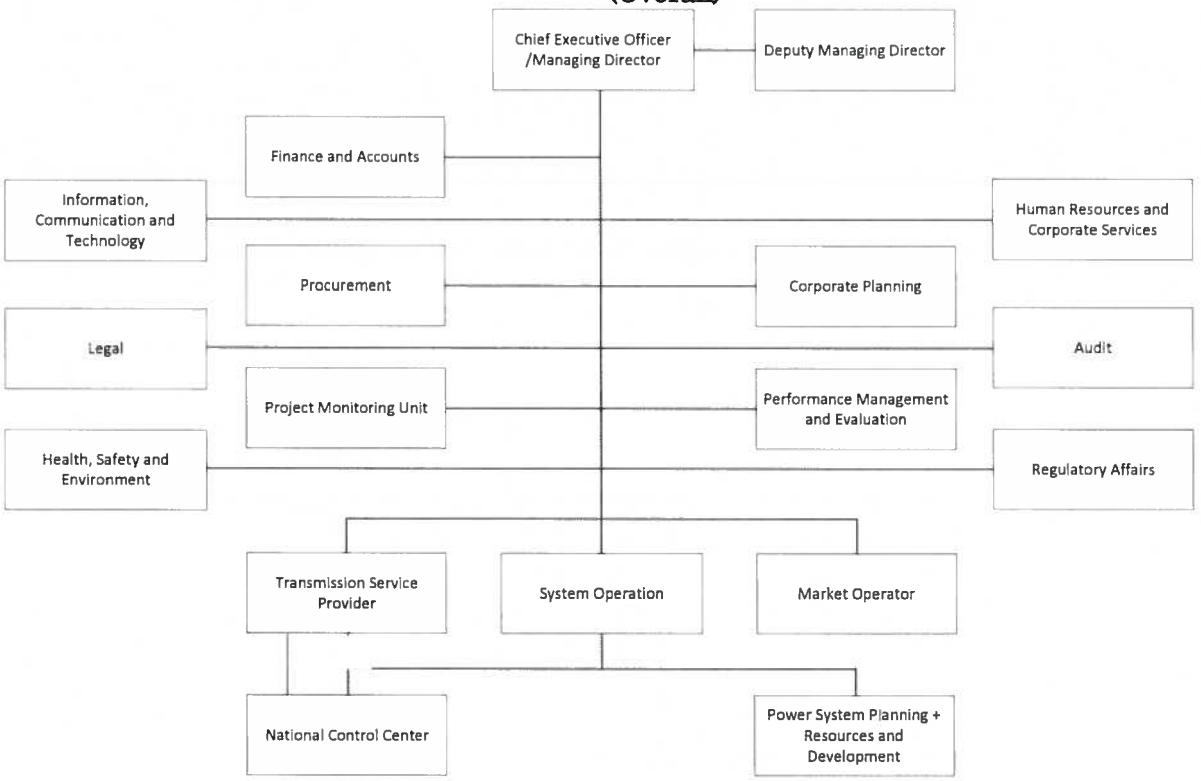
Location of the Study Sites (Federal Capital Territory and the surrounding area)

Annex - 2

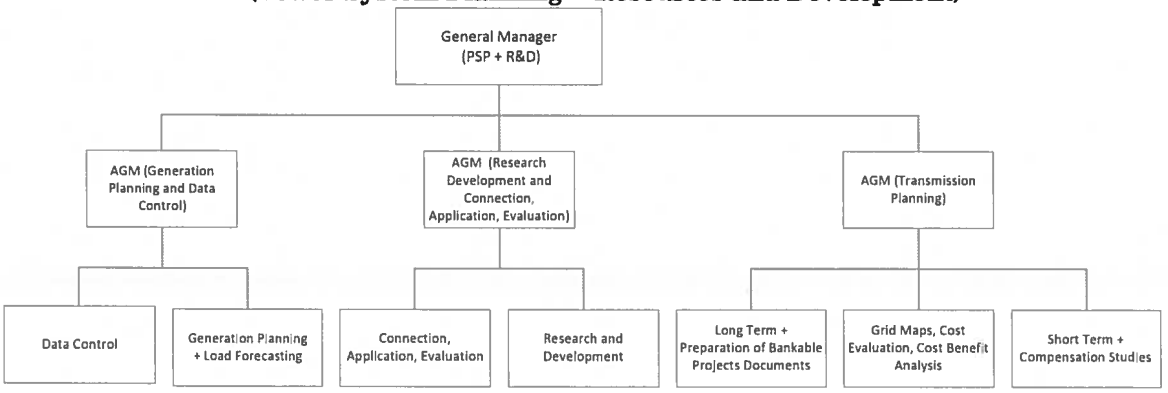
ORGANIZATION STRUCTURE OF FEDERAL MINISTRY OF POWER (FMP)



Organization Chart of TCN
(Overall)



Organization Chart of TCN
(Power System Planning + Resources and Development)



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1.Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures :

・Preparatory Survey
- The Survey conducted by JICA

・Appraisal &Approval
- Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet

・Authority for Determining Implementation
- The Notes exchanged between the GOJ and a recipient country

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・Implementation
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The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
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JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

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For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

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implementation of the Project after confirming the appropriateness of the Project.

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(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-7.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

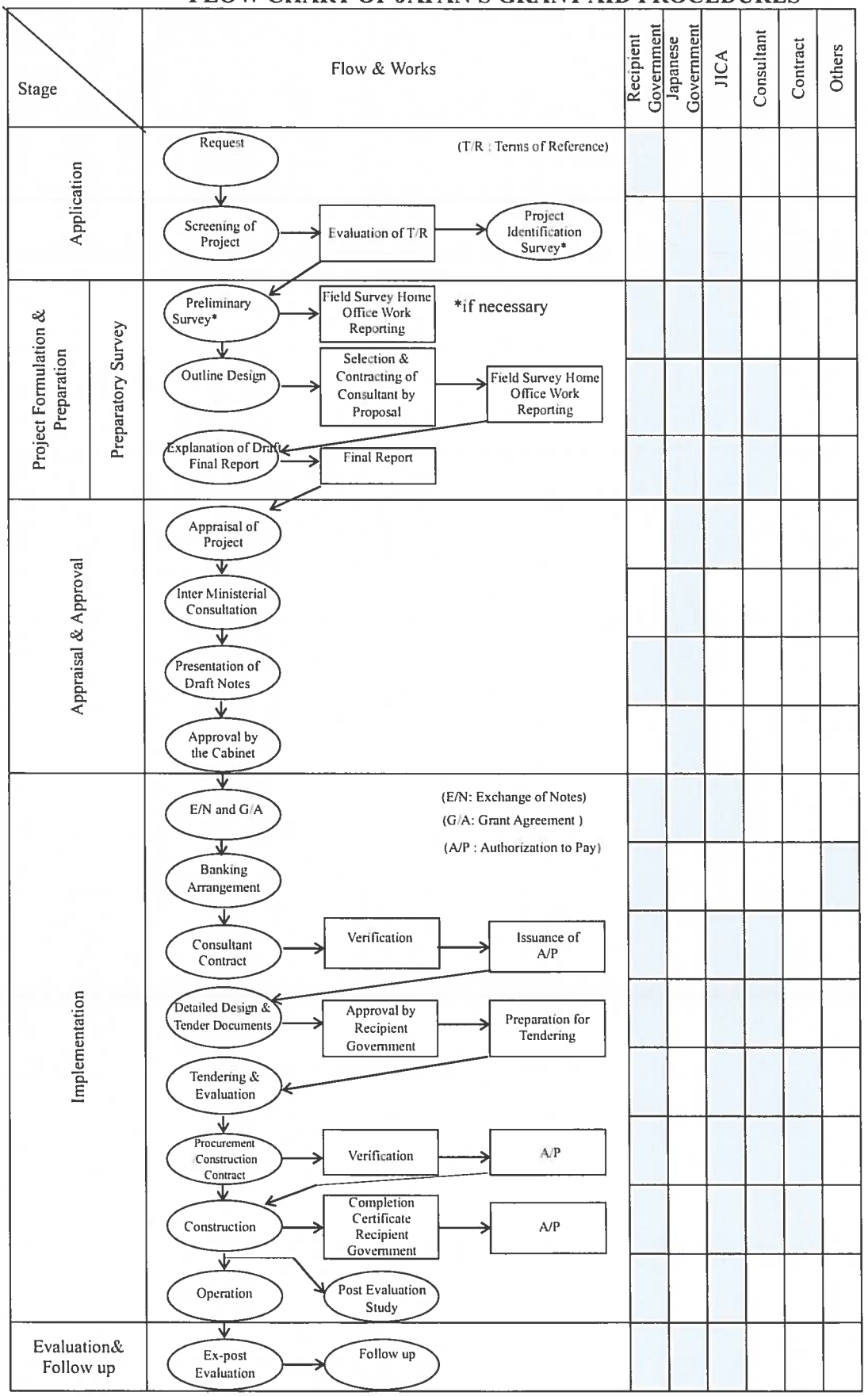
(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

(End)

Annex-5

FLOW CHART OF JAPAN'S GRANT AID PROCEDURES



Annex-6

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure lots of land necessary for the implementation of the Project and to clear the sites;		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site (including Access road)		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

(B/A : Banking Arrangement, A/P : Authorization to pay)

Minutes of Discussions
on the Preparatory Survey
on the Project for Emergency Improvement of
Electricity Supply Facilities in Abuja
in the Federal Republic of Nigeria

In response to the request from the Government of the Federal Republic of Nigeria (hereinafter referred to as "Nigeria"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Emergency Improvement of Electricity Supply Facilities in Abuja (hereinafter referred to as "the Project") .

JICA sent to Nigeria the Preparatory Survey Team (hereinafter referred to as "the Team") headed by Mr. Kazunari Oshima, a Senior Advisor, Energy and Mining Group, Industrial Development and Public Policy Department, JICA. The Team is scheduled to stay in the country from 19th to 25th June, 2015.

The Team held discussions with the concerned officials of Nigeria (hereinafter referred to as "the Nigerian side"). In the course of the discussions, the Nigerian side agreed and accepted the contents of the Draft Final Report and the Draft Technical Specifications, both sides have confirmed the main items described in the sheets attached hereto.

Abuja, 24th June, 2015

Mr. Kazunari Oshima
Leader, Preparatory Survey Team
Japan International Cooperation Agency
(JICA)

Engr. Afolabi John Oladele
Ag. Director, Transmission Services
Federal Ministry of Power (FMP)

Mr. Shahid Mohammad
Executive Director, Transmission Service Provider (TSP)
Transmission Company of Nigeria (TCN)

Witness

Mr. Oladimeji Tajudeen Shogbuyi
Ag. Director, International Cooperation
National Planning Commission (NPC)

ATTACHMENT

1. Contents of the Draft Final Report

The Nigerian side agreed and accepted in principle the contents of the Draft Final Report explained by the Team. The Team emphasized that the scope, the schedule and the cost for the Project are tentative and subject to change due to the domestic circumstances in Japan and in Nigeria. The Nigerian side understood it.

2. Objective of the Project

The objective of the Project is to improve and reinforce power supply by installing power capacitor and other associated equipment at Apo and Keffi substations in Nigeria.

3. Project Site

The Project sites are located as shown in Annex-1.

4. Responsible and Implementing Organizations

(1) The responsible organization is Federal Ministy of Power (FMP).
(2) The implementing organization is Transmission Company of Nigeria (TCN).
(3) The witness agency is National Planning Commission (NPC).
The organization structures of FMP and TCN are shown in Annex-4 and Annex-5, respectively.

5. Components of the Project

The components of the project are shown in Table below.

Site	132/33 kV Apo Substation		132/33 kV Keffi Substation	
Equipment Procurement and Installation	1. Power capacitor banks (132kV、60MVar)	1 set	1. Power capacitor banks (132kV、25MVar)	1 set
	2. Extra-high voltage switchgear	1 set	2. Switchgear for special high voltage	1 set
	3. Protection and control panel	1 set	3. Protection and control panel	1 set
	4. Substation earthing equipment	1 set	4. Substation earthing equipment	1 set
	5. Low voltage equipment	1 set	5. Low voltage equipment	1 set
	6. Foundation for equipment	1 set	6. 132 kV power cable (underground)	1 set
			7. DC supply system	1 set
			8. Foundation for equipment	1 set
Procurement	1. Spare parts		1 set	
	2. Test equipment and maintenance tools		1 set	

6. Japan's Grant Aid Scheme

(1) The Nigerian side has understood Japan's Grant Aid Scheme explained by the Team as described in Annex-6 and Annex-7.
(2) The Nigerian side will take the necessary measures, as described in Annex-8, for smooth implementation of the Project.

7. Project Cost

The Nigerian side agreed that the cost for the Project should not exceed the amount agreed on Exchange of Notes (E/N). The Nigerian side also agreed that the cost for the Project contains

procurement cost of equipment, transportation cost up to the Project site, construction cost and the Consultant fees.

8. Confidentiality of the project

(1) Detailed specifications of the Facilities and Equipment

Both sides agreed that all the information related to the Project including detailed drawings and specifications of the facilities and equipment and other technical information shall not be disclosed to any outside parties (i.e. outside of JICA and the Nigerian side) before the finalization of all contract(s) for the Project.

(2) Confidentiality of the Cost Estimation

The Team explained the estimated cost of the Project as described in Annex 9. Both sides agreed that the estimated cost for the Project should never be duplicated or disclosed to any outside parties (i.e. outside of JICA and the Nigerian side) before tender for the Project. The Nigerian side also understood that the estimated cost for the Project in Annex 9 is not the final and is subject to change as a result of examination through revision of the Outline Design Study.

9. Possibility of Change in Scope, Schedule and Cost of the Project

The Nigerian side and the Team confirmed that the scope, the schedule, and the cost for the Project are tentative and subject to change due to the domestic circumstances in Japan and in Nigeria.

10. Other Relevant Issues

(1) Undertakings to be taken by the Nigerian Side

The Nigerian side agreed to complete the items listed in Annex 10 by responsible organization(s) in accordance with the suggested timeline. In particular, the Nigerian side agreed to complete the following items by the date mentioned below.

1) Replacement or repair of damaged transformer, switchgear, gantry, control panel and lightning arrester at Apo Substation **by the end of November 2017.**
2) Calibration or replacement of power meter on the existing 132kV Control Panel at Keffi substation **by the end of June 2017.**
3) Installation and Commissioning of 2 × 50MVar capacitor banks and 1 × 150MVA transformer at Katampe substation **by the end of December 2015.**
4) Installation and commissioning of 1 × 75MVar Shunt Reactor at Gwagwalada substation **by the end of June 2016.**

The following items were agreed by the Nigerian side to be completed **by the end of October 2016.**

5) Land preparation for the project sites (Apo and Keffi) including storage yard for equipment and materials.
6) Site clearance & leveling (Apo and Keffi) including relocation or removal of existing lighting poles.
7) Securing Space for control and protection panel installed by JICA (Apo and Keffi).

The Nigerian Side also agreed the following item to be completed and paid by FMP.

8) Banking Arrangement (B/A), Authorization to Pay (A/P) and Bank Commission.

(2) Project Cost to be borne by the Nigerian side

The Nigerian side assured the Team that the Project cost to be borne by the Nigerian side, mentioned in Annex-9, shall be timely allocated from its own fund.

(End)

<List of Annex>

Annex-1	Location of the Project Sites
Annex-2	Layout of Apo Substation
Annex-3	Layout of Keffi Substation
Annex-4	Organization Structure of Federal Ministry of Power (FMP)
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Annex-7	Flow Chart of Japan's Grant Aid Procedures
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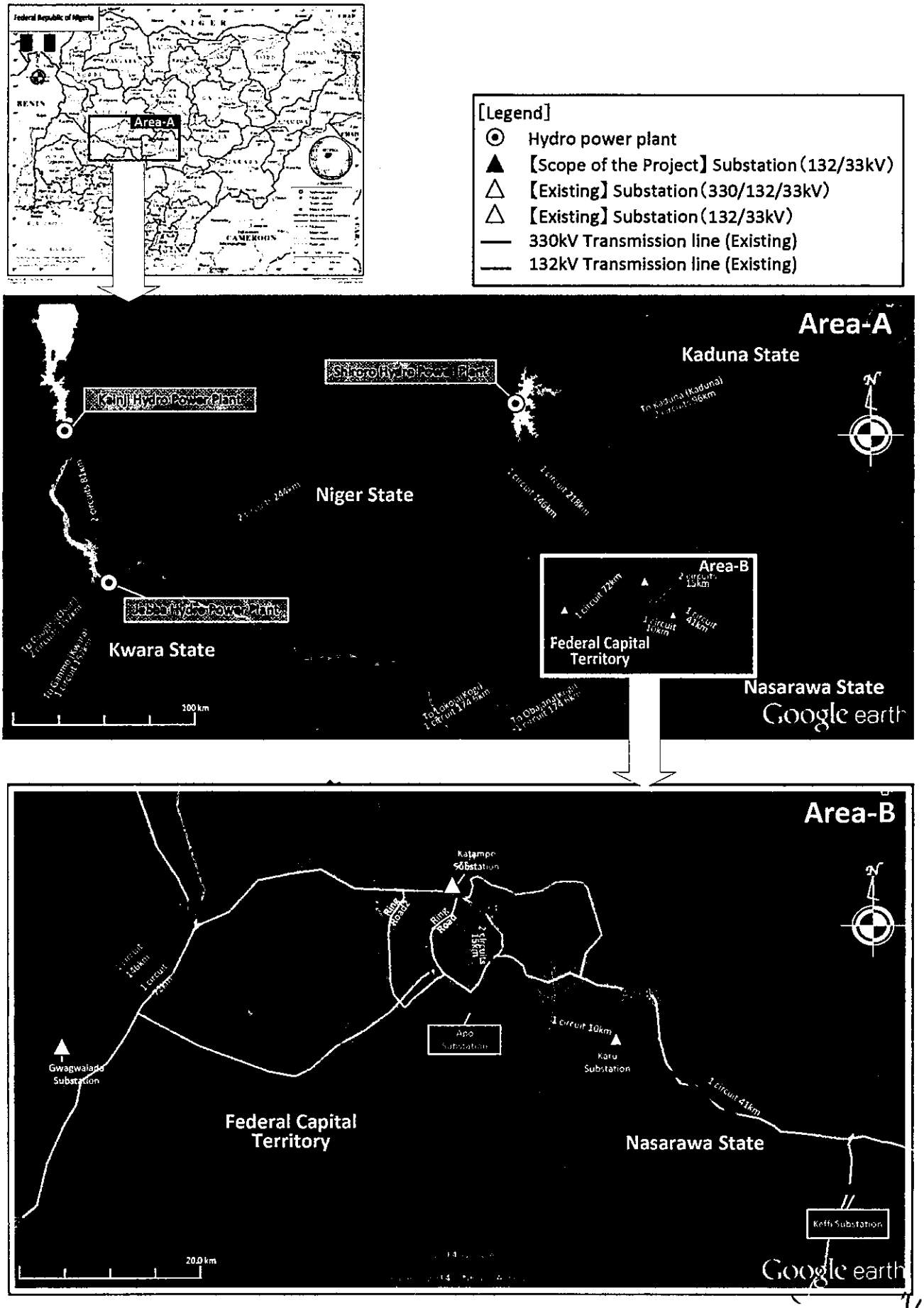
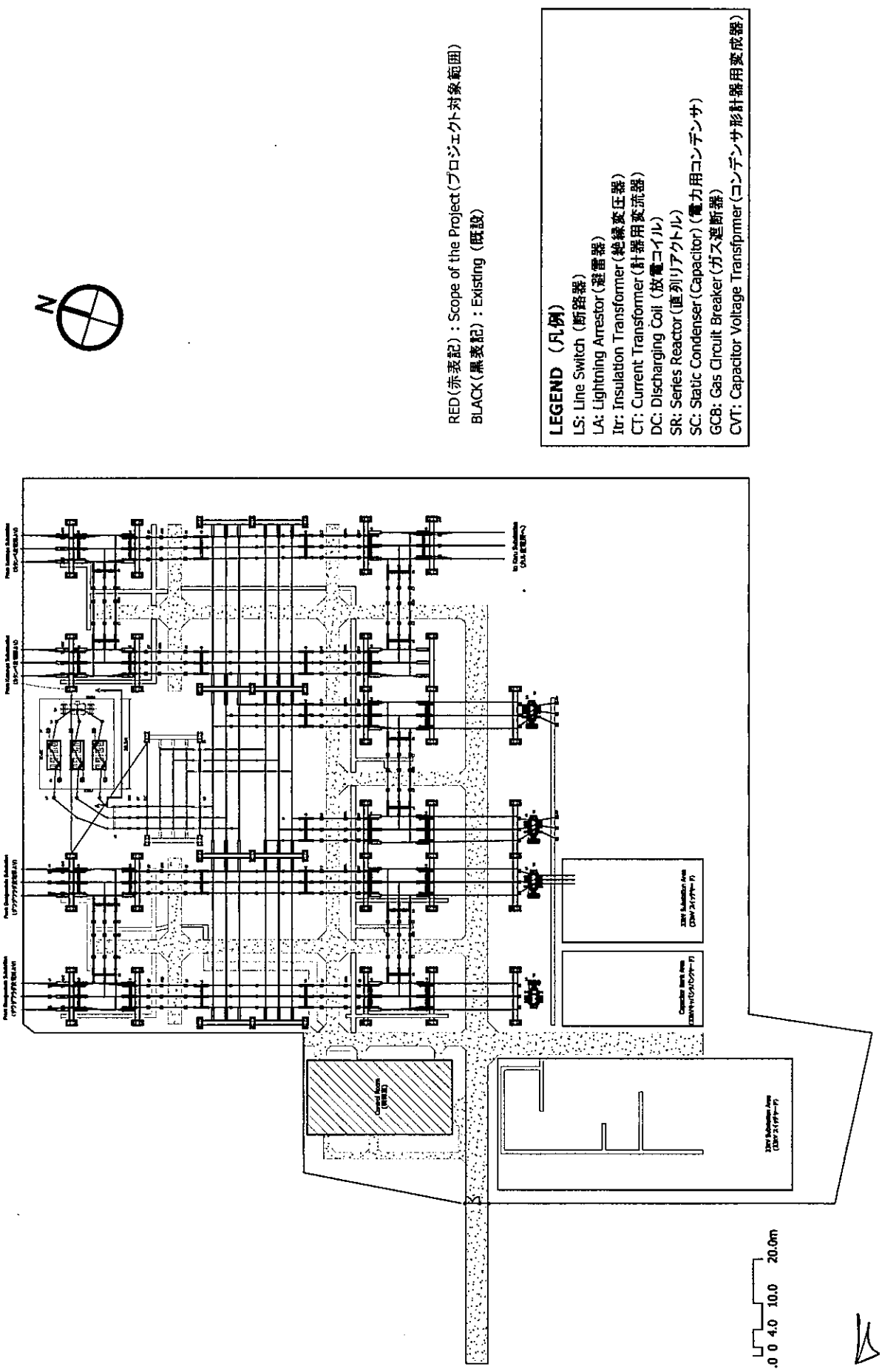
Annex-9	Estimated Project Cost
Annex-10	Tentative Implementation Schedule of the Project and Undertakings by the Nigerian Side

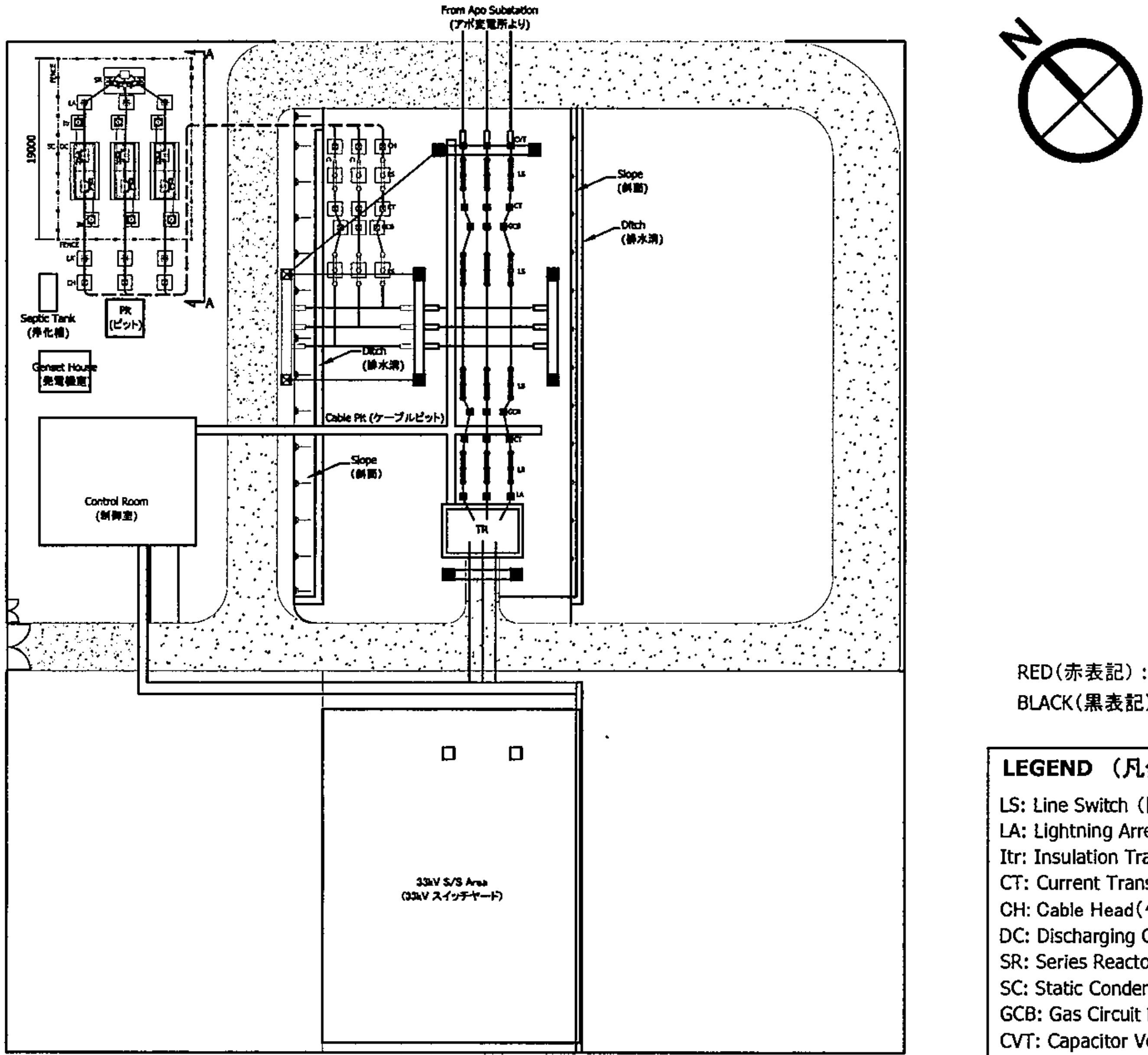
LOCATION OF THE PROJECT SITES



LAYOUT OF APO SUBSTATION



LAYOUT OF KEFFI SUBSTATION



RED(赤表記)：Scope of the Project (プロジェクト対象範囲)
BLACK(黒表記)：Existing (既設)

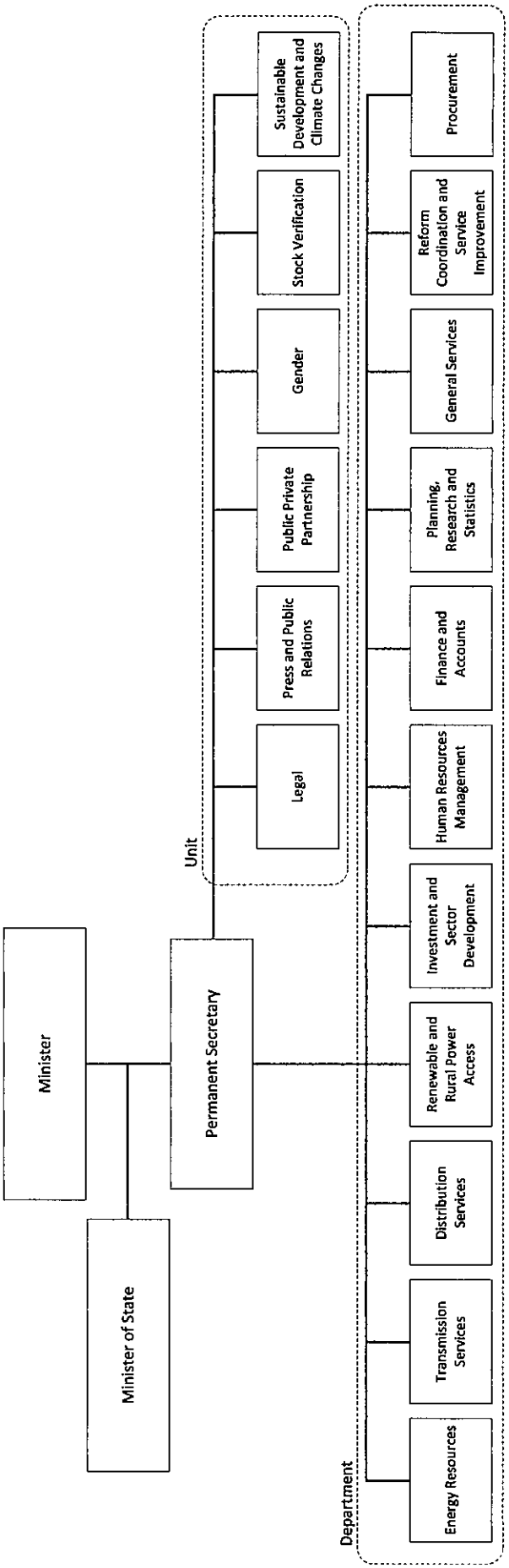
LEGEND (凡例)

LS: Line Switch (断路器)
LA: Lightning Arrestor(避雷器)
Itr: Insulation Transformer(絶縁変圧器)
CT: Current Transformer(計器用変流器)
CH: Cable Head(ケーブル終端)
DC: Discharging Coil (放電コイル)
SR: Series Reactor(直列リアクトル)
SC: Static Condenser(Capacitor)(電力用コンデンサ)
GCB: Gas Circuit Breaker(ガス遮断器)
CVT: Capacitor Voltage Transformer(コンデンサ形計器用変成器)

Annex-3

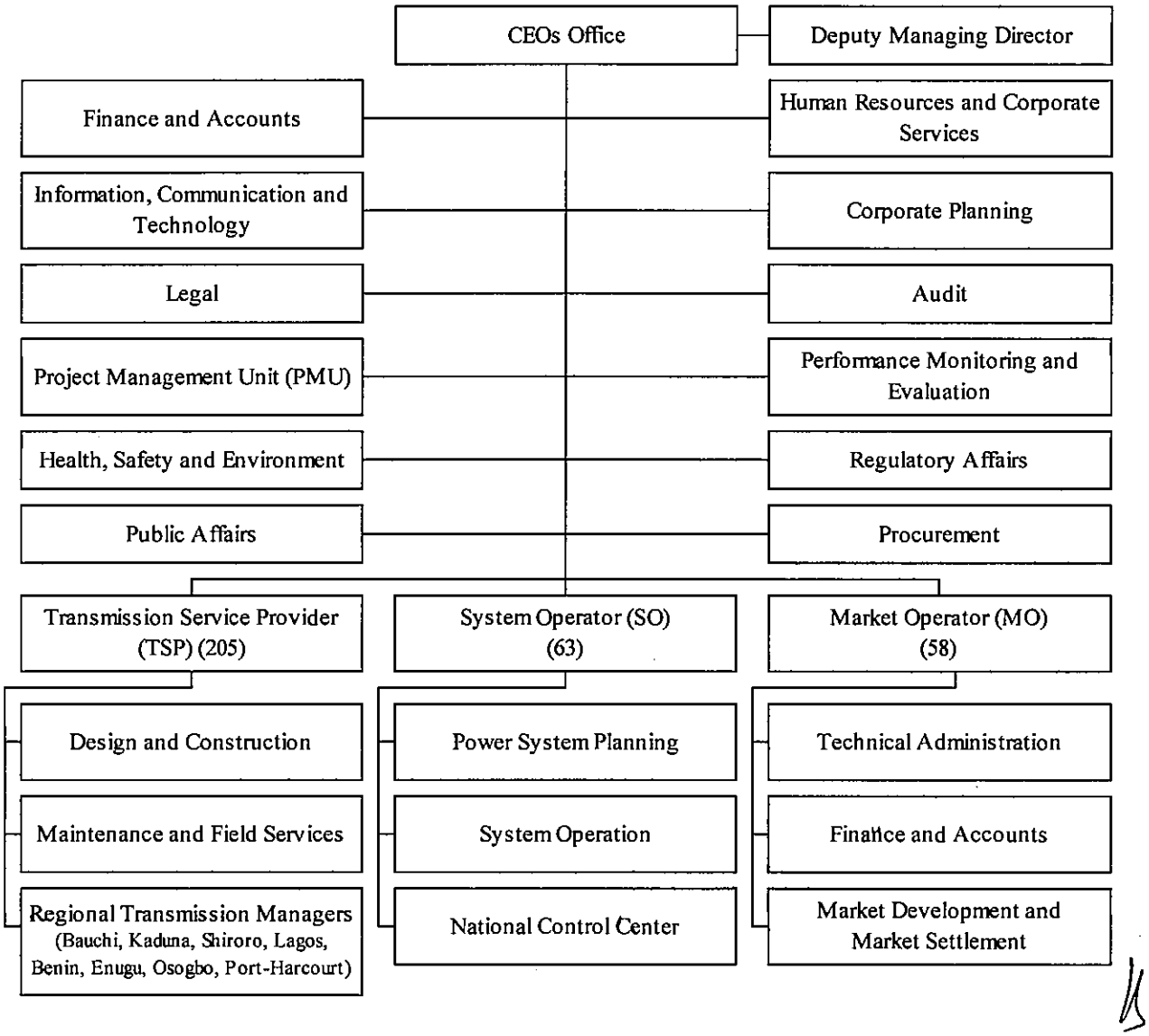
Annex-4

ORGANIZATION STRUCTURE OF FEDERAL MINISTY OF POWER (FMP)



Annex-5

ORGANIZATION STRUCTURE OF TRANSMISSION COMPANY OF NIGERIA (TCN)



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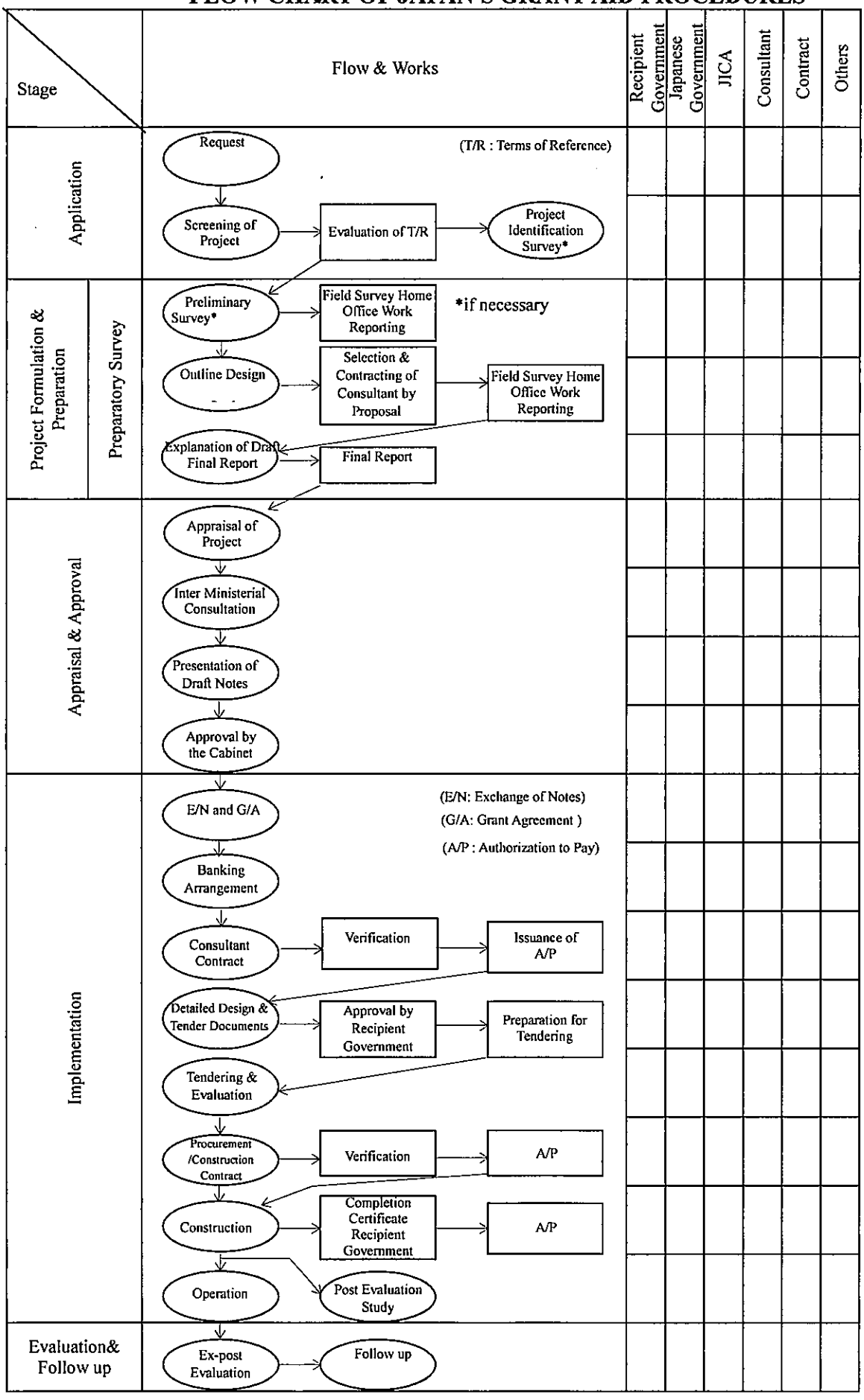
FLOW CHART OF JAPAN'S GRANT AID PROCEDURES



Major Undertakings to be taken by Each Government

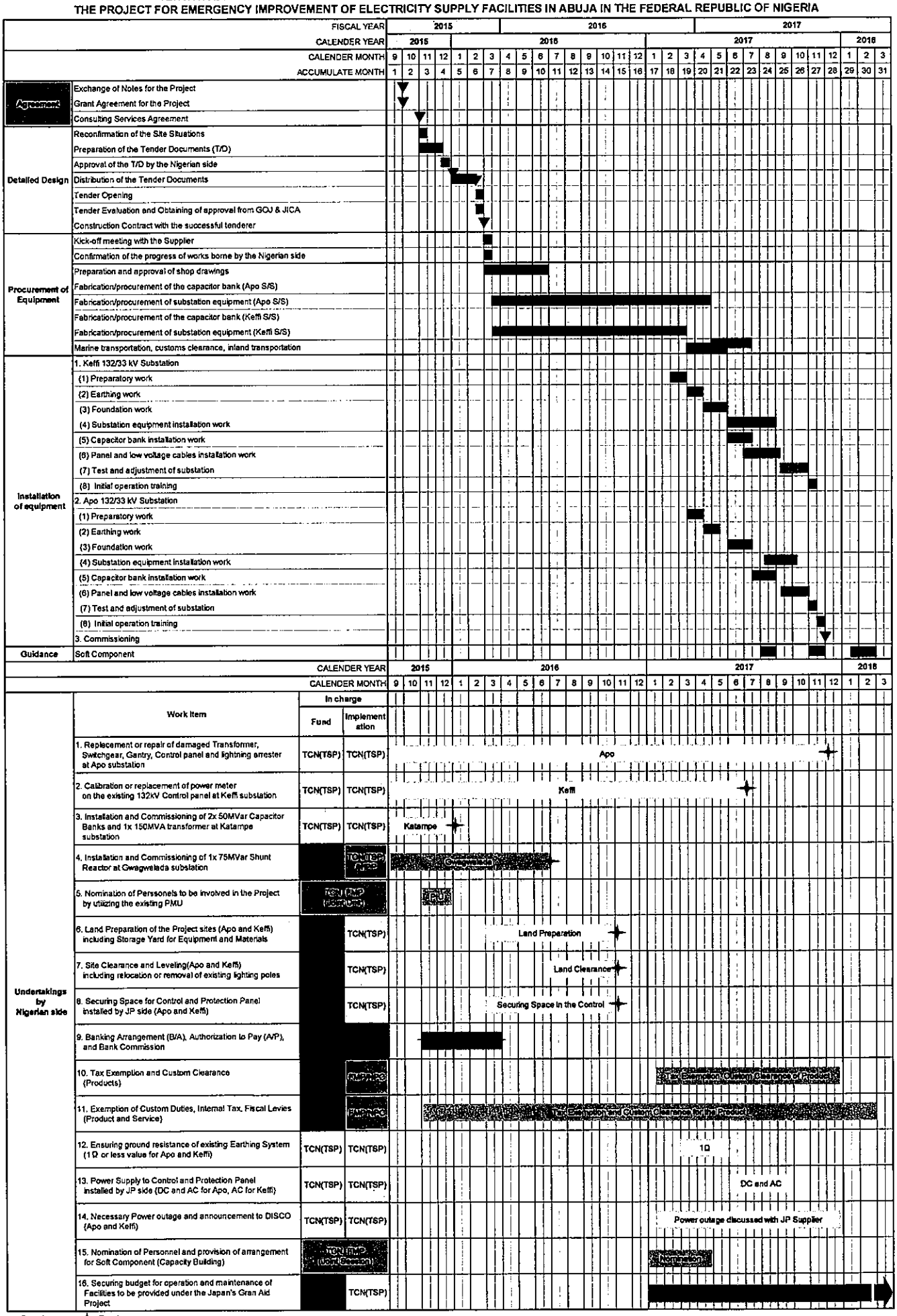
No.	Undertaking	To be covered by		Note
		Japanese side	Nigerian side	
1	(1) Acquisition of the Project sites for the installation of equipment		o	
	(2) Project site clearance		o	
2	To construct the following facilities			
	(1) Foundation for substation facilities	o		
	(2) Safety fences for power capacitors	o		
	(3) Access roads to the project sites		o	
3	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products			
	(1) Marine transportation of the Products from Japan to Nigeria	o		
	(2) Tax exemption and custom clearance of the Products at the port of disembarkation		o	
	(3) Internal transportation from the port of disembarkation to the project site	o		
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		o	
5	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into Nigeria and stay therein for the performance of their work		o	
6	To ensure that the facilities and the products be maintained and used properly and effectively for the implementation of the Project		o	
7	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		o	
8	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A			
	(1) Advising commission of A/P		o	
	(2) Payment commission		o	
9	Measures necessary to obtain the following permits: - Permits for installation work - Permits to access to restricted areas		o	To be obtained as necessary before the implementation of the Project
10	Construction of gates and fences for temporary storeyard		o	
11	Securing of parking during the work		o	
12	Office for construction work	o		For the Japanese contractor
13	Appropriate storage and safety control for materials and equipment at temporary storage	o		
14	Provision of places to dispose of surplus soil and waste water		o	
15	Manufacturing and procurement of materials and equipment	o		
16	Installation, adjustment and tests of materials and equipment	o		
17	Temporary dead-line work during the work		o	
18	Confirmation and ensuring of ground resistance value (1Ω or below) for existing grounding devices		o	Apo Substation and Keffi Substation
19	Removal of a light between existing double bus arrangements		o	Apo Substation
20	Removal of an existing light		o	Keffi Substation
21	Securement of place for control and protection panels in existing control buildings		o	Apo Substation and Keffi Substation

No.	Undertaking	To be covered by		Note
		Japanese side	Nigerian side	
22	Power supply (DC and AC) for control and protection panels to be procured		o	Apo Substation
23	Power supply (AC) for control and protective boards to be procured		o	Keffi Substation
24	Installation of lights for procured equipment	o		Keffi Substation
25	Initial operation guidance and operational guidance for maintenance and management of equipment procured	o		
26	Securing of the safety of persons concerned with the project at the project sites		o	
27	Response to and compensation for users of electricity in relation to outages inevitable for the work		o	
28	Announcement of outage plans to users of electricity during the work		o	

(Confidential)
Estimated Project Cost

This page is closed due to the confidentiality.

TENTATIVE IMPLEMENTATION SCHEDULE OF THE PROJECT AND UNDERTAKINGS BY THE NIGERIAN SIDE
THE PROJECT FOR EMERGENCY IMPROVEMENT OF ELECTRICITY SUPPLY FACILITIES IN ABUJA IN THE FEDERAL REPUBLIC OF NIGERIA



A-5　ソフトコンポーネント計画書

ナイジェリア連邦共和国

アブジャ変電設備緊急改修計画

準備調査

ソフトコンポーネント計画書

平成 27 年 2 月

八千代エンジニヤリング株式会社

目　　次

1. ソフトコンポーネントを計画する背景

ナイジェリア連邦共和国アブジャ変電設備緊急改修計画では、連邦首都区（FCT）に位置する 132/33 kV アポ変電所、及び隣接するナサラワ州に位置する 132/33 kV ケフィ変電所を対象として 132 kV 系統へ連系される電力用コンデンサの調達及び据付を行う。実施機関であるナイジェリア送電公社（Transmission Company of Nigeria：TCN）（以下、「TCN」と記す）が日々抱える電圧降下、及び電力損失の課題に対して、無効電力を補償することにより、より安定した電力供給の実現を目的とするものである。

TCN は電力用コンデンサの運用経験はあるものの、運転記録を含む、適切な運転・維持管理を行う技術者が不足していることから、設備を効率的に運用して無効電力が補償できずに、送電容量不足改善のあしかせとなっている。このような背景から、2014 年 11 月から 12 月に実施した概略設計調査の期間中に、TCN の経営層から運転維持管理要員の技術指導が要請された。

本ソフトコンポーネントを実施することにより、本プロジェクトの調達設備である電力用コンデンサと特別高圧開閉設備を対象とする運転維持管理能力、及び日常点検能力の向上に係る技術移転を行うものである。

2. ソフトコンポーネントの目標

本ソフトコンポーネントの目標は以下の通りである。

(1) 設備の持続的な運転及び日常点検を行うための基礎知識が移転される。
(2) 設備の持続的な維持管理を行うための基礎技術が移転される。
(3) 設備の適切な運転管理、日常点検を行うための管理技術が移転され、マニュアルとして取り纏められる。

3. ソフトコンポーネントの成果

本ソフトコンポーネントで達成されるべき成果は、表 1 のとおりである。

表 1　ソフトコンポーネントの成果

目　標	ソフトコンポーネントの成果	対象者
(1) 設備の持続的な運転及び日常点検を行うための基礎知識が移転される。	① 電力用コンデンサ、開閉設備の概要、特性を理解する。	・維持管理課(Maintenance and Field Service), TSP[1], TCN[2]
	② 安定した電力供給に係る理論を理解する。	・システムオペレーター課(System Operator), SO[3], TCN
(2) 設備の持続的な維持管理を行うための基礎技術が移転される。	① チェックリストに記載の各チェック項目の必要性を理解する。	・維持管理課(Maintenance and Field Service), TSP, TCN ・システムオペレーター課(System Operator), SO, TCN
	② コンピュータを用いた電子化によ	・システムオペレーター課(System

[1] TSP：送電部門（Transmission Service Provider）
[2] TCN：ナイジェリア送電公社（Transmission Company of Nigeria）
[3] SO： 系統運用部門（System Operation）

目　標	ソフトコンポーネントの成果	対象者
	るデータ管理の方法を習得する。	Operator), SO, TCN ・維持管理課(Maintenance and Field Service), TSP, TCN
(3) 設備の適切な運転管理、日常点検を行うための管理技術が移転され、マニュアルとして取り纏められる。	① 設備日常点検マニュアル（案）を作成する。	・維持管理課(Maintenance and Field Service), TSP, TCN
	② 運転マニュアル（案）を作成する。	・システムオペレーター課(System Operator), SO, TCN

なお、本プロジェクト実施中に日本人技術者（調達・据付業者）により実施される初期操作指導・運用指導は本プロジェクトの調達設備を対象に次の内容を実施する。

- 試験器具・保守用機材を用いた検査、点検、測定方法
- 開閉設備の操作方法
- 運転開始後の日常点検方法

以上のように、初期操作指導・運用指導内容は、本プロジェクトで調達される設備仕様を踏まえ、操作及び点検方法等について、調達・据付業者が当該設備に限定した運転・日常点検技術を指導するものである。一方、本ソフトコンポーネントにおいては、対象設備を含む開閉設備及び調相設備全般を管理する上で必要となる基礎技術の移転（チェックリスト項目の説明を含む）をコンサルタントが行う。その上で、調達・据付業者による指導は点検チェックリストを用いて実施し、理論と実践を相互補完的に理解する。調達・据付業者とコンサルタントによる作業区分は図１に示すとおりであり、初期操作指導・運用指導と本ソフトコンポーネントの内容は互いに補完し合う関係がある。

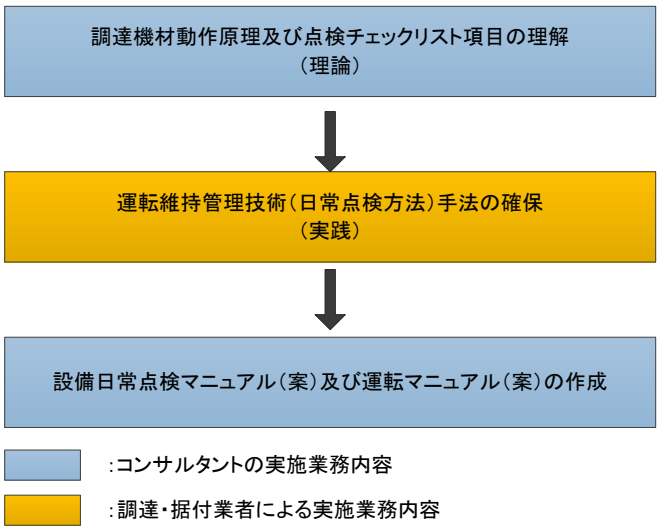


図１　コンサルタント及び調達・据付業者による業務区分と流れ

本ソフトコンポーネントを通して設備日常点検マニュアル（案）及び運転マニュアル（案）を整備し、点検手法や組織体制を明文化する。これにより、本ソフトコンポーネントの成果を活用して、他の変電所への技術の水平展開が期待される。

4. 成果達成度の確認方法

本ソフトコンポーネントの主な成果は、作成される設備日常点検マニュアル（案)、及び運転マニュアル（案）と参加者のレポートを確認することにより評価する。表２に活動内容別の成果確認方法を示す。設備日常点検マニュアル（案)、及び運転マニュアル（案）では、組織体制と役割、日常管理、定期点検、並びに緊急対応等の必要な項目が網羅され、技術的な内容が誤りなく記載されていることを確認する。座学研修の際には受講者に対してレポートを課し、技術移転のテーマ毎に受講者が理解した内容を記述させ、講義内容の理解度を評価する。なお、受講者の理解が十分でないと判断された項目については、補足講義を行う。

表２　ソフトコンポーネントの成果と確認方法

対象者	ソフトコンポーネントの成果	達成度確認方法
維持管理課 (Maintenance and Field Service), TSP, TCN	• 電力用コンデンサ、開閉設備の概要、特性を理解する。 • チェックリストに記載の各チェック項目の必要性を理解する。	レポート
	• 設備日常点検マニュアル（案）を作成する。	マニュアル
システムオペレータ一課 (System Operator), SO, TCN	• 安定した電力供給に係る理論を理解する。	レポート
	• コンピュータを用いた電子化によるデータ管理の方法を習得する。	レポート
	• 運転マニュアル（案）を作成する。	マニュアル

5. ソフトコンポーネントの活動（投入実施計画）

5-1　ソフトコンポーネントの内容と活動

本ソフトコンポーネントの活動内容は表３に示すように、電力用コンデンサ、及び特別高圧開閉設備の基礎から、運転管理、日常点検までの技術移転を図る。技術移転の手法は、座学、演習（受講者によるマニュアル作成）と機材を使用した実習を用いる。

表３　ソフトコンポーネントの活動内容と技術移転方法

目　標	ソフトコンポーネントの成果	活動内容	技術移転方法	主な対象者
(1) 設備の持続的な運転及び日常点検を行うための基礎知識が移転される。	① 電力用コンデンサ、開閉設備の概要､特性を理解する。	・電力用コンデンサ、開閉設備の交流回路遮断の原理と基礎知識を習得する。 ・変流器、計器用変圧器等の特徴と保護機能を理解する。	・座学 ・グループ演習	・維持管理課(Maintenance and Field Service), TSP, TCN
	② 安定した電力供給に係る理論を理解する。	・基本的な送電理論（無効電力と系統の安定運用、電圧上昇の原因等）を習得する。	・座学 ・グループ演習	・システムオペレーター課(System Operator), SO, TCN
(2) 設備の持続的な維持管理を行うための基礎技術が移転される。	① チェックリストに記載の各チェック項目の必要性を理解する。	・日常点検チェックリストの各項目について協議し、日常点検の重要性についての理解を深める。	・座学 ・実習（実機による機材試験操作）	・維持管理課(Maintenance and Field Service), TSP, TCN
	② コンピュータを用いた電子化によるデータ管理の方法を習得する。	・運転管理方法を理解する。 ・設備台帳を作成し、更新方法について理解する。	・座学 ・実習（運転データの記録・評価、設備の状態監視）	・システムオペレーター課(System Operator), SO, TCN ・維持管理課(Maintenance and Field Service), TSP, TCN
(3) 設備の適切な運転管理､日常点検を行うための管理技術が移転され､マニュアルとして取り纏められる。	① 設備日常点検マニュアル（案）を作成する。	・電力用コンデンサ、開閉設備の定期点検方法をマニュアルに纏める。	・座学、演習（マニュアル作成）	・維持管理課(Maintenance and Field Service), TSP, TCN
	② 運転マニュアル（案）を作成する。	・既存の運転管理マニュアルに基づき運転マニュアルを更新する。	・座学、演習（マニュアル作成）	・システムオペレーター課(System Operator), SO, TCN

5-2 投入計画

(1) 日本側の投入計画

本ソフトコンポーネントでは、表３の活動を実施することにより、TCN が電力用コンデンサをはじめとする設備の運転、並びに日常点検方法を具体的に理解し実践するために必要な技術を移転する。コンサルタントは、指導技術者 1、指導技術者 2 の 2 名を表４に示す期間ナイジェリアに派遣し、技術移転を行う。

表４　ソフトコンポーネントに係る投入計画

名称		格付	派遣期間（日数）	渡航回数	作業内容
1.	基礎知識の移転				
	指導技術者 1	3 号	1.00 月（30 日間）	1 回	・ 電力用コンデンサ、開閉設備の概要・特性に関する技術移転。 ・ 維持管理体制の再確認／修正と役割分担の整理
	指導技術者 2	3 号	1.00 月（30 日間）	1 回	・ 送電系統の概要・特性に関する技術移転。 ・ 運転管理体制の再確認／修正と役割分担の整理。
2.	管理・運用技術の移転				
	指導技術者 1	3 号	1.00 月（30 日間）	1 回	・ 機材の評価方法及び対処に係る技術移転。
	指導技術者 2	3 号	1.00 月（30 日間）	1 回	・ 運転管理方法の技術移転。 ・ 機材モニタリング方法の技術指導と設備点検チェックリストの整理。
3.	維持管理体制及びマニュアル整備				
	指導技術者 1	3 号	1.50 月（45 日間）	1 回	・ 維持管理マニュアル（草案）の作成。 ・ TCN 用維持管理マニュアル（案）作成指導。
	指導技術者 2	3 号	1.50 月（45 日間）	1 回	・ 運転管理マニュアル更新（草案）の作成。 ・ 運転管理マニュアル更新指導。

(2) ナイジェリア側の投入計画

TCN では各 132/33 kV 変電所にシステムオペレーター（System Operator: SO）と呼ばれる要員を 24 時間体制で配置し、オショボ給電指令所、及びアブジャ小区域（TCN の中で区分されている送電区域。連邦首都区及び周辺地域をカバーしている）の中心施設であるカタンペ変電所と連携して送電事業を行っている。一方、維持管理に係るエンジニアはアポ変電所に常駐し、各変電所へは短期出張することにより維持管理作業に従事している。そのため、本プロジェクトのソフトコンポーネント実施体制は図２、及び表５のように示される。

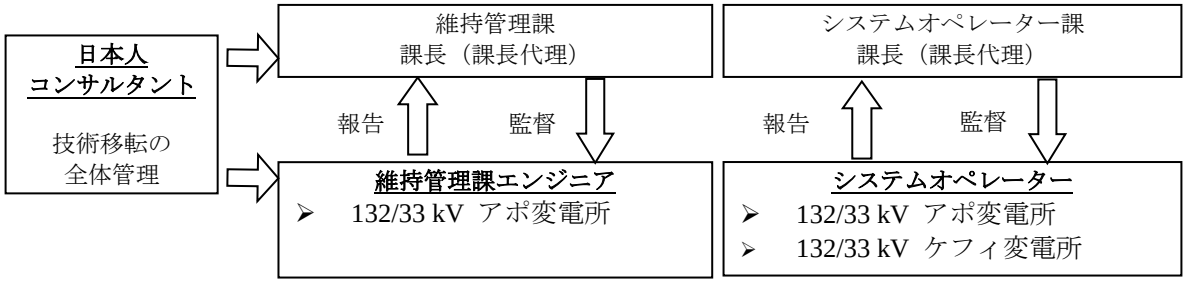


図２　変電設備の運転維持管理体制図（案）

表５　ソフトコンポーネント実施体制（案）

	日本人 コンサルタント	維持管理課 (Maintenance and Field Service), TSP, TCN	システムオペレーター課 (System Operator), SO, TCN
技術者	2 名	5−10 名[4]	3−5 名[5]
運営方法	全体の進捗状況管理	調達機材維持管理	調達機材、既設設備を含むシステムの維持管理
本ソフトコンポーネント内容のオリエンテーション	説明	参加	参加
マニュアル準備	助言	日常点検マニュアル作成	運転マニュアルの更新
維持管理フォローアップ	管理指導	維持管理報告	運転管理報告
報告先	- JICA 本部 - JICA ナイジェリア事務所	- コンサルタント - 維持管理課課長	- コンサルタント - 各変電所長

6. ソフトコンポーネントの実施リソースの調達方法

本プロジェクトで調達・据付される主要機器は本邦調達が想定されていることから、本ソフトコンポーネントで派遣する技術者は、日本の電力用コンデンサ設備及び開閉設備に精通している必要がある。このため、ソフトコンポーネントの実施リソースとしては、日本製品の特徴を熟知したコンサルタントを活用する。

また、TCN のシステムオペレーター課に対して持続的な運転管理技術の移転を達成するためデータ入力管理、及び設備台帳としての利用を目的とした運転管理用コンピュータを調達し、同機材を利用した運転維持管理の方法を技術移転する。コンピュータの活用は、現在検討されている更に高等な運用技術が求められる SCADA（電力系統監視制御）システムの導入時に、同機材の使用を円滑に開始するための基礎技能を習得する狙いもある。

同コンピュータは本プロジェクトサイトであるアポ変電所及びケフィ変電所に 1 台ずつ調達するため、合計 2 台とする。仕様を表６に示す。

表６　運転管理用コンピュータ要求仕様

仕様項目	要求仕様
台数	2
タイプ	デスクトップ型またはラップトップ型
オペレーションシステム	Windows 7
メモリー	2 GB 以上
ビット	64
アプリケーション	Microsoft Word, Excel を具備すること。

[4] アポ変電所に常駐する維持管理エンジニアの人数を示す。
[5] アポ変電所、ケフィ変電所各々の技術者数を示す。

7. ソフトコンポーネントの実施工程

ソフトコンポーネント実施工程を図３に示す

日本より派遣される技術者は、図３に示す実施工程に従い、それぞれのカテゴリーごとにソフトコンポーネントを実施する。各カテゴリーの実施時期及び留意事項については、以下のとおりである。

- **運転維持管理のための基礎知識の移転**
  運転管理、維持管理に関連して基礎知識を深め、日常点検の理解を深めることができるため、日本人技術者による初期操作・運用指導前に実施する。

  表５で示すとおり、本プロジェクトのソフトコンポーネントの対象グループは維持管理課、及びシステムオペレーター課であるが、双方のグループが互いの活動内容を理解した上でそれぞれの責務を果たすことが円滑な業務実施に必要となる。そのため、当該「基礎技術の移転」研修は 2 グループ共同で実施する。

- **管理・運用技術の移転**
  日本人技術者による初期操作指導・運用指導と並行して実施することにより、チェックリストを用いた日常点検の方法に対する理解を深める。

- **維持管理体制及びマニュアルの整備**
  初期操作指導・運用指導実施後、技術移転された日常点検技能、並びに本ソフトコンポーネントを通して整備された組織体制・役割等をマニュアルの形で纏める。

  マニュアル整備作業は、各グループが各々のグループを対象としたマニュアルを準備するが、このマニュアル作成を 2 グループが協働して実施する形式とし、互いの業務区分を検討させる。この作業を通し、運用時のグループ間の情報共有化が図れ、将来想定される SCADA システム構築時の情報基盤づくりに資することが期待される。

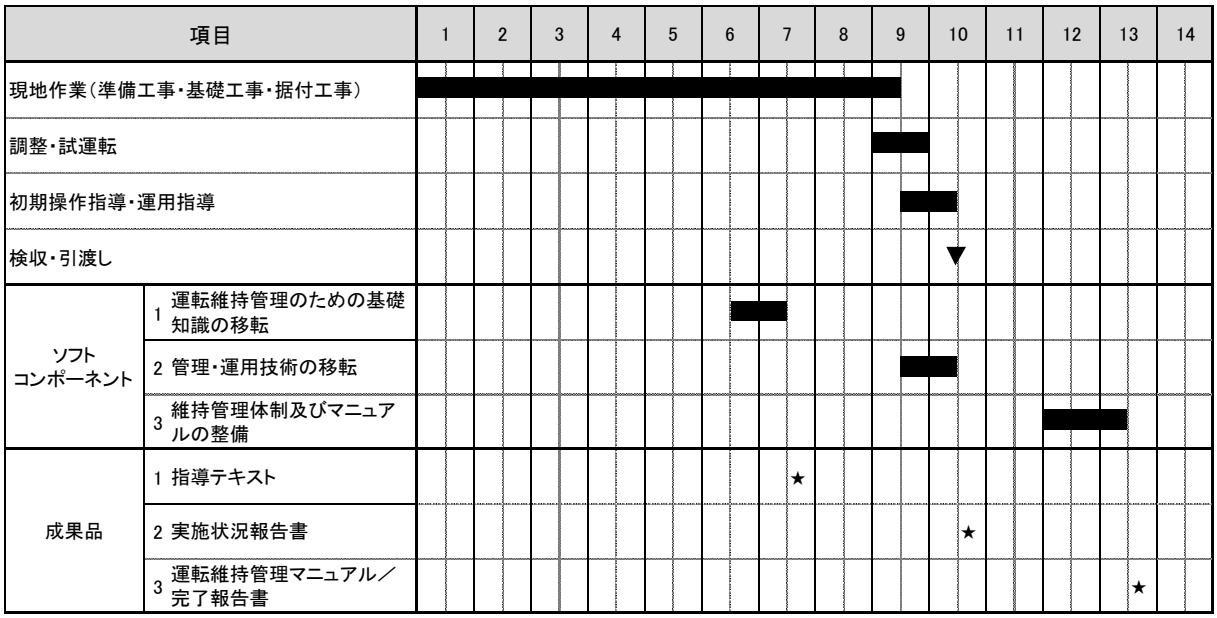


図３　ソフトコンポーネントの実施スケジュール

なお、維持管理グループより 1 名を研修リーダに任命するほか、各グループよりサブリーダを 1 名ずつ任命し、ソフトコンポーネント研修実施中の双方間の円滑な連絡と調整を取る体制を構築する。

8. 成果品

本プロジェクトのソフトコンポーネントの成果品は、運転管理マニュアル、維持管理マニュアル、実施状況報告書、完了報告書（施主向けには英文 Final Report）である。

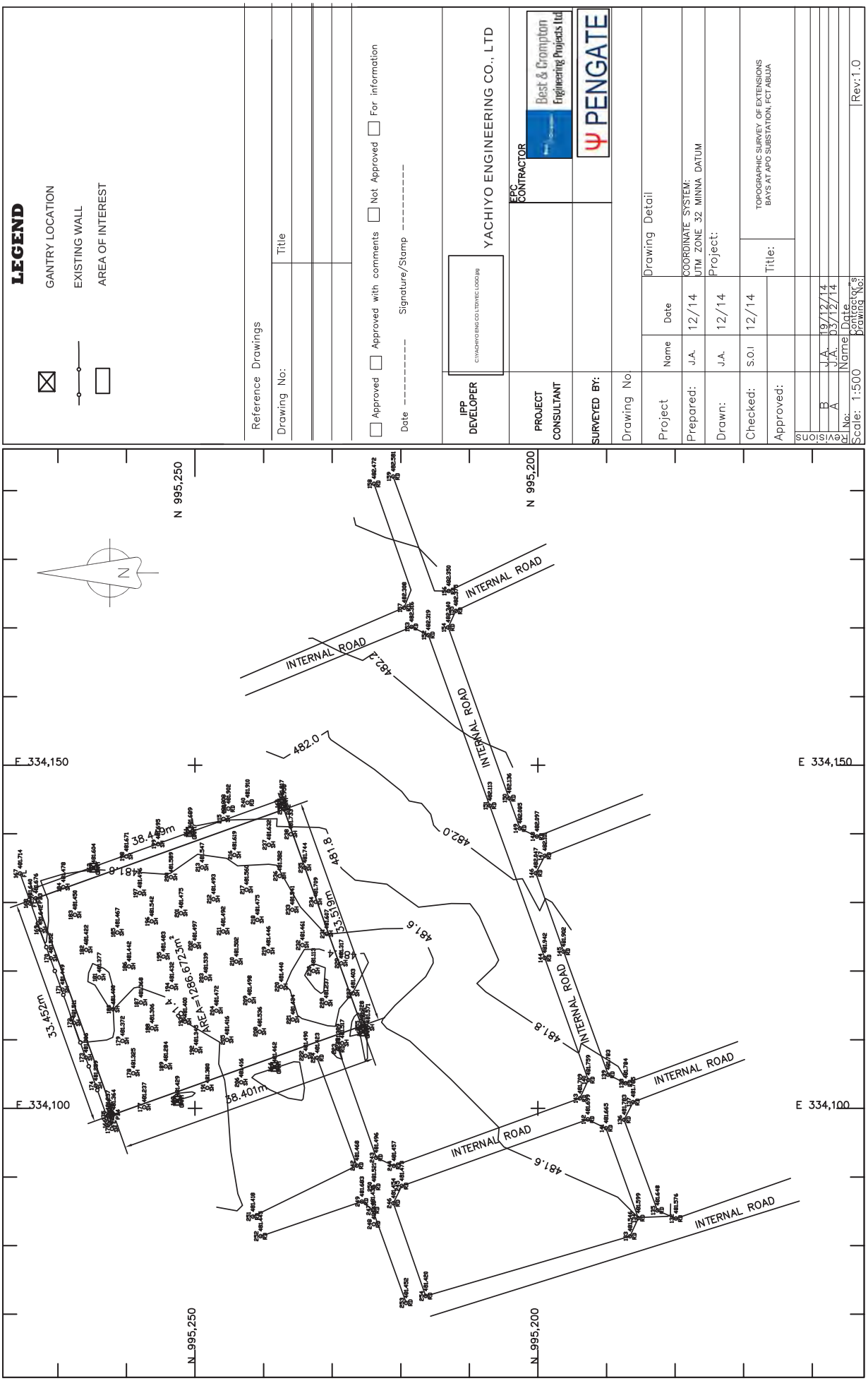
9. 相手国実施機関の責務

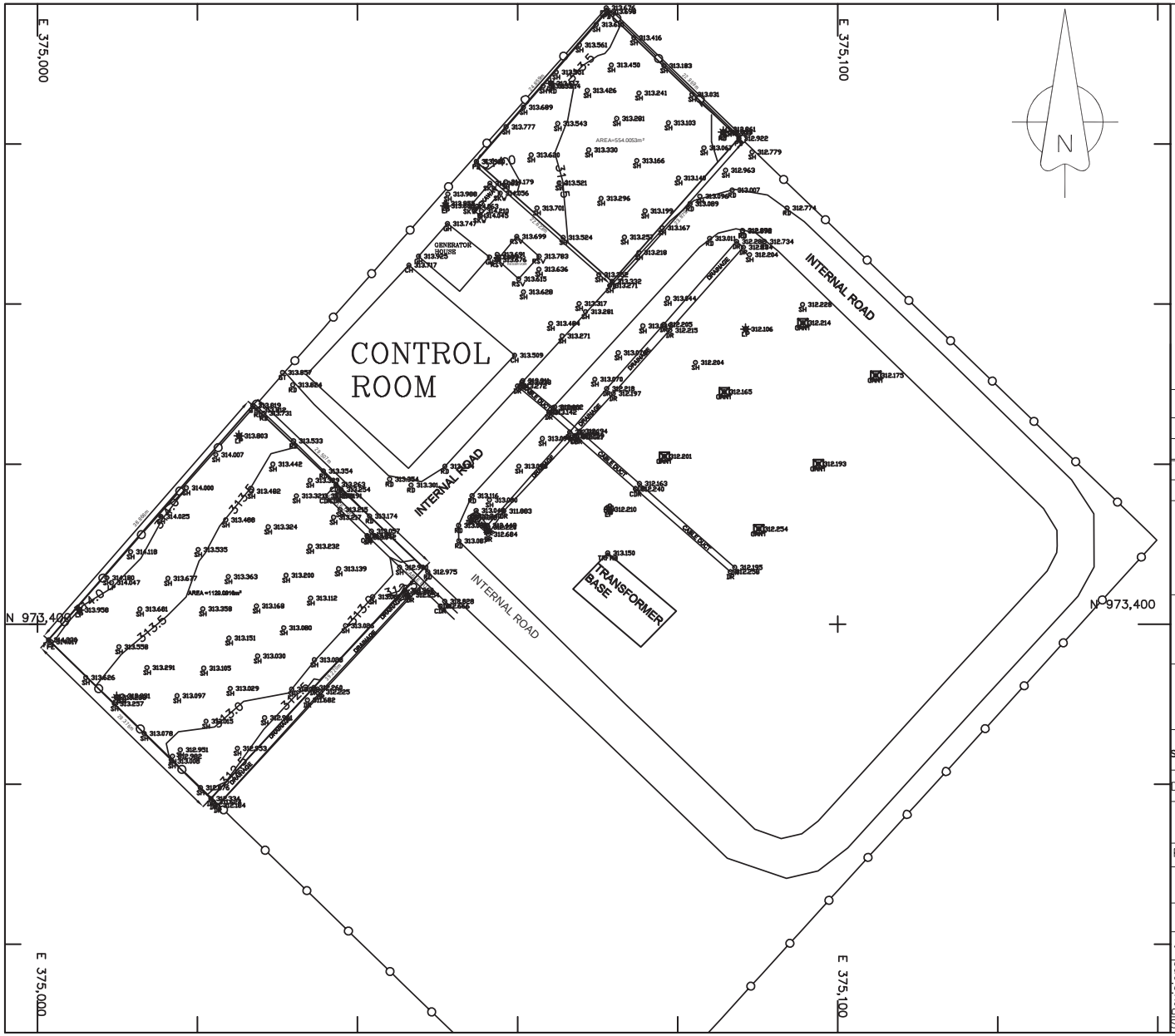
ナイジェリア側はソフトコンポーネントを円滑に実施してその効果を最大限に発現させるため、以下の責務を全うすることとする。

- TCN は、本ソフトコンポーネント実施に必要となる作業室等を用意する。
- TCN は、本ソフトコンポーネント実施に必要な受講者を選定する。
- 受講者は、コンサルタントと協議し、設備日常点検マニュアル（案)、及び運転マニュアル（案）の作成を率先して実施する。
- TCN は、一定期間において、各マニュアルに基づいた実績報告をコンサルタントへ提出する。

A-6　地形測量結果図（現地再委託）

A-6 地形測量結果図（現地再委託）





LEGEND

- GANTRY LOCATION
- DRAINAGE DUCT
- EXISTING WIRE FENCE
- LAMP POST
- AREA OF INTEREST

Reference Drawings

Drawing No:	Title

☐ Approved ☐ Approved with comments ☐ Not Approved ☐ For information

Date ---------- Signature/Stamp ----------

IPP DEVELOPER: C:\YACHIYO ENG CO LTD\YEC LOGO.jpg YACHIYO ENGINEERING CO., LTD

PROJECT CONSULTANT:

EPC CONTRACTOR: Best & Crompton Engineering Projects Ltd

SURVEYED BY: PENGATE

Drawing No.

Project	Name	Date
Prepared:	J.A.	12/14
Drawn:	J.A.	12/14
Checked:	S.O.I	12/14
Approved:		

Drawing Detail

COORDINATE SYSTEM: UTM ZONE 32 MINNA DATUM

Project:

Title: TOPOGRAPHIC SURVEY OF EXTENSIONS BAYS AT KEFFI SUBSTATION, NASSARAWA STATE

Revisions No:	Name	Date
B	J.A.	19/12/14
A	J.A.	03/12/14

Scale: 1:500 Contractor's Drawing No: Rev:1.0

A–6–2

A-7　地質調査結果報告書（現地再委託）

PROPOSED DEVELOPMENT AT APO SUB STATION, FCT, ABUJA

GEOTECHNICAL INVESTIGATION

PREPARED BY:

BEST&CROMPTON ENGINEERING AFRICA LTD.,

December, 2014

CLIENT: YACHIYO ENGINEERING CO. LTD.,

TABLE OF CONTENT

1.0 INTRODUCTION

The Client, **Yachiyo Engineering Co. Ltd**., commissioned Best & Crompton Engineering Africa Ltd., to proceed with subsoil investigations at the proposed development at **Apo Sub station, FCT Abuja.** This report is a consequence of the soil investigation and analyses, which is presented in an objective and professional manner.

The purpose of the subsoil investigation and attendant report is as follows:

- ≠ Determine the subsoil and surface/groundwater conditions of the designated location.
- ≠ Evaluation of the subsoil stratigraphic sequence geotechnical/engineering properties of the soil and the subsequent effects on foundation design and construction.
- ≠ Analysis of the data/results of tests carried out on the soil samples obtained and provide recommendations on the fit-for-purpose type of foundation for the proposed structure.

2.0 SITE ACCESSIBILITY

The sites are accessible through **Abuja road** to mention but a few.

3.0 DESCRIPTION OF WORK

The soil investigation comprised of and carried out in three parts;

- Field Work: Test (2Nos. DCPTs) and collation of the test results.

3.1 FIELD WORK

The site works were carried out on November, 2014.

The Scope of Work executed involved the performance of 2Nos. 2.5tons Dutch Cone Penetrometer Tests (DCPTs) to a depth of refusal.

DUTCH CONE PENETROMETER

The apparatus consists of a cylindrical probe, of 1000mm^2 cross sectional area, and a conic head of apex angle of 60^o. The probe is forced down through the soil at a steady rate of about 20mm/s in the closed position by exerting pressure force on outer sounding tube. If desired the point resistance and the resistance to side friction can be measured separately.

2Nos. static cone penetration tests were carried out using a 2.5tons capacity testing equipment (machine) on each site. The test involves advancing the cone into the ground slowly at a constant rate and the resistant to penetration measured at predetermined intervals of 0.25m depth. The tests were terminated at depths where the machine anchor legs lifted.

These tests were taken from the existing ground level down to depths refusal at each location.

The cone penetration test results are presented in a graphical form respectively in the Appendix to this Report.

3.2 ANALYSIS OF TEST RESULTS

3.2.1 Geological Description

Available geological record reveals that the investigated area is within the basement complex of Nigeria; it is characterized by crystalline rocks of Precambrian age. Rocks of granitic origin later intruded these rocks.

The sedimentary deposits found on top of the basement rock are product of the parent rocks that have undergone weathering and decomposition.

3.2.2 Subsoil Condition

The subsoil condition of the site, based on the DCP test carried out reveals predominantly cohesive soil as observed from the DCP Plot.

Details of the subsoil characteristics encountered during the Penetrometer tests are stated below:

Subsoil Condition based on the field work.

Dutch Cone Penetrometer Test

Address: Apo power station, FCT, Abuja.

Depth (m)	Description of Stratum
0.00 to –.1.00	Firm cohesive soil.
1.00 to –2.50	Firm becoming Stiff to hard cohesive soil.

Geotechnical Properties

Depth (m)	Geotechnical Properties
0.00 to –.1.00	Moderate geotechnical properties, moderate shear strength and moderate compressibility potential.
1.00 to –2.50	Moderate becoming good to very good geotechnical properties, moderate becoming high shear strength and low compressibility potential.

Geotechnical Engineering Parameters

Depth (m)	*P1(Kgf/cm^3)*	*P2(Kgf/cm^3)*
0.00 – 1.00m	***10 – 20***	***15 – 32***
1.00 – 2.50m	***9 – 55***	***10 – 62***

3.2.4 Site description and condition

The project site is an open piece of land within existing power substation. Structures around site show no sign of distress at the time of our investigation.

3.2.5 Topography.

The topography of the project site is nearly even topography.

3.2.6 Vegetation.

No vegetation was observed on the project site during our subsoil investigation.

4.1 FOUNDATION DISCUSSION AND RECOMMENDATION

4.1.1 Proposed Development

No structural detail of the proposed development was made available to us prior to the subsoil investigation, thus our recommendations are based on the DCP test carried out.

The geotechnical issues considered relevant to the proposed development include

- ≠ Soil bearing pressure
- ≠ Level of groundwater
- ≠ Recommendation of a suitable foundation type
- ≠ Excavation

4.1.2 RECOMMENDATION

The foundation type to be chosen for a particular structure depends largely on the followings;

- Loads to be transmitted
- Receiving soil strata
- Factor of safety against shear failure of the supporting soil must be adequate.
- Settlement should neither cause any unacceptable damage nor interfere with the function of the structure.

Foundations can be classified as shallow foundation or as deep foundation.

The choice between shallow foundation and deep foundation can be arrived at after careful consideration of the following elements.

1. The magnitude of the transmitted loads from the stratum,
2. The soil nature,

3. The economic aspects of the elements of the foundation work,
4. Problems concerning foundation construction.

4.1.3 Allowable bearing pressure and foundation recommendation

Allowable bearing pressure calculated in accordance with theoretical soil mechanics principle for depths are indicated below:

Differential Depth (m)	Allowable bearing Capacity (KN/m^2)
0.00 – 0.50	107
0.50 – 1.00	134
1.00 – 1.50	134
1.50 – 2.00	222

FOUNDATION RECOMMENDATION

Shallow Foundation

Shallow Foundation (Spread footing or Reinforced Raft Foundation) is considered adequate for the proposed development on the project site.

Groundwater

Groundwater was not encountered during the subsoil investigation work

METHOD OF CALCULATING ALLOWABLE BEARING PRESSURE IN COHESIVE SOIL IS GIVEN BY:

Empirical Method for calculating in Cohesive Soil is given by:

q_{ult} = 5.14Cu + ϫD (Prandtl method of estimating allowable bearing pressure)

$q_a = q_{ult}$/F.S (3) – For Shallow foundation

Or

If the Clay is very Sandy

Correlation between q_c and SPT (N – Values)

$N = q_C / 2$

q_a = 10N, or 5.0N (If Submerged)

Correlation between q_c and Cu

$Cu = q_c / 20$ (KN/m^2)

4.2.2 Settlement

Settlement for this allowable bearing pressure for each location stated above would not exceed ***25mm***.

Our analysis on settlement is based on the method stated below

S = 1.1Mv x 0.55qn x h

Where S = Total settlement

Mv = Volume of compressibility potential

qn = net foundation base pressure

h = depth of foundation

The table below shows the permissible settlement as per I.S Code.

Soil type	Permissible total settlement		Permissible differential settlement	
	For isolated footings	For raft footings	For isolated footings	For raft footings
Sandy	4.0cm	4.cm to 6.5cm	2.5cm	2.5cm
Clays	6.5cm	6.5 to 10.0cm	4.0cm	4.0cm

4.2.3 Factor of Safety

Factor of safety of 3 was adopted for our estimation of allowable bearing pressure.

4.2.4 Excavation

- ≠ Excavation could be achieved using conventional excavating equipment.
- ≠ Excavation support would not be required

4.2.5 General Precaution for Shallow Foundation Construction

It is recommended that the following general guidelines that govern the construction of shallow foundation should be observed when work starts on the site:

- ≠ Over excavation beyond the depths stated should not be done.
- ≠ Ingress of water into the excavated foundation trench should be prevented if the stated bearing value at the founding depth is to be achieved. A layer of concrete blinding should therefore be provided within a trench once it has been excavated.
- ≠ Adequate cover to the concrete should be allowed for the reinforcement bars to protect them from possible effect of corrosion.
- ≠ The sides of foundation should be backfilled up to existing ground level as soon as they are cast.

5.0 CONCLUSION

Shallow Foundation (Spread footing or Reinforced Raft foundation) is considered adequate for the proposed development on the project site.

Despite an objective soil investigation and reporting, a poorly designed and/or constructed foundation may lead to structural failure if all other environmental conditions remain constant.

BEST&CROMPTON ENGINEERING AFRICA LIMITED therefore recommends that the design and construction of all foundation and earthwork be carried out by a competent company in accordance with good and strict engineering practice expected of a professional. The construction contractor shall be guided by reference Code of Practices such as; British Institution CP 2004, 1973: Code of Practice for Foundation and BS 6031: Code of Practice for Earth Works.

M.Nageswara Rao

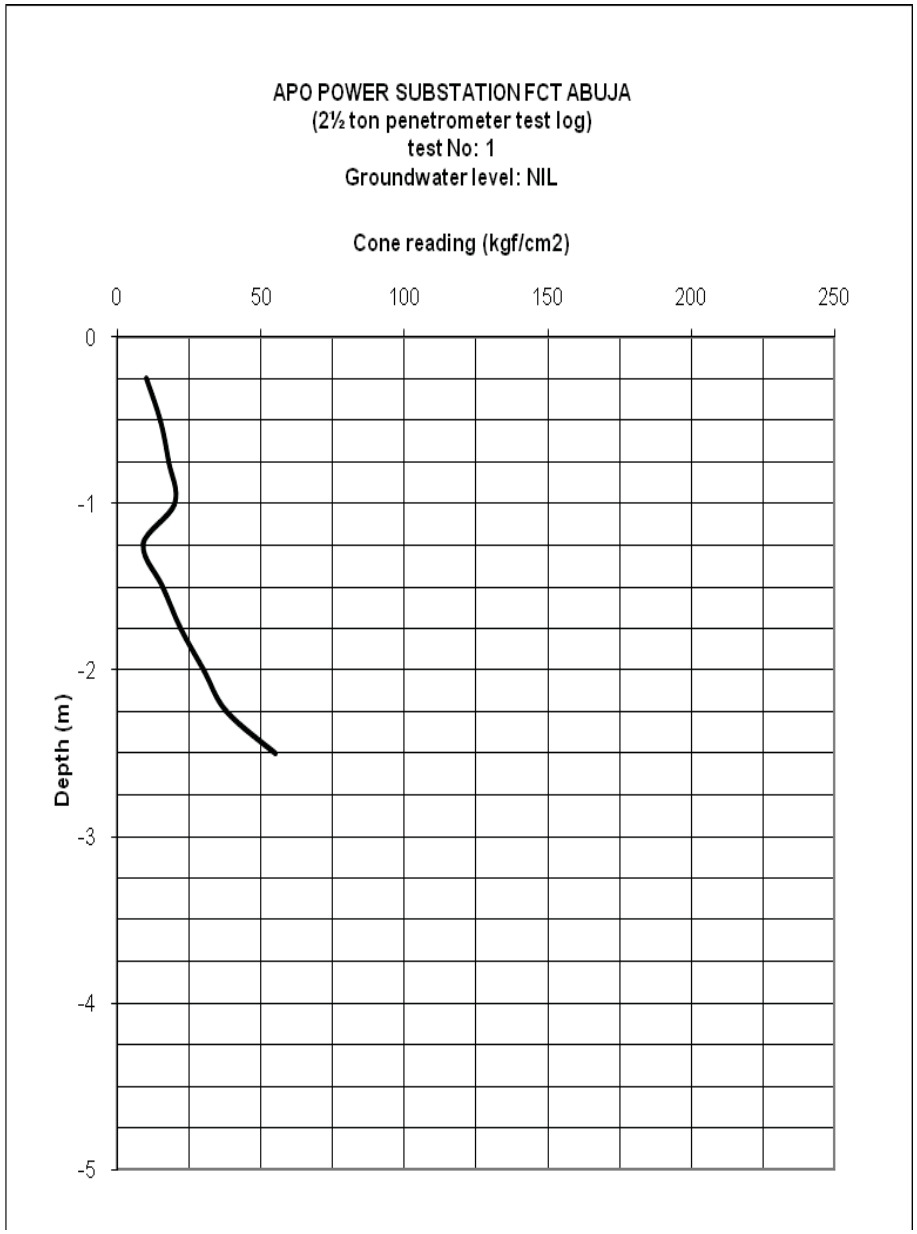
For Best & Crompton Engineering Africa Ltd.,

APPENDIX

FIELD LOGS

PENETROMETER 1

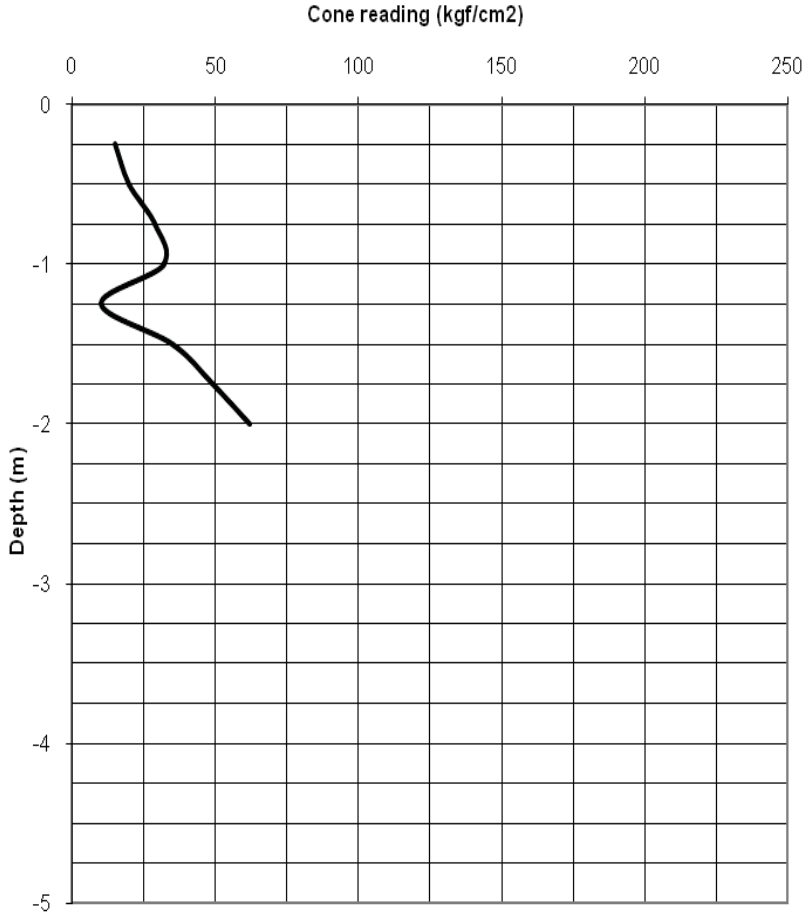
Qc	Depth
0	0
10	-0.25
15	-0.5
18	-0.75
20	-1
9	-1.25
16	-1.5
22	-1.75
30	-2
38	-2.25
55	-2.5
	-2.75



PENETROMETER 2

Qc	Depth
0	0
15	-0.25
20	-0.5
29	-0.75
32	-1
10	-1.25
35	-1.5
49	-1.75
62	-2
	-2.25

APOPOWER SUBSTATION FCT ABUJA
(2½ ton penetrometer test log)
test No: 2
Groundwater level: NIL



PICTURES OF WORK ON THE PROJECT SITE

NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience.

For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone Penetrometer tests (CPT) as below:

Relative Density	CPT Cone Value (qc — MPa)
Very loose	less than 2
Loose	2—5
Medium dense	5—15
Dense	15—25
Very dense	greater than 25

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

Reproduction of Information for Contractual Purposes

• In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open. Attention is drawn to the document

"Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers,

• A localised perched water table may lead to an erroneous indication of the true water table.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

PROPOSED DEVELOPMENT AT KEFFI SUB STATION, NASSARAWA ROAD, KEFFI, NASSARAWA STATE.

GEOTECHNICAL INVESTIGATION

PREPARED BY:

BEST & CROMPTON ENGINEERING AFRICA LTD.,

December, 2014

CLIENT: YACHIYO ENGINEERING CO. LTD.,

TABLE OF CONTENT

1.0 INTRODUCTION

The Client, **Yachiyo Engineering Co.Ltd: commissioned Best & Crompton Engineering Africa Ltd.,** to proceed with subsoil investigations at the proposed development at **Keffi Sub station, Nassarawa road, Keffi, Nassarawa State.** This report is a consequence of the soil investigation and analyses, which is presented in an objective and professional manner.

The purpose of the subsoil investigation and attendant report is as follows:

- ≠ Determine the subsoil and surface/groundwater conditions of the designated location.
- ≠ Evaluation of the subsoil stratigraphic sequence geotechnical/engineering properties of the soil and the subsequent effects on foundation design and construction.
- ≠ Analysis of the data/results of tests carried out on the soil samples obtained and provide recommendations on the fit-for-purpose type of foundation for the proposed structure.

2.0 SITE ACCESSIBILITY

The sites are accessible through **Nassarawa Road** to mention but a few.

3.0 DESCRIPTION OF WORK

The soil investigation comprised of and carried out in three parts;

- Field Work: Test (2Nos. DCPTs) and collation of the test results.

3.1 FIELD WORK

The site works were carried out on November, 2014.

The Scope of Work executed involved the performance of 2Nos. 2.5tons Dutch Cone Penetrometer Tests (DCPTs) to a depth of refusal.

DUTCH CONE PENETROMETER

The apparatus consists of a cylindrical probe, of 1000mm^2 cross sectional area, and a conic head of apex angle of 60^o. The probe is forced down through the soil at a steady rate of about 20mm/s in the closed position by exerting pressure force on outer sounding tube. If desired the point resistance and the resistance to side friction can be measured separately.

2Nos. static cone penetration tests were carried out using a 2.5tons capacity testing equipment (machine) on each site. The test involves advancing the cone into the ground slowly at a constant rate and the resistant to penetration measured at predetermined intervals of 0.25m depth. The tests were terminated at depths where the machine anchor legs lifted.

These tests were taken from the existing ground level down to depths refusal at each location.

The cone penetration test results are presented in a graphical form respectively in the Appendix to this Report.

3.2 ANALYSIS OF TEST RESULTS

3.2.1 Geological Description

Available geological record reveals that the investigated area is within the basement complex of Nigeria; it is characterized by crystalline rocks of Precambrian age. Rocks of granitic origin later intruded these rocks.

The sedimentary deposits found on top of the basement rock are product of the parent rocks that have undergone weathering and decomposition.

3.2.2 Subsoil Condition

The subsoil condition of the site, based on the DCP test carried out reveals predominantly cohesive soil as observed from the DCP Plot.

Details of the subsoil characteristics encountered during the Penetrometer tests are stated below:

Subsoil Condition based on the field work.

Dutch Cone Penetrometer Test

Address: Keffi power station, Nassarawa road, Keffi, Nassarawa State

Depth (m)	Description of Stratum
0.00 to –.0.50	Filling.
0.50 to –1.00	Stiff to very stiff cohesive soil with gravels.
1.00 to –2.00	Firm becoming Stiff to hard cohesive soil with gravels and pebbles.

Geotechnical Properties

Depth (m)	Geotechnical Properties
0.00 to –.0.50	Moderate geotechnical properties, moderate shear strength and moderate compressibility potential.
0.50 to –1.00	Good geotechnical properties, high shear strength and low compressibility potential.
1.00 to –2.00	Moderate becoming good to very good geotechnical properties, moderate becoming high shear strength and low compressibility potential.

Geotechnical Engineering Parameters

Depth (m)	*P1(kgf/cm^3)*	*P2(kgf/cm^3)*
0.00 – 0.50m	***10 – 25***	***5 – 15***
0.50 – 1.00m	***40 – 53***	***25 – 33***
1.00 – 2.00m	***–***	***15 – 62***

3.2.4 Site description and condition

The project site is an open piece of land within existing power substation. Structures around site show no sign of distress at the time of our investigation.

3.2.5 Topography.

The topography of the project site is undulating topography.

3.2.6 Vegetation.

Vegetation around the project site area is mainly grasses and weeds.

4.1 FOUNDATION DISCUSSION AND RECOMMENDATION

4.1.1 Proposed Development

No structural detail of the proposed development was made available to us prior to the subsoil investigation, thus our recommendations are based on the DCP test carried out.

The geotechnical issues considered relevant to the proposed development include

- ≠ Soil bearing pressure
- ≠ Level of groundwater
- ≠ Recommendation of a suitable foundation type
- ≠ Excavation

4.1.2 RECOMMENDATION

The foundation type to be chosen for a particular structure depends largely on the followings;

- Loads to be transmitted
- Receiving soil strata
- Factor of safety against shear failure of the supporting soil must be adequate.
- Settlement should neither cause any unacceptable damage nor interfere with the function of the structure.

Foundations can be classified as shallow foundation or as deep foundation.

The choice between shallow foundation and deep foundation can be arrived at after careful consideration of the following elements.

1. The magnitude of the transmitted loads from the stratum,
2. The soil nature,
3. The economic aspects of the elements of the foundation work,
4. Problems concerning foundation construction.

4.1.3 Allowable bearing pressure and foundation recommendation

Allowable bearing pressure calculated in accordance with theoretical soil mechanics principle for depths are indicated below:

Differential Depth (m)	Allowable bearing Capacity (KN/m^2)
0.00 – 0.50	**85**
0.50 – 1.00	**208**
1.00 – 1.50	**257**
1.50 – 2.00	**505**

FOUNDATION RECOMMENDATION

Shallow Foundation

Shallow Foundation (Spread footing) is considered adequate for the proposed development on the project site.

Groundwater

Groundwater was not encountered during the subsoil investigation work

METHOD OF CALCULATING ALLOWABLE BEARING PRESSURE IN COHESIVE SOIL IS GIVEN BY:

Empirical Method for calculating in Cohesive Soil is given by:

q_{ult} = 5.14Cu + ϫD (Prandtl method of estimating allowable bearing pressure)

$q_a = q_{ult}$/F.S (3) – For Shallow foundation

Or

If the Clay is very Sandy

Correlation between q_c and SPT (N – Values)

$N = q_C / 2$

q_a = 10N, or 5.0N (If Submerged)

Correlation between q_c and Cu

$Cu = q_c / 20$ (KN/m^2)

4.2.2 Settlement

Settlement for this allowable bearing pressure for each location stated above would not exceed ***25mm***.

Our analysis on settlement is based on the method stated below

S = 1.1Mv x 0.55qn x h

Where S = Total settlement

Mv = Volume of compressibility potential

qn = net foundation base pressure

h = depth of foundation

The table below shows the permissible settlement as per I.S Code.

Soil type	Permissible total settlement		Permissible differential settlement	
	For isolated footings	For raft footings	For isolated footings	For raft footings
Sandy	4.0cm	4.cm to 6.5cm	2.5cm	2.5cm
Clays	6.5cm	6.5 to 10.0cm	4.0cm	4.0cm

4.2.3 Factor of Safety

Factor of safety of 3 was adopted for our estimation of allowable bearing pressure.

4.2.4 Excavation

≠ Excavation could be achieved using conventional excavating equipment.

≠ Excavation support would not be required

4.2.5 General Precaution for Shallow Foundation Construction

It is recommended that the following general guidelines that govern the construction of shallow foundation should be observed when work starts on the site:

≠ Over excavation beyond the depths stated should not be done.

≠ Ingress of water into the excavated foundation trench should be prevented if the stated bearing value at the founding depth is to be achieved. A layer of concrete blinding should therefore be provided within a trench once it has been excavated.

≠ Adequate cover to the concrete should be allowed for the reinforcement bars to protect them from possible effect of corrosion.

≠ The sides of foundation should be backfilled up to existing ground level as soon as they are cast.

5.0 CONCLUSION

Shallow Foundation (Spread footing) is considered adequate for the proposed development on the project site.

Despite an objective soil investigation and reporting, a poorly designed and/or constructed foundation may lead to structural failure if all other environmental conditions remain constant.

BEST&CROMPTON ENGINEERING AFRICA LIMITED therefore recommends that the design and construction of all foundation and earthwork be carried out by a competent company in accordance with good and strict engineering practice expected of a professional. The construction contractor shall be guided by reference Code of Practices such as; British Institution CP 2004, 1973: Code of Practice for Foundation and BS 6031: Code of Practice for Earth Works.

A—7—15

M.Nageswara Rao

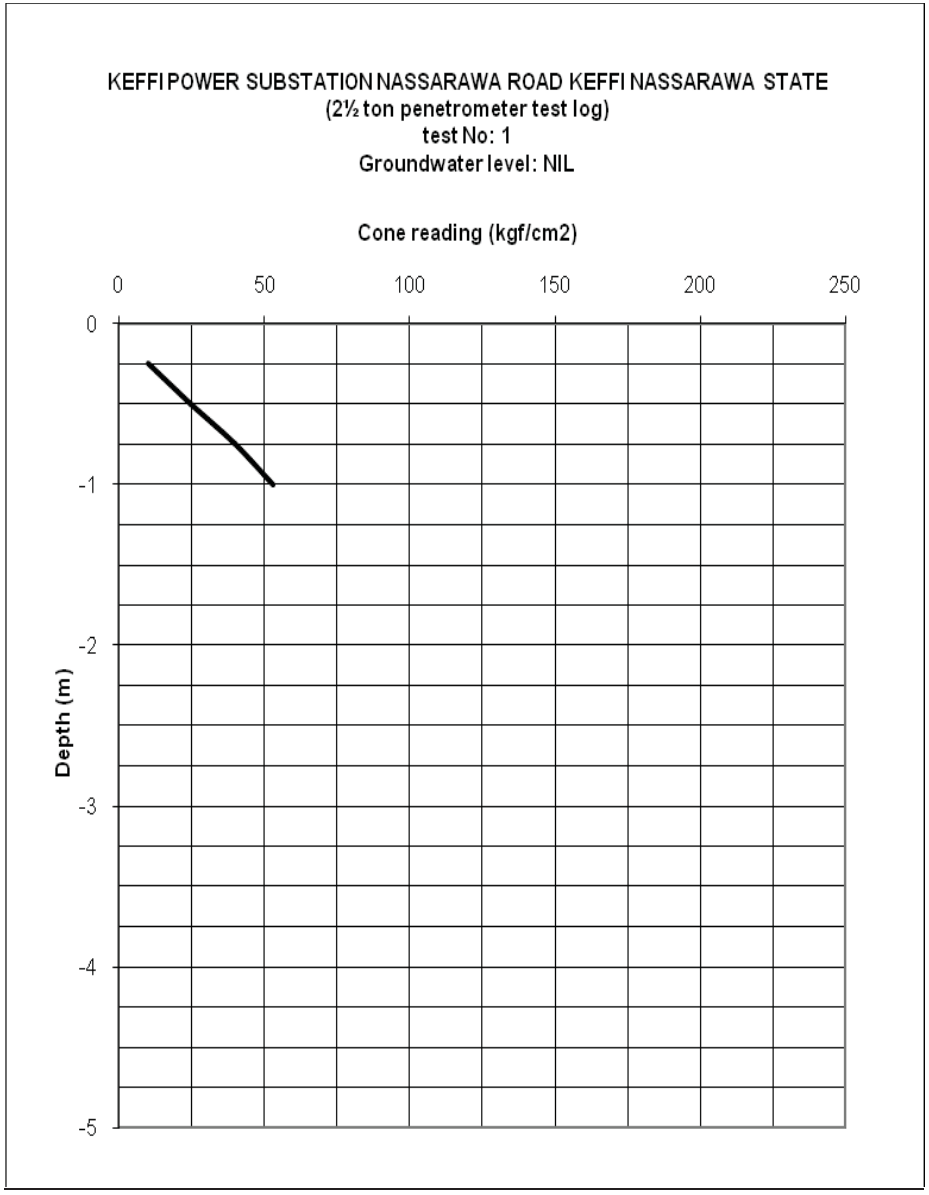
For Best & Crompton Engineering Africa Ltd.,

APPENDIX

FIELD LOGS

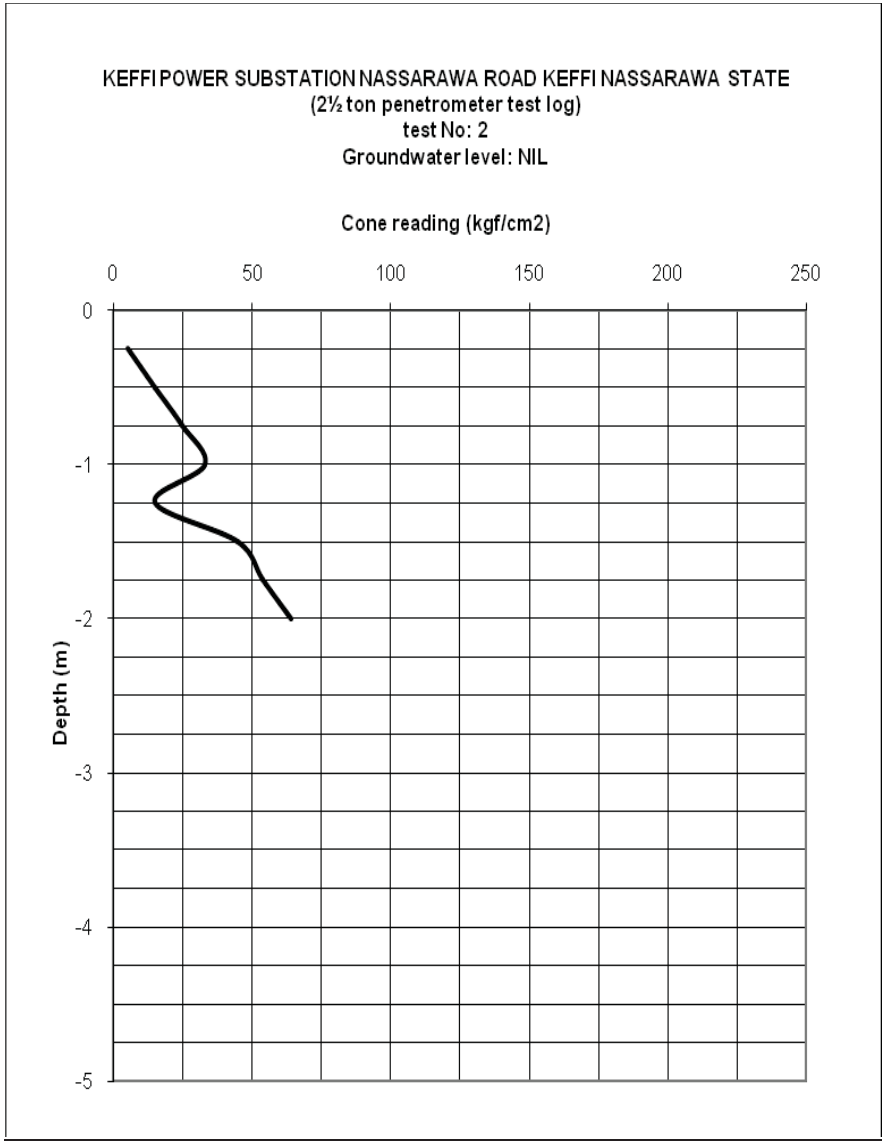
PENETROMETER 1

Qc	Depth
0	0
10	-0.25
25	-0.5
40	-0.75
53	-1
	-1.25



PENETROMETER 2

Qc	Depth
0	0
5	-0.25
15	-0.5
25	-0.75
33	-1
15	-1.25
45	-1.5
54	-1.75
64	-2
	-2.25



PICTURES SHOWING FIELD OPERATION ON THE PROJECT SITE

NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience.

For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone Penetrometer tests (CPT) as below:

Relative Density	CPT Cone Value (qc — MPa)
Very loose	less than 2
Loose	2—5
Medium dense	5—15
Dense	15—25
Very dense	greater than 25

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

Reproduction of Information for Contractual Purposes

• In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open. Attention is drawn to the document

"Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers,

• A localised perched water table may lead to an erroneous indication of the true water table.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

A-8　フィールドレポート

PREPARATORY SURVEY
FOR
THE PROJECT
FOR
EMERGENCY IMPROVEMENT
OF
ELECTRICITY SUPPLY FACILITIES IN ABUJA
IN
THE FEDERAL REPUBLIC OF NIGERIA

FIELD REPORT

12th DECEMBER 2014

Prepared and Submitted by:

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12/12/14

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12/12/14

JICA PREPARATORY SURVEY TEAM
Yachiyo Engineering Co.,Ltd.

Contents

1. Outline of the Project

1.1 Background of the Project

In response to the request from the Government of the Federal Republic of Nigeria (Nigeria), the Japan International Cooperation Agency (JICA), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (the Survey) for the Project for Emergency Improvement of Electricity Supply Facilities in Abuja (the Project).

JICA sent to Nigeria the Preparatory Survey Team (the Team) headed by Mr. Kazunari Oshima, Visiting Senior Advisor, JICA, to conduct the first field survey and the Team is scheduled to stay in the country from 3rd November to 15th December, 2014.

The Team continued discussions with the concerned officials of Nigeria and the field survey in Nigeria in consideration of mutual understandings made on the Minuets of Discussions signed among Japan International Cooperation Agency (JICA), the Federal Ministry of Power (FMP) and Transmission Company of Nigeria (TCN) on 19th November, 2014.

TCN and the Team had series of technical discussions to form mutual understandings about the contents, scope, preconditions for the Outline Design, basic specifications, general layouts, and so on of the Project in the First Field Survey. FMP, TCN and the Team agreed to record the following issues described on this Field Report as a conclusion of the First Field Survey and discussions.

Components of the Project and their priority will be further examined and may be modified through the consultation with the Japanese Ministry of Foreign Affairs and JICA headquarters. It is important for the Nigerian side to understand that the Preparatory Survey is not a commitment for the future implementation of the Project.

Particularly, in consideration of the schedule and procedures of Japan's Grant Aid projects, the Team explained that the outline design, planning of the implementation schedule, the cost estimation and so on of the Project will be carried out in accordance with the mutual understandings made on this Field Report.

FMP and TCN expressed understanding about the schedule and procedures of Japan's Grant Aid project and agreed with the Team to progress the further study, the outline design, planning of the implementation schedule, the cost estimation and so on of the Project in accordance with the mutual understandings made on this Field Report after the First Field Survey.

1.2 Framework for the Project

The framework for the Project is shown as follows.

(1) The responsible ministry is the Federal Ministry of Power (FMP).
(2) The implementing agency is Transmission Company of Nigeria (TCN).

1.3 Components of the Project on Minutes of Discussions on 19th November, 2014

The Components and their priority for the Project on Minutes of Discussions (M/D) concluded on 19th November, 2014 are shown in Table 1.3-1 and the locations are shown in the drawing G-01.

The Nigerian side and the Team discussed the final requested components of the Project and their priority. The rating of the priority shown in the following table is higher in the following manner: A, B and C.

Table 1.3-1 Final requested components of the Project and their priority

Component	Location	Specification	Priority
Installation of capacitor bank	Apo 132/33 kV Substation	60 MVar, 132 kV	A
Installation of capacitor bank	Keffi 132/33 kV Substation	25 MVar, 132 kV	A
Installation of Static Var Compensator (SVC)	Katampe 330/132/33 kV Substation	50 MVar, 330 kV	C
Installation of shunt reactor	Gwagwalada 330/132/33 kV Substation	75 MVar	B

<Note>

This report is mainly focused on the components for Apo 132/33 kV Substation and Keffi 132/33 kV Substation as they are prioritized with A.

In case of the components for Katmpe 330/132/33 kV Substation and Gwagwalada 330/132/33 kV Substation with priority C and B, the Team shall determine the voltage violation on the power flow analysis and study the appropriateness as Japan's Grant Aid Scheme in consultation with JICA and the Ministry of Foreign Affairs in Japan.

1.4 Obligations / Undertakings of the Nigerian side for the Project

(1) Preconditions

- TCN agreed to secure, clear and level the land space of the proposed substations for the Project as shown in the drawing L-01 and L-03 in accordance with agreement on M/D signed on 19th November, 2014.
- TCN agreed to obtain permission or consent from related authorities for power outage during the period of necessary construction work by the Japanese side.
- TCN agreed to ensure the earth resistance value with less than 1(one) ohm in case of the value with over 1(one) ohm on the existing earthing system.

(2) Necessary Inputs by the Nigerian side

1) Prior to the Commencement of the Construction Work

- For Apo 132/33 kV Substation (Refer to the drawing L-01 and L-02):
  - TCN agreed to secure the space for the installation of LV and control cables for the

Project in the existing cable pit.

- ✧ TCN agreed to relocate the existing outdoor lighting pole between busbars before commencement of the installation work by the Japanese side.
- ✧ TCN agreed to secure the place in the control building where the panels will be installed.
- ✧ TCN agreed to provide the power supply (DC110 V and AC415-240 V (3-phase)) to the panel which will be installed by the Project.
- ✧ TCN agreed to secure sites for temporary storage yard for the Project inside the Substation.

➢ For Keffi 132/33 kV Substation (Refer to the drawing L-03 and L-04):

- ✧ TCN agreed that the Japanese side shall install 132kV underground cable from existing 132kV switchyard to the yard for capacitor bank.
- ✧ TCN agreed to relocate the existing outdoor lighting pole before commencement of the installation work by the Japanese side.
- ✧ TCN agreed to secure places in the control building where the panels and batteries will be installed.
- ✧ TCN agreed to provide the power supply (AC415-240 V (3-phase)) from the existing LV panel to the panel which will be installed by the Project.
- ✧ TCN agreed to secure sites for temporary storage yard for the Project inside the Substation.

2) During the Construction Work

➢ For Apo 132/33 kV Substation

- ✧ TCN agreed that Japanese side shall install the overhead grounding wire between the existing one gantry and the other existing gantry above the capacitor bank.
- ✧ TCN agreed to temporarily remove the 132 kV overhead connecting line between Transformer No.1 bay and Transformer No.2 bay when the heavy vehicle will transport equipment enter into the site, if necessary.

➢ For Keffi 132/33 kV Substation:

- ✧ TCN agreed that Japanese side shall install the overhead grounding wire between the existing gantries and the new gantry.

➢ TCN agreed to schedule power outages required for installation work for the Project and carry out them in timely manner. TCN shall also manage any issue concerning the power

outages, including related procedures, and compensation to and grievances from customers (DISCO).

3) After the Commencement of Operation

➢ TCN agreed to operate and maintain the equipment properly.

2. Technical requirements confirmed in the First Field Survey

2.1 Technical requirements for the equipment of the substation for the Project

(1) Applicable Codes and Standards

The equipment of Substation Facilities of the Project shall be designed in accordance with IEC, JIS, JEC, JEM standards and/or equivalent.

(2) Design Condition for the equipment of the substations

Table 2.-1-1 indicates the electrical systems and design conditions applied to the Project.

Table 2.1-1 Electrical Systems and Design Conditions

Item		Substation system
Frequency		50 Hz
Phase		3-phase
Maximum voltage		145 kV
Nominal voltage		132 kV
Lightning impulse withstand voltage		650 kV
Power-frequency withstand voltage		275 kV
Grounding system		Direct
Phase to Earth wire (minimum distance)[1]		1,200 mm
Phase to Phase (minimum distance)[2]		2,400 mm
System voltage		
Voltage level [kV]	Minimum voltage [kV] (pu)	Maximum Voltage [kV] (pu)
132	118.8 (0.90)	145.0 (1.098)
System frequency		
Nominal frequency [Hz]	Minimum frequency [Hz] (pu)	Maximum frequency [Hz] (pu)
50	48.75 (0.975)	51.25 (1.025)

(3) Requirements for the equipment of the substations

The items and their specifications of the equipment procured by the Japanese side are shown in Table 2.1-2 and Table 2.1-3. Single Line Diagram for the equipment is shown in the drawing E-01 and E-02.

[1] Refer to P.64(NERC Regulation 2014)

[2] Refer to P.64(NERC Regulation 2014)

Table 2.1-2 Items and Specification of Equipment to be supplied for Apo 132/33 kV Substation

No.	Description	Specifications	Q'ty
AP-1	**132 kV Gas Circuit Breaker**		**1 set**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Three-pole, outdoor use porcelain (creepage distance shall be designed as Equivalent Salt Deposit Density(ESDD) is 0.03 mg/cm^2)	
	➢ Rated voltage	145 kV or higher	
	➢ Rated current	1,250 A or higher	
	➢ Rated breaking current	31.5 kA or higher	
	➢ CB operating sequence	O - 0.3 sec. – CO – 3 min. CO	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	➢ Control voltage	DC110 V, AC415 (3-phase) –AC240V (Single-phase)	
AP-2	**132 kV Line Switch**		**2 sets**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Three-pole, single-throw, outdoor use, horizontal double break rotating and insulator type (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Rated voltage	145 kV or higher	
	➢ Rated current	1,250 A or higher	
	➢ Short-time withstand current	31.5 kA or higher	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	➢ Control voltage	DC110 V	
AP-3	**132 kV Line Switch with earthing devise**		**1 set**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Three-pole, single-throw, outdoor use, horizontal double break rotating and insulator type (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Rated voltage	145 kV or higher	
	➢ Rated current	1,250 A or higher	
	➢ Short-time withstand current	31.5 kA or higher	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	➢ Control voltage	DC110 V	
	➢ Mechanical earthing device	Available	
AP-4	**132 kV Current Transformer**		**3 sets**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Outdoor use, single phase, oil-filled porcelain type or bushing type (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Highest system voltage	145 kV	
	➢ Core number	3 cores/phase	
	➢ Rated primary current	600 A	
	➢ Rated secondary current	1/1/1 A	
	➢ Tolerances	Core 1: Class 1.0 Core 2, 3: 5P20	
	➢ Rated burden	30 VA or higher	
	➢ Rated short-time current	25 kA (2 sec.) or higher	
	➢ Lightning impulse withstand voltage	650 kV or higher	

No.	Description	Specifications	Q'ty
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
AP-5	**132 kV Condenser type voltage transformer**		**3 sets**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Outdoor use, single phase, oil-filled porcelain type or bushing type (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Highest system voltage	145 kV	
	➢ Secondary circuits number	2 (Circuit 1: Metering, Circuit 2: Protection)	
	➢ Rated primary voltage	132/$\sqrt{3}$ kV	
	➢ Rated secondary current	110/$\sqrt{3}$ V (Both of 2 circuits)	
	➢ Tolerances	Core 1: Class 0.5 Core 2, 3: 3P	
	➢ Rated burden	100 VA or higher (Both of 2 circuits)	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
AP-6	**132 kV Lighting arrester**		**3 sets**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Outdoor use, Metal oxide without gap type, single phase (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Rated voltage	120 kV	
	➢ Rated discharge current	10 kA	
AP-7	**132 kV Capacitor bank**		**1 lot**
	➢ Standard	JEC, JIS, IEC or equivalent	
	➢ Type	Outdoor use (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Rated equipment	3-phase, 50 Hz, 132 kV	
	➢ Rated capacity	60 MVar (1 group)	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	(1) Power capacitor		
	➢ Rated phase voltage	81.2 kV (Single phase)	
	➢ Rated total capacity	63.8 MVar	
	(2) Series reactor		
	➢ Rated voltage	4860*/$\sqrt{3}$ V (3-phase)	
	➢ Reactance	6% of the power capacitor reactance	
	➢ Lightning impulse withstand voltage	400 kV or higher(reduced by lightning arrester)	
	➢ Power frequency withstand voltage (1 min.)	160 kV or higher(reduced by lightning arrester)	
	(3) Discharging coil		
	➢ Rated voltage	To be specified	
	➢ Total discharge capacity	63.8 MVar or higher	
	➢ Secondary voltage	110 V	
	➢ Secondary capacity	100 VA	
	➢ Allowable transformer ratio error	+/-1.0%	
	(4) Insulation transformer		
	➢ Primary voltage	110 V (Single phase)	
	➢ Secondary voltage	To be specified	
	➢ Secondary capacity	600 VA (100 VA x 6 units)	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	➢ Allowable transformer ratio error	+/-1.0%	
	(5) Lighting arrester		

No.	Description	Specifications	Q'ty
	➢ Type	Metal oxide without gap type	
	➢ Rated voltage	98 kV	
	(6) Insulated mounting structure		
	➢ Rated voltage	132 kV	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
AP-8	**132 kV Busbar, steel structures for busbars, insulators and other materials**		**1 lot**
	(1) 132 kV busbar		
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Conductor	Hard drawn standard wire (HDCC)	
	(2) Steel structures for busbars		
	➢ Standard	JIS or equivalent	
	➢ Size	Width: 14 m, height: 10 m	
	➢ Material	Galvanized steel	
	(3) Strain insulators for 132 kV busbars		
	➢ Standard	JIS or equivalent	
	➢ Type	Porcelain (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	(4) 132 kV Overhead conductors		
	➢ Standard	JIS or equivalent	
	➢ Material	ACSR	
	(5) Post insulators for 132 kV busbars		
	➢ Standard	JIS or equivalent	
	➢ Type	Porcelain (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	(6) Grounding wire		
	➢ Standard	JIS or equivalent	
	➢ Material	Galvanized iron-wire	
	(7) Other materials		
AP-9	**Substation earthing**		**1 lot**
	➢ Materials	Earthing conductors (copper wire) and terminals	
	➢ Earthing resistance	Less than 1 ohm	
AP-10	**Protection panel for 132 kV capacitor bank**		**1 panel**
	(1) Protection function		
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Indoor use, metal enclosed self–standing type	
	➢ Control voltage	DC110 V, AC 240 V (Single phase)	
	➢ Relay	- Under voltage relay - Over voltage relay - Voltage balance relay	
	➢ Alarming system	- Static temperature switch - Static internal faulty detecting device	
AP-11	**Control panel for 132 kV line**		**1 panel**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Indoor use, metal enclosed self–standing type	
	➢ Control voltage	DC110 V, AC415 (3-phase) –AC240V (Single-phase)	
	➢ Relay	- Overcurrent relay (Instant, time lagging)	
	➢ Metering indication	- Current, voltage and reactive power	
AP-12	**LV cable and materials**		**1 lot**
	➢ Low voltage cables	600 V power cables and control cables	
	➢ Cabling materials	Conduits, cable racks and others	
	➢ Fire-protection kit	Prevent the building from outdoor fire through cable pits	

Table 2.1-3 Items and Specification of Equipment to be supplied for Keffi 132/33 kV Substation

No.	Description	Specifications	Q'ty
KF-1	**132 kV Gas Circuit breaker**		**1 set**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Three-pole, outdoor use porcelain (creepage distance shall be designed as Equivalent Salt Deposit Density(ESDD) is 0.03 mg/cm^2)	
	➢ Rated voltage	145 kV or higher	
	➢ Rated current	1,250 A or higher	
	➢ Rated breaking current	31.5 kA or higher	
	➢ CB operating sequence	O - 0.3 sec. – CO – 3 min. CO	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	➢ Control voltage	DC110 V, AC415 (3-phase) –AC240V (Single-phase)	
KF-2	**132 kV Line Switch**		**1 set**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Three-pole, single-throw, outdoor use, horizontal double break rotating and insulator type (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Rated voltage	145 kV or higher	
	➢ Rated current	1,250 A or higher	
	➢ Short-time withstand current	31.5 kA or higher	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	➢ Control voltage	DC110 V	
KF-3	**132 kV Line Switch with earthing devise**		**1 set**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Three-pole, single-throw, outdoor use, horizontal double break rotating and insulator type (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Rated voltage	145 kV or higher	
	➢ Rated current	1,250 A or higher	
	➢ Short-time withstand current	31.5 kA or higher	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	➢ Control voltage	DC110 V	
	➢ Mechanical earthing device	Available	
KF-4	**132 kV Current Transformer**		**3 sets**
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Outdoor use, single phase, oil-filled porcelain type or bushing type (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Highest system voltage	145 kV	
	➢ Core number	3 cores/phase	
	➢ Rated primary current	300 A	
	➢ Rated secondary current	1/1/1 A	
	➢ Tolerances	Core 1: Class 1.0 Core 2, 3: 5P20	
	➢ Rated burden	30 VA or higher	
	➢ Rated short-time current	25 kA (2 sec.) or higher	
	➢ Lightning impulse withstand voltage	650 kV or higher	

No.	Description	Specifications	Q'ty
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
KF-5	**132 kV Lighting arrester**		3 sets
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Outdoor use, Metal oxide without gap type, single phase (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Rated voltage	120 kV	
	➢ Rated discharge current	10 kA	
KF-6	**132 kV Capacitor bank**		1 lot
	➢ Standard	JEC, JIS, IEC or equivalent	
	➢ Type	Outdoor use (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	➢ Rated equipment	3-phase, 50 Hz, 132 kV	
	➢ Rated capacity	25 MVar (1 group)	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	(1) Power capacitor		
	➢ Rated phase voltage	81.2 kV (Single phase)	
	➢ Rated total capacity	26.6 MVar	
	(2) Series reactor		
	➢ Rated voltage	4860*$\sqrt{3}$ V (3-phase)	
	➢ Reactance	6% of the power capacitor reactance	
	➢ Lightning impulse withstand voltage	400 kV or higher(reduced by lightning arrester)	
	➢ Power frequency withstand voltage (1 min.)	160 kV or higher(reduced by lightning arrester)	
	(3) Discharging coil		
	➢ Rated voltage	To be specified	
	➢ Total discharge capacity	26.6 MVar or higher	
	➢ Secondary voltage	110 V	
	➢ Secondary capacity	100 VA	
	➢ Allowable transformer ratio error	+/-1.0%	
	(4) Insulation transformer		
	➢ Primary voltage	110 V (Single phase)	
	➢ Secondary voltage	To be specified	
	➢ Secondary capacity	600 VA (100 VA x 6 units)	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
	➢ Allowable transformer ratio error	+/-1.0%	
	(5) Lighting arrester		
	➢ Type	Metal oxide without gap type	
	➢ Rated voltage	98 kV	
	(6) Insulated mounting structure		
	➢ Rated voltage	132 kV	
	➢ Lightning impulse withstand voltage	650 kV or higher	
	➢ Power frequency withstand voltage (1 min.)	275 kV or higher	
KF-7	**132 kV Busbar, steel structures for busbars, insulators and other materials**		1 lot
	(1) 132 kV busbar		
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Conductor	Hard drawn standard wire (HDCC)	
	(2) Steel structures for busbars		
	➢ Standard	JIS or equivalent	
	➢ Size	Width: 14 m, height: 10 m	
	➢ Material	Galvanized steel	

No.	Description	Specifications	Q'ty
	(3) Post insulators for 132 kV busbars		
	➢ Standard	JIS or equivalent	
	➢ Type	Porcelain (Creepage distance shall be designed as ESDD is 0.03 mg/cm^2)	
	(4) 132 kV Overhead conductors		
	➢ Standard	JIS or equivalent	
	➢ Material	ACSR or equivalent	
	(5) 132 kV Cable termination		
	➢ Type	Outdoor termination	
	(6) 132 kV Underground cable		
	➢ Type	XLPE	
	➢ Conductor	Copper	
	➢ Core	Single	
	➢ Seethe type	Ant-proof PVC	
	➢ Seethe color	Black	
	➢ Armor	Aluminum for direct burial or lead seethe	
	(7) Grounding wire		
	➢ Standard	JIS or equivalent	
	➢ Material	Galvanized iron-wire	
	(8) Other materials		
KF-8	**Substation earthing**		1 lot
	➢ Materials	Earthing conductors (copper wire) and terminals	
	➢ Earthing resistance	Less than 1 ohm	
KF-9	**Protection panel for 132 kV capacitor bank**		1 panel
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Indoor use, metal enclosed self –standing type	
	➢ Control voltage	DC110 V, AC 240 V (Single phase)	
	➢ Relay	- Under voltage relay - Over voltage relay - Voltage balance relay	
	➢ Alarming system	- Static temperature switch - Static internal faulty detecting device	
KF-10	**Control panel for 132 kV line**		1 panel
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Indoor use, metal enclosed self –standing type	
	➢ Control voltage	DC110 V, AC415 (3-phase) –AC240V (Single-phase)	
	➢ Relay	- Overcurrent relay (Instant, time lagging)	
	➢ Metering indication	- Current, voltage and reactive power	
KF-11	**DC power supply system**		1 lot
	➢ Standard	IEC, JEC, JIS, JEM or equivalent	
	➢ Type	Indoor use, metal enclosed thyristor type	
	➢ System	One charger	
	➢ Input	AC240 V (Single-phase)/AC415 V (three-phase) +/-10%	
	➢ Output	110V (+/-3%)	
	➢ Rated current	80 A	
	➢ Batteries	Lead-acid battery with control valves or equivalent, 450 Ah/10 hrs, 54 cells	
	➢ DC output circuits number	3 or higher	
KF-12	**LV cable and materials**		1 lot
	➢ Low voltage cables	600 V power cables and control cables	
	➢ Cabling materials	Conduits, cable racks and others	
	➢ Fire-protection kit	Prevent the building from outdoor fire through cable pits	

2.2 Technical requirements for the facilities of the substation of the Project

(1) Design Conditions for the Substation Facilities

The design conditions for the substation facilities are shown in the following Table 2.1.2-1.

Table 2.2-1 Basic Conditions for the Facility Design of the Project

Items		Values in Apo Substation	Values in Keffi Substation
Altitude		483 m	314 m
Ambient Temperature (Daily)	Maximum	36.0 Degree Celsius	
	Minimum	19.1 Degree Celsius	
	Mean	27.0 Degree Celsius	
Maximum Wind Velocity	(Sustained)	33.5 m/sec	
Annual Rain Fall		1,221 mm	
Seismic Force		Not Applicable	

(2) Requirements for the Substation Facilities

1) Foundation of Capacitor Bank

The Outline for the Foundation of Capacitor Bank is shown in Table 2.2-2. Foundations shall be placed in two (2) places.

Ground floor level should be +0.5 m from the design ground level.

Table 2.2-2 Outline for the Foundations of Capacitor Bank

Items	Contents	Details
Structure	Reinforced Concrete Mat Foundation	-
Height of story	1 story	GF:Space for 1 unit Reactor, 3 units of Lighting Arrestors, 6 units of Insulating Transformers, and 3 units of Capacitors [Note] For the equipment to avoid submerging to water on heavy rainy days, the floor level of the foundations shall be 0.5 m raised from the design ground level. Anchor Bolt and insert base: In order to fix each equipment anchor bolt and insert base must put in position Earthing Wire (36) 22mm² - 100 mm² earthing wire for each equipment must in place Control Cable Outlet (7) the control cables to 6 Insulating Transformers, and 1 Reactor must go through the foundation and bundled in one place
Total Floor Area	Approx. 300 m² (20m x 15m) in Apo Substation and 187 m² (17m x 11m) in Keffi Substation	At installation point (Anchor Bolt and insert base) foundation must bear load from each equipment
Building Area	Approx. 300 m² and 187 m²	The foundation must bear following weight 133,000 kg in Apo substation, 97,000 kg in Keffi substation.

2) Cable Pipe

The Outline of the Cable Pipe is shown in Table 2.2-3.

Table 2.2.3 Outline of the Cable Pipes

Items	Contents
Cable Pipe (1) from Capacitor Bank in Apo Substation to Existing Cable pit	D 100 mm, Length Approx. 55.5m (Depth =0.5m) material to be confirmed
Cable Pipe (2) from Capacitor Bank in Keffi Substation to Existing Cable pit	D 100 mm, Length Approx. 50.7m (Depth =0.5m) material to be confirmed
Cable Pipe (3) from Capacitor Bank in Keffi Substation to Switch Yard	Length Approx. 48.1m (Depth =0.5m) Diameter and material to be confirmed

The function of each pipe is as follows. Cable Pipe (1) and Cable Pipe (2) are for connection to Control Room. Cable Pipe (3) is for smooth cabling from switch yard to the capacitor bank.

2.3 Procurement Plan of Spare Parts and Test Equipment

Capability of sustainable operation and maintenance for the equipment of the Project by the recipient is one of conditions for the Japan's Grant Aid Project. The Nigerian side shall keep operation and maintenance for the equipment of the Project properly by himself, including procurement of spare parts. On the other hand, the warranty period for the Project is one (1) year after issuance of the completion certificate in case of the Japan's Grant Aid Project. To secure operation and maintenance for the equipment of the Project for the warranty period, the spare parts required for the period shall be provided as the scope of the Japanese side.

Possession of maintenance tools for proper operation and maintenance for the equipment of the Project by the Recipient is one of conditions for the Japan's Grant Aid Project. However, the special tools required for operation and maintenance of the equipment of the Project shall be provided as the scope of the Japanese side.

Outline of the spare parts and test equipment of the Project is shown in Table 2.3-1 and Table 2.3-2. More detailed parts, tools, test equipment and the quantity will be explained with the Draft Final Report.

Table 2.3-1 Spare Parts List

No.	Item	Q'ty
AP-1	**132 kV Gas Circuit Breaker**	
(1)	Trip coil	1
(2)	Closing coil	1
(3)	MCCB (each type)	1
(4)	Auxiliary relay (each type)	1
AP-2	**132 kV Line Switch**	
(1)	MCCB (each type)	1
(2)	Magnetic contactor (each type)	1

No.	Item	Q'ty
(3)	Auxiliary relay (each type)	1
AP-3	**132 kV Line Switch with earthing devise**	
(1)	MCCB (each type)	1
(2)	Magnetic contactor (each type)	1
(3)	Auxiliary relay (each type)	1
AP-10	**Protection panel for 132 kV capacitor bank**	
(1)	Protection relay (each type)	1
(2)	Switch (each type)	1
(3)	Lamp (each type)	1
(4)	MCCB (each type)	1
(5)	Auxiliary relay (each type)	1
(6)	Magnetic contactor (each type)	1
AP-11	**Control panel for 132 kV line**	
(1)	Protection relay (each type)	1
(2)	Switch (each type)	1
(3)	Lamp (each type)	1
(4)	MCCB (each type)	1
(5)	Auxiliary relay (each type)	1
(6)	Magnetic contactor (each type)	1
AP-12	**LV cable and materials**	
(1)	Fire protection kit	1
KF-1	**132 kV Gas Circuit Breaker**	
(1)	Trip coil	1
(2)	Closing coil	1
(3)	MCCB (each type)	1
(4)	Auxiliary relay (each type)	1
KF-2	**132 kV Line Switch**	
(1)	MCCB (each type)	1
(2)	Magnetic contactor (each type)	1
(3)	Auxiliary relay (each type)	1
KF-3	**132 kV Line Switch with earthing devise**	
(1)	MCCB (each type)	1
(2)	Magnetic contactor (each type)	1
(3)	Auxiliary relay (each type)	1
KF-9	**Protection panel for 132 kV capacitor bank**	
(1)	Protection relay (each type)	1
(2)	Switch (each type)	1
(3)	Lamp (each type)	1
(4)	MCCB (each type)	1

No.	Item	Q'ty
(5)	Auxiliary relay (each type)	1
(6)	Magnetic contactor (each type)	1
KF-10	**Control panel for 132 kV line**	
(1)	Protection relay (each type)	1
(2)	Switch (each type)	1
(3)	Lamp (each type)	1
(4)	MCCB (each type)	1
(5)	Auxiliary relay (each type)	1
(6)	Magnetic contactor (each type)	1
KF-11	**DC power supply system**	
(1)	Protection relay (each type)	1
(2)	Switch (each type)	1
(3)	Lamp (each type)	1
(4)	MCCB (each type)	1
(5)	Auxiliary relay (each type)	1
(6)	Magnetic contactor (each type)	1
KF-12	**LV cable and materials**	
(1)	Fire protection kit	1

Table 2.3-2 Test Equipment List

No.	Item	Q'ty
MT-1	Megger	1
MT-2	Capacitance measuring device	1
MT-3	Earthing resistance tester	1
MT-4	Switchgear testing device	1

2.4 On-the-Job Training (OJT)

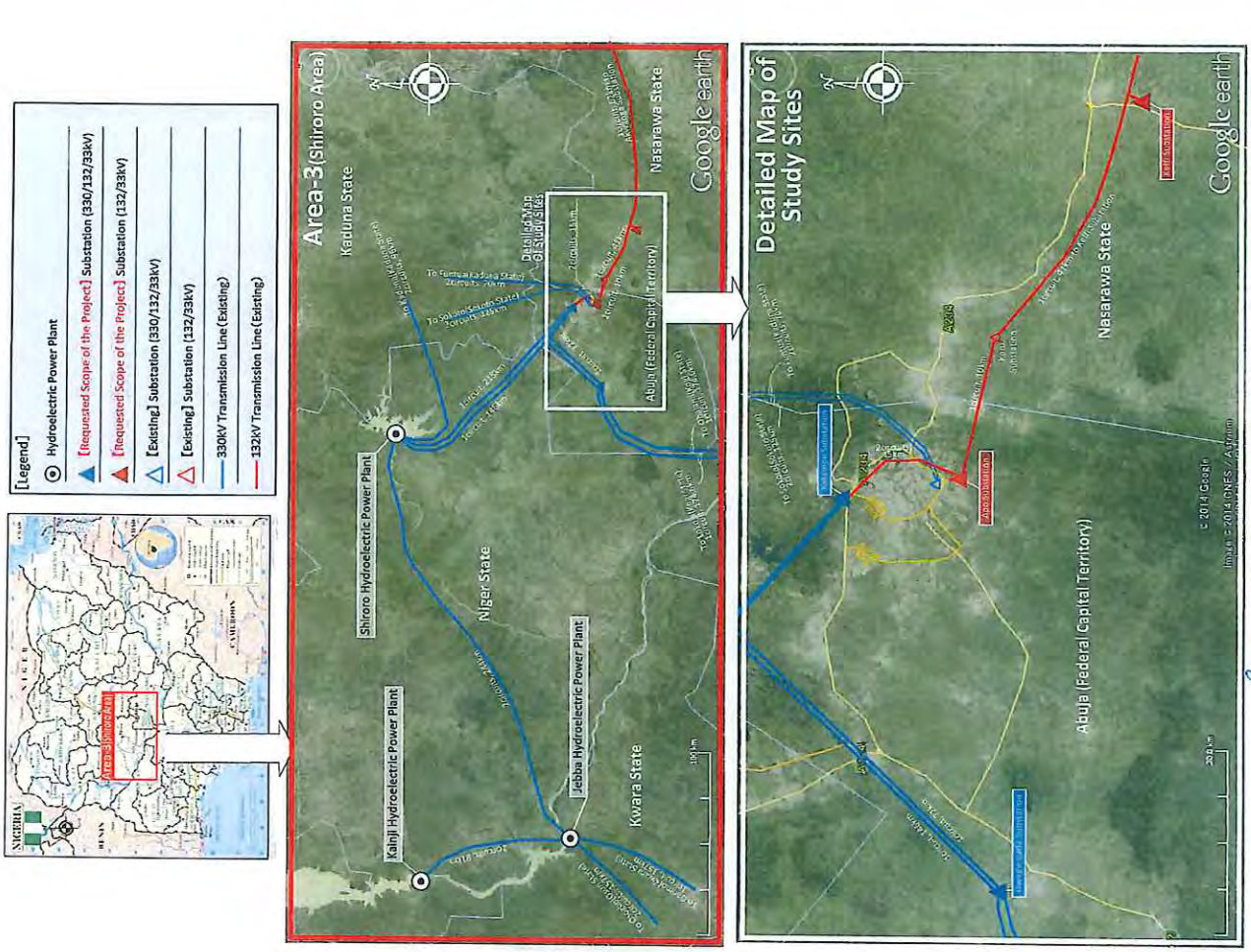
On-the-job training (OJT) will be carried out during the construction period. Through the OJT, maintenance and operation for the equipment of the Project will be carried out by Japanese skilled engineers from the manufacturers of the equipment for the Project at the project sites.

3. Tentative Implementation Schedule of the Project

The tentative implementation schedule is shown in Table-3.-1. In case that the Project is adapted by the Japanese Government, the Project will proceed as follows in the earliest scenario. It is important for both sides to understand that the tentative implementation schedule does not assume a commitment for the future implementation of the Project.

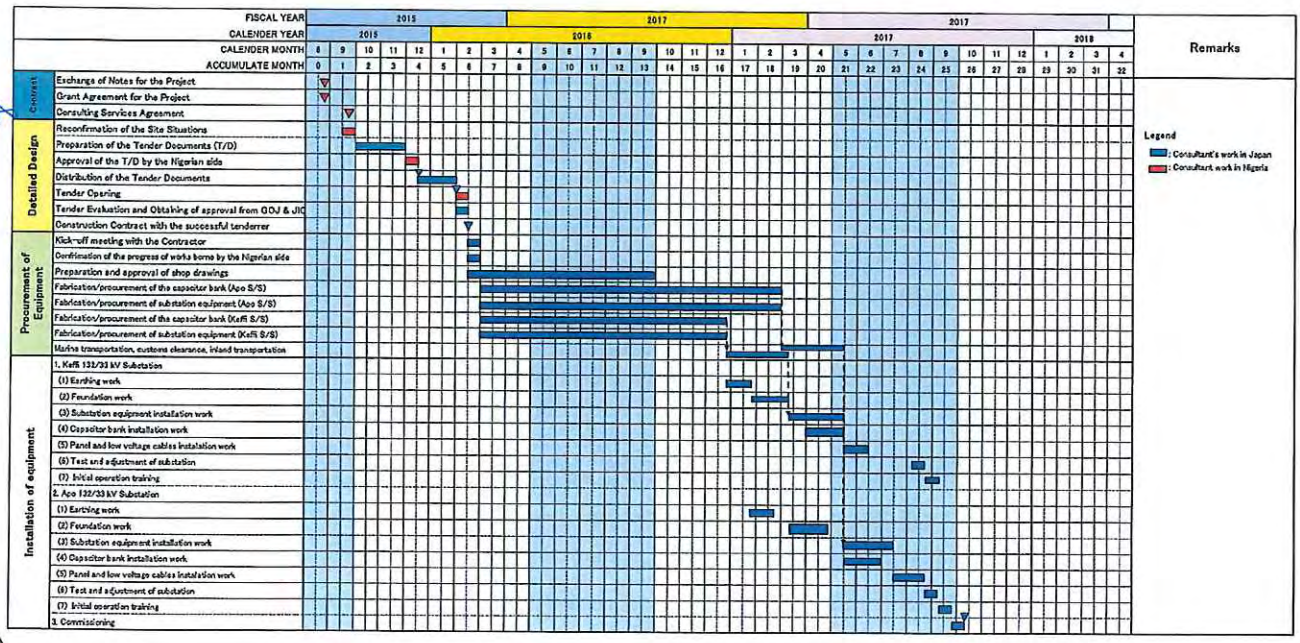
4. Drawings

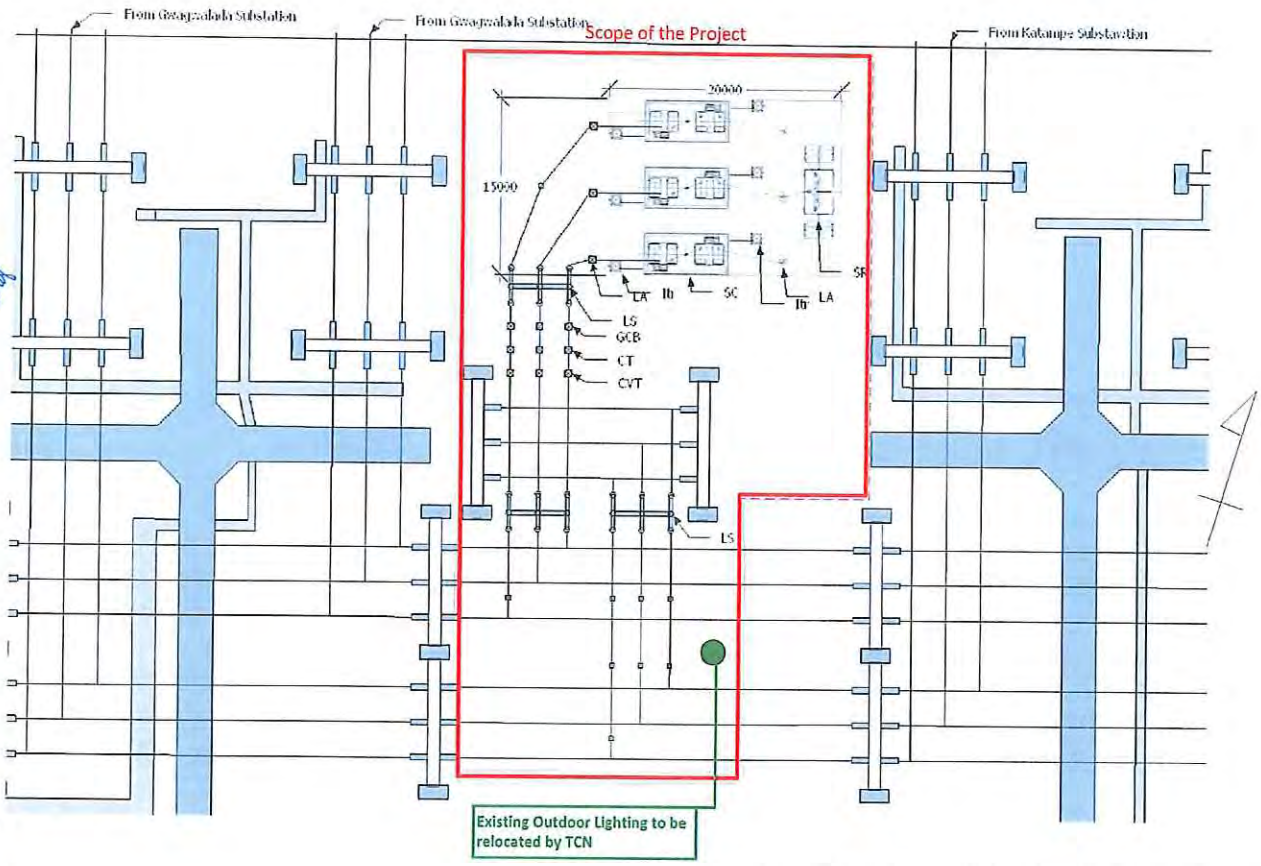
The outline drawings are followed after the Table-3.-1 Tentative Implementation Schedule.



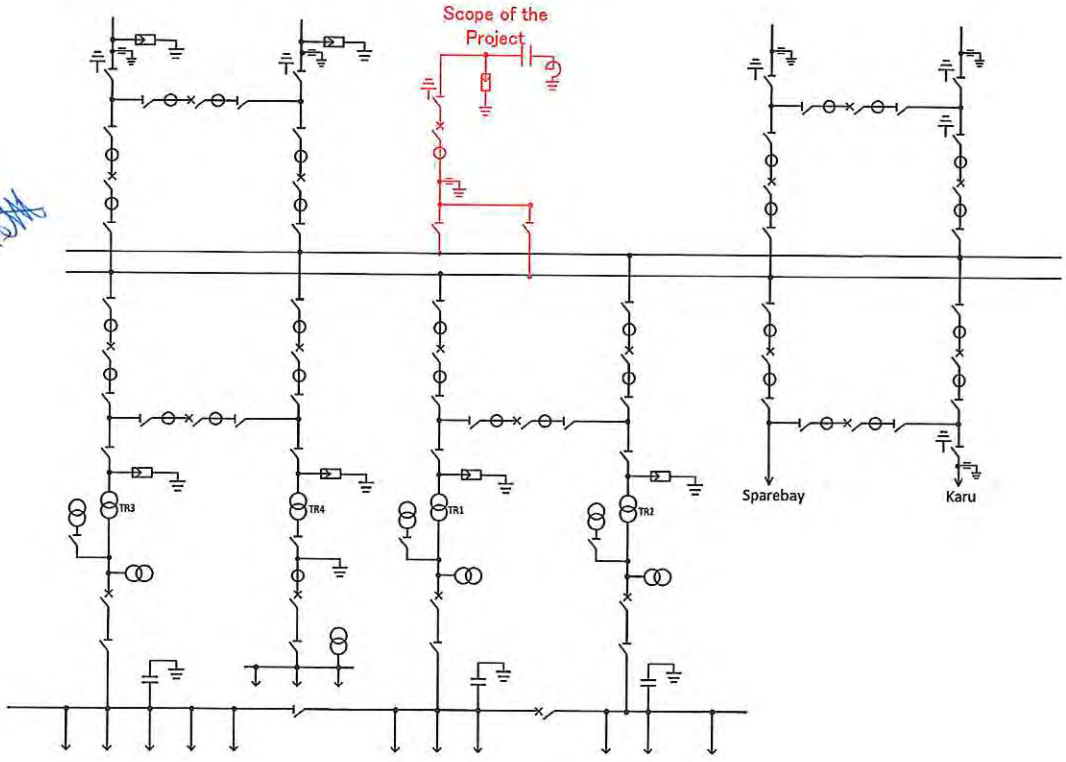
G-01 Location of the Proposed Substations for the Project

Table 3.-1 Tentative Implementation Schedule

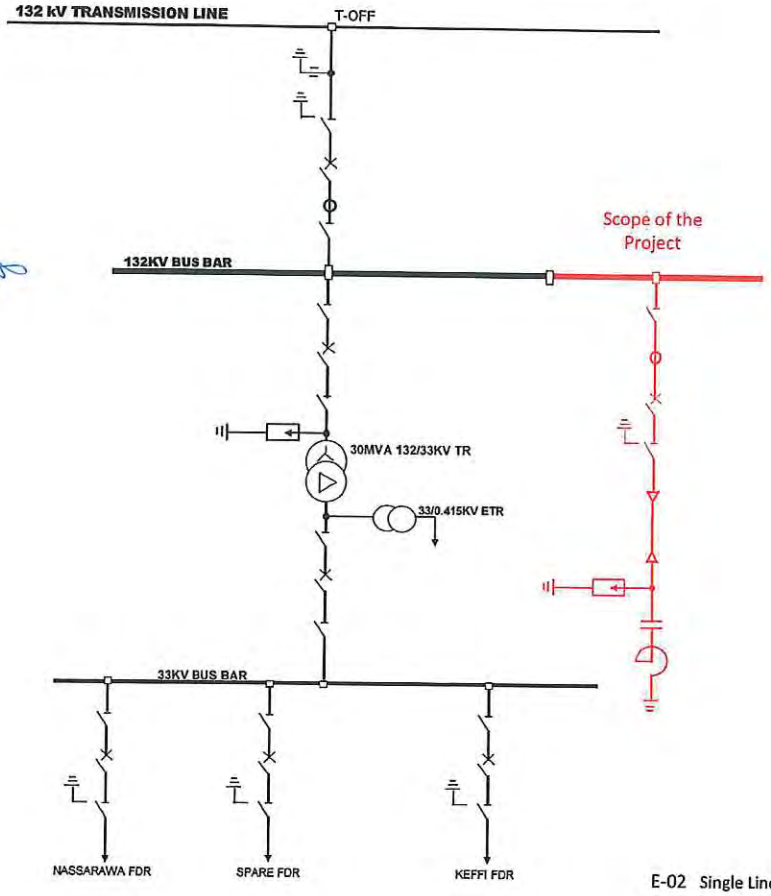




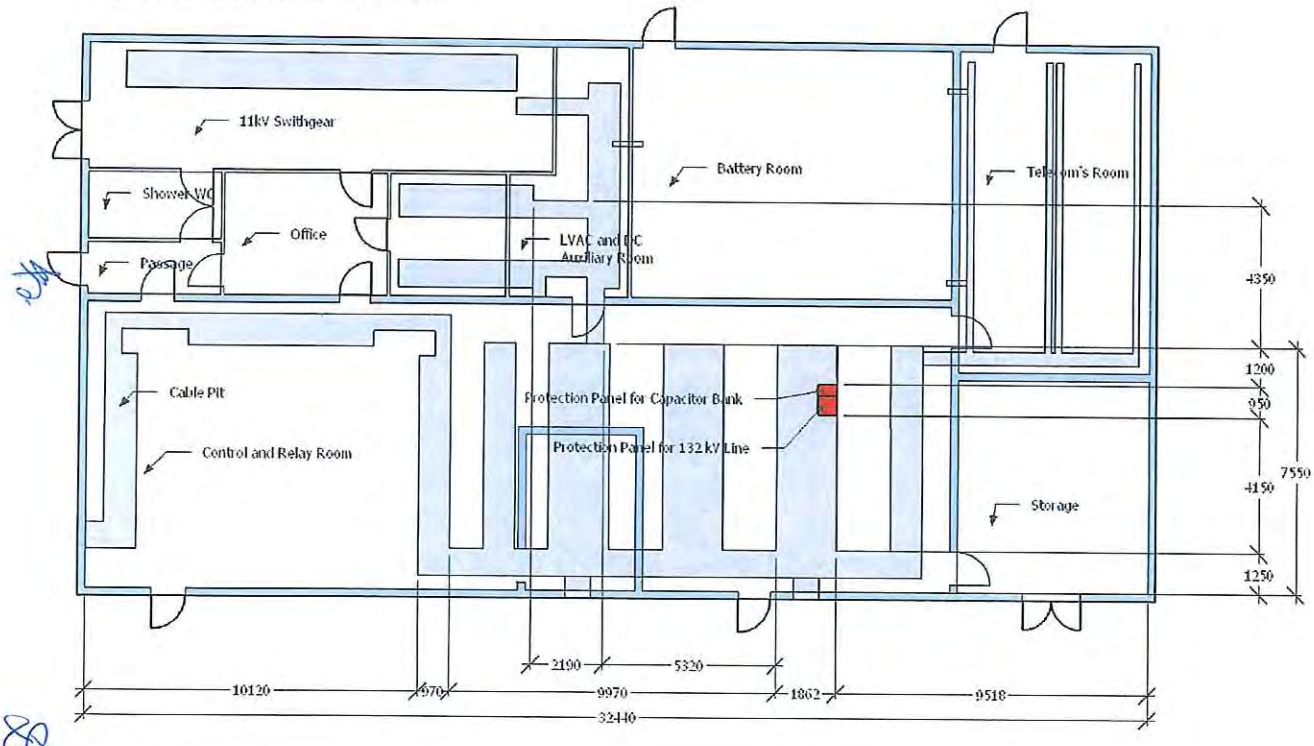
L-01 Layout Plan for Apo 132kV Switchyard (Apo Substation)



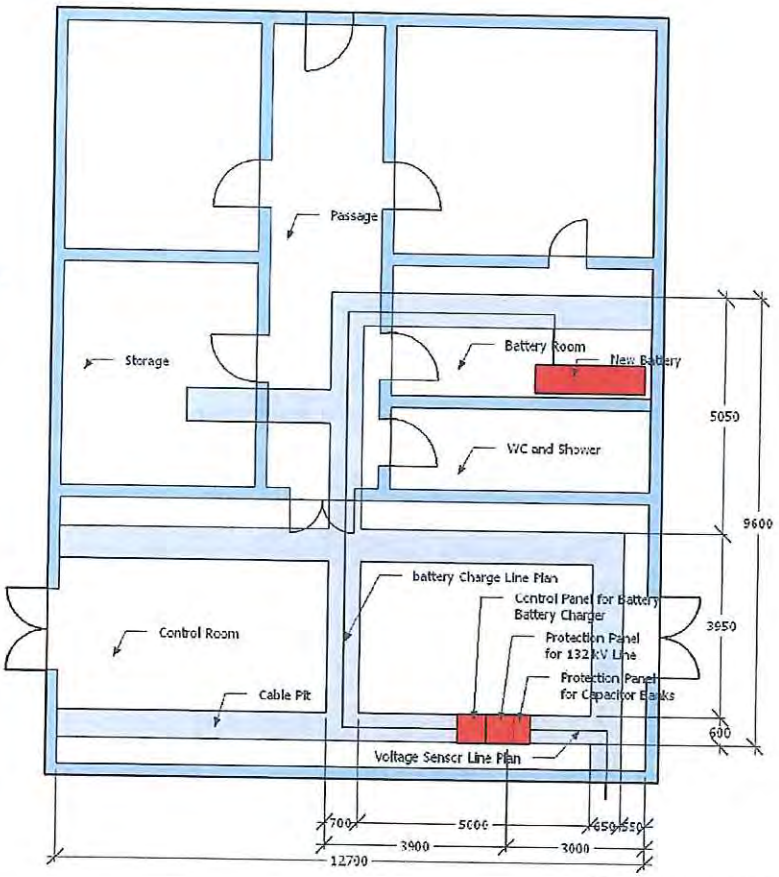
E-01 Single Line Diagram of Apo 132/33kV Substation



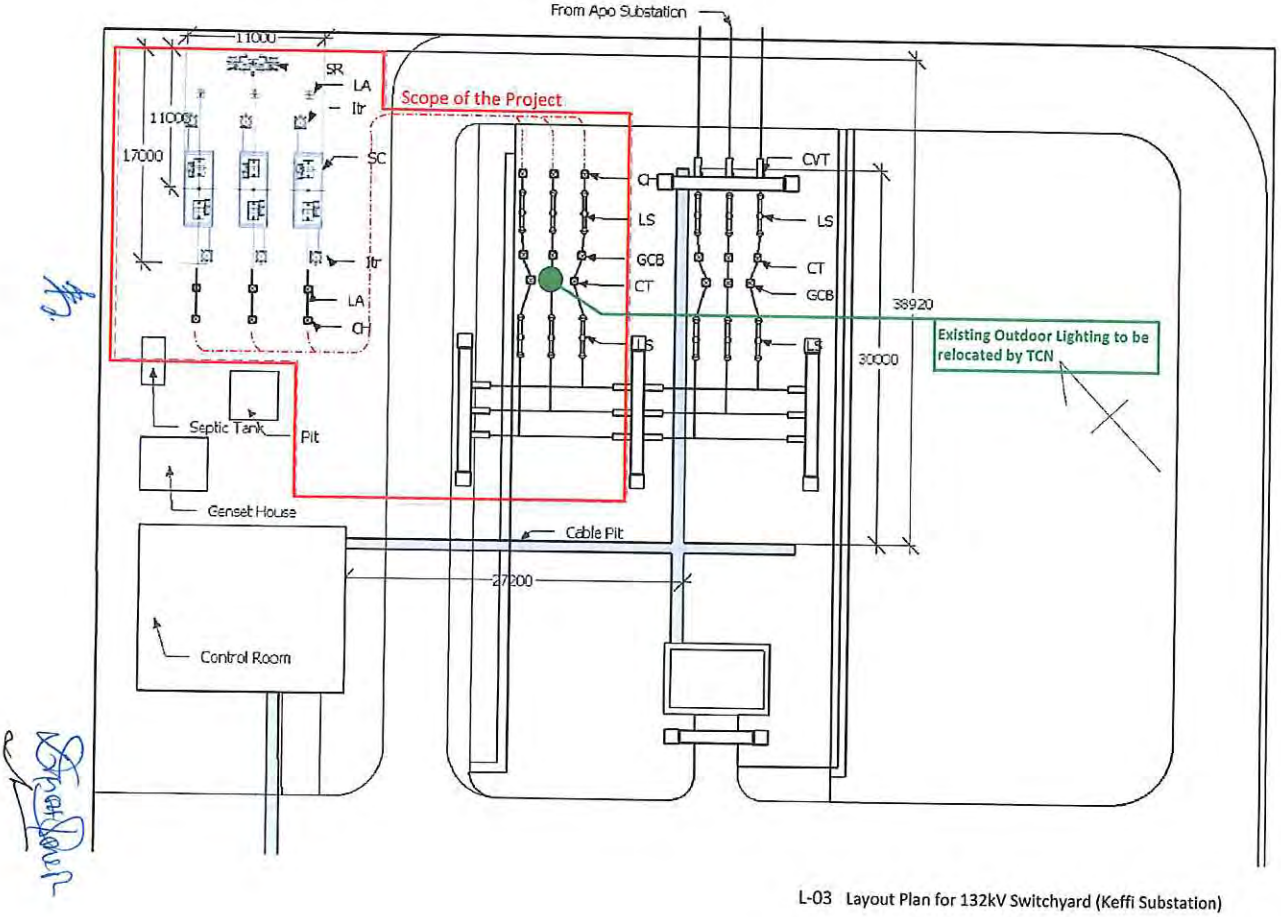
E-02 Single Line Diagram of Keffi 132/33kV Substation



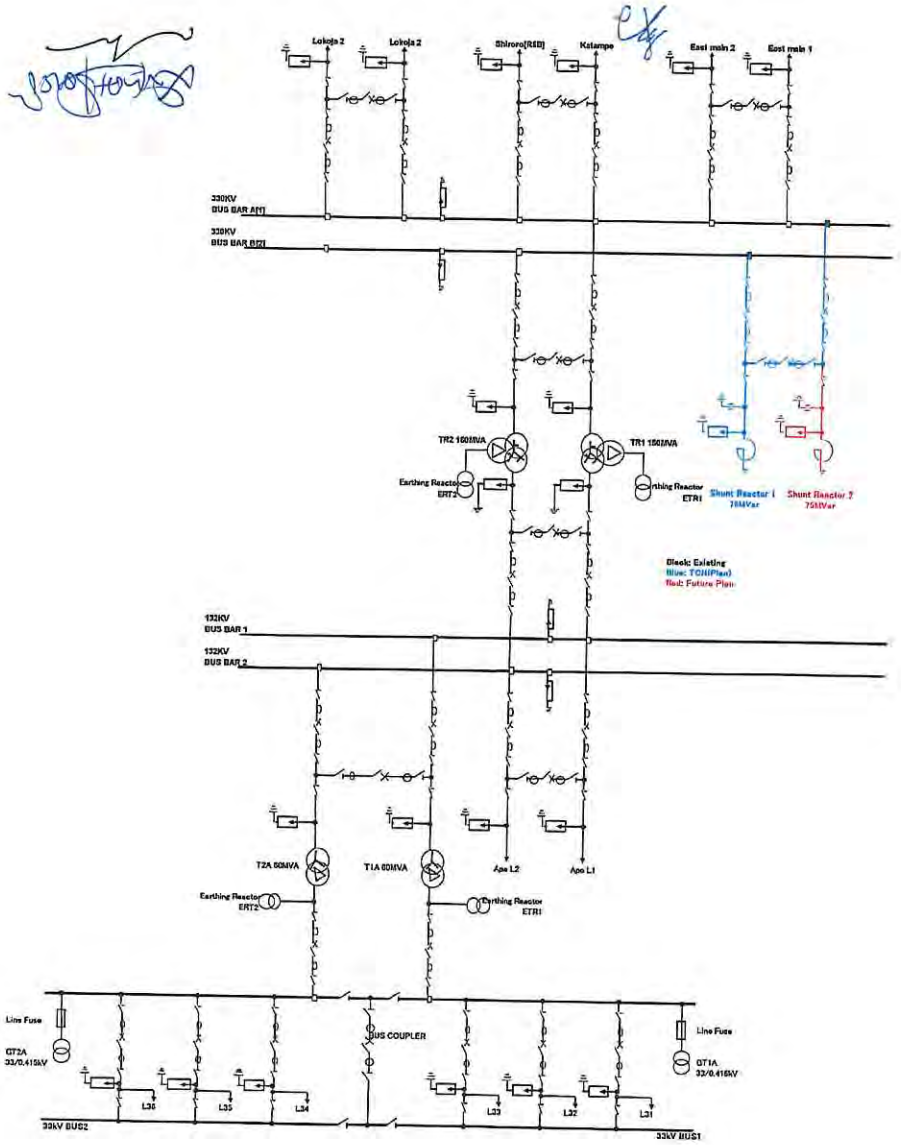
L-02 Layout Plan for Control Room (Apo Substation)



L-04 Layout Plan for Control Room (Keffi Substation)



L-03 Layout Plan for 132kV Switchyard (Keffi Substation)



E-03 Single Line Diagram of Gwagwalada 330/132/33kV Substation (For Reference)