【添付資料】

１．　調査団員・氏名

添付資料１．　調査団員・氏名

（１）第一次現地調査

氏名	担当業務	所属
杉山　茂	総括	独立行政法人国際協力機構 産業開発・公共政策部 資源・エネルギーグループ
山本　将史	計画管理	独立行政法人国際協力機構 産業開発・公共政策部 資源・エネルギーグループ
林　俊行	業務主任/電力計画	一般財団法人グローバル人材開発
近藤　和晃	副業務主任/電力計画/ 調達計画/積算	八千代エンジニヤリング株式会社
伊藤　静雄	変電設備	八千代エンジニヤリング株式会社
車田　輝雄	施設計画/基礎設計	八千代エンジニヤリング株式会社
小田　幸司	自然条件/積算	八千代エンジニヤリング株式会社
木下　信行	系統解析	八千代エンジニヤリング株式会社
岸　直矢	業務調整/電力計画補助	八千代エンジニヤリング株式会社

（２）第二次現地調査

氏名	担当業務	所属
小林　広幸	総括	独立行政法人国際協力機構 産業開発・公共政策部 資源・エネルギーグループ
早山　恒成	計画管理	独立行政法人国際協力機構 産業開発・公共政策部 資源・エネルギーグループ
林　俊行	業務主任/電力計画	一般財団法人グローバル人材開発
近藤　和晃	副業務主任/電力計画/ 調達計画/積算	八千代エンジニヤリング株式会社
明石　秀雄	変電設備	八千代エンジニヤリング株式会社
木下　信行	系統解析	八千代エンジニヤリング株式会社
岸　直矢	業務調整/電力計画補助	八千代エンジニヤリング株式会社

２．　調査行程

添付資料２．　調査行程

（１）第一次現地調査

No.	月日(曜日)	調査内容			宿泊地
		官ベース	コンサルタント		
		杉山、山本	林、近藤、伊藤、木下、岸	車田、小田	
1	11 月 20 日(日)		① 移動｛成田–香港｝		機内
2	11 月 21 日(月)		① 移動｛香港–ﾖﾊﾈｽﾌﾞﾙｸﾞ–ﾏﾌﾟﾄ｝ ② 団内協議		マプト
3	11 月 22 日(火)		① 表敬訪問及び調査説明（JICA ﾓｻﾞﾝﾋﾞｰｸ事務所）[8:30] ② 表敬訪問及び調査説明（ﾓｻﾞﾝﾋﾞｰｸ電力公社（EDM））[17:00] ③ 技術協議（EDM：①要請内容・範囲の確認、無償資金協力の仕組みの確認[17:00] ④ 技術協議（EDM：①質問票の提出と説明、各カウンターパートの確認）[17:00]		マプト
4	11 月 23 日(水)		① 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集）[8:45] ② 技術協議（EDM：グリッドコード入手、）[14:30]		マプト
5	11 月 24 日(木)		① 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集、変電所図面入手等）[9:00] ② 技術協議（EDM：PSSE データ、配電計画等の情報収集等）[8:30]		マプト
6	11 月 25 日(金)		① 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集、変電所図面入手等）[9:00] ② 現地作業事務所の確認[11:00] ③ 団内協議（コンポーネント方向性の確認）[16:00] ④ 潮流計算		マプト
7	11 月 26 日(土)		① マプト、マトラ及び郊外の状況調査（港湾、郊外の開発想定エリア、変電所、工場等）[9:00] ② データ解析（潮流計算等）		マプト
8	11 月 27 日(日)		① 資料整理 ② データ解析（潮流計算等）		マプト
9	11 月 28 日(月)		① 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集、変電所図面入手等）[9:00] ② 技術協議（EDM：PSSE データ、配電計画等の情報収集等）[8:30]		マプト
10	11 月 29 日(火)		① 既設送変配電設備調査（ﾏﾄﾗ・ｷﾞｬﾚ変電所、ﾏｼｬﾊﾞ変電所、ﾏﾄﾗ変電所、ﾎﾞｱﾝ変電所）[9:00]		マプト

No.	月日(曜日)	調査内容			宿泊地
		官ベース	コンサルタント		
		杉山、山本	林、近藤、伊藤、木下、岸	車田、小田	
11	11 月 30 日(水)		① 団内協議（コンポーネント方向性の確認）[11:00] ② 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集､変電所図面入手等）[14:00] ③ データ解析（潮流計算等）		マプト
12	12 月 1 日(木)		① 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集､変電所図面入手等）[9:00] ② 現地工事会社への見積依頼（Socigol [13:30]、Engco Investimentos [15:30]、MCC[16:00]） ③ 調査進捗説明（EDM：コンポーネント方向性、Infulene 変電所設備、移動変電所）[17:00]		マプト
13	12 月 2 日(金)		① 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集､変電所図面入手等）[9:00] ② 現地工事会社への見積依頼（Comac [10:00]） ③ 技術協議（EDM：系統解析）[11:00] ④ 調査進捗説明（JICA ﾓｻﾞﾝﾋﾞｰｸ事務所）[17:00]		マプト
14	12 月 3 日(土)		① 資料整理 ② データ解析（潮流計算等）		マプト
15	12 月 4 日(日)	① Infulene 変電所視察および調査進捗説明[11:00]			マプト
16	12 月 5 日(月)		① 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集、変電所図面入手等）[9:00] ② 技術協議（EDM：系統解析）[10:00] ③ 団内協議（M/D（案）の作成）[13:30]		マプト
		① 表敬訪問及び M/D 協議（EDM）[18:30] ・M/D 案説明 ・要請内容の確認並びに無償資金協力の仕組みの確認			
17	12 月 6 日(火)		① 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集､変電所図面入手等）[9:00] ② データ解析（潮流計算等）		マプト
		① 団内協議（M/D（案）の作成）[18:00]			
18	12 月 7 日(水)	① 表敬訪問及び M/D 協議（EDM）[8:00] ・M/D 案説明 ・要請内容の確認並びに無償資金協力の仕組みの確認			マプト
			① データ解析（潮流計算等） ② 現地調査結果概要の作成		

No.	月日(曜日)	調査内容			宿泊地
		官ベース	コンサルタント		
		杉山、山本	林、近藤、伊藤、木下、岸	車田、小田	
19	12 月 8 日(木)		① 既設送変配電設備調査(Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集、変電所図面入手等) [9:00] ② データ解析（潮流計算等） ③ 現地調査結果概要の作成		マプト
20	12 月 9 日(金)	① M/D の署名[11:00]	① 既設送変配電設備調査（Infulene 変電所：単線結線図、既設設備仕様、運転記録の収集､変電所図面入手等) [9:00] ② データ解析（潮流計算等） ③ 現地調査結果概要の作成		マプト
21	12 月 10 日(土)		① 資料整理 ② データ解析（潮流計算等）		マプト
22	12 月 11 日(日)		① 資料整理 ② データ解析（潮流計算等）		マプト
23	12 月 12 日(月)		① 技術協議（EDM：需要予測、免税措置等）[10:00] ② データ解析（潮流計算等） ③ 現地調査結果概要の作成	① 移動｛成田–香港｝	マプト 機内
24	12 月 13 日(火)		① 既設送変配電設備調査(Infulene 変電所) [9:00] ② 技術協議（EDM：他のプロジェクトの状況等）[10:00] ③ データ解析（潮流計算等） ④ 現地調査結果概要の作成	① 移動｛香港–ﾖﾊﾈｽﾌﾞﾙｸﾞ–ﾏﾌﾟﾄ｝ ② Infulene 変電所調査[13:00]	マプト
25	12 月 14 日(水)		① 技術協議（EDM：他のプロジェクトの状況等）[9:00] ② 既設送変配電設備調査（CTM 変電所）[13:00] ③ フィールドレポート案の作成 ④ データ解析（潮流計算等） ⑤ 現地調査結果概要の作成	① 現地再委託業者選定	マプト
26	12 月 15 日(木)		① 技術協議（EDM：コンポーネント確認等）[9:00] ② 既設送変配電設備調査（Infulene 変電所）[10:00] ③ フィールドレポート案協議[16:00] ④ データ解析（潮流計算等） ⑤ 現地調査結果概要の作成	① 現地再委託業者選定	マプト
27	12 月 16 日(金)		① 既設送変配電設備調査(Infulene 変電所）[10:00] ② フィールドレポート署名[13:00] ③ データ解析（潮流計算等） ④ 現地調査結果概要の作成	① 資料整理 ② 現地再委託契約	マプト
28	12 月 17 日(土)		① データ解析（潮流計算等） ② 現地調査結果概要の作成	① 現地調査結果概要の作成	マプト
29	12 月 18 日(日)		① データ解析（潮流計算等） ② 現地調査結果概要の作成	① 現地調査結果概要の作成	マプト

No.	月日(曜日)	調査内容			宿泊地
		官ベース	コンサルタント		
		杉山、山本	林、近藤、伊藤、木下、岸	車田、小田	
30	12 月 19 日(月)		① 既設送変配電設備調査(Infulene 変電所) [9:00] ② データ解析(潮流計算等) ③ 現地調査結果概要の作成	① 現地再委託業務監督 ② 現地調査結果概要の作成	マプト
31	12 月 20 日(火)		① 既設送変配電設備調査(Infulene 変電所) [9:00] ② データ解析(潮流計算等) ③ 現地調査結果概要の作成	① 移動{ﾏﾌﾟﾄ–ﾖﾊﾈｽﾌﾞﾙｸﾞ–香港}	マプト 機内
32	12 月 21 日(水)		① マプトシティカスタマーケアサービス事務所訪問[13:30] ② データ解析(潮流計算等) ③ 現地調査結果概要作成	① 移動{ドバイ–東京}	マプト
33	12 月 22 日(木)		① 既設送変配電設備調査(Infulene 変電所) [9:00] ② 現地調査結果概要作成 ③ 帰国挨拶(JICA ﾓｻﾞﾝﾋﾞｰｸ事務所) [15:00]		マプト
34	12 月 23 日(金)		① 移動{ﾏﾌﾟﾄ–ﾖﾊﾈｽﾌﾞﾙｸﾞ–香港}		機内
35	12 月 24 日(土)		① 移動{香港-成田}		帰国

（２）第二次現地調査

No.	月日（曜日）	調査内容		宿泊地
		官ベース	コンサルタント	
		小林、早山	林、近藤、明石、木下、岸	
1	4月23日（日）	① 移動{羽田–ｼﾝｶﾞﾎﾟｰﾙ–ﾖﾊﾈｽﾌﾞﾙｸﾞ}	① 移動{成田–香港–ヨハネスブルグ}	機内
2	4月24日（月）	① 移動{ヨハネスブルグ–マプト} ② 表敬訪問・調査予定の説明（JICA モザンビーク事務所）[13:30] ③ 表敬訪問・プロジェクト概要説明・MD（案）説明（鉱物資源エネルギー省（MIREME））[15:45]		マプト
3	4月25日（火）	① 表敬訪問・準備調査報告書（案）説明及び M/D（案）協議（モザンビーク電力公社（EDM））[8:30] ② 世銀プロジェクト関係者との協議[14:30] ③ EDM の財務部との協議[14:30]		マプト
4	4月26日（水）	① M/D（案）協議（EDM）[8:30] ② EDM のプロジェクト部長との協議[12:30]		マプト
5	4月27日（木）	① サイト現況確認（Infulene 変電所、Matola gale 変電所）[9:00] ② EDM 財務部長との協議[15:00] ③ M/D の署名[16:00]		マプト
6	4月28日（金）	① 帰国挨拶（JICA ﾓｻﾞﾝﾋﾞｰｸ事務所）[8:00] ② サイト現況確認（Infulene 変電所）[10:00]		マプト
7	4月29日（土）	① 移動{ﾏﾌﾟﾄ–ﾖﾊﾈｽﾌﾞﾙｸﾞ–ｼﾝｶﾞﾎﾟｰﾙ}	① 移動{ﾏﾌﾟﾄ–ﾖﾊﾈｽﾌﾞﾙｸﾞ–香港}	機内
8	4月30日（日）	② 移動{シンガポール–羽田}	① 移動{香港–成田}	帰国

３．　相手国関係者（面会者）リスト

添付資料３．　相手国関係者（面会者）リスト

所属及び氏名	職位
モザンビーク電力公社	
Electricidade de Mozambique (EDM)	
Mr. Mateus Magala	CEO
Mr. Carlos Yum	Executive Board Member
Mr. Aly Sicola Impija	Executive Board Member
Mr. Fatima Arthur	Executive Board Member
Mr. Antonio Gimo Junior	Director System Planning
Mr. Feliciano Andre Massingue	Director Transmission Network
Mr. Joaqium Ou-chim	Director Project
Mr. Geta Pery	Director Finance
Mr. Alberto R. Banze	Director Maputo City Customer Care Service
Mr. Abraao Rafael	Deputy Director Projects
Ms. Olga Utchavo	System Planning
Mr. Celso Saete	Infulene Substation Manager
Mr. Cesar Alfane	Project Manager (New Business Development)
Mr. Jose Micas	Project Manager
Mr. Claudio Dambe	Project Manager
Mr. Eduardo Zacarias Bule	Head of the Statistic and Planning Department
Mr. Felix Bucuane	Finance Directorate
Mr. Joaozinho Joao	Protection Engineer
Mr. Adriano Mandlate	Maintenance Department
Mr. Teodato Pedro Cossa	Electrical Engineer Heavy Maintenance
Ms. Rachel A. Baalessanvu	Electrical Engineer
Mr. Julio Guivala	System Planning
Mr. Gilberto Muchaya	System Planning
Mr. Faustind Edvardo	System Planning
Ms. Aissa Naimo	System Planning Environment
Mr. Sebastian Ngugulo	Transmission Planning
Ms. Yaca Cabra	Transmission Planning
Mr. Gil Vilanculo	Transmission Planning
Mr. Eltas Miambo	Operator, Boane Substation
Mr. Cristovao Novele	Lines Engineer
Mr. Andre Djive	Engineer
Mr. Guilherme Tenjua	Engineer
Ms. Ninlsa Pelembe	System Operator
Mr. Eikor Mabuie	System Operator

鉱物資源エネルギー省

Ministerio dos Recursos Minerais e Energia (MIREME)

Mr. Eugenio Simbine	National Director of Planning and Cooperation

世界銀行モザンビーク事務所

The World Bank Mozambique Office

Mr. Claudio Buque	Energy Specialist
Ms. Zayra Romo	Senior Energy Specialist

公共事業住宅省

Ministry of Public Works and Housing (MOPH)

Mr. Brito Antonio Soa	National Director
Ms. Sérgio Sitoe	Staff

JICA モザンビーク事務所

JICA Mozambique Office

須藤　勝義　氏	所長
青木　英剛　氏	次長
戸村　浩之　氏	所員

４．　協議議事録（M/D）

Minutes of Discussions
on the Preparatory Survey for the Project for
Emergency Rehabilitation of Transmission Network

Based on the several preliminary discussions between the Government of Republic of Mozambique (hereinafter referred to as "Mozambique") and the Government of Japan, Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of the Project for Emergency Rehabilitation of Transmission Network (hereinafter referred to as "the Project") to Mozambique, headed by Mr. Shigeru Sugiyama, Deputy Director General, Industry Development and Public Policy Department, JICA, from 4th to 10th December, 2016. The Team held a series of discussions with the officials of the Government of Mozambique and conducted a field survey. In the course of the discussions, both sides have confirmed the main items described in the attached sheets.

Maputo, 9th December, 2016

Mr. Shigeru Sugiyama	Dr. Mateus Magala
Leader	Chairman & CEO
Preparatory Survey Team	Electricidade de Mozambique, E.P.
Japan International Cooperation Agency	(EDM)
Japan	Mozambique

ATTACHMENT

1. Objective of the Project
   The objective of the Project is to achieve the stable power supply in Maputo metropolitan and surrounding areas through the upgrading of Infulene Substation and the procurement of a mobile substation, thereby contributing to economic development of Mozambique.

2. Title of the Preparatory Survey
   Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Emergency Rehabilitation of Transmission Network".

3. Project site
   Both sides confirmed that the site of the Project is Infulene Substation, which is shown in Annex 1.

4. Responsible authority for the Project
   Both sides confirmed the authorities responsible for the Project are as follows:

4-1. The Electricidade de Mozambique (EDM) will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be managed by relevant authorities properly and on time. The organization charts are shown in Annex 2. EDM is now under transformation process of the organization, therefore Annex 2 would be updated once new structure is authorized.

4-2. The line Ministry of the Executing Agency is the Ministerio dos Recursos Minerais e Energia (MIREME). The MIREME shall be responsible for supervising the Executing Agency on behalf of the Government of Mozambique.

5. Items requested by the Government of Mozambique
   As a result of discussions, both sides confirmed that the items requested by the Government of Mozambique are as follows:

Components		Capacity
Procurement and Installation Work at Infulene Substation		
1.	275kV Circuit Breaker (3 phases)	1 set
2.	275/66kV Transformer	250MVA × 1 unit
3.	11/0.4kV Station transformer	250kVA × 1 unit
4.	66kV Lightning Arrestor (3 phases)	1 set
5.	66kV Voltage Transformer (3 phases)	1 set
6.	66kV Current Transformer (3 phases)	1 set
7.	66kV Circuit Breaker (3 phases)	1 set
8.	66kV Disconnector (Line Switch) (3 phases)	2 sets
9.	66kV Overhead conductor (Secondary side of T2) (3 phases)	1 lot
10.	66kV Circuit Breaker (Bus coupler)	1 set
11.	66kV Disconncector (Bus coupler)	2 sets
12.	66kV Overhead conductor (Bus coupler)	1 lot
13.	Control and protection panels for T2 transformer	1 lot
14.	Foundation for equipment of the above and to be relocated	1 lot
15.	Maintenance Tools for the equipment	1 lot
16.	Spare Parts for the equipment	1 lot
Procurement Work		
1.	66/33kV Mobile Substation	20~40MVA × 1 set
2.	Maintenance Tools for the mobile substation	1 lot
3.	Spareparts for the mobile substation	1 lot

5-1. JICA will assess the feasibility of the above requested items through the survey and will report the findings to the Government of Japan. The final scope of the Project will be decided by the Government of Japan.

6. Procedures and Basic Principles of Japanese Grant

6-1. The Mozambique side agreed that the procedures and basic principles of Japanese Grant as described in Annex 3 shall be applied to the Project.
As for the monitoring of the implementation of the Project, JICA requires Mozambique side to submit the Project Monitoring Report that the form is attached as Annex 4.

6-2. The Mozambique side agreed to take the necessary measures, as described in Annex 5, for smooth implementation of the Project. The contents of the Annex 5 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report.
The contents of Annex 5 will be updated as the Preparatory Survey progresses, and eventually, will be used as an attachment to the Grant Agreement.

7. Schedule of the Survey

7-1. The Team will proceed with further survey in Mozambique until 23rd December, 2016.

7-2. An official request of the Project financing to the Government of Japan shall be submitted thorough the diplomatic channel by April, 2017.

7-3. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Mozambique in order to explain its contents around end of April, 2017.

7-4. If the contents of the draft Preparatory Survey Report is accepted and the undertakings for the Project are fully agreed by the Mozambique side, JICA will finalize the Preparatory Survey Report and send it to Mozambique around July, 2017.

7-5. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. The Mozambique side confirmed to give due environmental and social considerations during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8-2. The Project is categorized as "C" from the following considerations:
Not located in a sensitive area, nor has it sensitive characteristics, nor falls it into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant.

9. Other Relevant Issues

9-1. Upgrade of equipment

It has been agreed that the Mozambique side is responsible for renovating the equipment that is not covered by the Project whenever the necessity arises, so that the effect of the Project will be fully realized.

9-2. Further information required for the outline design of upgrading T2 transformer at Infulene Substation

The Mozambique side shall provide the following information ;

- Current capacity of 275kV busbar and 66kV busbar
- Control and relay connection diagram and available port/socket

Issue on the demarcation of the responsibility on the connection of control cables to the existing system will be discussed and concluded with the Team by 16th December, 2016.

9-3. Stoppage plan of substation equipment

At this stage, it is expected that power outage will not be required for the rehabilitation work of T2 bay; instead, the usage of some equipment will have to be stopped during the installation works as stated below:

- Replacement of 66kV bus coupler

The Mozambique side shall prepare the stoppage plan together with the Team by 16th December, 2016.

9-4. Ensuring Safety

The Team requested to the Mozambique side to secure the safety during the installation work by isolating the power supply, and providing the accurate information on the live lines in visible way. Both sides agreed to prepare safety procedure involving consultant and supplier during the implementation.

9-5. Space for the temporary storage yard, and offices for the consultant and the supplier

A space of approx. 2,500m^2 is required for the temporary storage yard, and offices for consultant and the contractor within the area of Infulene Substation.

Proposed location and needed facilities will be discussed and agreed upon between the Mozambique side and the Team.

9-6. Demarcation of responsibility on removing the existing T2 transformer and reclaiming the land

Prior to the installation of the new T2 transformer, the existing transformer has to be removed, its foundation has to be demolished, and the land has to be leveled. The Mozambique side and the Team have agreed that the work prior to the installation of the new transformer shall be conducted in line with the following demarcation.

Item	Japan Side	Mozambique side
1. Removal and transportation of the existing T2 transformer		○
2. Demolition of the existing foundation and leveling the land	○	

9-7. Upgrading plans of outgoing 66 kV feeders and their distribution substations

The Mozambique side shall submit the upgrading plans of outgoing 66 kV feeders from Infulene Substation and their distribution substations (66/33kV and/or 66/11kV) in Maputo City and Maputo Suburb areas by 16th December, 2016.

9-8. Provision of road regulation

The Team will prepare the specification of the mobile substation including its transformer capacity with the consideration of the road transportation regulation for weight applicable in Mozambique. The Mozambique side shall provide the relevant regulations to the Team by 16th December, 2016.

9-9. Provision of the answer to the remaining questionnaire

The Mozambique side shall answer to the remaining Questionnaire submitted by the Team with relevant documents by 16th December, 2016.

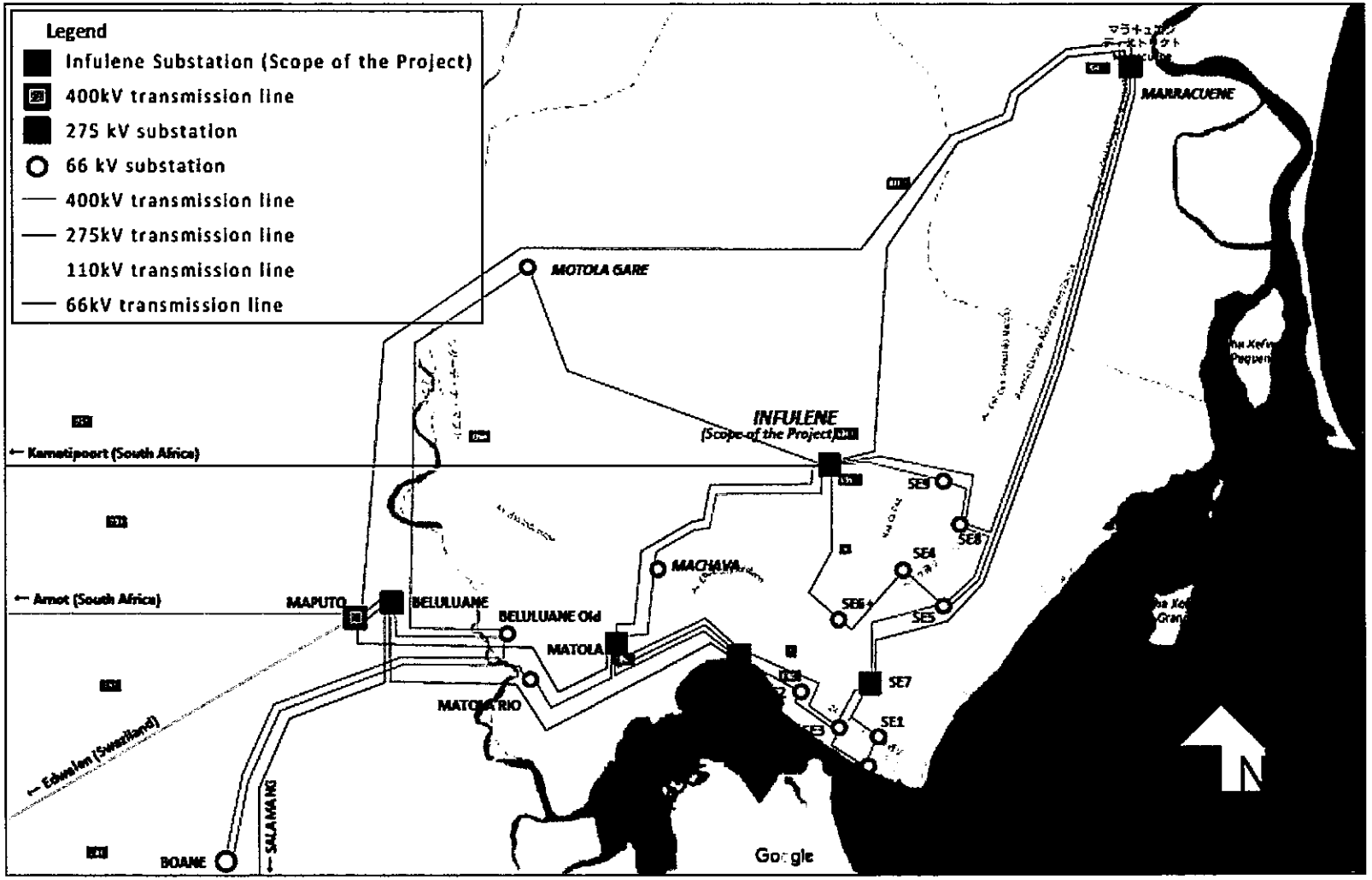
9-10. Continuing collaboration after completing the first field survey in Mozambique

After completing the first field survey in Mozambique, the Team will start analysis work to prepare the draft final report in Japan, and may have further questions to the Mozambique side to complete the draft final report. The Mozambique side has agreed to reply to such questions timely.

9-11. Submission of an official request

The Mozambique side understands that an official request needs to be submitted to the Government of Japan through diplomatic channel, for the Project to be appraised by the Government of Japan. The Mozambique side explained that it will submit the official request by April, 2017.

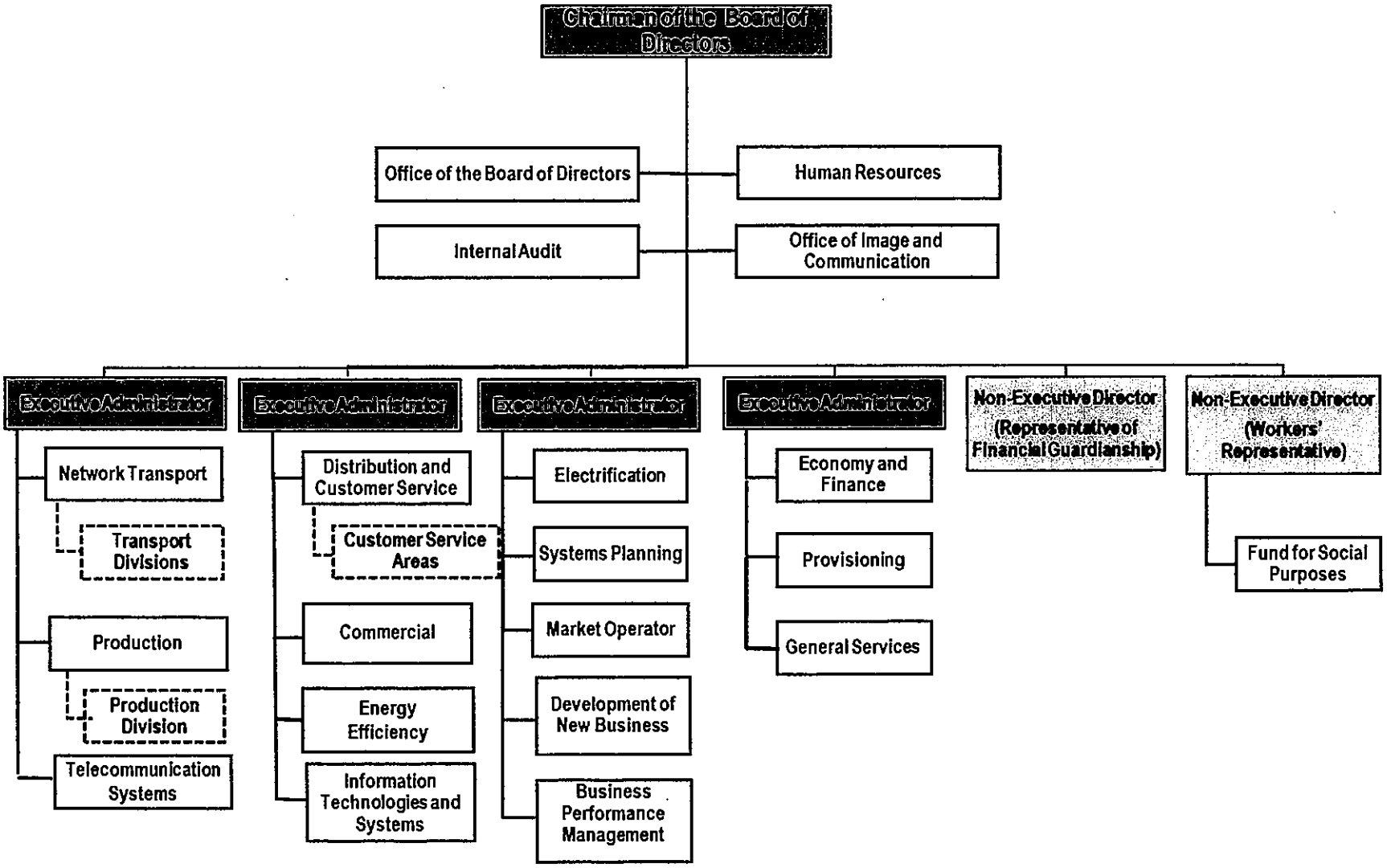
Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Japanese Grant
Annex 4 Project Monitoring Report (template)
Annex 5 Major Undertakings to be taken by the Government of Mozambique
Annex 6 PROCEDURES OF JAPANESE GRANT
Annex 7 Financial Flow of Japanese Grant (A/P Type)



[Source] Prepared by Preparatory Survey Team based on P.39, Chapter 4, Volume III, Master Plan Update Project, 2012-2027 (2014)

■ Maputo metropolitan area

Annex 2


Chairman of the Board of Directors
Office of the Board of Directors
Human Resources
Internal Audit
Office of Image and Communication
Executive Administrator
Executive Administrator
Executive Administrator
Executive Administrator
Non-Executive Director (Representative of Financial Guardianship)
Non-Executive Director (Workers' Representative)
Network Transport
Transport Divisions
Production
Production Division
Telecommunication Systems
Distribution and Customer Service
Customer Service Areas
Commercial
Energy Efficiency
Information Technologies and Systems
Electrification
Systems Planning
Market Operator
Development of New Business
Business Performance Management
Economy and Finance
Provisioning
General Services
Fund for Social Purposes

A-4-7

Annex 3

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" (Annex 6) for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the 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 necessary for the implementation of the Project.
- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take 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 executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

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

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable

to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" (Annex 7) for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) 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 to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX
20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Executing Agency	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Line Ministry	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:

2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*
Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks (*at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Major Undertakings to be taken by the Government of Mozambique

Specific obligations of the Government of Mozambique which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open bank account (B/A)	within 1 month after the signing of the G/A	EDM		
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract	EDM		
3	To secure and clear the lands for mobile substation	before notice of the bidding document	EDM		
4	To obtain the planning, zoning, building permit	before notice of the bidding document	EDM		
5	To clear, level and reclaim the project site for replacement of transformer, switchgear, and the place for the mobile substation	before notice of the bidding document	EDM		
6	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding documents	EDM		

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	EDM		
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	EDM		
	2) Payment commission for A/P	every payment	EDM		
3	To ensure prompt unloading and customs clearance at ports of disembarkation in recipient country and to assist the Supplier(s) with internal transportation therein	during the Project	EDM		
4	To accord Japanese nationals and/or physical persons of third countries 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 country of the Recipient and stay therein for the performance of their work	during the Project	EDM		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be borne by its designated authority without using the Grant	during the Project	EDM		
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	EDM		

7	To submit Project Monitoring Report	every month	EDM		
	To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	EDM		
8	To submit a report concerning completion of the Project	within six months after completion of the Project	EDM		

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	After completion of the construction	EDM		

Annex 6

PROCEDURES OF JAPANESE GRANT

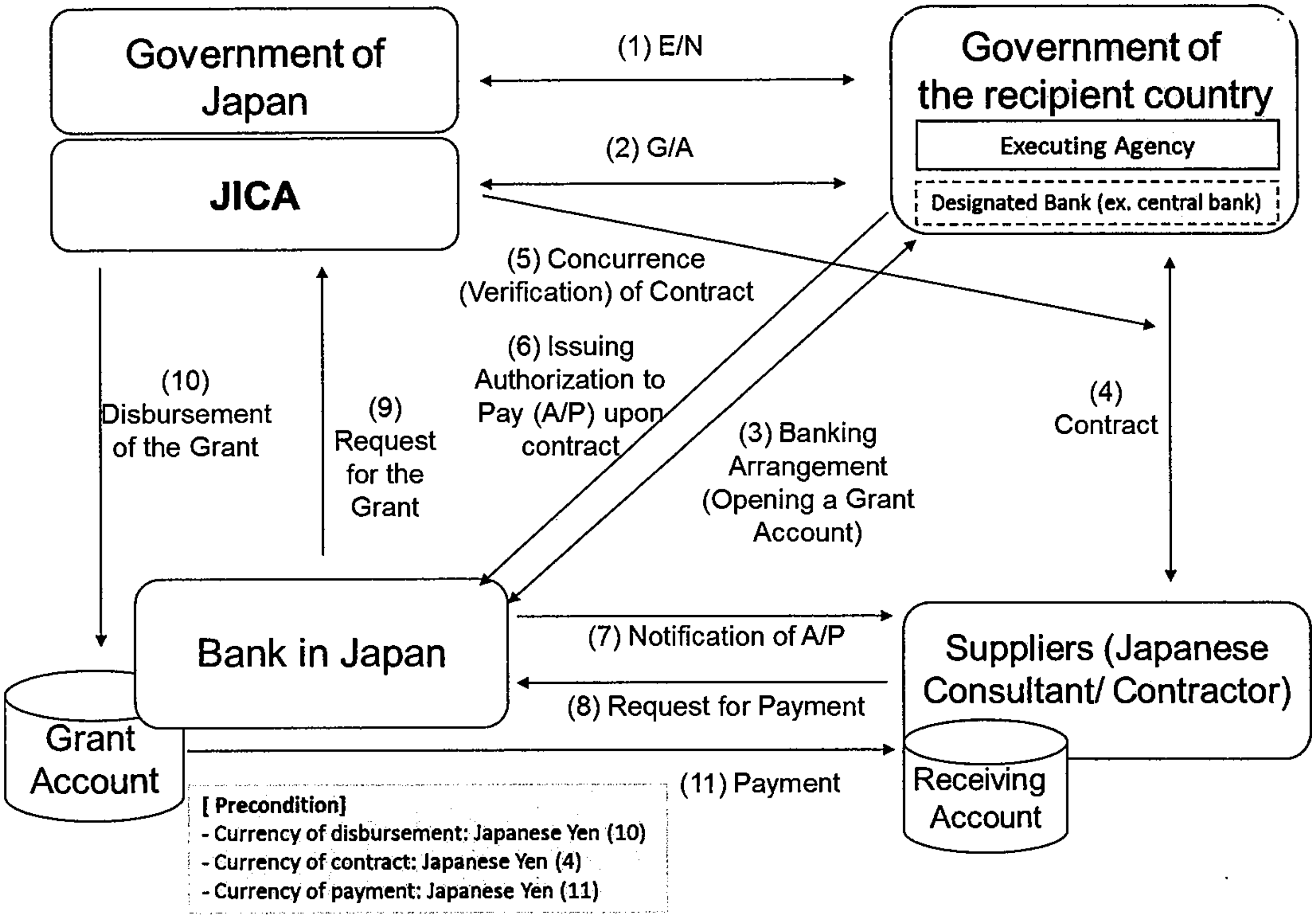
Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

notes:

1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.

Financial Flow of Japanese Grant (A/P Type)



Minutes of Discussions

on the Preparatory Survey for the Project for

Emergency Rehabilitation of Transmission Network

(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Electricidade de Moçambique, E.P (hereinafter referred to as "EDM") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 9th December 2016 and in response to the request from the Government of Republic of Mozambique (hereinafter referred to as "Mozambique") dated 25th January 2016, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Emergency Rehabilitation of Transmission Network (hereinafter referred to as "the Project"), headed by Hiroyuki Kobayashi, Deputy Director General of JICA Industrial Development and Public Policy Department from 23rd to 30th April, 2017.

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Maputo, 27th April, 2017

Mr. Hiroyuki Kobayashi
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Dr. Mateus Magala
Chairman & CEO
Electricidade de Moçambique, E.P.
(EDM)
Mozambique

Ministry of Mineral Resource and Energy
(MIREME)
Mozambique

ATTACHMENT

1. Objective of the Project

The objective of the Project is to achieve the stable power supply in Maputo metropolitan and surrounding areas through the upgrading of Infulene Substation and the procurement of a mobile substation, thereby contributing to economic development of Mozambique.

2. Title of the Preparatory Survey

Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Emergency Rehabilitation of Transmission Network".

3. Project site

Both sides confirmed that the site of the Project is Infulene Substation, which is shown in Annex 1.

4. Responsible authority for the Project

Both sides confirmed the authorities responsible for the Project are as follows:

4-1. The EDM will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken cared by relevant authorities properly and on time. The organization chart is shown in Annex 2.

4-2. The line ministry of the Executing Agency is the Ministerio dos Recursos Minerais e Energia (MIREME). The MIREME shall be responsible for supervising the Executing Agency on behalf of the Government of Mozambique

5. Contents of the Draft Report

After the explanation of the contents of the Draft Report by the Team, the Mozambique side agreed in principle to its contents and comments will be added by 12th May 2017, if necessary.

6. Cost estimate

Both sides confirmed that the cost estimate described in the Draft Report and in Annex 7. This cost is provisional and will be examined further by the Government of Japan for its approval.

7. Confidentiality of the cost estimate and technical specifications

Both sides confirmed that the cost estimate and technical specifications should never be disclosed to any third parties until all the contracts under the Project are concluded.

8. Procedures and Basic Principles of Japanese Grant

The Mozambique side agreed that the procedures and basic principles of Japanese Grant as described in Annex 3 shall be applied to the Project. In addition, the

Mozambique side agreed to take necessary measures according to the procedures.

9. Timeline for the project implementation

The Team explained to the Mozambique side that the expected timeline for the project implementation is as attached in Annex 4.

10. Expected outcomes and indicators

Both sides agreed that key indicators for expected outcomes are as follows. The Mozambique side will be responsible for the achievement of agreed key indicators targeted in year 2023 and shall monitor the progress based on those indicators after successful completion of the project. Both sides understand the capacity utilization rate of T1 transformer to T3 transformer was calculated based on the parameters such as demand forecast assumed in 2015.

[Quantitative indicators]

	2015	2023
Total capacity of T1 transformer to T3 transformer (275/66 kV) (MVA)	436	620
Total capacity utilization rate of T1 transformer to T3 transformer (%)	68.8	75.1

[Qualitative indicators]

The reliability of power supply is improved and the economic activities are promoted.

11. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 5. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in Annex 5, both sides confirmed that such customs duties, internal taxes and other fiscal levies including VAT, commercial tax, income tax and corporate tax, shall be clarified in the bid documents by EDM during the implementation stage of the Project.

The Mozambique side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. EDM assured to use its own money to make the refund in the Project if necessary. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that the Annex 5 will be used as an attachment of G/A.

12. Monitoring during the implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 6. The timing of

submission of the PMR is described in Annex 5.

13. Project completion

Both sides confirmed that the Project completes when all the facilities constructed and equipment procured and installed by the grant are in operation. The completion of the Project will be reported to JICA promptly, but in any event not later than six months after completion of the Project.

14. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, and Sustainability). The result of the evaluation will be publicized. The Mozambique side is required to provide necessary support for the data collection.

15. Schedule of the Study

JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Mozambique side around July 2017.

16. Environmental and Social Considerations

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as C because the Project is likely to have minimal adverse impact on the environment under the Guidelines.

17. Other Relevant Issues

17-1. Change of the work demarcation on the removal of the existing T2 transformer

On the Minutes of Discussions signed on December 9, 2016, it was agreed that EDM would remove the existing T2 transformer from the present location. However, EDM informed to JICA that it is not easy for EDM to implement this work on schedule etc. Therefore, the said agreement was amended and it is agreed that the work will be conducted by the Japanese side after the disconnection of cables etc. of T2 transformer from the system by EDM.

17-2. Connection work of the mobile substation to the 66kV line

After the procurement of the mobile substation by the Japanese side, EDM shall connect the mobile substation to the 66kV line at the designated location at Matola Gare Substation in an on-the-job training manner. After the connection of the mobile substation, Japanese side will conduct the site test and commissioning of this equipment.

17-3. Power stoppages of the 275 kV busbar and 66 kV busbar

For the safety purpose, EDM agreed to stop power at 275 kV busbar when the Japanese side will transport the 275 kV circuit breaker in the switch yard if necessary. EDM also agreed to stop power at 66 kV busbar when the Japanese side will conduct the installation work of the 66 kV substation facilities. The actual section of the busbars to stop energization will be either old busbar 1 or old busbar 2.

It is also agreed that power stoppage of both of the two busbars will not be taken place simultaneously.

17-4. The equipment which may be procured from third countries

The Team explained that the equipment/material for the Project would be basically procured from Japan. However, some of the items listed below may be procured from third countries due to availability and technical compatibility with the existing facilities. EDM agreed on the explanation by the Team.

1) 275 kV circuit breaker
2) 11 kV voltage transformer and current transformer (for the tertiary side of T2 transformer)
3) 66 kV equipment (voltage transformer, current transformer, circuit breaker, disconnecting switch)
4) Equipment pedestals
5) Control and protection panels
6) Oil analyzer
7) Relay tester

17-5. Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

17-6. Effective Utilization of the Mobile Substation

To ensure the effective utilization of the mobile substation to be procured in the Project, EDM agreed to operate the mobile substation in the way of the operation method proposed in the Draft Report.

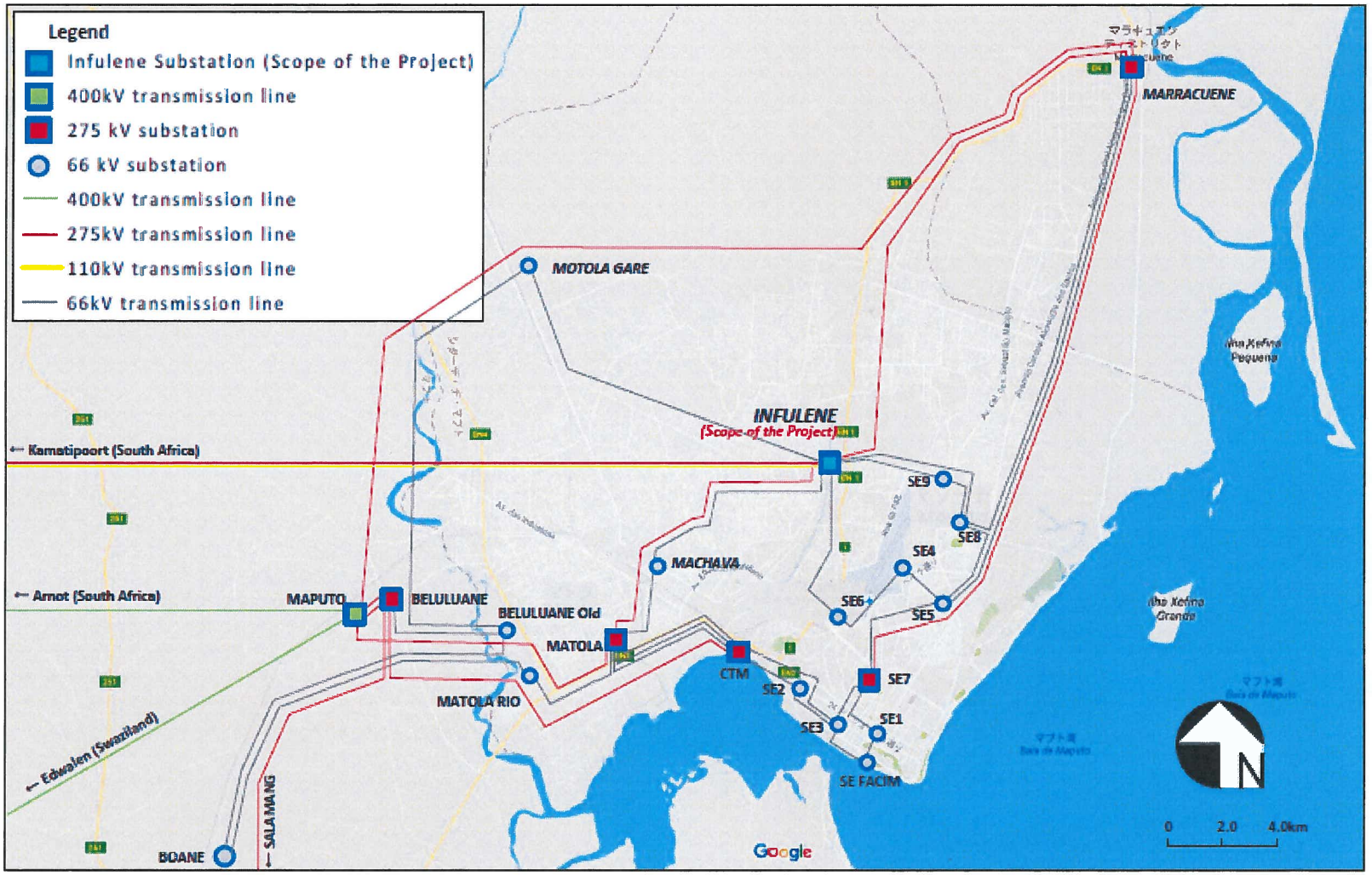
17-7. Importance of other related Projects.

Both sides confirmed the importance of the implementation of other related projects such as Short Term Investment Project (STIP) and Power Efficiency and Reliability Improvement Project (PERIP) as planned to maximize the effectiveness of the Project.

17-8. Change of the title of the Project

It is proposed to change the title of the Project to "the Project for Emergency Rehabilitation of Infulene Substation" in order to clarify the purpose of the Project. Japanese side agreed to convey the proposal to the Japanese related organizations.

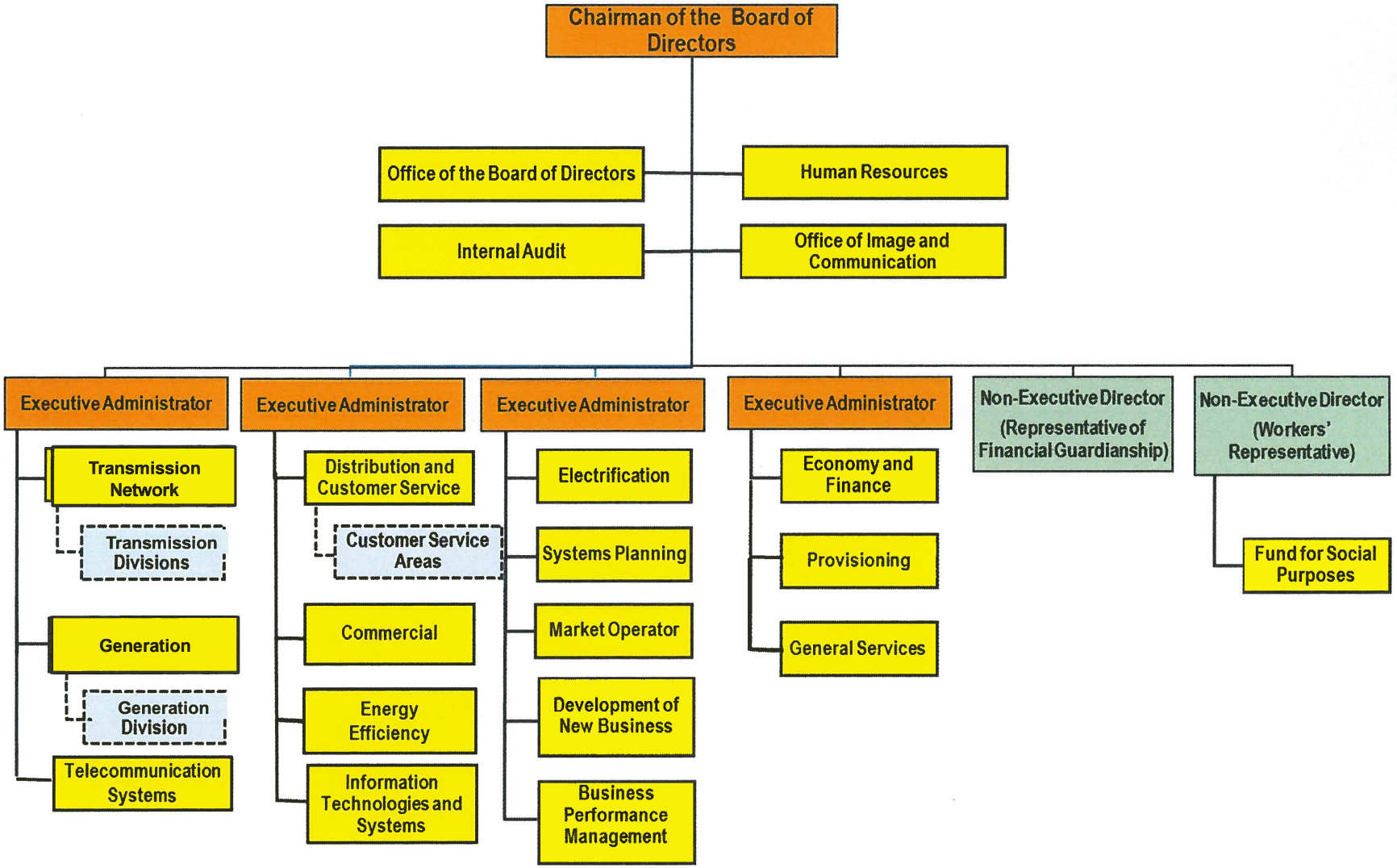
Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Japanese Grant
Annex 4 Project Implementation Schedule
Annex 5 Major Undertakings to be taken by the Government of Mozambique
Annex 6 Project Monitoring Report (template)
Annex 7 Estimated Project Cost



[Source] Prepared by Preparatory Survey Team based on P.39, Chapter 4, Volume III, Master Plan Update Project, 2012-2027 (2014)

■ Maputo metropolitan area

Annex 2


Chairman of the Board of Directors
Office of the Board of Directors
Human Resources
Internal Audit
Office of Image and Communication
Executive Administrator
Executive Administrator
Executive Administrator
Executive Administrator
Non-Executive Director (Representative of Financial Guardianship)
Non-Executive Director (Workers' Representative)
Transmission Network
Transmission Divisions
Generation
Generation Division
Telecommunication Systems
Distribution and Customer Service
Customer Service Areas
Commercial
Energy Efficiency
Information Technologies and Systems
Electrification
Systems Planning
Market Operator
Development of New Business
Business Performance Management
Economy and Finance
Provisioning
General Services
Fund for Social Purposes

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" (Annex 6) for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the 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 necessary for the implementation of the Project.
- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take 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 executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

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

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable

to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" (Annex 7) for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) 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 to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Attachment 1

PROCEDURES OF JAPANESE GRANT

Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

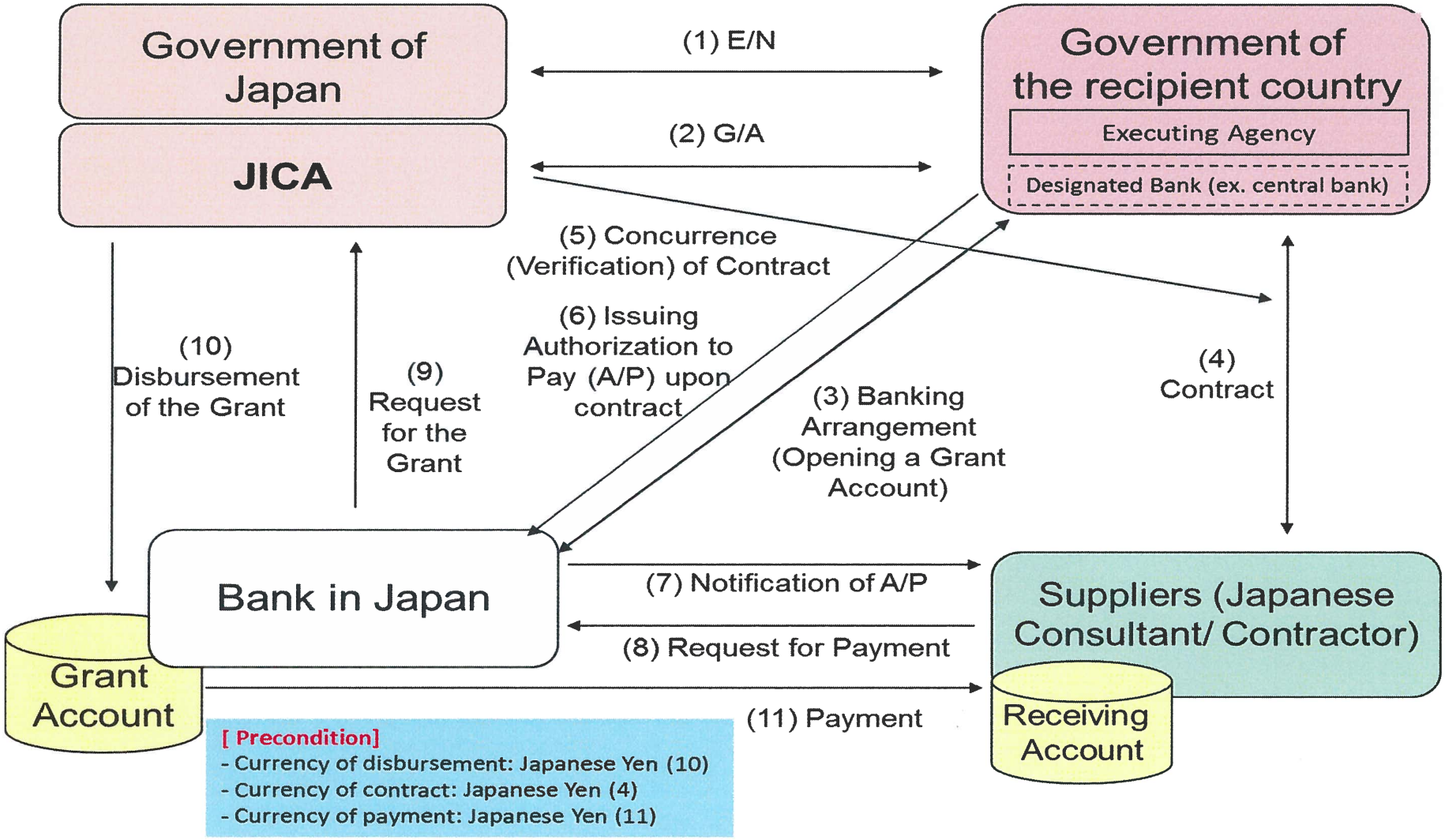
notes:

1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

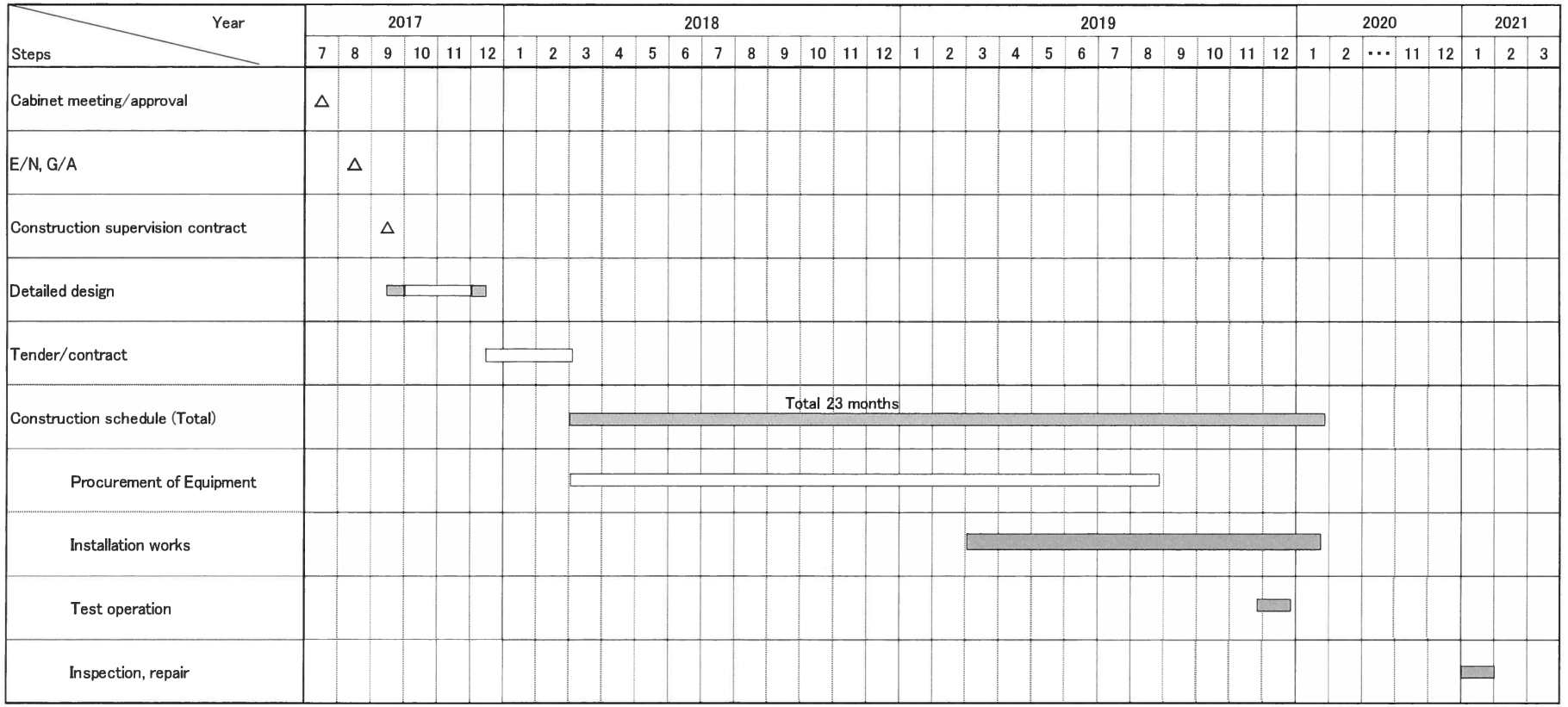
2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.

Attachment 2

Financial Flow of Japanese Grant (A/P Type)



Annex 4 Project Implementation Schedule



Annex 5

Major Undertakings to be taken by the Government of Mozambique

Specific obligations of the Government of Mozambique which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost (Thousand USD)	Ref.
1	To open bank account (B/A)	Within 1 month after the signing of the G/A	EDM	-	E/N G/A
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 3.5 months after the signing of the agreement	EDM	-	-
3	To secure the space and connection point of 66 kV line for mobile substation	before notice of the bidding document	EDM	-	-
4	To obtain the planning, zoning, building permit	before notice of the bidding document	EDM	-	-
5	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding documents	EDM	-	-
6	Acquisition of the approval as a rural electrification project from the Ministry of Economy and Finance	October 2017	EDM	-	
7	Allocation of the budget of Commision for A/P	October 2017	EDM	-	-

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost (Thousand USD)	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 2.5 months after the signing of the contract(s)	EDM	-	-
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A			-	-
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	EDM	-	-
	2) Payment commission for A/P	January 2018	EDM	0.6 (Consultant) 13.4 (Supplier)	-
3	To ensure prompt unloading and customs clearance at ports of disembarkation in recipient country and to assist the Supplier(s) with internal transportation therein	during the Project	EDM	-	-
4	To accord Japanese nationals and/or physical persons of third countries 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 country of the Recipient and stay therein for the performance of their	during the Project	EDM	-	-

	work				
5	To allocate necessary budget for EDM technicians and engineers to participate in factory acceptance test	Occasions of the acceptance test	EDM		
6	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be borne by its designated authority without using the Grant	During the Project	EDM	40.0	-
7	To remove cables and parts of the existing T2 transformer from the power lines	before the commencement of the work by the Supplier	EDM	-	-
8	Connection of the mobile substation to the connection point	during the Project	EDM	-	-
9	Power outage of 275kV busbar during the transportation of 275kV circuit breaker if necessary	during the Project	EDM	-	-
10	Power outage of 66kV busbar and temporary removal of the pipe bus at the installation work space	during the Project	EDM	-	-
11	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	EDM	-	-
12	To submit Project Monitoring Report	every 3 months	EDM	-	-
13	To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	EDM	-	-

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost (Thousand USD)	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid ➢ Allocation of maintenance cost	After completion of the Project	EDM	12.0/year	
2	To store maintenance tools and spare parts at Infulene Substation and not to be used for equipment at the other substations.	After completion of the Project	EDM	-	

Project Monitoring Report
on
the Project for the Emergency Rehabilitation of Transmission Network
Grant Agreement No. XXXXXXX
20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Executing Agency	Person in Charge (Designation) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Line Ministry	Person in Charge (Designation) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:

2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*
Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks (*at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Monitoring sheet on price of specified materials (Quarterly)
6. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
7. Pictures (by JPEG style by CD-R) (PMR (final)only)
8. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

(Confidential)

Estimated Project Cost

This page is closed due to the confidentiality.

This page is closed due to the confidentiality.

５．　技術協議録（**Field Report**）

PREPARATORY SURVEY
FOR
THE PROJECT
FOR
EMERGENCY REHABILITATION
OF
TRANSMISSION NETWORK

FIELD REPORT

16TH DECEMBER 2016

Prepared and Submitted by

Mr. Toshiyuki HAYASHI
Chief Consultant
JICA Preparatory Survey Team/

Confirmed and Agreed by

Mr. Feliciano Andre MASSINGUE
Director
Transmission Network Directorate
Electricidade de Mozambique

Mr. Abraão RAFAEL
Deputy Director
Electrification and Projects Directorate
Electricidade de Mozambique

JICA PREPARATORY SURVEY TEAM

Global Human Development Japan
Yachiyo Engineering Co., Ltd.

Contents

添付資料５．技術協議録（Field Report）

A-5-2

1. Outline of the Project

1.1 Background of the Project

Based on the several preliminary discussions between the Government of Republic of Mozambique (hereinafter referred to as "Mozambique") and the Government of Japan, Japan International Cooperation Agency (hereinafter referred to as "JICA"), dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of the Project for Emergency Rehabilitation of Transmission Network (hereinafter referred to as "the Project") to Mozambique, headed by Mr. Shigeru Sugiyama, Deputy Director General, Industry Development and Public Policy Department, JICA, from 4th to 10th December, 2016.

The Team continued discussions with the concerned officials of Mozambique and the field survey in Mozambique in consideration of mutual understandings made on the Minuets of Discussions signed between JICA and Electricidade de Mozambique, E.P. (EDM) on 9th December, 2016.

EDM and the Team had series of technical discussions to form mutual understandings about the contents, scope, preconditions for the Outline Design, basic specifications, and so on of the Project in the First Field Survey from 21st November to 16th December 2016. EDM 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 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 Mozambique side to understand that the Preparatory Survey is not a commitment for the future implementation of the Project.

EDM expressed understanding about the schedule and procedures of Japan's Grant Aid project, and agreed with the Team to progress the further study of the Project in accordance with the mutual understandings made in 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 line Ministry of the Executing Agency is the Ministerio dos Recursos Minerais e Energia (MIREME).
(2) The Executing Agency is the Electricidade de Mozambique (EDM).

1.3 Components of the Project on Minutes of Discussions on 9th December, 2016

The components of the Project are shown in Table 1.3-1 as agreed on the Minutes of Discussion (MD) signed on 9th December, 2016. The locations are shown in the **Annex-1**

Table 1.3-1 Components of the Project

Components		Capacity
Procurement and Installation Work at Infulene Substation		
1.	275kV Circuit Breaker (3 phases)	1 set
2.	275/66kV Transformer	250MVA 1 unit
3.	11/0.4kV Station transformer	250kVA 1 unit
4.	66kV Lightning Arrestor (3 phases)	1 set
5.	66kV Voltage Transformer (3 phases)	1 set
6.	66kV Current Transformer (3 phases)	1 set
7.	66kV Circuit Breaker (3 phases)	1 set
8.	66kV Disconnector (Line Switch) (3 phases)	2 sets
9.	66kV Overhead conductor (Secondary side of T2) (3 phases)	1 lot
10.	66kV Circuit Breaker (Bus coupler)	1 set
11.	66kV Disconnector (Bus coupler)	2 sets
12.	66kV Overhead conductor (Bus coupler)	1 lot
13.	Control and protection panels for T2 transformer	1 lot
14.	Foundation for equipment of the above and to be relocated	1 lot
15.	Maintenance Tools for the equipment	1 lot
16.	Spare Parts for the equipment	1 lot
Procurement Work		
1.	66/33kV Mobile Substation	20/40MVA 1 set
2.	Maintenance Tools for the mobile substation	1 lot
3.	Spare parts for the mobile substation	1 lot

1.4 Obligations / Undertakings of the Mozambique side for the Project

(1) Preconditions

- EDM has agreed to formulate the budget for the smooth implementation of the Project in around October, 2017. The budget shall cover the followings, but not limited to[1]:
  - Removal of T2 transformer and its auxiliaries from the present location.
  - Expenses for Value Added Tax (VAT) to be refunded to the Supplier.
- EDM agreed to obtain permission or consent from related authorities for power outage during the period of necessary installation work by the Japanese side, if necessary.

(2) Necessary Inputs by the Mozambique side

1) Prior to the Commencement of the installation work to be borne by the Japanese side

- EDM agreed to remove the existing T2 transformer from the present location.
- EDM agreed to secure the place where the panels for the T2 transformer shall be installed (See the Annex-2)
- EDM agreed to secure sites for temporary store yard and offices for the Project inside the

[1] Before the second field survey scheduled in April 2017, the refund/exemption of corporate and income taxes will be confirmed and the necessary procedure shall be made.

substation (See the Annex-3).

2) During the Installation Work

- EDM has understood that the safety environment for the installation work is indispensable. Thus, EDM has agreed to provide the free space for Japanese side by removing the 66kV busbars during the installation work.
- EDM has agreed to make arrangement with the Supplier to provide the power stoppage of one 275kV busbar when the 275kV circuit breaker will be transported to the installation place, if necessary. The stoppage shall not interrupt the power supply for more than 10 hours continuously.
- EDM has agreed to carry out the site test for the mobile substation at Infulene Substation or another designated substation.

3) After the Commencement of Operation

- EDM has 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	275kV Substation system	66kV Substation system
Frequency	50 Hz	
Phase	3-phase	
Maximum voltage	300kV	72.5kV
Nominal voltage	275kV	66kV
Lightning impulse withstand voltage	1050kV	325kV
Power-frequency withstand voltage	450kV	140kV
Grounding system	Direct	
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 is shown in the **Annex-4**.

Table 2.1-2 Items and Specification of equipment to be procured by the Project

No.	Equipment	Specifications	Quantity
1-1	**275kV Circuit Breaker (porcelain clad type)**	-	**1 set**
	Standard	IEC, JIS, JEC, JEM or equivalent	
	Rated voltage	300kV	
	Rated current	3150A	
	Rated frequency	50Hz	
	Rated short-time current	31.5kA, 3sec	
	Lightning impulse withstand voltage	1050kV	
	Power frequency withstand voltage	450kV	
1-2	**275kV Overhead Line and Terminals**		**1 lot**
	Standard	IEC	
	Overhead Line	Cu 150mm² (Double-conductor)	
1-3	**275/66/11kV Three-phase Autotransformer**		**1 unit**
	Standard	IEC, JIS, JEC, JEM or equivalent	
	Type	Outdoor use, On-load tap changer	
	Rated capacity	Primary and Secondary: 250MVA, Tertiary: 40MVA	
	Rated voltage	Primary voltage: 275 kV, Secondary Voltage: 66 kV, Tertiary voltage: 11kV	
	Rated frequency	50Hz	
	Connection	Primary and Secondary side Star connection(Solidly grounding), Tertiary side: Delta connection (Non-grounding)	
	Lightning impulse withstand voltage	Primary side: 1050kV or more, Secondary side: 350kV or more, Primary and Secondary side neutral point: 250kV or more, Tertiary: 95kV or more	
	Power frequency withstand voltage	Primary side: 460 kV or more, Primary and Secondary side neutral point: 95kV or more, Secondary side: 140 kV or more	
	Tap number	21 taps	
1-4	**Station Transformer for T2**		**1 unit**
	Standard	IEC, JIS, JEC, JEM or equivalent	
	Type	Outdoor use, Oil-immersed transformer	
	Voltage transformation ratio	11/0.4kV	
	Rated capacity	250kVA	
	Vector group	YNyn0d11 (Built-in stabilizing windings)	
	Rated frequency	50Hz	
	Power frequency withstand voltage	38kV 1min	
	Lightning impulse withstand voltage	95kV	
1-5	**11kV Voltage Transformer and Through Type Current Transformer for T2 Tertiary Side**		**1 lot**
	Standard	IEC, JIS, JEC, JEM or equivalent	
	Type	Outdoor use,	
	Power frequency withstand voltage	38kV 1min	
	Lightning impulse withstand voltage	95kV	
	Voltage transformation ratio	11000 √3 / 110 √3 / 110 V	
	Current transformation ratio	50/1A	
1-6	**66kV Lightning Arrestor**		**3 sets**
	Standard	IEC, JIS, JEC, JEM or equivalent	
	Type	Outdoor use, Silicone porcelain bushing	

No.	Equipment	Specifications	Quantity
	・ Discharge current	10kA	
	・ Rated frequency	50Hz	
1-7	**66kV Voltage Transformer**		3 sets
	・ Standard	IEC, JIS, JEC, JEM or equivalent	
	・ Type	Outdoor use	
	・ Nominal Voltage	66kV	
	・ Power frequency withstand voltage	140kV 1min	
	・ Lightning impulse withstand voltage	325kV	
	・ Rated frequency	50Hz	
	・ Voltage transformation ratio	66000 √ 3 / 110 √ 3 / 110 √ 3V	
	・ Creepage distance	31mm/kV	
1-8	**66kV Current Transformers**		3 sets
	・ Standard	IEC, JIS, JEC, JEM or equivalent	
	・ Type	Outdoor use	
	・ Nominal Voltage	66kV	
	・ Power frequency withstand voltage	140kV	
	・ Lightning impulse withstand voltage	325kV	
	・ Rated frequency	50Hz	
	・ Current transformation ratio	2400-1600-600-400/1-1-1-1A	
	・ Creepage distance	31mm/kV	
1-9	**66kV Circuit Breaker**		2 sets
	・ Standard	IEC, JIS, JEC, JEM or equivalent	
	・ Type	Outdoor use	
	・ Rated voltage	72.5kV	
	・ Rated frequency	50Hz	
	・ Rated current	3150A	
	・ Power frequency withstand voltage	140kV 1min	
	・ Lightning impulse withstand voltage	325kV	
	・ Rated short-time current	40kA 3sec	
	・ Creepage distance	31mm/kV	
1-10	**66kV Disconnector**		4 sets
	・ Standard	IEC, JIS, JEC, JEM or equivalent	
	・ Type	Outdoor use	
	・ Rated voltage	72.5kV	
	・ Rated frequency	50Hz	
	・ Rated current	3150A	
	・ Power frequency withstand voltage	140kV	
	・ Lightning impulse withstand voltage	325kV	
	・ Rated short-time current	31.5kA 3sec.	
	・ Creepage distance	31mm/kV	
1-11	**Overhead Line and Terminals for T2 Secondary Side and Bus Tie**		1 lot
	・ Standard	IEC, JEC, etc.	
	・ Aluminum electric wire	IEC/LAAC2 865mm²	
1-12	**Copper Pipe**		1 lot
	・ Standard	IEC	
	・ Size	50-30Φ	
1-13	**Equipment Pedestal**		1 lot
	・ Hot dip galvanizing	(To be specified)	
1-14	**Earthing System for T2 Secondary Side**		1 lot
	・ Materials - Buried earthing wire - Insulation coating earthing wire - Connecting material	 Annealed copper stranded wire (A) 100mm² or equivalent Vinyl insulation wire (38mm² IV) or equivalent C-type Compressed connector or bolt connector or equivalent	

No.	Equipment	Specifications	Quantity
1-15	**Protection and Control & Relay Panels for T2 Transformer**		1 lot
	・ Standard	IEC, JIS, JEC, JEM or equivalent	
	・ Type	Indoor use, metal enclosed type	
1-16	**Maintenance Tools**		1 lot
	・ Insulation resistance tester	IEC,JEM,JEC,JES or equivalent, 1 set	
	・ Phase rotation meter	IEC,JEM,JEC,JES or equivalent, 1 set	
	・ Clamp meter	IEC,JEM,JEC,JES or equivalent, 1 set	
	・ Circuit tester	IEC,JEM,JEC,JES or equivalent, 3 sets	
1-17	**Insulating Oil Analysis Equipment (moisture, gas, etc.)**		1 set
	・ Standard	IEC, JIS, JEC, JEM or equivalent	
1-18	**Insulating Oil Purifier**		1set
	・ Standard	IEC, JIS, JEC, JEM or equivalent	
1-19	**Withstand Voltage Tester**		1 lot
	・ Power	Three-phase, 400 V, 50 Hz	
	・ Output voltage	0~60kV	
1-20	**Protection Relay Tester**		1 lot
	・ Rated frequency	50Hz	

Table 2.1-3 Specification of mobile substation to be procured by the Project

No.	Equipment	Specifications	Quantity
2-1	**66/33kV Mobile Substation**		1 lot
	・ Standard	IEC, JIS, JEC, JEM or equivalent	
	・ Voltage transformation ratio	66/33kV	
	・ Rated capacity	20MVA	

2.2 Technical requirements for the equipment and foundation of the substation of the Project

(1) Design Conditions for the equipment and foundation

The design conditions for the substation facilities are shown in the following Table 2.2-1.

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

Items		
Altitude		<500m above sea level
Ambient Temperature (Daily)	Maximum	50°C
	Minimum	0°C
Rainy season		October to March
Average Annual Rain Fall		800-1,700mm
Relative Humidity		>70%
Thunderstorms		70 days per year
Wind speed		45m/s
Design wind pressure		1.5kN/m²
Seisme coefficient		0.1g

(2) Requirements for the Foundation of T2 Transformer/

The Outline for the foundation of T2 Transformer is shown in Table 2.2-2.

Top level of foundation should be +0.0 m from the design ground level.

Table 2.2-2 Outline for the Foundation of T2 Transformer

Items	Contents	Details
Structure	Reinforced Concrete Mat Foundation	Concrete compressive strength (Fc) is 21N/mm^2
Depth of Foundation	Until bearing capacity level	Allowable bearing capacity is over 100kN/m^2
Total Foundation Area	7 x 11 = 77m^2 (Approx.)	The T2 foundation must bear following weight 2,400kN

2.3 Procurement Plan of Spare Parts and Maintenance Equipment

Capability of sustainable operation and maintenance for the equipment of the Project by the Recipient is one of the conditions for the Japan's Grant Aid Project. The Mozambique side shall keep operation and maintenance for the equipment of the Project properly by themselves, 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 the conditions for the Japan's Grant Aid Project. Therefore, 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 maintenance 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 in the Draft Final Report.

Table 2.3-1 Spare Parts List

No.	Item	Q'ty
1-3	**275/66/11kV Three-phase Autotransformer**	
(1)	275 kV bushing	1
(2)	66 kV bushing	1
(3)	11 kV bushing	1
(4)	Buchholz relay	1
(5)	Oil temperature gauge	1
(6)	Oil level gauge	1
(7)	MCCB (each type)	1
(8)	Auxiliary relay (each)	1
(9)	Fuse (each type)	100%
(10)	Lamp (each type)	100%
(11)	LED lamp with socket (each type)	10%

No.	Item	Q'ty
(12)	Packing (each type)	100%
(13)	Pressure relief valve (if applicable)	1 unit
1-6	**66kV Lightning Arrestor**	
	Lightning arrestor part	1 unit
1-8	**66kV Current Transformer**	
	Current transformer part	1 unit
1-9	**66kV Circuit Breaker**	
(1)	Motor circuit fuse	100%
(2)	Circuit Breaker pole	1 unit
1-10	**66kV Disconnector**	
(1)	Motor circuit fuse	100%
(2)	Disconnector blade	1 unit
1-15	**Protection and Control & Relay Panels for T2 Transformer**	
(1)	Differential relay	1 unit

Table 2.3-2 Maintenance Equipment List

No.	Item	Q'ty
1-16	**Maintenance Tools**	**1**
1-17	**Insulating Oil Analysis Equipment (moisture, gas, etc.)**	**1**
1-18	**Insulating Oil Purifier**	**1**
1-19	**Withstand Voltage Tester**	**1**
1-20	**Protection Relay Tester**	**1**

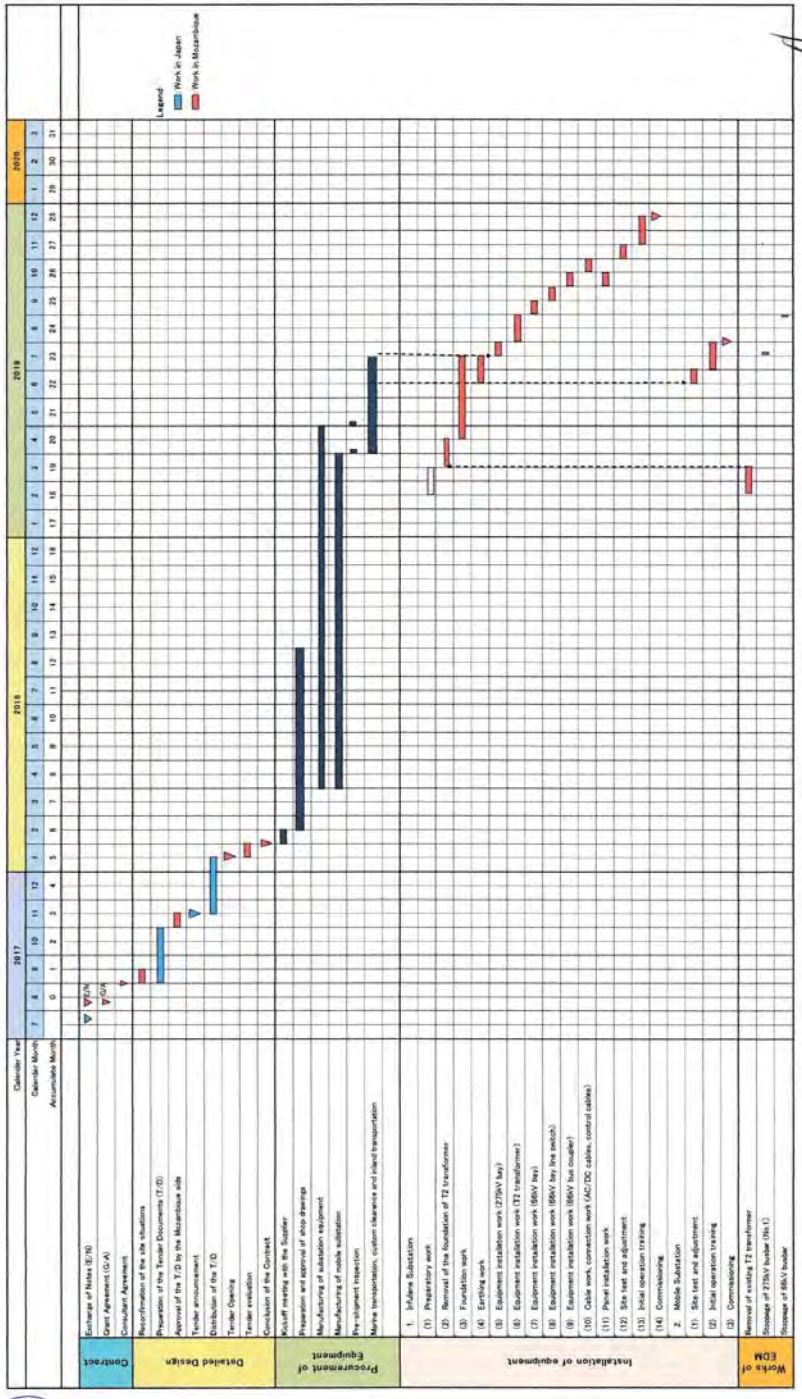
2.4 On-the-Job Training (OJT)

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

3. Tentative Implementation Schedule of the Project

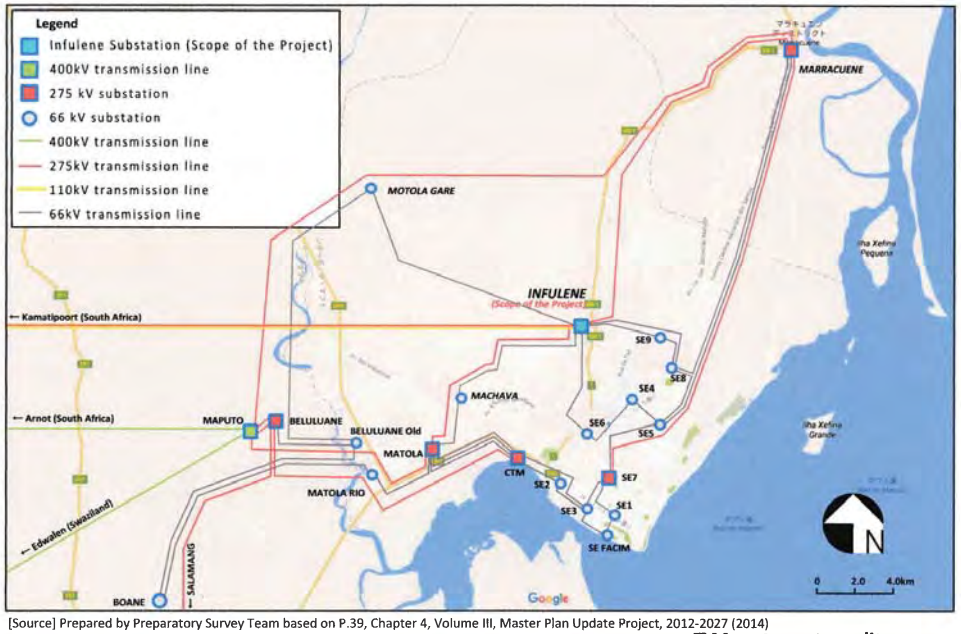
The tentative implementation schedule is shown in Table3-1. In case that the Project is adapted by the Japanese Government, the Project will proceed as follows in the earliest scenario. It is important for both sides to understand that the tentative implementation schedule does not assume the commitment for the future implementation of the Project.

Table 3-1 Tentative Implementation Schedule



■ Republic of Mozambique

■ Map of Africa

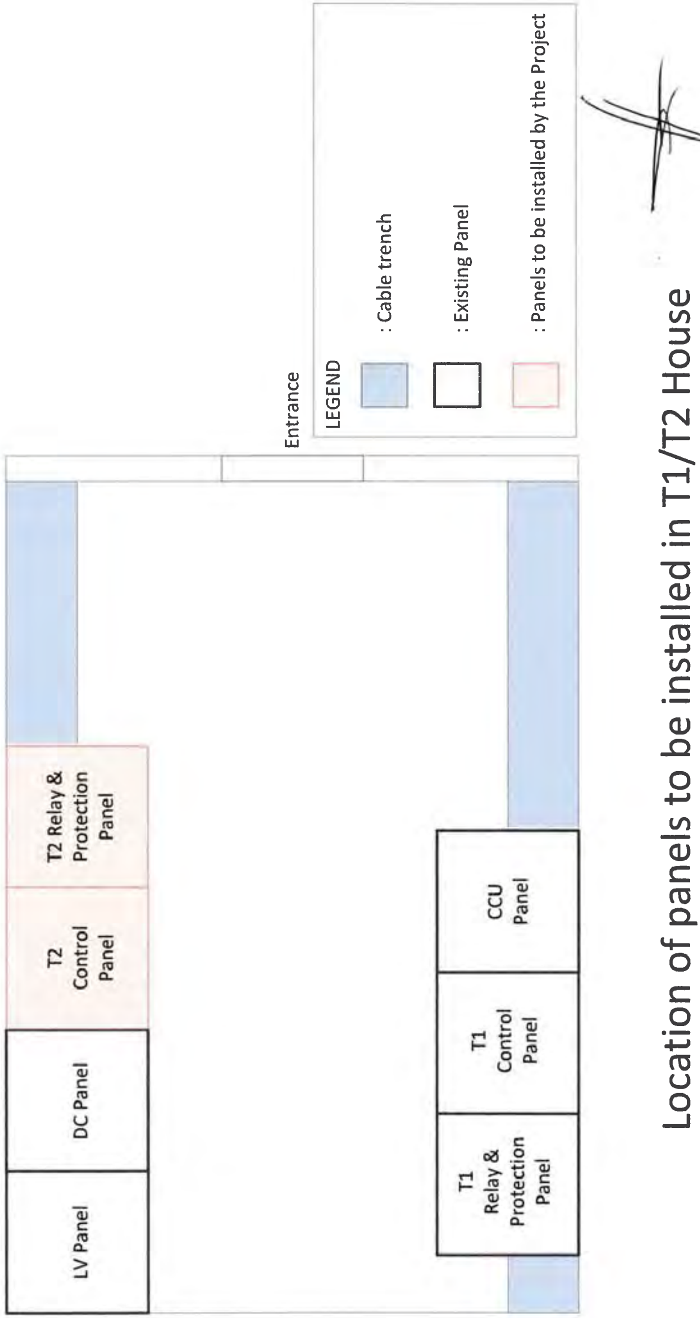


[Source] Prepared by Preparatory Survey Team based on P.39, Chapter 4, Volume III, Master Plan Update Project, 2012-2027 (2014)

■ Maputo metropolitan area

LOCATION OF THE PROJECT SITE

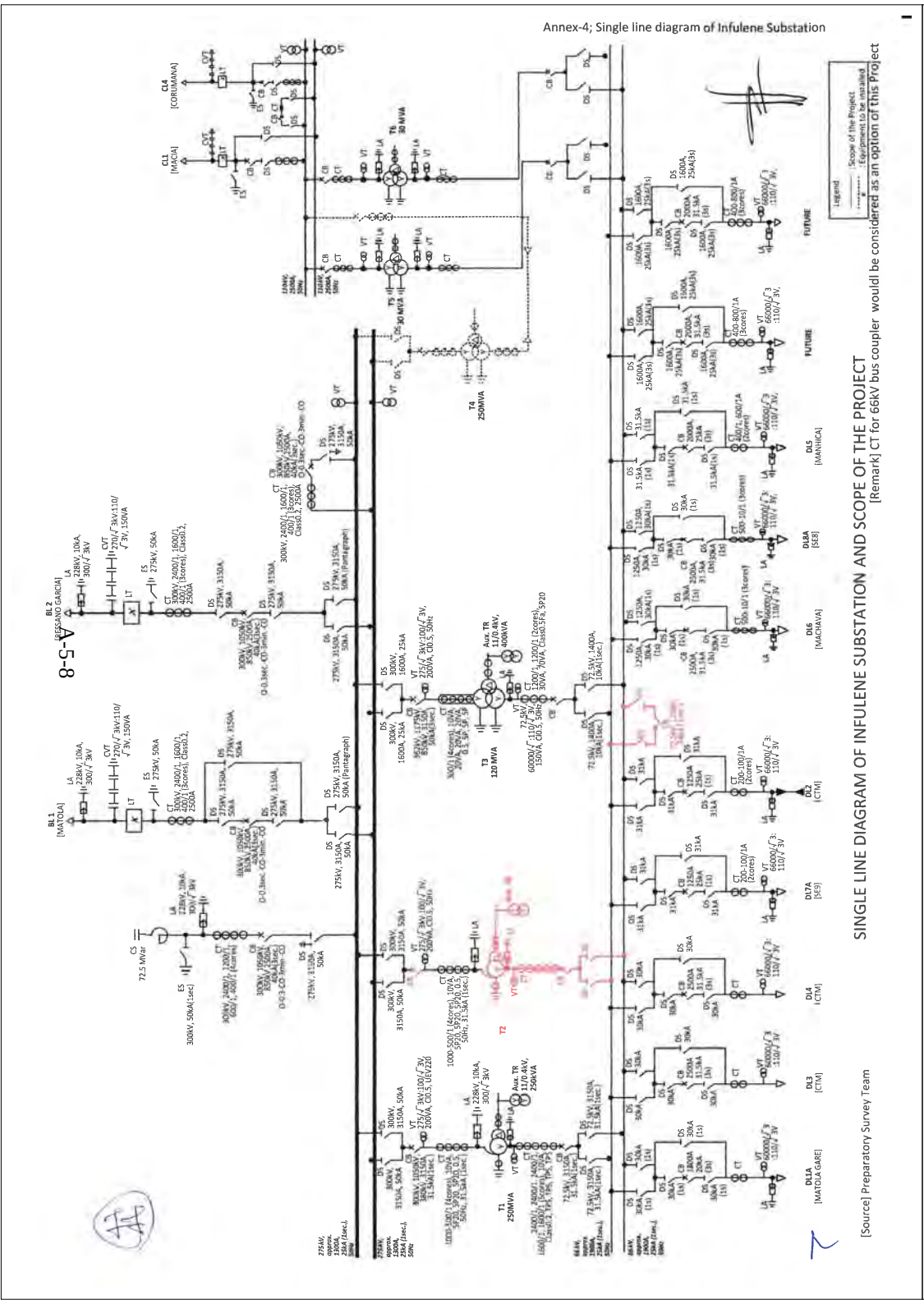
Annex – 2 ; Location of panels to be installed



Location of panels to be installed in T1/T2 House

Annex – 3 ; Location of temporary storeyard and offices

Candidate sites of temporary storeyard and offices



Minutes of Discussions
on the Preparatory Survey for the Project for
Emergency Rehabilitation of Transmission Network

Based on the several preliminary discussions between the Government of Republic of Mozambique (hereinafter referred to as "Mozambique") and the Government of Japan, Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of the Project for Emergency Rehabilitation of Transmission Network (hereinafter referred to as "the Project") to Mozambique, headed by Mr. Shigeru Sugiyama, Deputy Director General, Industry Development and Public Policy Department, JICA, from 4th to 10th December, 2016. The Team held a series of discussions with the officials of the Government of Mozambique and conducted a field survey. In the course of the discussions, both sides have confirmed the main items described in the attached sheets.

Maputo, 9th December, 2016

Mr. Shigeru Sugiyama	Dr. Mateus Magala
Leader	Chairman & CEO
Preparatory Survey Team	Electricidade de Mozambique, E.P.
Japan International Cooperation Agency	(EDM)
Japan	Mozambique

ATTACHMENT

1. Objective of the Project
The objective of the Project is to achieve the stable power supply in Maputo metropolitan and surrounding areas through the upgrading of Infulene Substation and the procurement of a mobile substation, thereby contributing to economic development of Mozambique.

2. Title of the Preparatory Survey
Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Emergency Rehabilitation of Transmission Network".

3. Project site
Both sides confirmed that the site of the Project is Infulene Substation, which is shown in Annex 1.

4. Responsible authority for the Project
Both sides confirmed the authorities responsible for the Project are as follows:

4-1. The Electricidade de Mozambique (EDM) will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be managed by relevant authorities properly and on time. The organization charts are shown in Annex 2. EDM is now under transformation process of the organization, therefore Annex 2 would be updated once new structure is authorized.

4-2. The line Ministry of the Executing Agency is the Ministerio dos Recursos Minerais e Energia (MIREME). The MIREME shall be responsible for supervising the Executing Agency on behalf of the Government of Mozambique.

5. Items requested by the Government of Mozambique
As a result of discussions, both sides confirmed that the items requested by the Government of Mozambique are as follows:

Components		Capacity
Procurement and Installation Work at Infulene Substation		
1.	275kV Circuit Breaker (3 phases)	1 set
2.	275/66kV Transformer	250MVA × 1 unit
3.	11/0.4kV Station transformer	250kVA × 1 unit
4.	66kV Lightning Arrestor (3 phases)	1 set
5.	66kV Voltage Transformer (3 phases)	1 set
6.	66kV Current Transformer (3 phases)	1 set
7.	66kV Circuit Breaker (3 phases)	1 set
8.	66kV Disconnector (Line Switch) (3 phases)	2 sets
9.	66kV Overhead conductor (Secondary side of T2) (3 phases)	1 lot
10.	66kV Circuit Breaker (Bus coupler)	1 set
11.	66kV Disconnecetor (Bus coupler)	2 sets
12.	66kV Overhead conductor (Bus coupler)	1 lot
13.	Control and protection panels for T2 transformer	1 lot
14.	Foundation for equipment of the above and to be relocated	1 lot
15.	Maintenance Tools for the equipment	1 lot
16.	Spare Parts for the equipment	1 lot
Procurement Work		
1.	66/33kV Mobile Substation	20~40MVA × 1 set
2.	Maintenance Tools for the mobile substation	1 lot
3.	Spareparts for the mobile substation	1 lot

5-1. JICA will assess the feasibility of the above requested items through the survey and will report the findings to the Government of Japan. The final scope of the Project will be decided by the Government of Japan.

6. Procedures and Basic Principles of Japanese Grant

6-1. The Mozambique side agreed that the procedures and basic principles of Japanese Grant as described in Annex 3 shall be applied to the Project.
As for the monitoring of the implementation of the Project, JICA requires Mozambique side to submit the Project Monitoring Report that the form is attached as Annex 4.

6-2. The Mozambique side agreed to take the necessary measures, as described in Annex 5, for smooth implementation of the Project. The contents of the Annex 5 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report.
The contents of Annex 5 will be updated as the Preparatory Survey progresses, and eventually, will be used as an attachment to the Grant Agreement.

7. Schedule of the Survey

7-1. The Team will proceed with further survey in Mozambique until 23rd December, 2016.

7-2. An official request of the Project financing to the Government of Japan shall be submitted thorough the diplomatic channel by April, 2017.

7-3. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Mozambique in order to explain its contents around end of April, 2017.

7-4. If the contents of the draft Preparatory Survey Report is accepted and the undertakings for the Project are fully agreed by the Mozambique side, JICA will finalize the Preparatory Survey Report and send it to Mozambique around July, 2017.

7-5. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. The Mozambique side confirmed to give due environmental and social considerations during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8-2. The Project is categorized as "C" from the following considerations:
Not located in a sensitive area, nor has it sensitive characteristics, nor falls it into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant.

9. Other Relevant Issues

9-1. Upgrade of equipment

It has been agreed that the Mozambique side is responsible for renovating the equipment that is not covered by the Project whenever the necessity arises, so that the effect of the Project will be fully realized.

9-2. Further information required for the outline design of upgrading T2 transformer at Infulene Substation

The Mozambique side shall provide the following information ;

- Current capacity of 275kV busbar and 66kV busbar
- Control and relay connection diagram and available port/socket

Issue on the demarcation of the responsibility on the connection of control cables to the existing system will be discussed and concluded with the Team by 16th December, 2016.

9-3. Stoppage plan of substation equipment

At this stage, it is expected that power outage will not be required for the rehabilitation work of T2 bay; instead, the usage of some equipment will have to be stopped during the installation works as stated below:

- Replacement of 66kV bus coupler

The Mozambique side shall prepare the stoppage plan together with the Team by 16th December, 2016.

9-4. Ensuring Safety

The Team requested to the Mozambique side to secure the safety during the installation work by isolating the power supply, and providing the accurate information on the live lines in visible way. Both sides agreed to prepare safety procedure involving consultant and supplier during the implementation.

9-5. Space for the temporary storage yard, and offices for the consultant and the supplier

A space of approx. 2,500m^2 is required for the temporary storage yard, and offices for consultant and the contractor within the area of Infulene Substation.

Proposed location and needed facilities will be discussed and agreed upon between the Mozambique side and the Team.

9-6. Demarcation of responsibility on removing the existing T2 transformer and reclaiming the land

Prior to the installation of the new T2 transformer, the existing transformer has to be removed, its foundation has to be demolished, and the land has to be leveled. The Mozambique side and the Team have agreed that the work prior to the installation of the new transformer shall be conducted in line with the following demarcation.

Item	Japan Side	Mozambique side
1. Removal and transportation of the existing T2 transformer		○
2. Demolition of the existing foundation and leveling the land	○	

9-7. Upgrading plans of outgoing 66 kV feeders and their distribution substations

The Mozambique side shall submit the upgrading plans of outgoing 66 kV feeders from Infulene Substation and their distribution substations (66/33kV and/or 66/11kV) in Maputo City and Maputo Suburb areas by 16th December, 2016.

9-8. Provision of road regulation

The Team will prepare the specification of the mobile substation including its transformer capacity with the consideration of the road transportation regulation for weight applicable in Mozambique. The Mozambique side shall provide the relevant regulations to the Team by 16th December, 2016.

9-9. Provision of the answer to the remaining questionnaire

The Mozambique side shall answer to the remaining Questionnaire submitted by the Team with relevant documents by 16th December, 2016.

9-10. Continuing collaboration after completing the first field survey in Mozambique

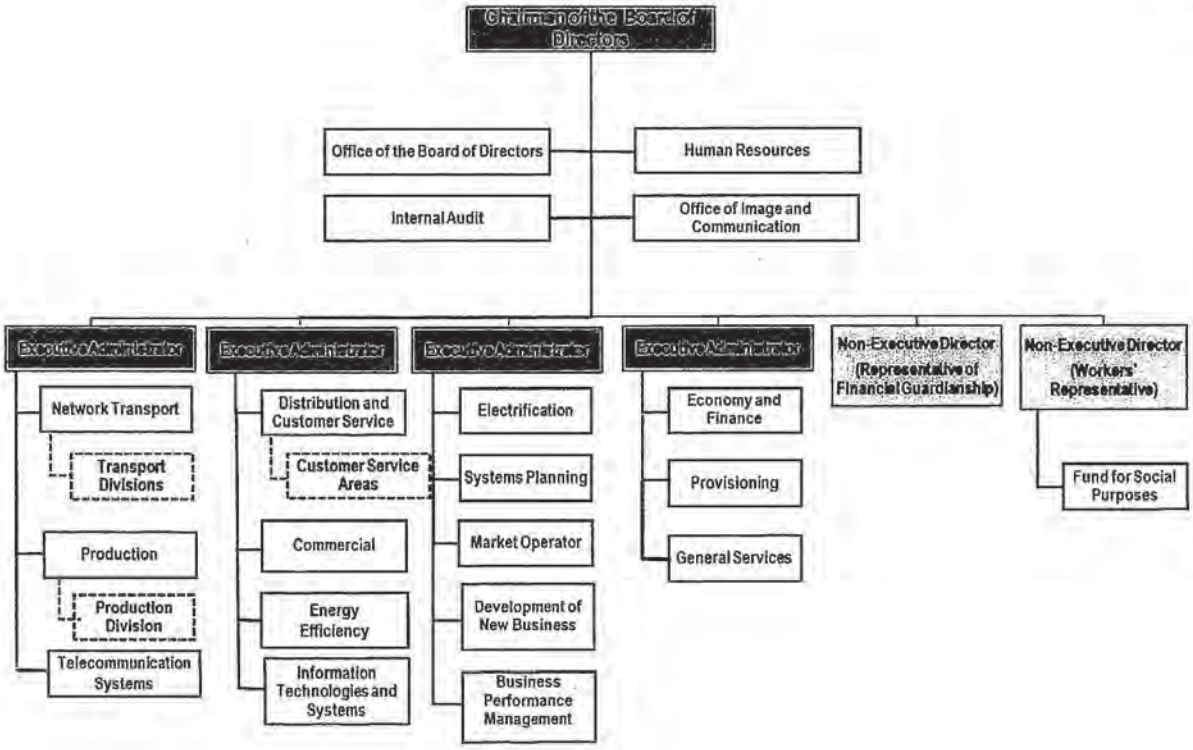
After completing the first field survey in Mozambique, the Team will start analysis work to prepare the draft final report in Japan, and may have further questions to the Mozambique side to complete the draft final report. The Mozambique side has agreed to reply to such questions timely.

9-11. Submission of an official request

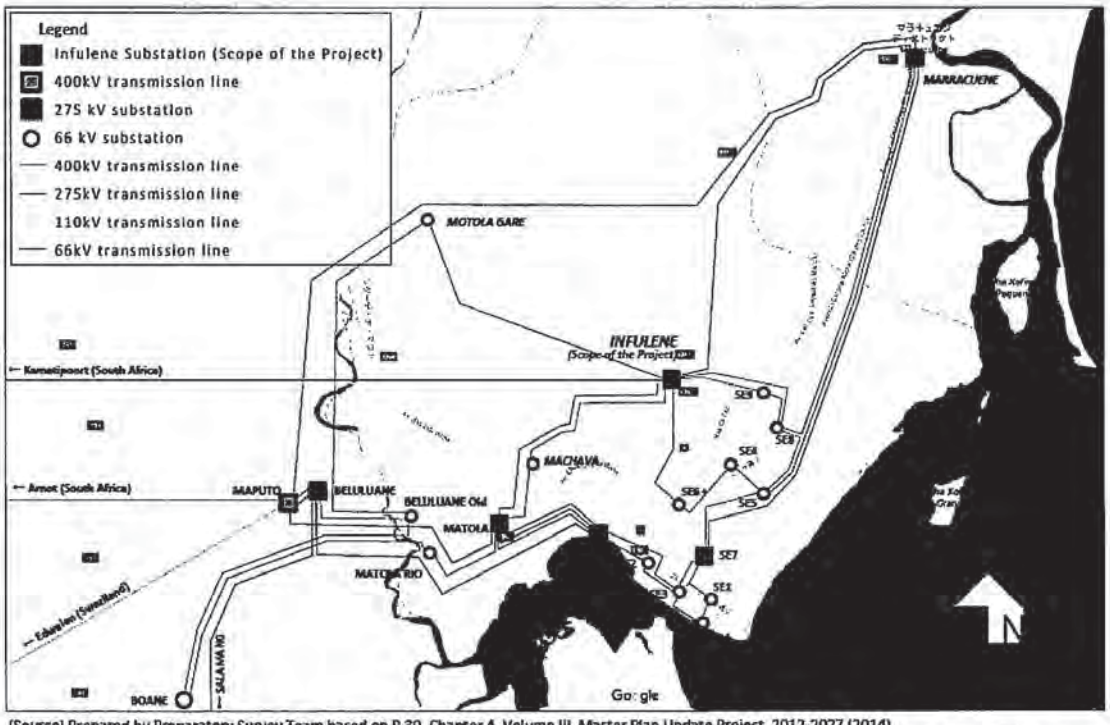
The Mozambique side understands that an official request needs to be submitted to the Government of Japan through diplomatic channel, for the Project to be appraised by the Government of Japan. The Mozambique side explained that it will submit the official request by April, 2017.

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Japanese Grant
Annex 4 Project Monitoring Report (template)
Annex 5 Major Undertakings to be taken by the Government of Mozambique
Annex 6 PROCEDURES OF JAPANESE GRANT
Annex 7 Financial Flow of Japanese Grant (A/P Type)

Annex 2



Annex1



[Source] Prepared by Preparatory Survey Team based on P.39, Chapter 4, Volume III, Master Plan Update Project, 2012-2027 (2014)

■ Maputo metropolitan area

Annex 3

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" (Annex 6) for details):

(1) Preparation
- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal
-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes
-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")
-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")
-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement
-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation
-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the 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 necessary for the implementation of the Project.
- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take 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 executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

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

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable

to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" (Annex 7) for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) 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 to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Annex 4

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX
20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Executing Agency	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Line Ministry	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original *(proposed in the outline design)*	Original *(at the time of signing the Grant Agreement)*	Actual

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations
See Attachment 2.

2-4-2 Activities
See Attachment 3.

2-4-3 Report on RD
See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:

2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)*
name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*
Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

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Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Annex 5

Major Undertakings to be taken by the Government of Mozambique

Specific obligations of the Government of Mozambique which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open bank account (B/A)	within 1 month after the signing of the G/A	EDM		
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract	EDM		
3	To secure and clear the lands for mobile substation	before notice of the bidding document	EDM		
4	To obtain the planning, zoning, building permit	before notice of the bidding document	EDM		
5	To clear, level and reclaim the project site for replacement of transformer, switchgear, and the place for the mobile substation	before notice of the bidding document	EDM		
6	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding documents	EDM		

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	EDM		
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	EDM		
	2) Payment commission for A/P	every payment	EDM		
3	To ensure prompt unloading and customs clearance at ports of disembarkation in recipient country and to assist the Supplier(s) with internal transportation therein	during the Project	EDM		
4	To accord Japanese nationals and/or physical persons of third countries 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 country of the Recipient and stay therein for the performance of their work	during the Project	EDM		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be borne by its designated authority without using the Grant	during the Project	EDM		
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	EDM		

7	To submit Project Monitoring Report	every month	EDM		
	To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	EDM		
8	To submit a report concerning completion of the Project	within six months after completion of the Project	EDM		

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	After completion of the construction	EDM		

Annex 6

PROCEDURES OF JAPANESE GRANT

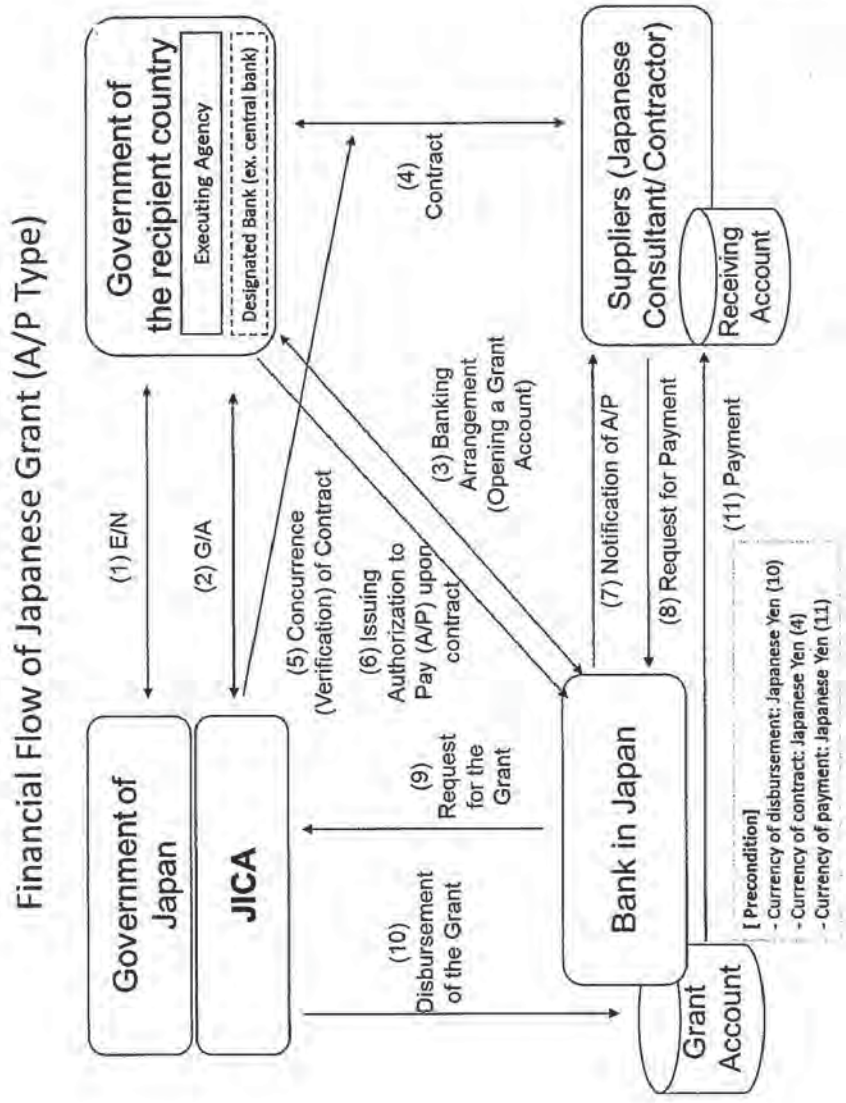
Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

notes:

1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.

Annex 7



６．　地質・測量調査報告書

INFULENE ELECTRICAL SUBSTATION

MATOLA CITY – MAPUTO PROVINCE

MOZAMBIQUE

GEOLOGICAL AND GEOTECHNICAL SURVEY

FINAL REPORT

YACHIYO ENGINEERING CO.,LTD.
Consulting Engineers & Architects

ÍNDICE

1 - INTRODUCTION

As requested by **YACHIYO ENGINEERING CO., LTD**, Tecnasol Mozambique carried out a geological and geotechnical investigation campaign for the expansion of the Infulene electrical substation, located at Matola City, Maputo Province in Mozambique.

The purpose of this campaign was to make the geological-geotechnical characterization of the site, by the means of borehole that allowed the lithology's identification and evaluate their resistance characteristics by performing SPT tests and two dynamic probing light (DPL). In this borehole, three undisturbed samples were taken to perform geomechanical laboratory tests.

The locations of the borehole and DPL are show on the appended drawing (drawing nº P16/0495-3749/001/0/11568).

In this report we describe the work done, the results obtained, geotechnical considerations and foundation recommendation's.

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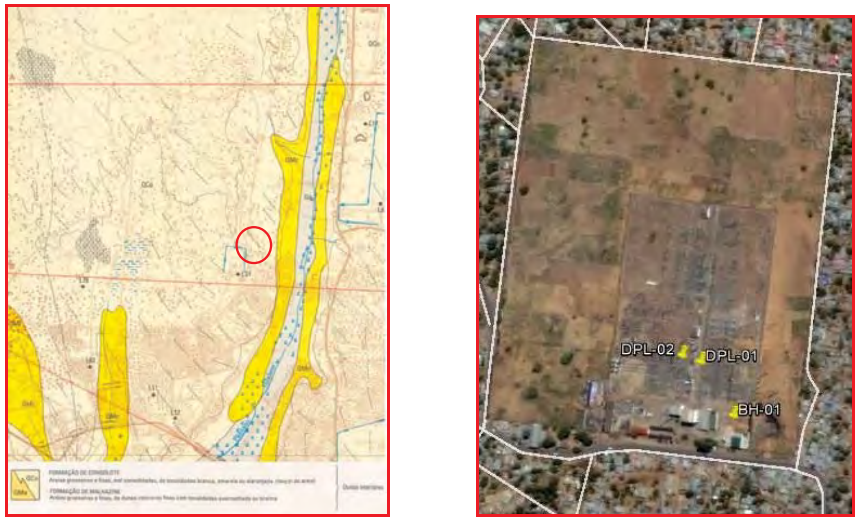
INFULENE ELECTRICAL SUBSTATION
GEOLOGICAL AND GEOTECHNICAL SURVEY
FINAL REPORT

2 - GEOLOGICAL SETTINGS

The area in question are represented on Maputo Geological Map (sheet 2532D3), published by Mozambique National Department of Geology (1:50 000 scale), where the "Congolote Formation" (Qco), dated at Quaternary, occurs. Is characterized by "coarse to fine grained sands (interior dunes)",
At the present location this formation is represented by fine to medium-grained silty sands, reddish brown, loose to very dense.

Mozambican Geological Map,
Extract of Maputo Geological Map (sheet 2532D3) **Site Location**
Original scale – 1:50 000



Study area

Figure 1 – Maputo geological map extract, 1:50 000 (published scale) and borehole location

3 - GROUND INVESTIGATION WORKS

3.1. General

The geological-geotechnical recognition program submitted by the Client included the realization of one borehole and two Dynamic probing light (DPL). This borehole was vertical and was drilled with rotary equipment. At the same time as the borehole was drilled, SPT tests were also carried out. These ones were undertaken at intervals of 1.5 m or whenever the characteristics of the ground being drilled allowed.

The criterion adopted for the end of the borehole was to obtain 3 consecutives SPT test greater than 60 blows.

Undisturbed samples of cohesive soils was obtained at the top of each change of stratum and at a spacing of not more than 1.5m in the borehole.

The works were implemented by Tecnasol based on the design provided by the Client.

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3.1.1. Drilling

As mentioned above, 1 vertical borehole was drilled, with 30.0 m depth.

This borehole is presented in the layout given by the Client (drawing nº P16/0495-3749/001/0/11568).

Table I indicated for the borehole, the coordinate and final depth.

Table I

Borehole	Depth reached (m)	Coordinates		
		E	N	Z
BH1	30.0	452868.5070	7128746.2929	58.49

INFULENE ELECTRICAL SUBSTATION
GEOLOGICAL AND GEOTECHNICAL SURVEY
FINAL REPORT

The drilling was carried out using a rotary probe driven by a hydraulic diesel engine. The drilling is carried out by means of the rotary action, transmitted by the rotating head of the drilling machine, to the assembly constituted by the pins and the tip.

In this drilling process, the progression is made through the placement of new sections of tracks until the desired depth is reached. Since the column is not very rigid, it is advisable to place a piece - "cardin" - between the last hole and the rotating head of the machine.

In drilling, the action of a circulating fluid is not necessary since the helical shape promotes the raising of the disaggregated material from the bottom of the hole to the surface, keeping the hole clean.

The borehole is considered to be finished and accepted when the defined stop criterion is reached.

Figure 2 - Drilling rig in borehole 1

By using the results obtained from the drilling program carried out and combining this with the available bibliographic information and reconnaissance work done at the site, it's possible define the litho-stratigraphic units shown in Table II and described below.

Table II

Age	Formation	Lithology
Recent	*Top soil*	Light brown, dry, fine grained silty sand,
Quaternary	*Congolote Formation* (Qco)	Reddish brown, dry to moist, fine grained silty sand, loose to medium dense
		Reddish brown, moist, fine grained, clayey silty sand, medium dense to very dense

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Recent – Top soil

Sands – Were identified with 3.0 m thicknesses, corresponding to light brown, dry, fine-grained silty sand.

Quaternary – *Congolote Formation* (Qco)

Silty sand – were identified between 3.0m and 19.0 m, corresponding to reddish brown, dry to moist, fine grained silty sand.

Clayey-silty sand – were identified from 19m to the maximum prospected depth, corresponding to reddish brown and whitish, moist, clayey-silty sand.

3.2. In situ tests

3.2.1 SPT test

The objective of dynamic penetration tests, SPT type, is to determine the resistance of the ground to the penetration of a standardised sampling probe while also taking representative samples. These tests are carried out inside boreholes at previously defined depths and whenever there is a change of lithology.

The test consists of driving a standard probe by the application of dynamic energy produced through the dropping of a pile driver. The dropping height and the weight of the pile driver are both standard: the pile driver weighs 63.5 Kg (140 lb), while the dropping height is 76 cm (30 in). The pile driver is released by an automatic device.

Before the test is started, the borehole is cleaned of any debris in order that the sampler can enter the ground without any interference. When the test was done in ground where the borehole walls were unstable it was necessary to case those boreholes. The sampler, connected to a string of rods, is lowered to the depth where the test is to be carried out. The sampler comprises a steel tube 457 mm long, with exterior and interior diameters of 51 mm and 35 mm, respectively.

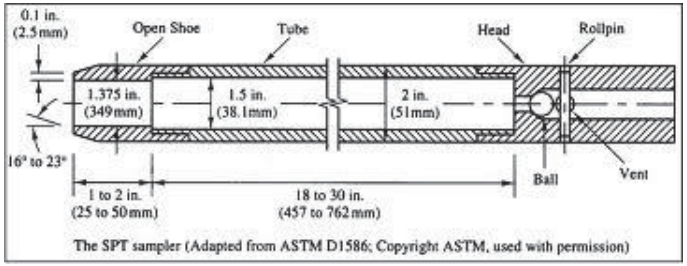

Figure 3 – SPT sampler

After the test starts, a note is taken of the number of blows necessary for the sampler to penetrate 15 cm (6in). Following that, a note is taken of the number of blows necessary for the sampler to penetrate 30 cm (12in). When the sampler does not penetrate 30 cm with 60 blows, the penetration achieved for 60 blows is noted. This is the end of the test. After the test is completed, the sampler is opened by the operator and

the visual appearance of the sample is recorded, as are any transition zones, the sample length, etc. The last 15 cm of the sample are put into a sealed container. A label put inside the container records the number and name of the project, the date, the borehole name (or number), the depth at which the sample was collected, and the test results (number of blows in the different phases and respective penetrations).

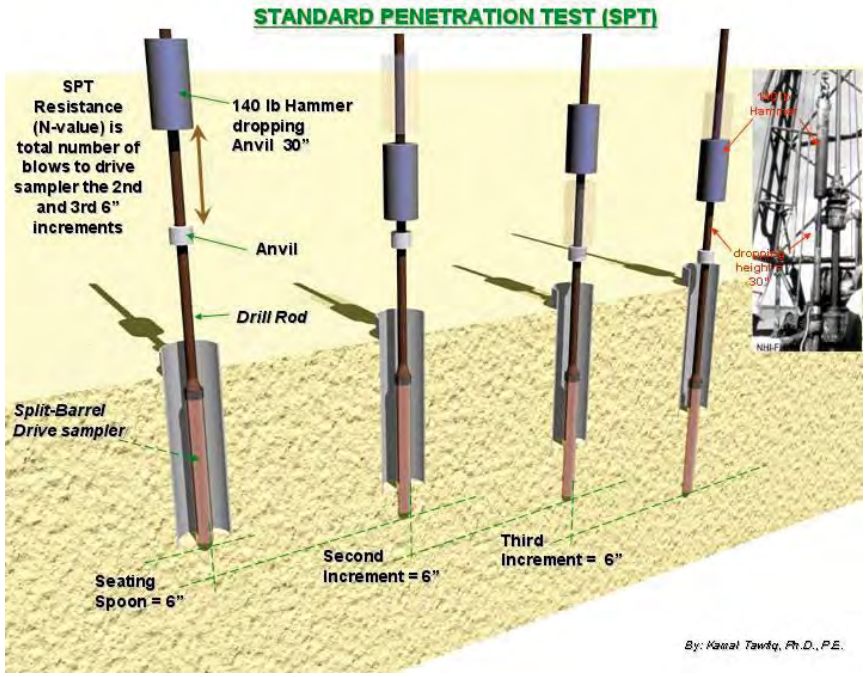

Figure 4 – Standard Penetration Test Phases

Through the carrying out of the SPT tests it is possible to relate the number of blows needed to penetrate the sampler into the ground with unconfined compressive strength or with compacity (Terzaghi and Peck, "Soil Mechanics in Engineering Practice").

For the analysis of the results, it is necessary to make corrections related to depth and energy dissipation. The first correction has to be made since the tension caused by the weight of the ground itself influences

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the results, while the second correction concerns the dissipation of the "theoretical" energy corresponding to the pile driver weight and the height the pile driver is dropped until its hits the tip.

The value corrected for depth is given by the following formula:

$$N_1 = C_N \times N$$

Where C_N is the correction factor and N is the number of blows counted in the test.

When an automatic pile driver triggering device is used, energy dissipation is 40%, in other words, only 60% of the potential energy reaches the tip of the equipment.

In the case of the automatic device used in the work in question, the correction is:

$$N_d = 0{,}60 \times N_1$$

The tests were done at regular intervals, every 1.5 m, using a standard sampler (Terzaghi sampler), with a total of 20 tests being carried out. Table III presents, by borehole, the N_{SPT} values obtained.

Table III

Depth (m)	1.5	3.0	4.5	6.0	6.60	9.0	10.5	11.1	12	13.5	15.0	16.5	18.0	18.6	21.0	22.5	24	25.5	27	28.5	30
N_{spt}	3	5	7	US	14	17	U.S	15	16	20	19	5	U.S	23	28	33	49	25	60	60	60

		$N_{SPT} \leq 20$		$23 \leq N_{SPT} \leq 49$		$N_{SPT} \geq 60$

U.S – Undisturbed Sample

The results are presented in the appended borehole description and interpretative cross-sections show at drawings nº. P16/0495-3749/001/0/11568.

3.2.2 DPL test

3.2.2.1 General

The DPL test is an expedited and fast execution test, applicable to soil and / or soil behavioral materials and to depths of penetration of the order of ten meters.

The dynamic probing light (DPL) is integrated into a group of dynamic penetrometers whose basic principle is the crimping of a standard part with known geometric characteristics, using for that purpose a quantity of energy that can be scaled.

The test with this penetrometer evaluates the resistance offered by the ground to the penetration of a conical tip, connected to the tip of metal rods, which is driven by a force of shock, that is, by the action of a pylon with standard weight and fall.

The test with the light dynamic penetrometer consists of dropping a standardized height of 50 cm, weighing 10 kg, by counting the number of strokes (n) required to penetrate a 10 cm Conical shape attached to the tip of the rods.

The pestle is released automatically and moves along the guide rod so as to hit the steel hold that drives the descent of the set of rods, at the tip of which the cone is connected, to the depth of execution of the test.

In general, the test is terminated when the number of strokes reaches values between 125 and 150 strokes, for penetrations equal to or less than 10 cm. The experience in the execution of this type of tests allows to admit that, for values of this order of magnitude, there will already be in the presence of compact and / or consistent formations.

In the present case, two (2) tests were carried out, for each test, the depth reached and the coordinates were presented in Table IV.

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Table IV

Test	Depth reached (m)	Coordinates		
		E	N	Z
DPL01	11.0	454461	7137121	58.44
DPL02	11.0	454442	7137124	58.43

3.2.2.2 Results obtained

The results of the DPL tests are expressed as a function of the depth reached by the conical tip, by the number of strokes corresponding to every 10 cm. Thus, for the different depths, the value of the resistance to the penetration of the terrain (qd) is determined by the following equation:

$$q_d = \frac{n \times M^2 \times H}{A \times E \times (M + P)} \quad (kg/cm^2)$$

Where:

M - weight of the pestle;

H - dropping height of the pylon;

A - area of the base of the cone;

E – penetration;

P - weight of cone assembly, guide rod and stand;

N - number of strokes for feed E.

The results of the tests are expressed in graphical form, depending on the depth reached by the cone, by the number of strokes for a 10 cm crimping and the corresponding apparent dynamic resistances. Thus, the results of the tests carried out are presented in the graphic form.

The graphs shown are:

- Number of strokes (Nd) vs depth
- Dynamic resistance (Qd) vs depth
- Correlation Nº of strokes DPL (Nd) vs Nº strokes NSPT (NSPT = 0.7Nd)

The following figure illustrate the execution of DPL in the Infulene electrical substation.

Figure 5 – Illustration of DPL-01 and DPL-02 works at the site

Field works included DPL tests developed throughout January on dry weather conditions and DPL features are given in Table V below.

Table V

Ref.	Date	Final Depth	UTM Coordinates (WGS84)		Water level (m)	Depth of blow count (m)			Depth of Q_d (m)			Refusal (Y/N
		(m)	E	S		<17	17 - 30	> 30	< 8 MPa	8 – 12 MPa	> 13 MPa	
DPL-01	25/01/17	11.0	454461	7137121	ND	0.4 – 5.8 8.0 – 8.5	0.0 – 0.4 8.5 – 9.9 9.9 – 11	--	0.4 – 5.6 8.1 – 8.5 9.4 – 9.9	0.0 – 0.4 5.6 – 8.1 9.9 – 11.0	--	No
DPL-02	25/01/17	11.0	454461	7137124	ND	0.0– 5.1	5.1 – 5.4 6.1 – 9.6	9.6 – 11.0	0.0 – 5.0 5.4 – 6.0	5.0 – 5.4 6.0 – 8.9	9.0 – 11.0	No

3.3 Water levels

The water levels were measured in all the boreholes at 12 hours intervals - at the beginning and at the end of the work day. These measurements are shown in Table VI.

Table VI

Borehole	Date	Water level depth (m)		Depth borehole (m)
		Beginning of shift	End of shift	
BH1	17/01	–	Moist	10
	18/01	Moist	Moist	20.0
	19/01	Moist	Moist	30.0

According to the table VI, and the observations made in the field to control and evaluate the behavior of the local water level, it can be affirmed that in the study area, up to the depths reached, no water levels were detected.

3.4 Undisturbed samples

In order to characterize the occurring lithology in geomechanical terms, Tecnasol perform a collection of 3 undisturbed samples using a Moran sampler. After collection, each sample was suitably packaged, sealed and referenced.

Figure 6 – Moran sampler

Table VII indicate the collection depths and the respective lithologies.

Table VII

Borehole	Depth (m)	lithologies
BH1	6.0 – 6.60	Reddish brown, silty sand
	10.50 – 11.10	Reddish brown, silty sand
	18.0 – 18.60	Reddish brown, clayey-silty sand

3.5 Laboratory tests

In order to determine some geomechanical parameters of the soils, 3 undisturbed samples were tested.

The collected samples were subjected to the following laboratorial tests:

- Particle size by sieving;
- Atterberg limits (LL, PL and PI);
- Water content of soil;
- Specific gravity;
- Unconfined compressive strength of cohesive soils;
- Consolidated-undrained triaxial compression test.

Soil laboratory testing results are summarized in the following table. The complete laboratory data records are available in the attached to this report.

Table VIII

Boreholes	Type of sample	Depth (m)	Particle size %<P200 (0.074mm)	Atteberg limits		Moisture Content	Classification		Specific gravity	Unconfined compression	Triaxial compression test				
				LL (%)	IP (%)	(%)	ASTM	AASHTO	g/cm3	qu E (MPa)	qu E (MPa)	σ_3 ϕ (KP)	σ_1 ϕ (KPA)	C ϕ (o)	C' ϕ (o)
BH1	U.S	6.0 – 6.60	14.3	N/P	N/P	4.8	SM	A-2-4(0)	2,626	29.8 5500					
	U.S	10.50 – 11.10	14.9	N/P	N/P	9.6	SM	A-2-4 (0)	2,611	13.7 1346	--	50 100 200	214 410 828	2 37	0 34
	U.S	18.0 – 18.60	20.8	19.9	4.6	14.8	SC-SM	A-2-4 (0)	2,590	19.2 1323					

US-Undisturbed sample

From the laboratory test is important to say that, the quantities of triaxial tests original planned (3 samples), were only one was tested, and two not tested because, undisturbed samples, as the name implies, are samples that must be prepared respecting the conditions in which they arrive at the Laboratory.

Soils without cohesion or weak cohesion, soils with relatively large fragments of rock, completely saturated soils being very soft, are some examples that hinders the first phase of the test, which is the preparation and molding of the test speciment.

These test pieces must have a height to diameter ratio of 1.8 to 2.0 and for the triaxial test 3 test pieces are required under these conditions.

The samples collected in this process 12117, had the conditions described below:

- BH-01 (6,00 - 6,60) - Sample with poor cohesion. Phase of the molding: sample very sensitive to touch, split easily. We only get a sample with the required dimensions. (Figure 8), so it was not possible to perform the Triaxial Test.

- BH-01 (10,50 - 11,10) - Sample with slight cohesion. Phase of the molding: the slight cohesion of this sample allowed us to obtain the three test specimens to the test.

- BH-01 (18,00 - 18,60) - Sample with some cohesion, but completely saturated. Phase of the molding: the sample presented with much water, being a fine sand slightly clayey, became very soft and could not support the own weight. Any attempt to level the faces or cut with the required measurement, the specimen completely deformed. We obtained only one specimen from a sample area with less water. (Figure 9), situation that don't allowed to perform the Triaxial Test.

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Figure 8 and 9 – Preparation of samples for triaxial tests.

4 - GEOTECHNICAL INTERPRETATION

4.1. General

The geotechnical considerations set out in the following items are based on the obtained data from the ground investigation works and laboratory tests specifically defined for this design.

4.2. Geotechnical Zones

Based on the analysis and interpretation of the results obtained in the surveys carried out, three geotechnical zones were defined: GZ3 to GZ1, as indicated in the interpretive cross-section (drawings nº. P16/0495-3749/001/0/11568) attached.

Geotechnical Zone 3 (GZ3)

This is the worst geotechnical zone and was defined from the surface to a maximum depth of 18.6 m.

Is represented by top soil and silty sands. The N_{SPT} values in this zone are between 3 and 20.

Geotechnical Zone 2 (GZ2)

This zone was defined underlying GZ3, with a thicknesses of 8.4 m. Is represented by reddish brown clayey-silt sand, with N_{SPT} values between 23 and 49, but most frequent between 23 to 33 blows.

Geotechnical Zone 1 (GZ1)

This is the zone with the best geotechnical characteristics, developing to the maximum prospected depths. Is represented by reddish brown, clayey-silty sand, with N_{SPT} values greater 60 blows.

The following table presents the depths to which the different geotechnical zones defined above are intersected (Table IX).

Table IX

Borehole	GZ3	GZ2	GZ1
BH1	0.0 – 18.6	18.6 – 27.0	27.0 – 30.0

4.3. Geotechnical Parameters

Following the available information, having for base the results of the geotechnical investigation and the area recognition, it's possible to suggest the following geotechnical parameters for the geotechnical zones previously defined (Table X).

Table X

Zones	Description	SPT (Blows)	Specific gravity γ (KN/m³)	Angle of internal friction ϕ′ (º)	Cohesion c′ (kPa)	Deformability modulus E's (MPa)
GZ3	(Brown and reddish brown, silty sand) Top soil.	3 – 20 (5 - 15)[1]	16 - 18	25 - 35	--	5 - 30
GZ2	Reddish Brown, silty sand.	23 – 49 (23 - 33)[1]	18 - 20	36 - 39	--	30 - 45
GZ1	Reddish brown, clayey-silty sand	60	22	42	--	75

[1] - More frequent values

The values of geotechnical parameters shown correspond to the estimates for the extreme values of SPT interested in this area. For intermediate values of SPT, the parameters should be estimated by interpolation.

5 - FOUNDATIONS CONSIDERATIONS

5.1. Direct Foundations – Allowable Bearing Capacity

According to information received, the future structures' ground level shall be located approximately 1.0m to 2.0m depth from grade level, which means that the ZG3 geotechnical zone will be the direct foundations general supporting stratum.

In the presented document, the method proposed by Bowles (1988) for allowable bearing capacity estimate was adopted, based on correlations with SPT values.

This simplified method assumes the following fundamental principles:

1. Inclination ground surface below 10%;
2. Homogeneous soil characteristics in the influence area of the footing (0.5xB above and 2.0xB below footing);
3. Resultant of action loads presenting inclination lower than 10% with vertical direction;
4. Maximum limit settlement = 25mm.

Due to some heterogeneity regarding the ZG3 SPT values, the following allowable bearing pressures were estimated for two scenarios, corresponding to foundations located at 1.0m and 2.0m depth, according to the SPT average values and foundation widths (B):

Table XI

Geotechnical Zone	Foundation width, B (m)	Significant depth (1.0m+1.5xB to 2.0B) (m)	SPT average value	Allowable pressure, qa (kPa)
ZG3	1.0	2.5 to 3.0	= **3**	75
	2.0	4.0 to 5.0	= (3+5+7)/3=**5**	80
	3.0	5.5 to 7.0	= (3+5+7+14)/4=7.25 ≈ **7.0**	100
	4.0	7.0 to 9.0	= (3+5+7+14+17)/5=9.2 ≈ **9.0**	120
	5.0	8.5 to 11.0	= (3+5+7+14+17+15)/6=10.17 ≈ **10.0**	140

Table XI – Foundations located at 1.0m depth - Allowable pressures

Table XII

Geotechnical Zone	Foundation width, B (m)	Significant depth (2.0m+1.5xB to 2.0B) (m)	SPT average value	Allowable pressure, qa (kPa)
ZG3	1.0	3.5 to 4.0	= **5**	75
	2.0	5.0 to 6.0	= (5+7)/2 = **6.0**	80
	3.0	6.5 to 8.0	= (5+7+14)/3=8.67 ≈ **8.5**	100
	4.0	8.0 to 10.0	= (5+7+14+17)/4=10.75 ≈ **10.5**	120
	5.0	9.5 to 12.0	= (5+7+14+17+15)/5=11.6 ≈ **11.5**	140

Table XII – Foundations located at 2.0m depth - Allowable pressures

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In case of maximum limit settlement less than 25mm and/or foundation width exceeding 5.0m, a settlement analysis shall be performed.

It's important to highlight that the presented value estimates shall be used in low precision design calculations. Otherwise, other direct foundation design methods are recommended such as, for example, Meyerhof, Hansen or Eurocode 7 formulations.

5.2. Indirect Foundations –Bearing Capacities

As an alternative to a direct foundations system, a methodology to estimate indirect foundations (piles) bearing capacity is presented.

The design method suggested uses a semi-empirical model developed by ***Bustamante & Gianeselli*** called experimental-penetrometer method. This method is based on the information collected from a large number of load tests, which supplied experimental data used to validate design methods based on CPT tests results, on this case obtained through correlation between SPT tests and q_c values.

Considering the methodology mentioned, compressive ground resistance of each foundation element, R_{cd} is obtained adding the relative portions of limit base resistance and limit shaft resistance, affected by its respective partial safety factors. The result shall be compared to the axial compressive load in service conditions.

- $$R_{cd} = \frac{R_{bk}}{\gamma_b} + \frac{R_{sk}}{\gamma_s}$$

where:

R_{bk} is the characteristic base resistance;

R_{sk} is the characteristic shaft resistance;

γ_b is a partial safety factor for base resistance, equal to 3.0;

γ_s is a partial safety factor for shaft resistance, equal to 2.0;

The characteristic base resistance is calculated through the following expression:

- $$\mathbf{R_{bk} = q_c \cdot k_c \cdot A}$$

where:

q_c is the unit cone resistance (CPT) calculated by correlation with the average number of blows of the SPT test obtained in the distance between 1.5D above the base and 1.5D bellow (q_c~0.4 x $N_{SPT,mean}$ (MPa) for sands/silty sands);

k_c is the penetrometer factor, function of soil type and execution techniques;

A is the pile base section.

The shaft resistance is obtained as follows:

- $$\mathbf{R_{sk} = \sum_i (q_{s,i} \cdot P \cdot l_i)}$$

where:

l_i is the thickness of stratum i;

P is the pile perimeter;

$q_{s.i}$ is the unit shaft resistance along stratum i, calculated based on unit cone resistance (CPT), q_c, and factor α, dependant on soil type and execution techniques:

$$q_{s.i} = \frac{q_{c.i}}{\alpha_i}$$

The maximum values of $q_{s.i}$ to adopt in each case, as well as the penetrometer factor k_c and coefficient α can be found in the following tables (sand):

Table XIII

State of Sand	q_c (MPa)	Pile Category			
		Coefficient, α_{CPC}		Maximum Limit of f_s (MPa)	
		Concrete	Steel	Concrete	Steel
Loose	< 5	60	120	0.035	0.035
Medium dense	5 to 12	100	200	0.08	0.08
Dense to very dense	> 12	150	200	0.12	0.12

Table XIII – maximum values of $q_{s.i}$ and coefficient α

Table XIV

State of Sand	q_c (MPa)	Factor k_c
Loose	< 5	0.5
Medium dense	5 to 12	0.5
Dense to very dense	> 12	0.4

Table XIV – penetrometer factor k_c

As an example of the described method, the following tables indicate the estimate bearing capacities for Ø600, Ø800 and Ø1000mm drilled piles, for the geological-geotechnical information collected by borehole BH1 and pile base at midpoint of GZ2 (L_{pile} = 22.0m).

Table XV

Borehole	Pile Diameter (mm)	Geotechnical Zone	SPT average value	q_c (Mpa)	α	q_s (Mpa)	$q_{s,lim}$ (Mpa)	l (m)	R_{sk} (kN)	K_c	R_{bk} (kN)	R_{cd} (kN)
BH1	600	GZ3	12.1	4.84	60	0.081	0.035	17.5	**1154**	-	-	**1594**
		GZ2	33.75	13.5	150	0.09	0.12	4.5	**763**	0.5	**1909**	
	800	GZ3	12.1	4.84	60	0.081	0.035	17.5	**1539**	-	-	**2410**
		GZ2	33.75	13.5	150	0.09	0.12	4.5	**1018**	0.5	**3393**	
	1000	GZ3	12.1	4.84	60	0.081	0.035	17.5	**1924**	-	-	**3365**
		GZ2	33.75	13.5	150	0.09	0.12	4.5	**1272**	0.5	**5301**	

Table XV – Pile bearing capacity in BH1 influence area and pile base at midpoint of GZ2 (L_{pile} = 22.0m)

6 - FINAL CONSIDERATIONS

The analysis and interpretation of the results obtained through the geological and geotechnical investigation and the geotechnical zones defined (drawings nº. P16/0495-3749/001/0/11568) turns possible the following considerations:

a) Lithology

The following sequence strata characterize the study area:

- Top soil (brown, dry, silty sandy);
- *Congolote Formation* (reddish brown, silty sand and clayey-silty sand).

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b) Water level

- According to water levels measured during the execution of borehole, it is not expected the occurrence of groundwater in the study area to the prospected depths.

c) Foundation

- The solution to adopt for foundations should be according to the loads to be transmitted, combined with the geotechnical characteristics of the foundation soil.
- Two foundation types are suggested in Chapter 5 of the present Report – direct and indirect foundations - and an estimate of the respective bearing capacities is also presented for different types of foundation geometries.
- The choice on the type of foundation to be adopted shall be performed by the Foundations Engineer, according to the information provided in the present Geotechnical Report and the future structures' load characteristics.

The presented considerations shall be conveniently evaluated at construction stage by a specialist, in order to confirm the assumptions made in the present Geotechnical Report.

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Maputo, March 2017

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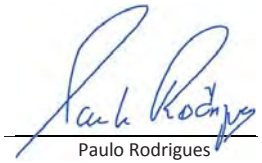

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7 - ATTACHMENTS

Annex I – Triangular and size classification of soils

Annex II – Boreholes and Photos

Annex III – Dynamic probing Light

Annex IV – Laboratory tests

Annex V – Borehole location plant and interpretive cross-sections.

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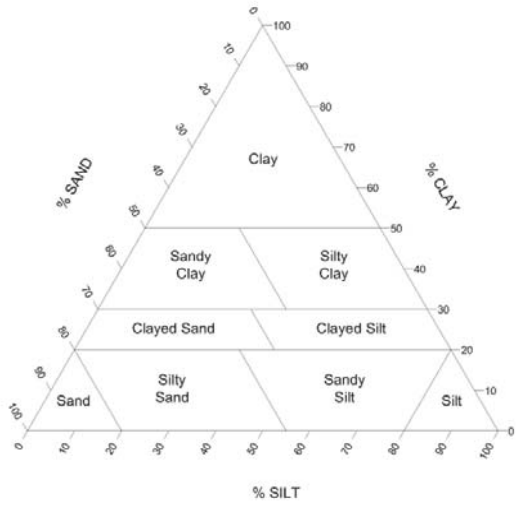
INFULENE ELECTRICAL SUBSTATION
GEOLOGICAL AND GEOTECHNICAL SURVEY
FINAL REPORT

ANNEX I – Triangular and size classification of soils

TRIANGULAR AND GRANULOMETRIC CLASSIFICATION OF SOILS



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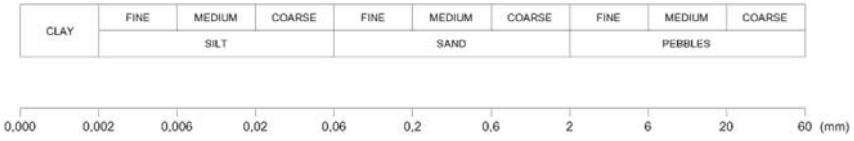

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INFULENE ELECTRICAL SUBSTATION
GEOLOGICAL AND GEOTECHNICAL SURVEY
FINAL REPORT

ANNEX II – BOREHOLES AND PHOTOS

WORK: Substation in Infulene, Maputo.

CLIENT: YACHIYO ENGINEERING CO.,LTD. Consulting Engineers & Architects

LOCATION: Infulene, Matola City, Maputo Province.

BOREHOLE BH1

WORK No 16001

N: 7137049 E: 454503 H: 58.49 m DIRECTION: DEPTH: 30.0 m DEG. FROM HORIZ.: 90° ROTARY BORING Proj. No. PC16/495/AAP

BORING Hollow stem augers ø = 200mm CASING WATER LEVEL DETECTED PIEZOMETRIC Logger JAN/17 AEM Geolog. JAN/17 GO/CP

EQUIPMENT: Mustang A-32 CB STARTED:17/01/2017 COMPLETED: 19/01/2017 Page 1 of 4

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAFY	RECOVERY PERCENTAGE / R.Q.D. (0 % 100)	TESTS AND SAMPLING: S.P.T. 1st Phase (0 No. of blows (N) 60)	2nd and 3rd Phases Penet. (cm)	Tests	GEOTECH. ZONE
17/01	58,0 … 48,5		0,00 … 10,00		(0,00, 3,00) Light brown, dry, fine grained, silty sand, very loose.					1	1+2 30	U.S	
					(3,00, 10,00) Reddish brown, dry to moist, fine grained, silty sand, loose to medium dense.					2	2+3 30		
										2	3+4 30		
										6	6+8 30		
										6	8+9 30		

Notes: U.S - Undisturbed sample

WORK: Substation in Infulene, Maputo.

CLIENT: YACHIYO ENGINEERING CO.,LTD. Consulting Engineers & Architects

LOCATION: Infulene, Matola City, Maputo Province.

BOREHOLE BH1

WORK No 16001

N: 7137049 E: 454503 H: 58.49 m DIRECTION: DEPTH: 30.0 m DEG. FROM HORIZ.: 90° ROTARY BORING Proj. No. PC16/495/AAP

BORING Hollow stem augers ø = 200mm CASING WATER LEVEL DETECTED PIEZOMETRIC Logger JAN/17 AEM Geolog. JAN/17 GO/CP

EQUIPMENT: Mustang A-32 CB STARTED:17/01/2017 COMPLETED: 19/01/2017 Page 2 of 4

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAFY	RECOVERY PERCENTAGE / R.Q.D. (0 % 100)	TESTS AND SAMPLING: S.P.T. 1st Phase (0 No. of blows (N) 60)	2nd and 3rd Phases Penet. (cm)	Tests	GEOTECH. ZONE
18/01	48,5 … 39,0		10,00 … 19,50		(10,00, 19,00) Reddish brown, dry to moist, fine grained, silty sand, medium dense to loose.					6	7+8 30	U.S	
										7	7+9 30		
										8	9+11 30		
										7	9+10 30		
										3	2+3 30		
					(19,00, 20,00) Reddish brown, moist, fine grained, clayey-silty sand, medium dense					8	10+13 30	U.S	

Notes: U.S - Undisturbed sample

WORK: Substation in Infulene, Maputo.

CLIENT: YACHIYO ENGINEERING CO.,LTD. Consulting Engineers & Architects

LOCATION: Infulene, Matola City, Maputo Province.

BOREHOLE BH1

WORK No 16001

N: 7137049 E: 454503 H: 58.49 m DIRECTION: DEPTH: 30.0 m DEG. FROM HORIZ.: 90°

ROTARY BORING

Proj. No. PC16/495/AAP

BORING Hollow stem augers ø = 200mm CASING

WATER LEVEL: DETECTED, PIEZOMETRIC

Logger JAN/17 AEM

Geolog. JAN/17 GO/CP

EQUIPMENT: Mustang A-32 CB STARTED: 17/01/2017 COMPLETED: 19/01/2017

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DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAFY	RECOVERY PERCENTAGE / R.Q.D. (0 % 100)	TESTS AND SAMPLING: S.P.T. 1st Phase (0 No. of blows (N) 60)	2nd and 3rd Phases Penet. (cm)	Tests	GEOTECH. ZONE
19/01	38,5		20,00		(20,00, 27,00) Reddish brown, moist, fine grained, clayey-silty sand, medium dense to dense					11	13+15 30		
	38,0		20,50										
	37,5		21,00										
	37,0		21,50										
	36,5		22,00										
	36,0		22,50							10	15+18 30		
	35,5		23,00										
	35,0		23,50										
	34,5		24,00							18	21+28 30		
	34,0		24,50										
	33,5		25,00										
	33,0		25,50							6	15+10 30		
	32,5		26,00										
	32,0		26,50										
	31,5		27,00		(27,00, 30,28) Reddish brown, moist, fine grained, clayey-silty sand, very dense.					24	29+31 25		
	31,0		27,50										
	30,5		28,00										
	30,0		28,50							26	31+29 23		
	29,5		29,00										
	29,0		29,50										

Notes: U.S - Undisturbed sample

WORK: Substation in Infulene, Maputo.

CLIENT: YACHIYO ENGINEERING CO.,LTD. Consulting Engineers & Architects

LOCATION: Infulene, Matola City, Maputo Province.

BOREHOLE BH1

WORK No 16001

N: 7137049 E: 454503 H: 58.49 m DIRECTION: DEPTH: 30.0 m DEG. FROM HORIZ.: 90°

ROTARY BORING

Proj. No. PC16/495/AAP

BORING Hollow stem augers ø = 200mm CASING

WATER LEVEL: DETECTED, PIEZOMETRIC

Logger JAN/17 AEM

Geolog. JAN/17 GO/CP

EQUIPMENT: Mustang A-32 CB STARTED: 17/01/2017 COMPLETED: 19/01/2017

Page 4 of 4

DATES	ELEVATION	DIAMETERS	DEPTH (m)	LITHOLOGY	DESCRIPTION	WEATHERING	FRACTURATION	STRATIGRAFY	RECOVERY PERCENTAGE / R.Q.D. (0 % 100)	TESTS AND SAMPLING: S.P.T. 1st Phase (0 No. of blows (N) 60)	2nd and 3rd Phases Penet. (cm)	Tests	GEOTECH. ZONE
	28,5		30,00							30	60+0 13		

Notes: U.S - Undisturbed sample

SUBSTATION IN INFULENE – GEOTECHNICAL GEOLOGICAL PROSPECTING BOREHOLE 1

0.0 – 16.50 m

tecnasol
YACHIYO ENGINEERING CO.,LTD.
Consulting Engineers & Architects

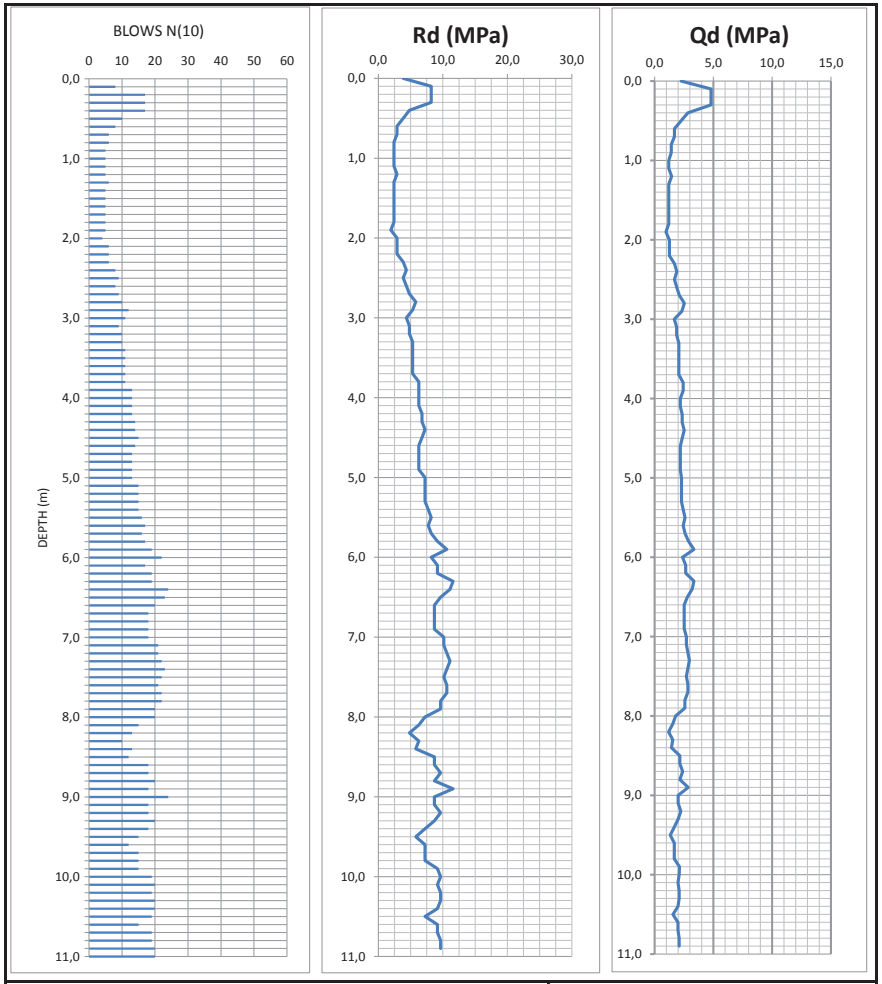
SUBSTATION IN INFULENE – GEOTECHNICAL GEOLOGICAL PROSPECTING BOREHOLE 1

16.50 m – 30.0 m

ANNEX III – DYNAMIC PROBING LIGHT

tecnasol	**Dynamic Probing Light**	YACHIYO ENGINEERING CO.,LTD.
SUBSTATION IN INFULENE	Coordinates (WGS84):	**DPL-01**
	M = 454463.443 m	
	P = 7137119.094 m	**Date:**
Location: Infulene - Maputo	Z = 58.44 m	25-01-2017

Hammer mass =	10,0 kg	Length of drive rods =	1,0 m	**Prof:** 11.0 m
Height of fall =	0,5 m	Avil + guide rod =	4,20 kg	
Weight of drive rods =	2,925 kg	Unit interval=	0,1 m	



Obs: At 5m depth is observed a light humidity

Technician: Arlindo Mauelele

Verified by: Gonçalo Oliveira

tecnasol	Dynamic Probing Light	YACHIYO ENGINEERING CO.,LTD.
SUBSTATION IN INFULENE	Coordinates (WGS84): M = 454463.443 m P = 7137119.094 m Z = 58.44 m	**DPL-01** **Date:** 25-01-2017
Location: Infulene - Maputo		

Prof. (m)		$N_{(10)}$	Rd (MPa)	Qd (MPa)
0,0	0,1	8	3,9	2,3
0,1	0,2	17	8,2	4,8
0,2	0,3	17	8,2	4,8
0,3	0,4	17	8,2	4,8
0,4	0,5	10	4,8	2,8
0,5	0,6	8	3,9	2,3
0,6	0,7	6	2,9	1,7
0,7	0,8	6	2,9	1,7
0,8	0,9	5	2,4	1,4
0,9	1,0	5	2,4	1,4
1,0	1,1	5	2,4	1,2
1,1	1,2	5	2,4	1,2
1,2	1,3	6	2,9	1,4
1,3	1,4	5	2,4	1,2
1,4	1,5	5	2,4	1,2
1,5	1,6	5	2,4	1,2
1,6	1,7	5	2,4	1,2
1,7	1,8	5	2,4	1,2
1,8	1,9	5	2,4	1,2
1,9	2,0	4	1,9	1,0
2,0	2,1	6	2,9	1,3
2,1	2,2	6	2,9	1,3
2,2	2,3	6	2,9	1,3
2,3	2,4	8	3,9	1,7
2,4	2,5	9	4,3	1,9
2,5	2,6	8	3,9	1,7
2,6	2,7	9	4,3	1,9
2,7	2,8	10	4,8	2,1
2,8	2,9	12	5,8	2,5
2,9	3,0	11	5,3	2,3
3,0	3,1	9	4,3	1,7
3,1	3,2	10	4,8	1,9
3,2	3,3	10	4,8	1,9
3,3	3,4	11	5,3	2,1
3,4	3,5	11	5,3	2,1
3,5	3,6	11	5,3	2,1
3,6	3,7	11	5,3	2,1
3,7	3,8	11	5,3	2,1
3,8	3,9	13	6,3	2,4
3,9	4,0	13	6,3	2,4
4,0	4,1	13	6,3	2,2
4,1	4,2	13	6,3	2,2
4,2	4,3	14	6,8	2,3
4,3	4,4	14	6,8	2,3
4,4	4,5	15	7,2	2,5
4,5	4,6	14	6,8	2,3
4,6	4,7	13	6,3	2,2
4,7	4,8	13	6,3	2,2
4,8	4,9	13	6,3	2,2
4,9	5,0	13	6,3	2,2
5,0	5,1	15	7,2	2,3
5,1	5,2	15	7,2	2,3
5,2	5,3	15	7,2	2,3
5,3	5,4	15	7,2	2,3
5,4	5,5	16	7,7	2,4
5,5	5,6	17	8,2	2,6
5,6	5,7	16	7,7	2,4
5,7	5,8	17	8,2	2,6
5,8	5,9	19	9,2	2,9
5,9	6,0	22	10,6	3,4
6,0	6,1	17	8,2	2,4
6,1	6,2	19	9,2	2,7
6,2	6,3	19	9,2	2,7
6,3	6,4	24	11,6	3,3
6,4	6,5	23	11,1	3,2
6,5	6,6	20	9,6	2,8
6,6	6,7	18	8,7	2,5
6,7	6,8	18	8,7	2,5
6,8	6,9	18	8,7	2,5
6,9	7,0	18	8,7	2,5
7,0	7,1	21	10,1	2,7
7,1	7,2	21	10,1	2,7
7,2	7,3	22	10,6	2,8
7,3	7,4	23	11,1	3,0
7,4	7,5	22	10,6	2,8
7,5	7,6	21	10,1	2,7
7,6	7,7	22,0	10,6	2,8
7,7	7,8	22,0	10,6	2,8
7,8	7,9	20,0	9,6	2,6
7,9	8,0	20,0	9,6	2,6
8,0	8,1	15,0	7,2	1,8
8,1	8,2	13,0	6,3	1,6
8,2	8,3	10,0	4,8	1,2
8,3	8,4	13,0	6,3	1,6
8,4	8,5	12,0	5,8	1,4
8,5	8,6	18,0	8,7	2,1
8,6	8,7	18,0	8,7	2,1
8,7	8,8	20,0	9,6	2,4
8,8	8,9	18,0	8,7	2,1
8,9	9,0	24,0	11,6	2,9
9,0	9,1	18,0	8,7	2,0
9,1	9,2	18,0	8,7	2,0
9,2	9,3	20,0	9,6	2,2
9,3	9,4	18,0	8,7	2,0
9,4	9,5	15,0	7,2	1,7
9,5	9,6	12,0	5,8	1,3
9,6	9,7	15,0	7,2	1,7
9,7	9,8	15,0	7,2	1,7
9,8	9,9	15,0	7,2	1,7
9,9	10,0	19,0	9,2	2,1
10,0	10,1	20,0	9,6	2,1
10,1	10,2	19,0	9,2	2,0
10,2	10,3	20,0	9,6	2,1
10,3	10,4	20,0	9,6	2,1
10,4	10,5	19,0	9,2	2,0
10,5	10,6	15,0	7,2	1,6
10,6	10,7	19,0	9,2	2,0
10,7	10,8	19,0	9,2	2,0
10,8	10,9	20,0	9,6	2,1
10,9	11,0	20,0	9,6	2,1

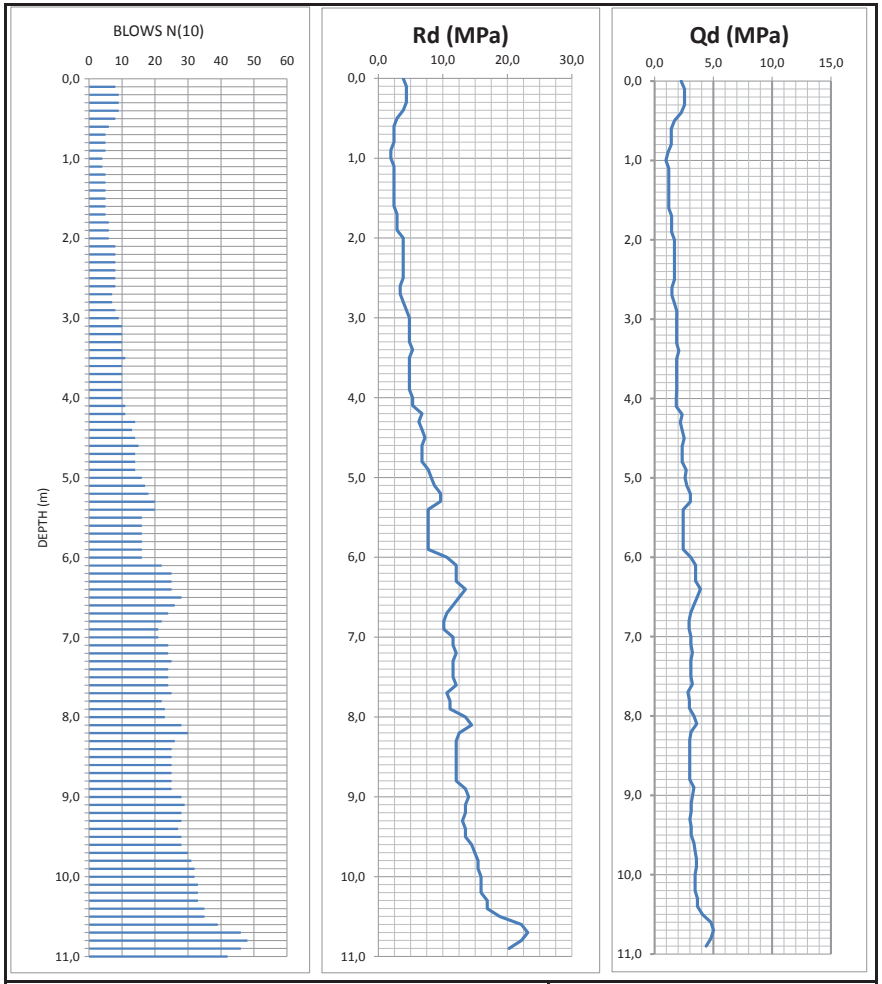
DPL-01

Obs: At 5m depth is observed a light humidity

Technician: Arlindo Mauelele
Verified by: Gonçalo Oliveira

tecnasol	Dynamic Probing Light	YACHIYO ENGINEERING CO.,LTD.
SUBSTATION IN INFULENE	Coordinates (WGS84): M = 454442.121 m P = 7137123.641 m Z = 58.43 m	**DPL-02** **Date:** 25-01-2017
Location: Infulene - Maputo		

Hammer mass =	10,0 kg	Length of drive rods =	1,0 m	**Prof:** 11.0 m
Height of fall =	0,5 m	Avil + guide rod =	4,20 kg	
Weight of drive rods =	2,925 kg	Unit interval=	0,1 m	



Obs: At 5m depth is observed a light humidity

Technician: Arlindo Mauelele
Verified by: Gonçalo Oliveira

tecnasol	Dynamic Probing Light	YACHIYO ENGINEERING CO.,LTD.
SUBSTATION IN INFULENE	Coordinates (WGS84): M = 454442.121 m P = 7137123.641 m Z = 58.43 m	DPL-02 Date: 25-01-2017
Location: Infulene - Maputo		

Prof. (m)		$N_{(10)}$	Rd (MPa)	Qd (MPa)
0,0	0,1	8	3,9	2,3
0,1	0,2	9	4,3	2,5
0,2	0,3	9	4,3	2,5
0,3	0,4	9	4,3	2,5
0,4	0,5	8	3,9	2,3
0,5	0,6	6	2,9	1,7
0,6	0,7	5	2,4	1,4
0,7	0,8	5	2,4	1,4
0,8	0,9	5	2,4	1,4
0,9	1,0	4	1,9	1,1
1,0	1,1	4	1,9	1,0
1,1	1,2	5	2,4	1,2
1,2	1,3	5	2,4	1,2
1,3	1,4	5	2,4	1,2
1,4	1,5	5	2,4	1,2
1,5	1,6	5	2,4	1,2
1,6	1,7	5	2,4	1,2
1,7	1,8	6	2,9	1,4
1,8	1,9	6	2,9	1,4
1,9	2,0	6	2,9	1,4
2,0	2,1	8	3,9	1,7
2,1	2,2	8	3,9	1,7
2,2	2,3	8	3,9	1,7
2,3	2,4	8	3,9	1,7
2,4	2,5	8	3,9	1,7
2,5	2,6	8	3,9	1,7
2,6	2,7	7	3,4	1,5
2,7	2,8	7	3,4	1,5
2,8	2,9	8	3,9	1,7
2,9	3,0	9	4,3	1,9
3,0	3,1	10	4,8	1,9
3,1	3,2	10	4,8	1,9
3,2	3,3	10	4,8	1,9
3,3	3,4	10	4,8	1,9
3,4	3,5	11	5,3	2,1
3,5	3,6	10	4,8	1,9
3,6	3,7	10	4,8	1,9
3,7	3,8	10	4,8	1,9
3,8	3,9	10	4,8	1,9
3,9	4,0	10	4,8	1,9
4,0	4,1	11	5,3	1,8
4,1	4,2	11	5,3	1,8
4,2	4,3	14	6,8	2,3
4,3	4,4	13	6,3	2,2
4,4	4,5	14	6,8	2,3
4,5	4,6	15	7,2	2,5
4,6	4,7	14	6,8	2,3
4,7	4,8	14	6,8	2,3
4,8	4,9	14	6,8	2,3
4,9	5,0	16	7,7	2,7
5,0	5,1	17	8,2	2,6
5,1	5,2	18	8,7	2,7
5,2	5,3	20	9,6	3,0
5,3	5,4	20	9,6	3,0
5,4	5,5	16	7,7	2,4
5,5	5,6	16	7,7	2,4
5,6	5,7	16	7,7	2,4
5,7	5,8	16	7,7	2,4
5,8	5,9	16	7,7	2,4
5,9	6,0	16	7,7	2,4
6,0	6,1	22	10,6	3,1
6,1	6,2	25	12,1	3,5
6,2	6,3	25	12,1	3,5
6,3	6,4	25	12,1	3,5
6,4	6,5	28	13,5	3,9
6,5	6,6	26	12,5	3,6
6,6	6,7	24	11,6	3,3
6,7	6,8	22	10,6	3,1
6,8	6,9	21	10,1	2,9
6,9	7,0	21	10,1	2,9
7,0	7,1	24	11,6	3,1
7,1	7,2	24	11,6	3,1
7,2	7,3	25	12,1	3,2
7,3	7,4	24	11,6	3,1
7,4	7,5	24	11,6	3,1
7,5	7,6	24	11,6	3,1
7,6	7,7	25,0	12,1	3,2
7,7	7,8	22,0	10,6	2,8
7,8	7,9	23,0	11,1	3,0
7,9	8,0	23,0	11,1	3,0
8,0	8,1	28,0	13,5	3,3
8,1	8,2	30,0	14,5	3,6
8,2	8,3	26,0	12,5	3,1
8,3	8,4	25,0	12,1	3,0
8,4	8,5	25,0	12,1	3,0
8,5	8,6	25,0	12,1	3,0
8,6	8,7	25,0	12,1	3,0
8,7	8,8	25,0	12,1	3,0
8,8	8,9	25,0	12,1	3,0
8,9	9,0	28,0	13,5	3,3
9,0	9,1	29,0	14,0	3,2
9,1	9,2	28,0	13,5	3,1
9,2	9,3	28,0	13,5	3,1
9,3	9,4	27,0	13,0	3,0
9,4	9,5	28,0	13,5	3,1
9,5	9,6	28,0	13,5	3,1
9,6	9,7	30,0	14,5	3,3
9,7	9,8	31,0	15,0	3,5
9,8	9,9	32,0	15,4	3,6
9,9	10,0	32,0	15,4	3,6
10,0	10,1	33,0	15,9	3,4
10,1	10,2	33,0	15,9	3,4
10,2	10,3	33,0	15,9	3,4
10,3	10,4	35,0	16,9	3,7
10,4	10,5	35,0	16,9	3,7
10,5	10,6	39,0	18,8	4,1
10,6	10,7	46,0	22,2	4,8
10,7	10,8	48,0	23,2	5,0
10,8	10,9	46,0	22,2	4,8
10,9	11,0	42,0	20,3	4,4

DPL-02

Obs: At 5m depth is observed a light humidity

Technician: Arlindo Mauelele

Verified by: Gonçalo Oliveira

ANNEX IV – LABORATORY TEST

Geocontrole

tecnasol elevo GROUP

JOB : GEOTECNHICAL STUDY - INFULENE

Job N. 12117 - Lot 1

Sample information					Identification tests							Mechanical tests												Chemical tests					
																		Triaxial Compression Test											
Sample Nº	Borehole or Pit Nº	Depth (m)	Description following ASTM D2487	Classf. ASTM (D2487) ASTM (D3282)	Moisture Content (%)	Specific Gravity < #4,75 mm (g/cm3)	Atterberg Limits LL / PI (%)	Density of soil Wet / Dry (g/cm3)	Density Maximum and Minimum (g/cm3)	Sieve Analysis <2.0 mm <0.42 mm (%)	Sieve Analysis <0.074 mm <0.0014 mm (%)	Direct Shear C (Kpa) ϕ (°)	Direct Shear C` (Kpa) ϕ` (°)	Consolidation Cc / σ`p / e0	Consolidation Cv (cm2/s) K (cm/s)	Unconfined Compression Test qu / E (kPa)	qu / E (kPa)	σ 3 (kPa)	σ 1 (kPa)	C (Kpa) ϕ (°)	C` (Kpa) ϕ` (°)	pH	Sulphate Content as SO3 (%)	Chloride Content (%)	Organic Content (%)	Carbonate Content as CO2 (%)	Dissolved Solids mg/L
12676	BH-1	6,00-6,60	Redish brown, silty sand	SM	4,8	2,626	N/P	-	-	100,0	14,3	-	-	-	-	29,8	-	-	-	-	-	-	-	-	-	-	-
				A-2-4 (0)			N/P	-	-	89,8	-	-	-	-	-	5500											
12677	BH-1	10,50-11,10	Redish brown, silty sand	SM	9,6	2,611	N/P	-	-	100,0	14,9	-	-	-	-	13,7	-	50 100 200	214 410 828	2 37	0 34	-	-	-	-	-	-
				A-2-4 (0)			N/P	-	-	90,9	-	-	-	-	-	1346											
12678	BH-1	18,00-18,60	Redish brown, clayey-silty sand	SC-SM	14,8	2,590	19,9	-	-	100,0	20,8	-	-	-	-	19,2	-	-	-	-	-	-	-	-	-	-	-
				A-2-4 (0)			4,6	-	-	92,5	-	-	-	-	-	1323											

Verified by : Date: 17/02/2017

Geocontrole Geotecnia e Estruturas de Fundação Lda Moçambique

tecnasol elevo GROUP

Job : GEOTECNHICAL STUDY - INFULENE

Job N. : 12117 - Lot 1

DETERMINATION OF WATER CONTENT OF SOIL AND ROCK BY MASS

Standard method: ASTM D 2216 - 05

Sample Register date : 25/01/2017 **Sample Nº : 12676**

Material description : Redish brown, silty sand **Borehole or Pit : BH-1**

Depth (m) : 6,00-6,60

Specimen number	Container number	m^{w+c} Mass of wet soil + container (0,01g)	m^{d+c} Mass of dry soil + container (0,01g)	m^c Mass of container (0,01g)	$m^{ml}=m^{w+c} - m^{d+c}$ Mass of moisture loss (0,01g)	$m^d=m^{d+c} - m^c$ Mass of dry soil (0,01g)	$MC=m^{ml}/m^d*100$ Moisture content (0,1 %)
1	41	190,35	185,11	77,56	5,24	107,55	4,9
2	13	214,40	208,18	78,99	6,22	129,19	4,8
3	31	212,08	206,02	80,30	6,06	125,72	4,8

MOISTURE CONTENT Mc = 4,8 (0,1%)

REMARKS :

Tested by : **Verified by :**

Date : 25/01/2017 **Date :**

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tecnasol elevo GROUP

JOB : **GEOTECNHICAL STUDY - INFULENE**

Job N. **12117 - Lot 1**

STANDARD TEST METHOD FOR PARTICLE - SIZE ANALYSIS OF SOILS

Standard method : ASTM D 6913 & ASTM D 422

Sample Register date : 25/01/2017 **Sample Nº 12676**

Material description : Redish brown, silty sand **Borehole or Pit :** BH-1

Depth (m): 6,00-6,60

TOTAL WEIGHT OF SAMPLE (g)	p1=	107,58 g
TOTAL ACCUMULATED WEIGHT RETAINED BY SIEVE Nº 10 (g)	p2=	0,00 g
TOTAL WEIGHT OF SAMPLE BELOW SIEVE Nº 10 (g)	p3=	107,58 g
TOTAL WEIGHT USED IN TEST BELOW SIEVE Nº 10 (g)	p4=	107,58 g

Sieve designation (ASTM)	Mesh aperture (mm)	Mass accumulated in sieve Mass (g)	Mass accumulated in sieve %	% Passing	Sieve designation (ASTM)	Mesh aperture (mm)	Mass accumulated in sieve Mass (g)	Mass accumulated in sieve %	%Passing (Referred to the total weight)
3"	75,0	0	0,0	**100,0**	nº 20	0,840	0,40	0,4	**99,6**
2 1/2"	63,0	0	0,0	**100,0**	nº 40	0,425	10,94	10,2	**89,8**
2"	50,0	0	0,0	**100,0**	nº 60	0,250	38,22	35,5	**64,5**
1 1/2"	37,5	0	0,0	**100,0**	nº 100	0,150	87,44	81,3	**18,7**
1"	25,0	0	0,0	**100,0**	nº 140	0,105	91,31	84,9	**15,1**
3/4"	19,0	0	0,0	**100,0**	nº 200	0,075	92,23	85,7	**14,3**
1/2"	12,5	0	0,0	**100,0**					
3/8"	9,5	0	0,0	**100,0**					
nº 4	4,75	0	0,0	**100,0**					
nº 10	2,00	0,00	0,0	**100,0**					

Hydrometer (151H) nº

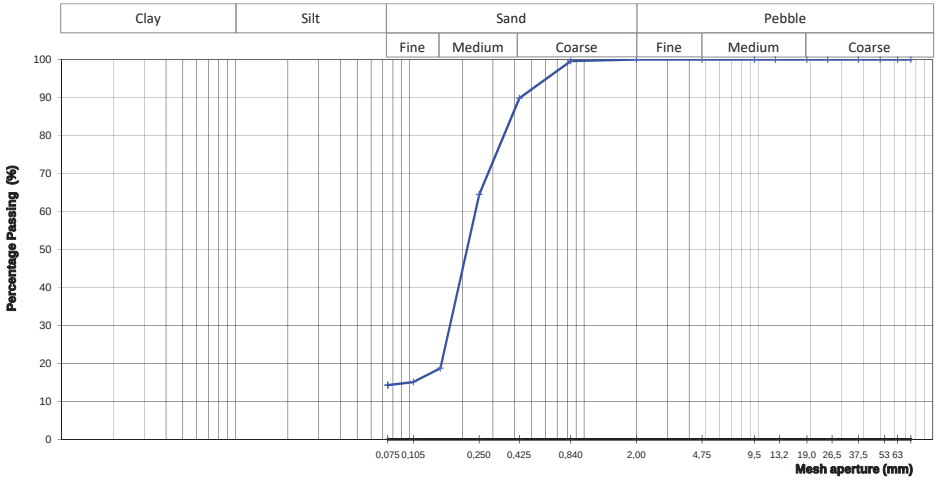
Specific gravity of soil

Correction dispersing agent

Correction meniscus

Time (min)	Temp. (°)	Readings (L)	Composite correction	Heigth read. (L)	Reading corrected	Particle diameter (D)	% of particles referred to the total

Curve Particle Size Distribution



REMARKS :

Tested by : **Verified by :** **Page 2 of 5**

Date : 27/01/2017 **Date :**

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A-6-23

Geocontrole — Geotecnia e Estruturas de Fundação Lda — Moçambique

tecnasol elevo GROUP

JOB : **GEOTECNHICAL STUDY - INFULENE**

Job N. : **12117 - Lot 1**

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

Standard method: ASTM D 4318

Sample Register date : 25/01/2017 **Sample Nº : 12676**

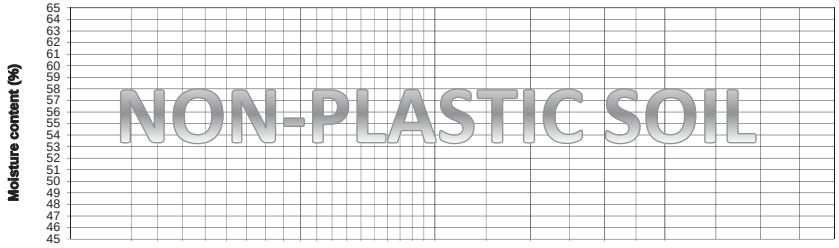
Material description : Redish brown, silty sand **Borehole or Pit :** BH-1

Depth (m): 6,00-6,60

Liquid Limit

	Container n.º					
m2	Mass of wet soil + container	(g)				
m3	Mass of dry soil + container	(g)				
m1	Mass of container	(g)				
md=m3-m1	Mass of dry soil	(g)				
mw=m2-m3	Mass of moisture loss	(g)				
w=100*mw/md	Moisture content	(%)				
	Number of bumps					

LL= N/P %



Plastic Limit

	Container n.º					
m2	Mass of wet soil + container	(g)				
m3	Mass of dry soil + container	(g)				
m1	Mass of container	(g)				
md=m3-m1	Mass of dry soil	(g)				
mw=m2-m3	Mass of moisture loss	(g)				
w=100*mw/md	Moisture content	(%)				

PL= N/P %

Plasticity Index

PI=(LL-PL)= N/P - N/P = N/P %

Tested by : **Verified by :** **Page 3 of 5**

Date : 30/01/2017 **Date :**

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Geocontrole — Geotecnia e Estruturas de Fundação Lda — Moçambique

tecnasol elevo GROUP

JOB : **GEOTECNHICAL STUDY - INFULENE**

Job N. **12117 - Lot 1**

SPECIFIC GRAVITY OF SOIL BY WATER PYCNOMETER

Standard method: ASTM D854-02

Sample Register date : 25/01/2017 **Sample Nº : 12676**

Material description : Redish brown, silty sand **Borehole or Pit :** BH-1

Depth (m): 6,00-6,60

Pycnometer n.°	**nº**	44	55
Test temperature (t)	**°C**	27,0	27,0
Temperature coeficient	**K**	0,99831	0,99831
Pycnometer + sample + distilled water (g)	**$M_{rws,t}$**	189,38	189,89
Pycnometer + distilled water (g)	**$M_{rw,t}$**	173,72	174,19
Container	**nº**	12	14
Container mass (g)	**P_1**	193,36	186,58
Mass of the oven dry soil + Container (g)	**P_2**	218,6	211,93
Mass of the oven dry soil (g)	**M_s**	25,24	25,35
Specific gravity (g/cm³)	**G_t**	2,635	2,627
Specific gravity at 20ºC (g/cm³)	**$G_{20ºC}$**	2,630	2,623
Average (g/cm³)	**$G_{20ºC}$**	**2,626**	

[X] **Method A**

[ ] **Method B**

$$G_t = \frac{M_s}{\left[M_{\rho w,t} - (M_{\rho ws,t} - M_s)\right]}$$

REMARKS: _____

Tested by : **Verified by :** **Page 4 of 5**

Date : 27/01/2017 **Date :**

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A-6-24

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JOB : GEOTECNHICAL STUDY - INFULENE

Job N. 12117 - Lot 1

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS

Standard method: ASTM D 2166-00

Sample Register date : 25/01/2017 **Sample nº : 12676**

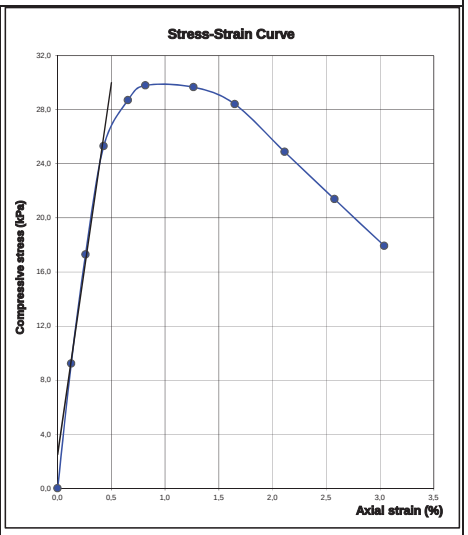
Material description : Redish brown, silty sand **Borehole nº :** BH-1

Depth (m): 6,00-6,60

Height specimen	**(L_o)**	12,20	cm	**Type of sample:**		Undisturbed
Diameter specimen	**(D_o)**	5,90	cm	**Water content** (obtained after shear with entire specimen)	**(w)**	4,5 %
Cross-sectional area	**(A_o)**	27,34	cm^2		**(ρ_w)**	17,6 kN/m^3
Volume specimen	**(V_o)**	333,54	cm^3	**Dry bulk density**	**(ρ_d)**	16,8 kN/m^3
Wt. specimen wet	**(W_w)**	597,9	g	**Specific gravity** (measured)	**(G)**	2,626 g/cm^3
Wt. specimen dry	**(W_d)**	572,09	g	**Degree of saturation**	**(S_r)**	22 %

Time (min:seg)	STRAIN dial	STRAIN %	LOAD Div	LOAD N	CORR. AREA (cm^2)	STRESS (kPa)
00:00	0	0,00	0	0	27,34	0,0
00:20	154	0,13	8	25	27,37	9,2
00:40	316	0,26	15	47	27,41	17,3
01:05	523	0,43	22	70	27,46	25,3
01:32	797	0,65	25	79	27,52	28,7
01:55	997	0,82	26	82	27,56	29,8
02:56	1543	1,26	26	82	27,69	29,7
03:50	2010	1,65	25	79	27,80	28,4
04:44	2576	2,11	22	70	27,93	24,9
05:38	3142	2,58	19	60	28,06	21,4
06:32	3708	3,04	16	51	28,20	17,9

Strain rate: 0,42 **%/min** / 0,51 **mm/min**



q_u= 29,8 kPa

S_u= 14,9 kPa

E_{av}= 5500 kPa

(average modulus)

REMARKS:

Tested by : **Verified by :** **Page 5 of 5**

Date: 30/01/2017 **Date:**

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Job : **GEOTECNHICAL STUDY - INFULENE**

Job N. : **12117 - Lot 1**

DETERMINATION OF WATER CONTENT OF SOIL AND ROCK BY MASS

Standard method: ASTM D 2216 - 05

Sample Register date : 25/01/2017 **Sample Nº : 12677**

Material description : Redish brown, silty sand **Borehole or Pit : BH-1**

Depth (m) : 10,50-11,10

Specimen number			1	2	3
Container number			5	29	18
m^{w+c}	Mass of wet soil + container	(0,01g)	201,27	215,77	217,81
m^{d+c}	Mass of dry soil + container	(0,01g)	190,61	203,93	205,58
m^{c}	Mass of container	(0,01g)	78,69	78,78	79,86
$m^{ml}=m^{w+c} - m^{d+c}$	Mass of moisture loss	(0,01g)	10,66	11,84	12,23
$m^{d}=m^{d+c} - m^{c}$	Mass of dry soil	(0,01g)	111,92	125,15	125,72
$MC=m^{ml}/m^{d}*100$	Moisture content	(0,1 %)	9,5	9,5	9,7

MOISTURE CONTENT Mc = 9,6 (0.1%)

REMARKS :

Tested by : **Verified by :** **Page 1 of 12**

Date : 25/01/2017 **Date :**

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A-6-25

Job : **GEOTECNHICAL STUDY - INFULENE**

Job N. **12117 - Lot 1**

STANDARD TEST METHOD FOR PARTICLE - SIZE ANALYSIS OF SOILS

Standard method : ASTM D 6913 & ASTM D 422

Sample Register date : 25/01/2017 **Sample Nº 12677**

Material description : Redish brown, silty sand **Borehole or Pit :** BH-1

Depth (m): 10,50-11,10

TOTAL WEIGHT OF SAMPLE (g) p1= 125,83 g

TOTAL ACCUMULATED WEIGHT RETAINED BY SIEVE Nº 10 (g) p2= 0,00 g

TOTAL WEIGHT OF SAMPLE BELOW SIEVE Nº 10 (g) p3= 125,83 g

TOTAL WEIGHT USED IN TEST BELOW SIEVE Nº 10 (g) p4= 125,83 g

Sieve designation (ASTM)	Mesh aperture (mm)	Mass accumulated in sieve Mass (g)	Mass accumulated in sieve %	% Passing	Sieve designation (ASTM)	Mesh aperture (mm)	Mass accumulated in sieve Mass (g)	Mass accumulated in sieve %	%Passing (Referred to the total weight)
3"	75,0	0	0,0	**100,0**	nº 20	0,840	0,45	0,4	**99,6**
2 1/2"	63,0	0	0,0	**100,0**	nº 40	0,425	11,43	9,1	**90,9**
2"	50,0	0	0,0	**100,0**	nº 60	0,250	40,67	32,3	**67,7**
1 1/2"	37,5	0	0,0	**100,0**	nº 100	0,150	99,66	79,2	**20,8**
1"	25,0	0	0,0	**100,0**	nº 140	0,105	105,88	84,1	**15,9**
3/4"	19,0	0	0,0	**100,0**	nº 200	0,075	107,10	85,1	**14,9**
1/2"	12,5	0	0,0	**100,0**					
3/8"	9,5	0	0,0	**100,0**					
nº 4	4,75	0	0,0	**100,0**					
nº 10	2,00	0,00	0,0	**100,0**					

Hydrometer (151H) nº

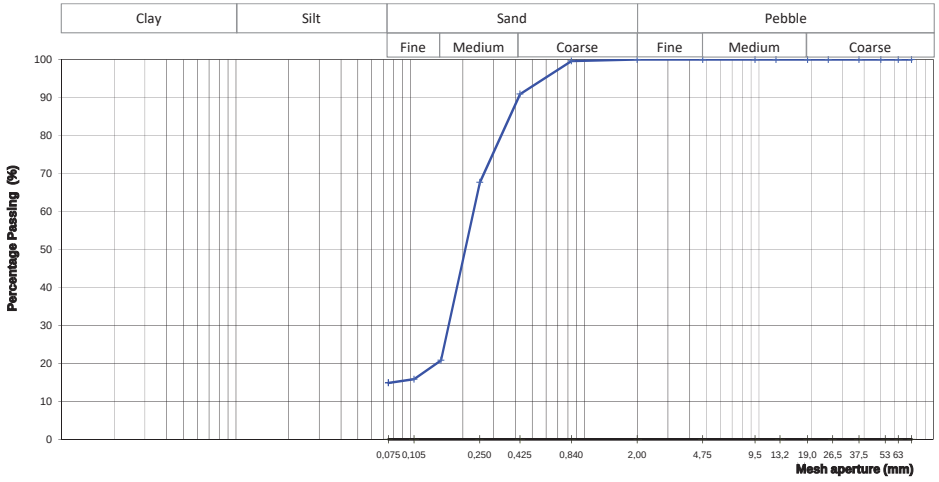
Specific gravity of soil

Correction dispersing agent

Correction meniscus

Time (min)	Temp. (°)	Readings (L)	Composite correction	Heigth read. (L)	Reading corrected	Particle diameter (D)	% of particles referred to the total

Curve Particle Size Distribution



REMARKS :

Tested by : **Verified by :** **Page 2 of 12**

Date : 27/01/2017 **Date :**

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JOB : **GEOTECNHICAL STUDY - INFULENE**

Job N. : **12117 - Lot 1**

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

Standard method: ASTM D 4318

Sample Register date : 25/01/2017 **Sample Nº : 12677**

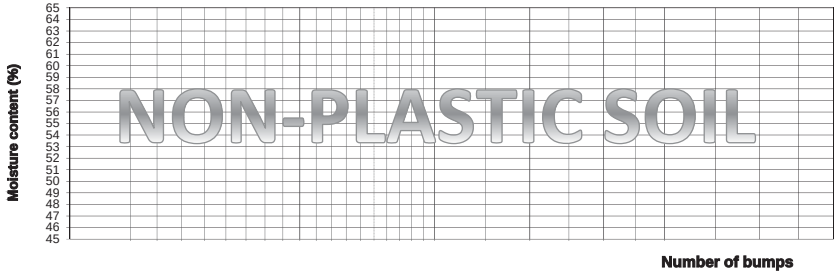
Material description : Redish brown, silty sand **Borehole or Pit :** BH-1

Depth (m): 10,50-11,10

Liquid Limit

	Container n.º					
m2	Mass of wet soil + container	(g)				
m3	Mass of dry soil + container	(g)				
m1	Mass of container	(g)				
md=m3-m1	Mass of dry soil	(g)				
mw=m2-m3	Mass of moisture loss	(g)				
w=100*mw/md	Moisture content	(%)				
	Number of bumps					

LL= N/P %



Plastic Limit

	Container n.º					
m2	Mass of wet soil + container	(g)				
m3	Mass of dry soil + container	(g)				
m1	Mass of container	(g)				
md=m3-m1	Mass of dry soil	(g)				
mw=m2-m3	Mass of moisture loss	(g)				
w=100*mw/md	Moisture content	(%)				

PL= N/P %

Plasticity Index

PI=(LL-PL)= N/P - N/P = N/P %

Tested by : **Verified by :**

Date : 30/01/2017 **Date :**

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A-6-26

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JOB : **GEOTECNHICAL STUDY - INFULENE**

Job N. **12117 - Lot 1**

SPECIFIC GRAVITY OF SOIL BY WATER PYCNOMETER

Standard method: ASTM D854-02

Sample Register date : 25/01/2017 **Sample Nº : 12677**

Material description : Redish brown, silty sand **Borehole or Pit :** BH-1

Depth (m): 10,50-11,10

Pycnometer n.º	**nº**	44	55
Test temperature (t)	**ºC**	26,0	26,0
Temperature coeficient	**K**	0,99858	0,99858
Pycnometer + sample + distilled water (g)	**$M_{rws,t}$**	189,23	189,89
Pycnometer + distilled water (g)	**$M_{rw,t}$**	173,72	174,19
Container	**nº**	22	31
Container mass (g)	**P_1**	187,61	187,79
Mass of the oven dry soil + Container (g)	**P_2**	212,72	213,22
Mass of the oven dry soil (g)	**M_s**	25,11	25,43
Specific gravity (g/cm³)	**G_t**	2,616	2,614
Specific gravity at 20ºC (g/cm³)	**$G_{20ºC}$**	2,612	2,610
Average (g/cm³)	**$G_{20ºC}$**	**2,611**	

[X] **Method A**

[ ] **Method B**

$$G_t = \frac{M_s}{\left[M_{\rho w,t} - (M_{\rho ws,t} - M_s)\right]}$$

REMARKS: _____

Tested by : **Verified by :**

Date : 27/01/2017 **Date :**

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JOB : GEOTECNHICAL STUDY - INFULENE

Job N. 12117 - Lot 1

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS

Standard method: ASTM D 2166-00

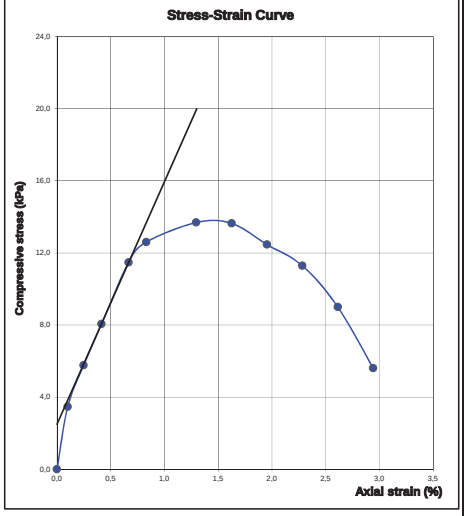
Sample Register date : 25/01/2017 **Sample nº :** 12677

Material description : Redish brown, silty sand **Borehole nº :** BH-1

Depth (m): 10,50-11,10

Height specimen	(L_0)	12,00 cm	**Type of sample:**	Undisturbed	
Diameter specimen	(D_0)	5,90 cm	**Water content** (obtained after shear with entire specimen)	(w) 7,2	%
Cross-sectional area	(A_0)	27,34 cm^2		(ρ_w) 18,9	kN/m^3
Volume specimen	(V_0)	328,08 cm^3	**Dry bulk density**	(ρ_d) 17,6	kN/m^3
Wt. specimen wet	(W_w)	631,3 g	**Specific gravity** (measured)	(G) 2,611	g/cm^3
Wt. specimen dry	(W_d)	588,91 g	**Degree of saturation**	(S_r) 41	%

Time (min:seg)	STRAIN dial	STRAIN %	LOAD Div	LOAD N	CORR. AREA (cm^2)	STRESS (kPa)
00:00	0	0,00	0	0	27,34	0,0
00:19	119	0,10	3	9	27,37	3,5
00:37	297	0,25	5	16	27,41	5,8
01:00	497	0,41	7	22	27,45	8,1
01:35	799	0,67	10	32	27,52	11,5
02:03	997	0,83	11	35	27,57	12,6
03:10	1555	1,30	12	38	27,70	13,7
03:57	1950	1,63	12	38	27,79	13,6
04:44	2345	1,95	11	35	27,88	12,5
05:31	2740	2,28	10	32	27,98	11,3
06:18	3135	2,61	8	25	28,07	9,0
07:05	3530	2,94	5	16	28,17	5,6
Strain rate:		0,41	**%/min**	/	0,49	**mm/min**



q_u= **13,7** kPa

S_u= **6,8** kPa

E_{av}= **1346** kPa

(average modulus)

REMARKS:

Tested by : **Verified by :**

Date: 30/01/2017 **Date:**

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A-6-27

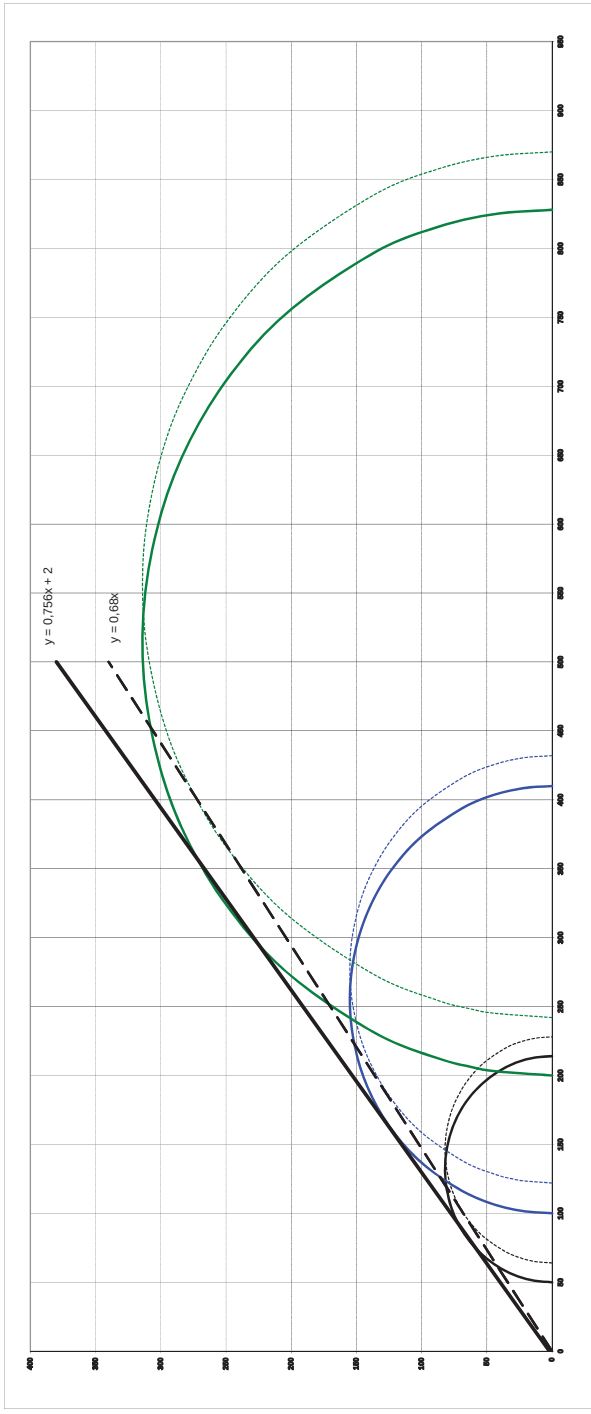
TECNASOL

GEOTECHNICAL STUDY - INFULENE

12117

MOHR ENVELOPE

12677 - I	BH-01	10,50-11,10
12677 - II	BH-01	10,50-11,10
12677 - III	BH-01	10,50-11,10



C = 2 kPa
ϕ = 37 °
C´ = 0 kPa
ϕ´ = 34 °

CHECK:

PAGE 6 OF 12

σ_1	σ_3	u	$(\sigma_1-\sigma_3)/2$	$(\sigma_1+\sigma_3)/2$	$\sigma_1-\sigma_3$
214	50	-14	82	146	164
410	100	-22	155	277	310
828	200	-42	314	556	628

COMMENTS:

Mod.P.L.28/4

Geocontrole

Rua Xavier Matola,362 Unidade C, Cx Postal nº 15-Matola-Maputo-Moçambique Tel.: 25821720402 Fax: 25821720404 e-mail: mail@geocontrole.pt

TEST REPORT

Process	12117	**Lot**	1	
Sample Register Date	31/01/2017	**Client :**	TECNASOL	**Borehole** BH-01
Test Conclusion Date	16/02/2017	**Job :**	GEOTECHNICAL STUDY - INFULENE	**Sample** 12677 - I
				Depth 10,50-11,10

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST WITH MEASUREMENT OF PORE PRESSURE

BS 1377 - PART 8

1 - PREPARATION	Heigth H (cm)	Diam. F (cm)	Area F (cm2)	Volume F (cm3)	Total Weigth P (g)	Dry Weigth Ps (g)
PREPARATION	11,6	5,9	27,34	317,1	659,8	
END OF CONSOLITION	11,53	5,87	27,02	311,7	725,4	
END OF TEST						609,5

TYPE OF TEST	CU
CHAMBER Nº	51
TYPE OF RUBER:	Thin
PAPER (drain)	No
DATE:	31/01/2017

2 - SATURATION

DATE	HOUR	CHAMBER PRESSURE	BACK-PRESSURE	CONSOLID. PRESSURE	SKEMPTON PARAMETER (B)			
	HH/mm	kPa	kPa	kPa	Δσ3 (kPa)	READ U (kPa)	ΔU (kPa)	B %
31/01/2017	11:20	50	40	10		---		
	---	---				---		
01/02/2017	08:00	50	40	10	40	40	19	48
	08:20	90				59		
02/02/2017	08:00	90	81	9	41	81	30	73
	08:20	131				111		
03/02/2017	08:00	130	122	8	41	122	33	80
	08:20	171				155		
04/02/2017	08:00	171	165	6	39	165	34	87
	08:20	210				199		
05/02/2017	08:00	210	204	6	40	204	37	93
	08:20	250				241		
06/02/2017	08:00	250	240	10	41	240	40	98
	08:20	291				280		

Pressure metter nº MAN-1

DONED BY:

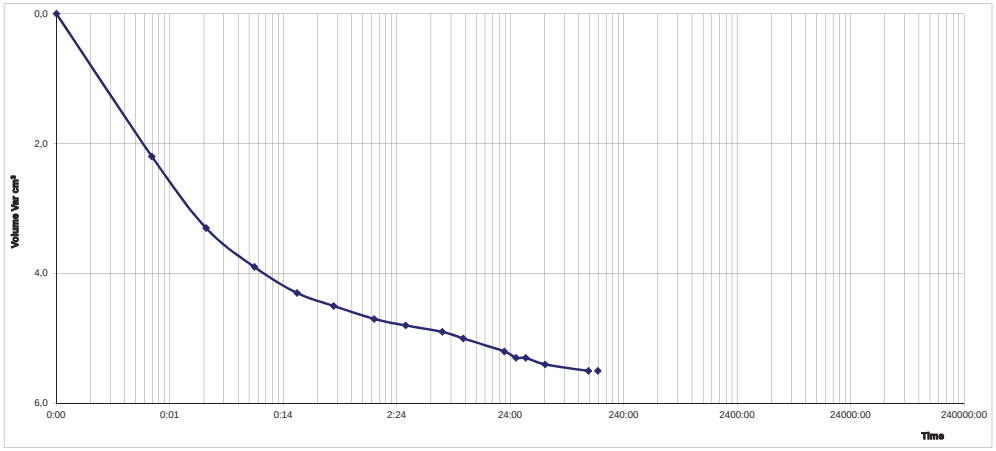
3 - CONSOLIDATION

CHAMBER PRESSURE (kPa)	290	CHAMBER PRESSURE (kPa)	
BACK-PRESSURE (kPa)	240	BACK-PRESSURE (kPa)	

DATE	HOUR	VOLUME VARIAT.	DATE	HOUR	VOLUME VARIAT.
DD/MM/AA	hh/mm/ss	cm³	DD/MM/AA	hh/mm/ss	cm³
8/2/17	10:11	23,4			
8/2/17	10:12	21,2			
8/2/17	10:14	20,1			
8/2/17	10:19	19,5			
8/2/17	10:30	19,1			
8/2/17	10:51	18,9			
8/2/17	11:42	18,7			
8/2/17	13:03	18,6			
8/2/17	16:14	18,5			
8/2/17	19:25	18,4			
9/2/17	7:25	18,2			
9/2/17	13:11	18,1			
9/2/17	18:57	18,1			
10/2/17	10:57	18,0			
13/2/17	7:18	17,9			
14/2/17	8:02	17,9			

Volume metter nº Lab.005.007 — **Volume metter nº**

DONED BY: — **DONED BY:**



COMMENTS:

Mod.PL.28.5/6 - 21/5/09

A-6-28

Geocontrole

Rua Xavier Matola,362 Unidade C, Cx Postal nº 15-Matola-Maputo-Moçambique Tel.: 25821720402 Fax: 25821720404 e-mail: mail@geocontrole.pt

TEST REPORT

Process	12117	**Lot**	1	**Borehole** BH-01
Sample Register Date	31/01/2017	**Client :**	TECNASOL	**Sample** 12677 - I
Test Conclusion Date	16/02/2017	**Job :**	GEOTECHNICAL STUDY - INFULENE	**Depth** 10,50-11,10

SPECIMEN CHARACTERISTIC PREPARATION / CONSOLIDATION / SATURATION

BEGINNING OF THE TEST

DIAMETER SPECIMEN	(ϕ)	5,9	cm
HEIGHT SPECIMEN	(H_0)	11,6	cm
WATER CONTENT	(w)	8,2	%
WET SPECIFIC WEIGHT	(γ)	20,4	kN/m³
DRY SPECIFIC WEIGHT	(γ_d)	18,8	kN/m³

END OF THE TEST

WATER CONTENT	(w)	19,0	%
WET SPECIFIC WEIGHT	(γ)	22,8	kN/m³
DRY SPECIFIC WEIGHT	(γ_d)	19,2	kN/m³

SATURATION:

SKEMPTON PARAMETER	(B)	97,6	%

CONSOLIDATION:

REDUCED VOLUME	(Δv)	5,5	cm³
STRAIN	(ΔH)	0,07	cm
CONSOLIDATION COEFICIENTE	(CV)	—	

Particle Density 2,811

VALUES FOR SHEARING PHASE CALCULATION

ΔU (kPa)	σ1-σ3 (kPa)	AXIAL strain (%)	σ1/σ3	Consolidation Time (seg)	Consolidation Δv
0	0	0,0	1,00	08/02/2017 10:11	23,4
2	35	0,1	1,71	08/02/2017 10:12	21,2
5	54	0,3	2,08	08/02/2017 10:14	20,1
9	68	0,6	2,36	08/02/2017 10:19	19,5
11	82	0,8	2,63	08/02/2017 10:30	19,1
13	104	1,1	3,07	08/02/2017 10:51	18,9
13	114	1,8	3,29	08/02/2017 11:42	18,7
10	126	2,6	3,52	08/02/2017 13:03	18,6
2	137	3,5	3,75	08/02/2017 16:14	18,5
-2	149	4,3	3,97	08/02/2017 19:25	18,4
-6	162	5,3	4,23	09/02/2017 07:25	18,2
-10	164	6,5	4,28	09/02/2017 13:11	18,1
-14	164	8,1	4,29	09/02/2017 18:57	18,1
-18	164	8,9	4,28	10/02/2017 10:57	18,0
-23	162	10,3	4,23	13/02/2017 07:18	17,9
-30	157	11,5	4,14	14/02/2017 08:02	17,9
-32	146	13,5	3,91		
				∇_{t100}	—

CONSIDERED VALUES IN RUPTURE

σ3	50	kPa	U	-14	kPa
σ1-σ3	164	kPa	$\bar{\sigma}_3$	64	kPa
σ1	214	kPa	$\bar{\sigma}_1$	228	kPa

If required this photo can be sent by e-mail

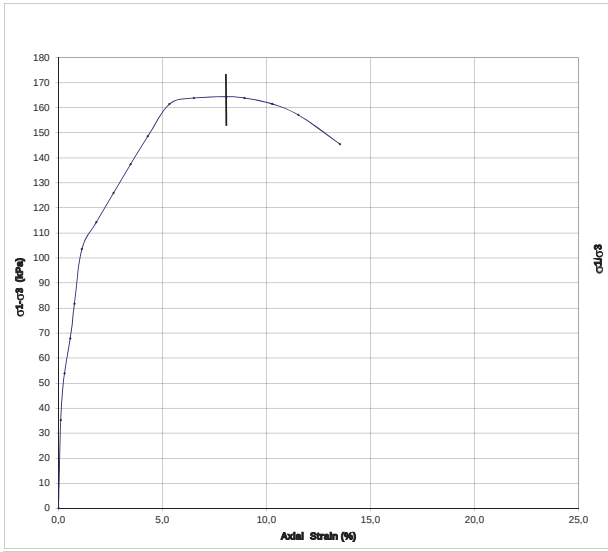
RUPTURE SCHEME

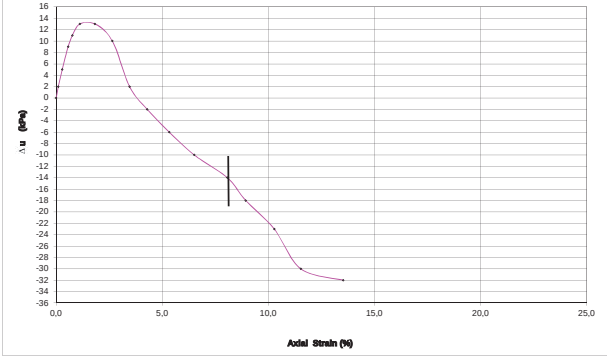
TRIAXIAL TEST

"CU" TEST

BS 1377

WITH PORE PRESSURE MEASURE





DONE BY: — **CHECK:**

COMMENTS:

Mod.PL.28/1

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Geocontrole
Rua Xavier Matola,362 Unidade C, Cx Postal nº 15-Matola-Maputo-Moçambique Tel.: 25821720402 Fax: 25821720404 e-mail: mail@geocontrole.pt

TEST REPORT				Borehole
Process	12117	Lot	1	BH-01
				Sample 12677 - II
Sample Register Date 31/01/2017	Client :	TECNASOL		Depth
Test Conclusion Date 16/02/2017	Job :	GEOTECHNICAL STUDY - INFULENE		10,50-11,10

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST WITH MEASUREMENT OF PORE PRESSURE

BS 1377 - PART 8

1 - PREPARATION	Heigth H (cm)	Diam. F (cm)	Area F (cm2)	Volume F (cm3)	Total Weigth P (g)	Dry Weigth Ps (g)
PREPARATION	11,5	5,9	27,34	314,4	625,4	
END OF CONSOLITION	11,41	5,85	26,90	306,8	682,2	
END OF TEST						575,9

TYPE OF TEST	CU
CHAMBER Nº	52
TYPE OF RUBER:	Thin
PAPER (drain)	No

DATE: 31/01/2017

2 - SATURATION

DATE	HOUR	CHAMBER PRESSURE	BACK-PRESSURE	CONSOLID. PRESSURE	SKEMPTON PARAMETER (B)			
	HH/mm	kPa	kPa	kPa	Δσ3 (kPa)	READ U (kPa)	ΔU (kPa)	B %
31/01/2017	11:50	50	40	10		---		
	---	---				---		
01/02/2017	08:20	50	40	10	40	40	20	50
	08:40	90				60		
02/02/2017	08:20	91	81	10	40	81	31	78
	08:40	131				112		
03/02/2017	08:20	130	122	8	40	122	32	80
	08:40	170				154		
04/02/2017	08:20	171	165	6	40	165	33	83
	08:40	211				198		
05/02/2017	08:20	210	204	6	40	204	37	93
	08:40	250				241		
06/02/2017	08:20	250	240	10	40	240	40	100
	08:40	290				280		

Pressure meter nº: MAN-1

DONED BY:

3 - CONSOLIDATION

CHAMBER PRESSURE (kPa)	340	CHAMBER PRESSURE (kPa)	
BACK-PRESSURE (kPa)	240	BACK-PRESSURE (kPa)	

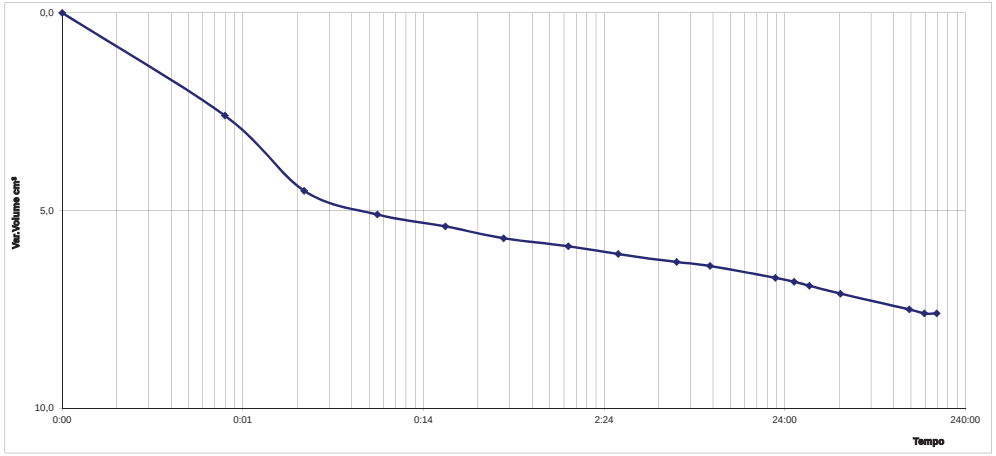
DATE	HOUR	VOLUMM VARIAT.	DATE	HOUR	VOLUMM VARIAT.
DD/MM/AA	hh/mm/ss	cm³	DD/MM/AA	hh/mm/ss	cm³
8/2/17	10:11	36,5			
8/2/17	10:12	39,1			
8/2/17	10:14	41,0			
8/2/17	10:19	41,6			
8/2/17	10:30	41,9			
8/2/17	10:51	42,2			
8/2/17	11:42	42,4			
8/2/17	13:03	42,6			
8/2/17	16:14	42,8			
8/2/17	19:25	42,9			
9/2/17	7:25	43,2			
9/2/17	13:11	43,3			
9/2/17	18:57	43,4			
10/2/17	10:57	43,6			
13/2/17	7:18	44,0			
14/2/17	8:02	44,1			
15/2/17	8:15	44,1			

Volume metter nº: Lab.005.006

DONED BY:

Volume metter nº

DONED BY:



COMMENTS:

Mod.PL.28.5/6 - 21/5/09

A-6-29

Geocontrole
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TEST REPORT

				Borehole
Process	12117	Lot	1	BH-01
				Sample 12677 - II
Sample Register Date 31/01/2017	Client :	TECNASOL		Depth
Test Conclusion Date 16/02/2017	Job :	GEOTECHNICAL STUDY - INFULENE		10,50-11,10

RUPTURE SCHEME

SPECIMEN CHARACTERISTIC PREPARATION / CONSOLIDATION / SATURATION

BEGINNING OF THE TEST

DIAMETER SPECIMEN	(ϕ)	5,90	cm
HEIGHT SPECIMEN	(H_0)	11,50	cm
WATER CONTENT	(W)	8,6	%
WET SPECIFIC WEIGHT	(γ)	19,5	kN/m³
DRY SPECIFIC WEIGHT	(γ_d)	18,0	kN/m³

END OF THE TEST

WATER CONTENT	(W)	18,5	%
WET SPECIFIC WEIGHT	(γ)	21,8	kN/m³
DRY SPECIFIC WEIGHT	(γ_d)	18,4	kN/m³

SATURATION:

SKEMPTON PARAMETER	(B)	100	%

CONSOLIDATION:

REDUCED VOLUME	(ΔV)	7,6	cm³
STRAIN	(ΔH)	0,09	cm
CONSOLIDATION COEFICIENTE	(CV)	—	
Particle Density		—	

VALUES FOR SHEARING PHASE CALCULATION

ΔU (kPa)	σ1-σ3 (kPa)	AXIAL strain (%)	σ1/σ3	Consolidation Time (seg)	Consolidation Δv
0	0	0,0	1,00	08/02/2017 10:11	36,5
4	58	0,1	1,58	08/02/2017 10:12	39,1
6	130	0,3	2,30	08/02/2017 10:14	41,0
8	167	0,6	2,67	08/02/2017 10:19	41,6
10	205	0,8	3,05	08/02/2017 10:30	41,9
11	235	1,2	3,35	08/02/2017 10:51	42,2
12	266	1,9	3,66	08/02/2017 11:42	42,4
8	282	2,5	3,82	08/02/2017 13:03	42,6
2	296	3,2	3,96	08/02/2017 16:14	42,8
-4	303	4,3	4,03	08/02/2017 19:25	42,9
-12	307	5,5	4,07	09/02/2017 07:25	43,2
-17	310	6,6	4,10	09/02/2017 13:11	43,3
-22	310	8,0	4,10	09/02/2017 18:57	43,4
-26	308	9,0	4,08	10/02/2017 10:57	43,6
-30	304	10,3	4,04	13/02/2017 07:18	44,0
-38	301	11,6	4,01	14/02/2017 08:02	44,1
-45	281	13,7	3,81	15/02/2017 08:15	44,1
-50	242	16,0	3,42		
				V_{t100}	—

CONSIDERED VALUES IN RUPTURE

σ3	100	kPa	U	-22	kPa
σ1-σ3	310	kPa	$\bar{\sigma}_3$	122	kPa
σ1	410	kPa	$\bar{\sigma}_1$	432	kPa

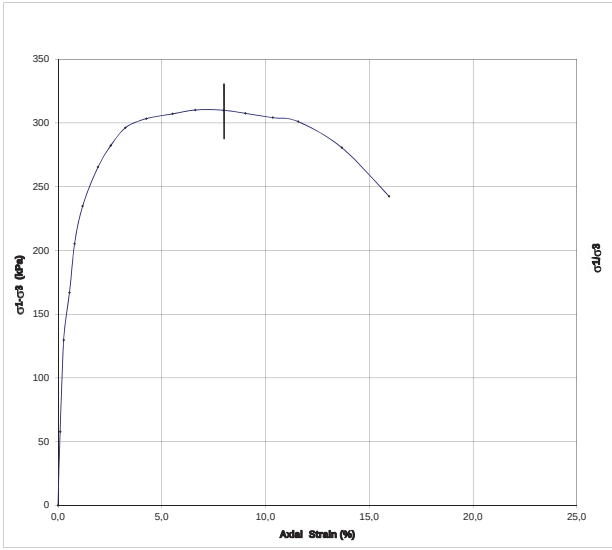
If required this photo can be sent by e-mail

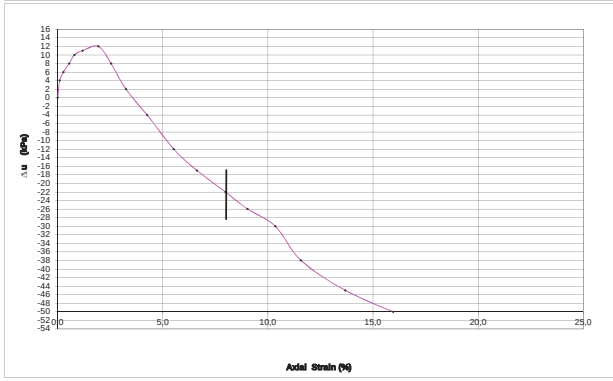
TRIAXIAL TEST

"CU" TEST

BS 1377

WITH PORE PRESSURE MEASURE





DONE BY:

CHECK:

COMMENTS:

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TEST REPORT				Borehole
				BH-01
Process	12117	Lot	1	Sample
				12677 - III
Sample Register Date	Client :	TECNASOL		Depth
31/01/2017				
Test Conclusion Date	Job :	GEOTECHNICAL STUDY - INFULENE		10,50-11,10
16/02/2017				

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST WITH MEASUREMENT OF PORE PRESSURE

BS 1377 - PART 8

1 - PREPARATION	Heigth H (cm)	Diam. F (cm)	Area F (cm2)	Volume F (cm3)	Total Weigth P (g)	Dry Weigth Ps (g)
PREPARATION	11,5	5,9	27,34	314,4	614,1	
END OF CONSOLITION	11,41	5,85	26,90	306,8	664,5	
END OF TEST						567,1

TYPE OF TEST	CU
CHAMBER Nº	53
TYPE OF RUBER:	Thin
PAPER (drain)	No

DATE: 31/01/2017

2 - SATURATION

DATE	HOUR	CHAMBER PRESSURE	BACK-PRESSURE	CONSOLID. PRESSURE	SKEMPTON PARAMETER (B)			
	HH/mm	kPa	kPa	kPa	$\Delta\sigma_3$ (kPa)	READ U (kPa)	ΔU (kPa)	B %
31/01/2017	12:45	50	40	10		---		
	---	---				---		
01/02/2017	08:40	51	40	11	39	40	21	54
	09:00	90				61		
02/02/2017	08:40	91	81	10	39	81	33	85
	09:00	130				114		
03/02/2017	08:40	130	122	8	40	122	35	88
	09:00	170				157		
04/02/2017	08:40	170	165	5	41	165	37	90
	09:00	211				202		
05/02/2017	08:40	210	204	6	39	204	36	92
	09:00	249				240		
06/02/2017	08:40	250	240	10	41	240	39	95
	09:00	291				279		

Pressure metter nº: MAN-1

DONED BY:

3 - CONSOLIDATION

CHAMBER PRESSURE (kPa)	440
BACK-PRESSURE (kPa)	240

DATE	HOUR	VOLUME VARIAT.
DD/MM/AA	hh/mm/ss	cm³
8/2/17	10:11	5,5
8/2/17	10:12	6,9
8/2/17	10:14	8,8
8/2/17	10:19	10,1
8/2/17	10:30	10,8
8/2/17	10:51	11,8
8/2/17	11:42	12,7
8/2/17	13:03	13,5
8/2/17	16:14	14,0
8/2/17	19:25	14,5
9/2/17	7:25	15,2
9/2/17	13:11	15,4
9/2/17	18:57	15,6
10/2/17	10:57	15,8
13/2/17	7:18	16,4
14/2/17	8:02	16,5
15/2/17	8:10	16,5

Volume metter nº: Lab.005.007

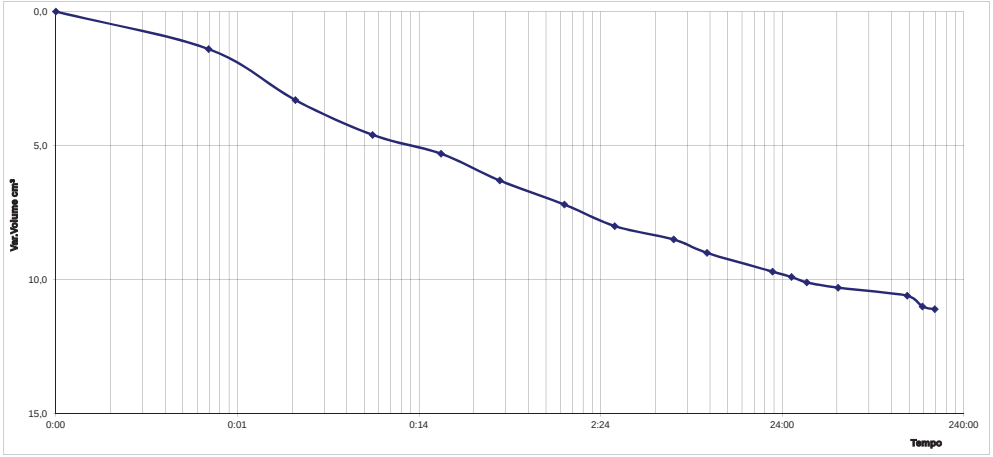
DONED BY:

CHAMBER PRESSURE (kPa)

BACK-PRESSURE (kPa)

Volume metter nº

DONED BY:



COMMENTS:

Mod.PL.28.II/0 - 21/5/09

A-6-30

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Rua Xavier Matola,362 Unidade C, Cx Postal nº 15-Matola-Maputo-Moçambique Tel.: 25821720402 Fax: 25821720404 e-mail: mail@geocontrole.pt

TEST REPORT

Borehole	BH-01
Process 12117 Lot 1	Sample 12677 - III
Sample Register Date 31/01/2017	Client : TECNASOL
Test Conclusion Date 16/02/2017	Job : GEOTECHNICAL STUDY - INFULENE
	Depth 10,50-11,10

RUPTURE SCHEME

SPECIMEN CHARACTERISTIC PREPARATION / CONSOLIDATION / SATURATION

BEGINNING OF THE TEST

DIAMETER SPECIMEN	(ϕ)	5,90	cm
HEIGHT SPECIMEN	(H_0)	11,80	cm
WATER CONTENT	(w)	8,3	%
WET SPECIFIC WEIGHT	(γ)	19,1	kN/m³
DRY SPECIFIC WEIGHT	(γ_d)	17,7	kN/m³

END OF THE TEST

WATER CONTENT	(w)	17,2	%
WET SPECIFIC WEIGHT	(γ)	21,5	kN/m³
DRY SPECIFIC WEIGHT	(γ_d)	18,3	kN/m³

SATURATION:

SKEMPTON PARAMETER	(B)	95,1	%

CONSOLIDATION:

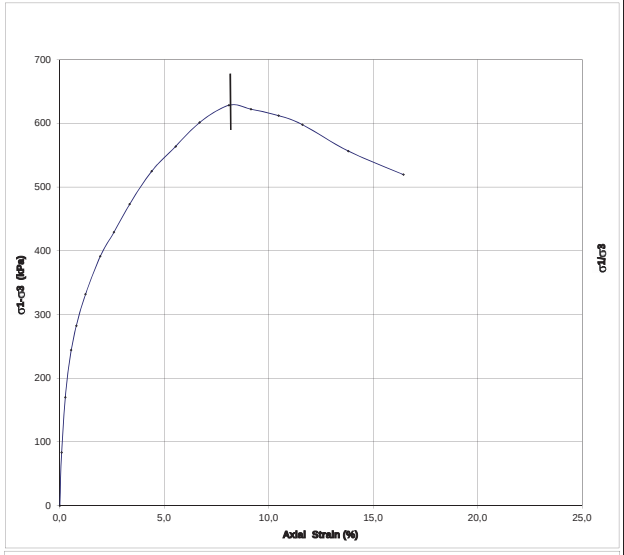
REDUCED VOLUME	(ΔV)	11	cm³
STRAIN	(ΔH)	0,13	cm
CONSOLIDATION COEFICIENTE	(CV)	—	
Particle Density		—	

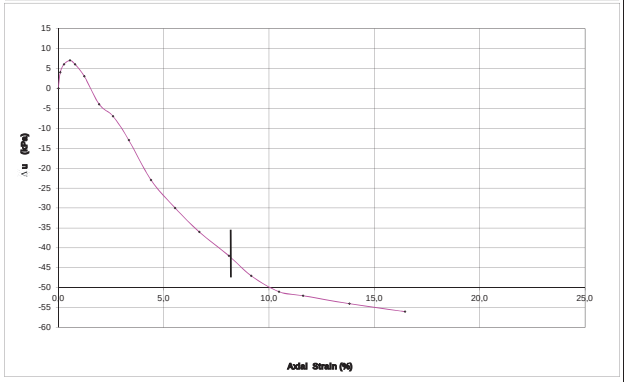
TRIAXIAL TEST

"CU" TEST

BS 1377

WITH PORE PRESSURE MEASURE





VALUES FOR SHEARING PHASE CALCULATION

ΔU (kPa)	σ1-σ3 (kPa)	AXIAL strain (%)	σ1/σ3	Consolidation	
				Time (seg)	Δv
0	0	0,0	1,00	08/02/2017 10:11	5,5
4	83	0,1	1,42	08/02/2017 10:12	6,9
6	170	0,3	1,85	08/02/2017 10:14	8,8
7	244	0,5	2,22	08/02/2017 10:19	10,1
6	282	0,8	2,41	08/02/2017 10:30	10,8
3	332	1,2	2,66	08/02/2017 10:51	11,8
-4	391	1,9	2,96	08/02/2017 11:42	12,7
-7	429	2,6	3,15	08/02/2017 13:03	13,5
-13	473	3,3	3,37	08/02/2017 16:14	14,0
-23	525	4,4	3,62	08/02/2017 19:25	14,5
-30	564	5,5	3,82	09/02/2017 07:25	15,2
-36	601	6,7	4,01	09/02/2017 13:11	15,4
-42	628	8,1	4,14	09/02/2017 18:57	15,6
-47	622	9,2	4,11	10/02/2017 10:57	15,8
-51	612	10,5	4,06	13/02/2017 07:18	16,4
-52	598	11,6	3,99	14/02/2017 08:02	16,5
-54	556	13,8	3,78	15/02/2017 08:10	16,5
-56	519	16,5	3,60		
				$\forall_{100}$	

CONSIDERED VALUES IN RUPTURE

σ_3	200	kPa	U	-42	kPa
σ_1-σ_3	628	kPa	$\overline{\sigma_3}$	242	kPa
σ_1	828	kPa	$\overline{\sigma_1}$	870	kPa

If required this photo can be sent by e-mail

DONE BY:	CHECK:

COMMENTS:

Mod.PL.28/1

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Job : **GEOTECNHICAL STUDY - INFULENE**

Job N. : **12117 - Lot 1**

DETERMINATION OF WATER CONTENT OF SOIL AND ROCK BY MASS

Standard method: ASTM D 2216 - 05

Sample Register date : 25/01/2017 **Sample Nº : 12678**

Material description : Redish brown, clayey-silty sand **Borehole or Pit : BH-1**

Depth (m) : 18,00-18,60

Specimen number			1	2	3
Container number			19	22	36
m^{w+c}	Mass of wet soil + container	(0,01g)	218,01	229,16	246,69
m^{d+c}	Mass of dry soil + container	(0,01g)	200,67	209,78	226,07
m^{c}	Mass of container	(0,01g)	78,20	79,94	90,20
$m^{ml}=m^{w+c} - m^{d+c}$	Mass of moisture loss	(0,01g)	17,34	19,38	20,62
$m^{d}=m^{d+c} - m^{c}$	Mass of dry soil	(0,01g)	122,47	129,84	135,87
$MC=m^{ml}/m^{d}*100$	Moisture content	(0,1 %)	14,2	14,9	15,2

MOISTURE CONTENT Mc = 14,8 (0.1%)

REMARKS :

Tested by : **Verified by :**

Date : 25/01/2017 **Date :**

Page 1 of 5

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A-6-31

Job : **GEOTECNHICAL STUDY - INFULENE**

Job N. **12117 - Lot 1**

STANDARD TEST METHOD FOR PARTICLE - SIZE ANALYSIS OF SOILS

Standard method : ASTM D 6913 & ASTM D 422

Sample Register date : 25/01/2017 **Sample Nº 12678**

Material description : Redish brown, clayey-silty sand **Borehole or Pit :** BH-1

Depth (m): 18,00-18,60

TOTAL WEIGHT OF SAMPLE (g) p1= 122,32 g

TOTAL ACCUMULATED WEIGHT RETAINED BY SIEVE Nº 10 (g) p2= 0,00 g

TOTAL WEIGHT OF SAMPLE BELOW SIEVE Nº 10 (g) p3= 122,32 g

TOTAL WEIGHT USED IN TEST BELOW SIEVE Nº 10 (g) p4= 122,32 g

Sieve designation (ASTM)	Mesh aperture (mm)	Mass accumulated in sieve Mass (g)	Mass accumulated in sieve %	% Passing	Sieve designation (ASTM)	Mesh aperture (mm)	Mass accumulated in sieve Mass (g)	Mass accumulated in sieve %	%Passing (Referred to the total weight)
3"	75,0	0	0,0	**100,0**	nº 20	0,840	0,55	0,4	**99,6**
2 1/2"	63,0	0	0,0	**100,0**	nº 40	0,425	9,23	7,5	**92,5**
2"	50,0	0	0,0	**100,0**	nº 60	0,250	39,30	32,1	**67,9**
1 1/2"	37,5	0	0,0	**100,0**	nº 100	0,150	90,64	74,1	**25,9**
1"	25,0	0	0,0	**100,0**	nº 140	0,105	95,29	77,9	**22,1**
3/4"	19,0	0	0,0	**100,0**	nº 200	0,075	96,86	79,2	**20,8**
1/2"	12,5	0	0,0	**100,0**					
3/8"	9,5	0	0,0	**100,0**					
nº 4	4,75	0	0,0	**100,0**					
nº 10	2,00	0,00	0,0	**100,0**					

Hydrometer (151H) nº

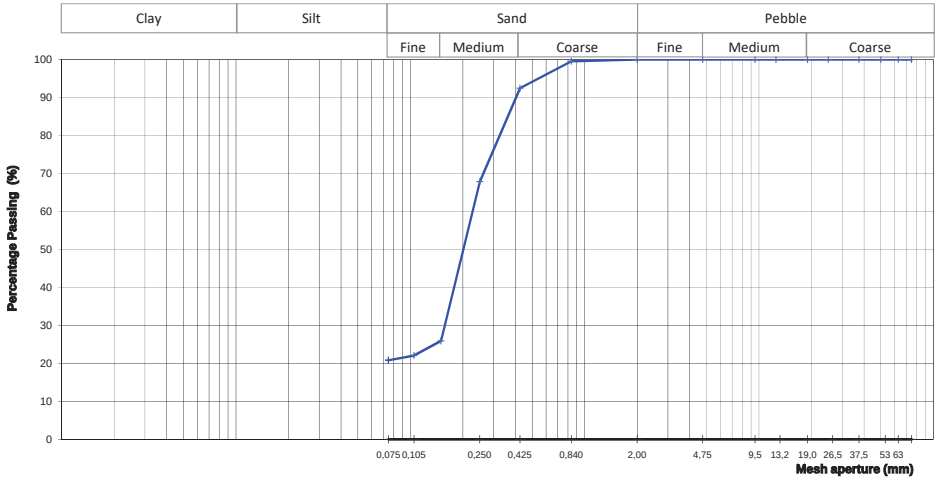
Specific gravity of soil

Correction dispersing agent

Correction meniscus

Time (min)	Temp. (°)	Readings (L)	Composite correction	Heigth read. (L)	Reading corrected	Particle diameter (D)	% of particles referred to the total

Curve Particle Size Distribution



REMARKS :

Tested by : **Verified by :**

Date : 27/01/2017 **Date :**

Page 2 of 5

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Geocontrole — Geotecnia e Estruturas de Fundação Lda — Moçambique

tecnasol elevo GROUP

JOB : **GEOTECNHICAL STUDY - INFULENE**

Job N. : **12117 - Lot 1**

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

Standard method: ASTM D 4318

Sample Register date : 25/01/2017 **Sample Nº : 12678**

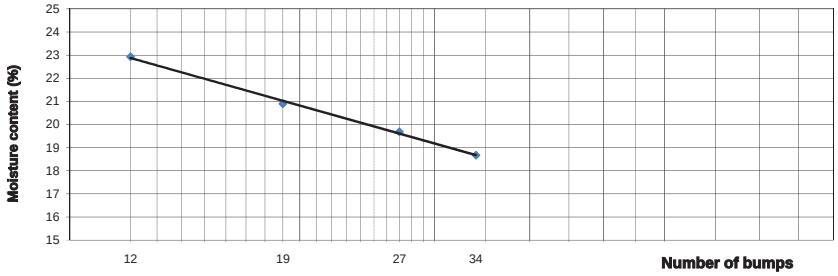
Material description : Redish brown, clayey-silty sand **Borehole or Pit :** BH-1

Depth (m): 18,00-18,60

Liquid Limit

	Container n.º		492	73	496	217
m2	Mass of wet soil + container	(g)	14,31	13,20	14,58	13,01
m3	Mass of dry soil + container	(g)	13,23	12,13	13,59	12,08
m1	Mass of container	(g)	8,52	7,01	8,56	7,10
md=m3-m1	Mass of dry soil	(g)	4,7	5,1	5,0	5,0
mw=m2-m3	Mass of moisture loss	(g)	1,1	1,1	1,0	0,9
w=100*mw/md	Moisture content	(%)	22,9	20,9	19,7	18,7
	Number of bumps		12	19	27	34

LL= 19,9 %



Plastic Limit

	Container n.º		213	212	211	215
m2	Mass of wet soil + container	(g)	9,28	9,38	9,39	9,43
m3	Mass of dry soil + container	(g)	8,97	9,05	9,08	9,10
m1	Mass of container	(g)	6,94	6,90	6,97	7,03
md=m3-m1	Mass of dry soil	(g)	2,0	2,2	2,1	2,1
mw=m2-m3	Mass of moisture loss	(g)	0,3	0,3	0,3	0,3
w=100*mw/md	Moisture content	(%)	15,3	15,3	14,7	15,9

PL= 15,3 %

REMARKS : Wet preparation / Method A - multipoit test

Plasticity Index

PI=(LL-PL)= 19,9 - 15,3 = 4,6 %

Tested by : **Verified by :** **Page 3 of 5**

Date : 31/01/2017 **Date :**

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A-6-32

Geocontrole — Geotecnia e Estruturas de Fundação Lda — Moçambique

tecnasol elevo GROUP

JOB : **GEOTECNHICAL STUDY - INFULENE**

Job N. **12117 - Lot 1**

SPECIFIC GRAVITY OF SOIL BY WATER PYCNOMETER

Standard method: ASTM D854-02

Sample Register date : 25/01/2017 **Sample Nº : 12678**

Material description : Redish brown, clayey-silty sand **Borehole or Pit :** BH-1

Depth (m): 18,00-18,60

Pycnometer n.º	**nº**	3	82
Test temperature (t)	**ºC**	27,0	27,0
Temperature coeficient	**K**	0,99831	0,99831
Pycnometer + sample + distilled water (g)	**$M_{rws,t}$**	159,19	157,61
Pycnometer + distilled water (g)	**$M_{rw,t}$**	143,88	142,26
Container	**nº**	61	23
Container mass (g)	**P_1**	188,30	175,84
Mass of the oven dry soil + Container (g)	**P_2**	213,19	200,84
Mass of the oven dry soil (g)	**M_s**	24,89	25,00
Specific gravity (g/cm³)	**G_t**	2,598	2,591
Specific gravity at 20ºC (g/cm³)	**$G_{20ºC}$**	2,594	2,586
Average (g/cm³)	**$G_{20ºC}$**	**2,590**	

[X] **Method A**

[ ] **Method B**

$$G_t = \frac{M_s}{\left[M_{\rho w,t} - (M_{\rho ws,t} - M_s)\right]}$$

REMARKS: _____

Tested by : **Verified by :** **Page 4 of 5**

Date : 30/01/2017 **Date :**

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Geocontrole — Geotecnia e Estruturas de Fundação Lda — Moçambique

tecnasol elevo GROUP

JOB : GEOTECNHICAL STUDY - INFULENE

Job N. 12117 - Lot 1

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS

Standard method: ASTM D 2166-00

Sample Register date : 25/01/2017 **Sample nº :** 12678

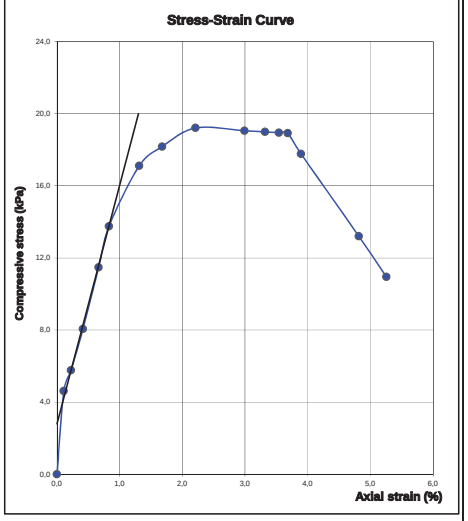
Material description : Redish brown, clayey-silty sand **Borehole nº :** BH-1

Depth (m): 18,00-18,60

Height specimen	(L_0)	12,02 cm	**Type of sample:**	Undisturbed	
Diameter specimen	(D_0)	5,90 cm	**Water content** (obtained after shear with entire specimen)	(w)	15,5 %
Cross-sectional area	(A_0)	27,34 cm^2		(ρ_w)	22,1 kN/m^3
Volume specimen	(V_0)	328,62 cm^3	**Dry bulk density**	(ρ_d)	19,1 kN/m^3
Wt. specimen wet	(W_w)	740,68 g	**Specific gravity** (measured)	(G)	2,590 g/cm^3
Wt. specimen dry	(W_d)	641,32 g	**Degree of saturation**	(S_r)	123 %

Time (min:seg)	STRAIN dial	STRAIN %	LOAD Div	LOAD N	CORR. AREA (cm^2)	STRESS (kPa)
00:00	0	0,00	0	0	27,34	0,0
00:15	130	0,11	4	13	27,37	4,6
00:31	268	0,22	5	16	27,40	5,8
00:56	497	0,41	7	22	27,45	8,1
01:29	799	0,66	10	32	27,52	11,5
02:00	997	0,83	12	38	27,57	13,8
02:54	1575	1,31	15	47	27,70	17,1
03:47	2017	1,68	16	51	27,81	18,2
04:44	2655	2,21	17	54	27,96	19,2
06:35	3597	2,99	17	54	28,18	19,1
07:30	3988	3,32	17	54	28,28	19,0
07:49	4257	3,54	17	54	28,34	19,0
08:10	4426	3,68	17	54	28,38	18,9
08:44	4680	3,89	16	51	28,45	17,8
11:00	5789	4,82	12	38	28,72	13,2
11:55	6315	5,25	10	32	28,86	11,0

Strain rate: 0,41 %/min / 0,50 mm/min



q_u= **19,2** kPa

S_u= **9,6** kPa

E_{av}= **1323** kPa

(average modulus)

REMARKS:

Tested by :

Date: 30/01/2017

Verified by :

Date:

Page 5 of 5

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A-6-33

tecnasol elevo GROUP

INFULENE ELECTRICAL SUBSTATION

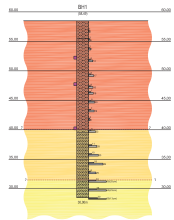
GEOLOGICAL AND GEOTECHNICAL SURVEY

FINAL REPORT

ANNEX V – BOREHOLE LOCATION PLAN AND INTERPRETATIVE CROSS-SECTION

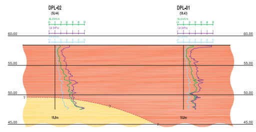
GEOLOGICAL-GEOTECHICAL LOCATION PLAN

Scale 1/1000



INTERPRETATIVE CROSS-SECTION A-A'

Scale 1/200



INTERPRETATIVE CROSS-SECTION B-B'

Scale 1/200

SUMMARY TABLE

Geotechnical Zone		Description	NSPT (Blows)	Specific Weight γ (kN/m³)	Angle of Internal Friction Ø' (°)	Cohesion C' (KPa)	Deformability Modulus E's (MPa)
	GZ3	Top soil (Brown and reddish brown, silty sand)	3 - 20 (5 - 15)*	16 - 18	25 - 35	-	5 - 30
	GZ2	Reddish brown, silty sand	23 - 49 (23 - 33)*	18 - 20	36 - 39	-	30 - 45
	GZ1	Reddish brown, clayey-silty sand	60	22	42	-	75

* - Most common values

AERIAL PHOTO

EXTRACT OF GEOLOGICAL MAP OF MOZAMBIQUE
Maputo
(Scale: 1/50 000)

BOREHOLES AND DPL'S COORDINATES AND LEVELS TABLE

BOREHOLES	COORDINATES		LEVEL
	E	N	Z (m)
BH1	454500.402	7137050.726	58.49
DPL-01	454463,443	7137119,094	58,44
DPL-02	454442.121	7137123.641	58.43

Coordenate System: WGS 84 - UTM Zone 36
(Universal Transverse Mercator)

LEGEND:

DPL... (00.00) — DPL'S (*Dynamic Penetrometer Light*) carried out by "Tecnasol FGE - Fundações e Geotecnia, S.A.", on January 2017

S... (00.00) — Boreholes carried out by "Tecnasol FGE - Fundações e Geotecnia, S.A.", on January 2017

A — A' Interpretative cross-section

Area under study

LITHOLOGY

Recent: Silty sand

Quaternary: Silty sand; Clayey-silty sand

ENSAIOS

DPL... (0,00)

BLOWS N

Qd (MPa)

Rd (MPa)

0.00m — Depth (m)

EXECUTED BOREHOLES

A-A' Intersection of interpretative cross-section

BH1 (0,00) — Borehole level

SPT POSITIONING AND RESULTS (Standard Penetration Test)

Lithological limit

Undisturbed sample

3 Blows for 15 cm penetration - 1st Phase

11 Blows for 30 cm penetration - 2nd and 3rd Phases

DENIAL - 60 blows reached in the 1st Phase

19 Blows for 15 cm penetration - 1st Phase

60 Blows for 28 cm penetration - 2nd and 3rd Phases

00.00m — Depth (m)

Probable geotechnical limit

Index	Alteration	Date	Drawn	Verified	Validated

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YACHIYO ENGINEERING CO.,LTD

ELETRICAL SUBSTATION IN INFULENE
MAPUTO - MOZAMBIQUE
•
GEOLOGICAL-GEOTECHNICAL SURVEY
•
INTERPRETATIVE CROSS SECTIONS

Proj./Rev.	Arlindo Mauélele
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Ver.	Paulo Rodrigues
Val.	Gonçalo Oliveira

File name:	Date:	Scale	Drawing Nº
160495001.dwg	fev.2017	1/200 1/1000	P16/0495-3749/001/0/11568

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７．　移動式変電所の **Matola Gare** 変電所への輸送ルート

移動式変電所輸送ルート（Maputo 港－Matola Gare 変電所）