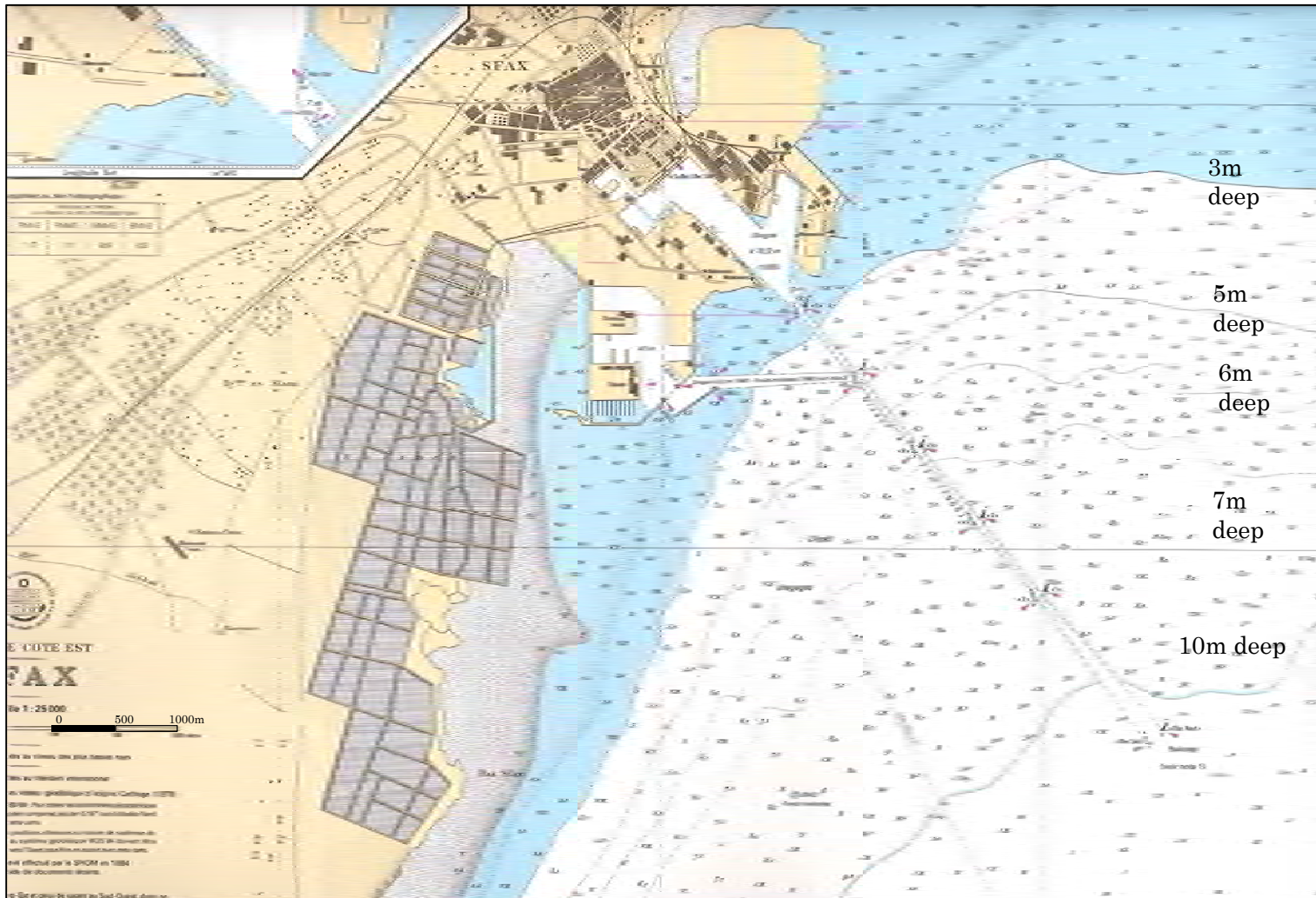


## 第 2 章 自然状况・社会状况

## 2.1-1 スファックス港



2.1-1

## 第4章 スファックス大都市圏の水需給計画

4.1-1 フランス国マルセイユ国際ドナー会議発表資料



REPUBLIQUE TUNISIENNE  
MINISTRE DE L'AGRICULTURE  
SOCIETE NATIONALE D'EXPLOITATION ET DE DISTRIBUTION DES EAUX

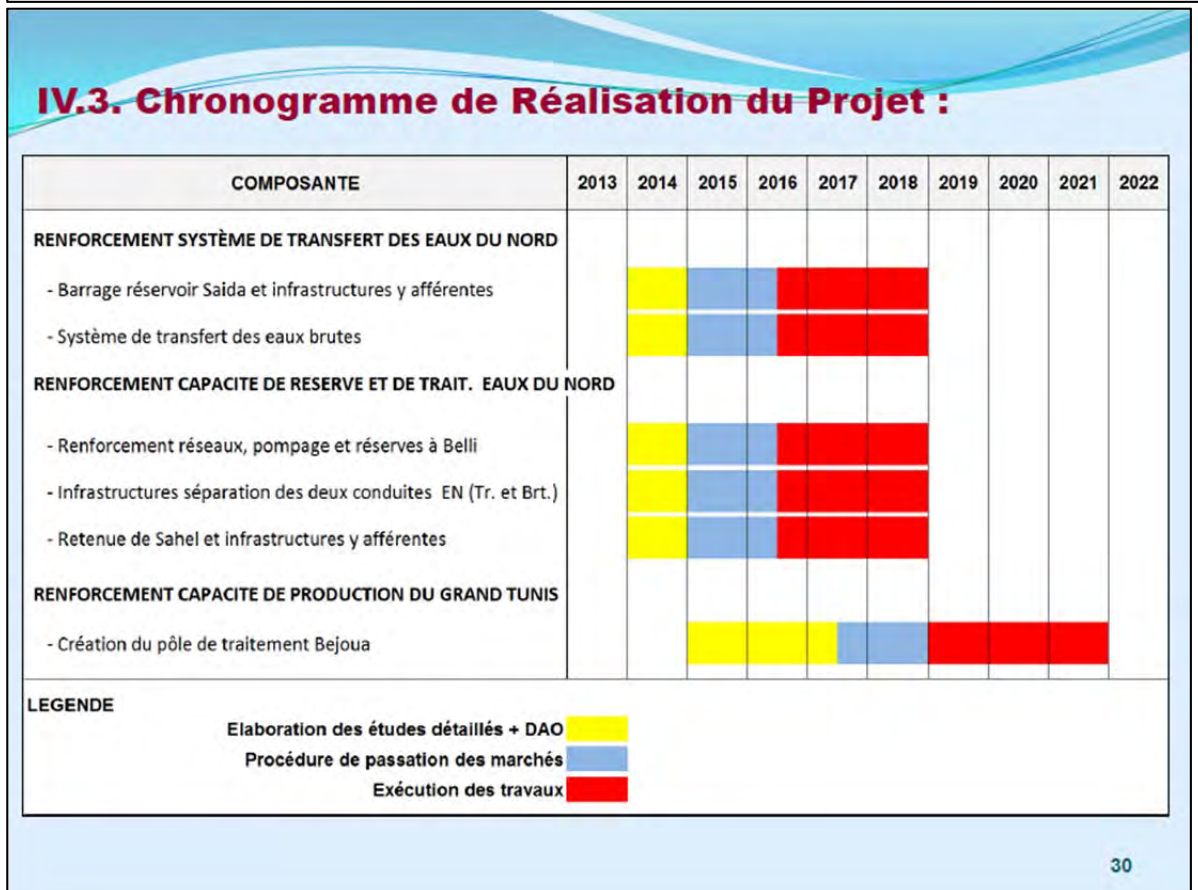


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## Marseille, 4 et 5 Février 2014

### Projet National d'investissement de Renforcement et de Sécurisation de l'Alimentation d'Eau Potable

Présenté par : Adnan BOUBAKER  
DIRECTEUR CENTRAL DES ETUDES



## Construction du barrage réservoir Saida (1/4)

**RESPONSABLE DE MISE EN OEUVRE : DGBGTH**

**EXPLOITANT : SONEDE ou DGBGTH**

**OBJET** : Construction d'un barrage réservoir à Saida dans la région de Béjaoua (à l'Ouest du Grand Tunis) pour stocker une eau prélevée du canal Medjerda Cap y compris l'infrastructure d'alimentation

**POPULATION CONCERNEE**: 5.5 million d'habitants

**OBJECTIFS :**

- Régulation saisonnière pour combler le déficit en ressources en période estivale.
- Sécurisation de l'approvisionnement en eau potable en cas de problème au niveau du canal Medjerda Cap Bon.

35

## Construction du barrage réservoir Saida (2/4)

**CONSISTANCE DES TRAVAUX :**

- 1/ Construction d'un barrage réservoir à Saida (45 Mm<sup>3</sup>),
- 2/ Réalisation d'adduction d'alimentation,
- 3 / Construction de stations de pompage.
- 4/ Construction d'un réservoir de mise en charge
- 5/ Raccordement au réseau électrique MT de la STEG.

**COÛT ESTIMATIF : 121.3 MDT HT (54.0 million €)**

Sous composante	Coût (MDT)
Retenue de régulation (45 Mm <sup>3</sup> )	81.4
Adductions	22.1
Pompage	13.3
Réservoir	4.1
Electrification	0.5
<b>TOTAL</b>	<b>121.3</b>

36

## Construction du barrage réservoir Saida (3/4)

### ETAT D'AVANCEMENT DES ETUDES :

- APD achevé en 1999 par VODNIIFORMPROEKT Mouscou.
- Les TDR de l'Etude d'impact sur l'environnement, sont en cours de préparation par la DGBGTH.

### PLANNING DE REALISATION : (2016-2018)

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## Construction du barrage réservoir Saida (4/4)



38

## Système de transfert des eaux brutes de Saida vers Belli (1/3)

**RESPONSABLE DE MISE EN OEUVRE : SONEDE**

**EXPLOITANT : SONEDE ou SECADENORD**

**OBJET : Transférer pendant la période de faible demande en eau les eaux brutes depuis le barrage réservoir à réaliser à Saida vers la station de pompage El Kouine au pied du complexe Belli**

**POPULATION CONCERNEE: 3.0 million d'habitants**

**OBJECTIFS :**

Satisfaire les besoins en eau potable pour les régions du Grand Tunis et de Sahel.

**CONSISTANCE DES TRAVAUX :**

- 1/ Pose de conduites de transfert.
- 2/ Construction de stations de pompage.

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## Système de transfert des eaux brutes de Saida vers Belli (2/3)

**COUT ESTIMATIF : 90 MDT HT (40.0 million €)**

Désignation	Coût (MDT)
Adductions	78.1
Pompage	8.7
Acquisition de terrain	3.4
<b>TOTAL</b>	<b>90.2</b>

**ETAT D'AVANCEMENT DES ETUDES :**

- Etude de faisabilité SOGREAH-STUDI –IDEA CONSULT, 2005.
- Etude stratégique, SONEDE 2013.
- Etudes d'exécution et DAO en cours par SONEDE

**PLANNING DE REALISATION :**  
(2016-2018)

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### Système de transfert des eaux brutes de Saida vers Belli (3/3)



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### Construction du barrage réservoir Sahel (1/3)

**RESPONSABLE DE MISE EN OEUVRE : DGBGTH**

**EXPLOITANT : SONEDE**

**OBJET : Construction d'un barrage réservoir dans la région de Kalaa Kébira pour stocker une eau prélevée du système de transfert des eaux du Nord**

**POPULATION CONCERNEE: 2.3 million d'habitants**

**OBJECTIFS :**

- Stocker des quantités d'eaux importantes et de les restituer au réseau après traitement en période de forte demande.
- Sécurisation de l'approvisionnement en eau potable de la région du Sahel et en partie de Sfax en cas de problème au niveau du canal Medjerda, d'interruption accidentelle de la production dans la station de traitement de Belli ou incident sur l'adduction des Eaux du Nord

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## Construction du barrage réservoir Sahel (2/3)

### CONSISTANCE DES TRAVAUX :

- 1/ Construction d'un barrage réservoir (26 Mm<sup>3</sup>),
- 2/ Réalisation d'adduction d'alimentation et une station de pompage

COUT ESTIMATIF : 113.6 MDT HT (50.5 million €)

Désignation	Coût (MDT)
Retenue de régulation (26 Mm <sup>3</sup> )	88.2
Adductions	21.1
Pompage	4.3
<b>TOTAL</b>	<b>113.6</b>

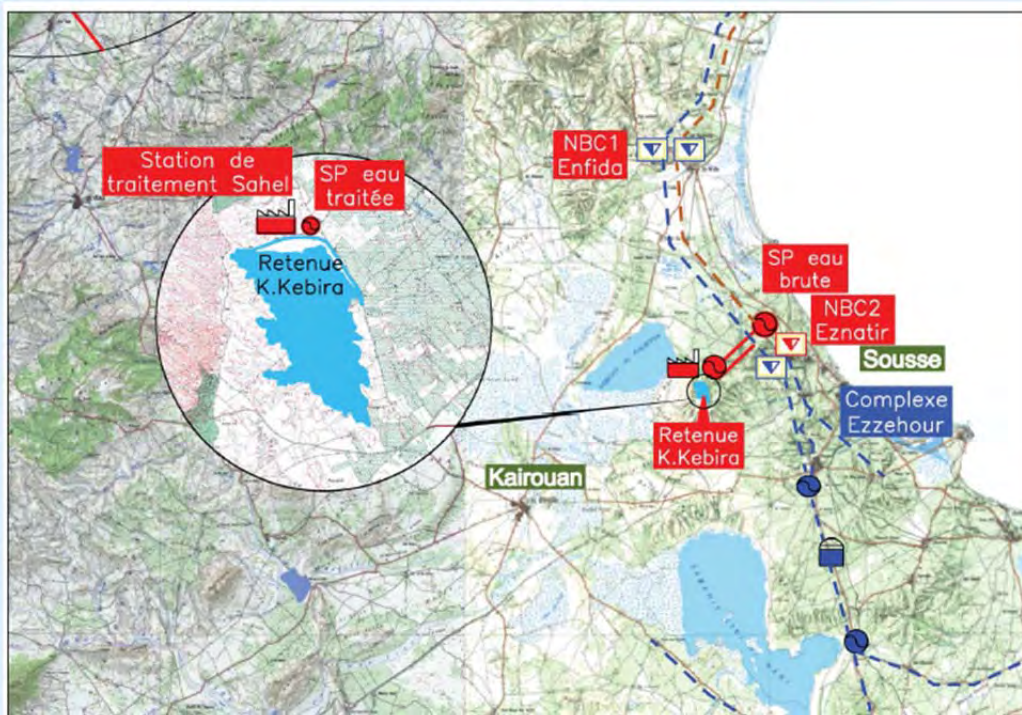
### ETAT D'AVANCEMENT DES ETUDES :

- Etude de faisabilité SOGREA-STUDI –IDEACONSULT, 2005.
- Etude d'avant projet sommaire, groupement STUKY – CONCEPT, 2011
- Etude d'impact sur l'environnement, groupement STUKY – CONCEPT, transmis à l'ANPE depuis le 26 mars 2013.
- Etude d'avant projet détaillé en cours, groupement STUKY – CONCEPT.

PLANNING DE REALISATION :  
(2016-2018)

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## Construction du barrage réservoir Sahel (3/3)



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## Renforcement des réseaux et capacité de réserve des eaux du Nord pour les régions de Sahel et Sfax (1/2)

**RESPONSABLE DE MISE EN OEUVRE : SONEDE**

**EXPLOITANT : SONEDE**

**OBJET** : Transférer les eaux brutes pendant la période de faible demande en eau depuis la station de pompage El Khouine située au pied du complexe Belli vers un barrage réservoir à réaliser dans la région du Sahel

**POPULATION CONCERNEE**: 2.3 million d'habitants

**OBJECTIFS** :

Satisfaire les besoins en eau potable pour les régions du Cap Bon, Sahel et Sfax jusqu'à l'horizon 2030

**CONSISTANCE DES TRAVAUX** :

- 1/ Renforcement réseaux, capacités de pompage et réserves à Belli
- 2 / Séparation des deux conduites des eaux du Nord (traitée et brutes)

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## Renforcement des réseaux et capacité de réserve des eaux du Nord pour les régions de Sahel et Sfax (2/2)

**COÛT ESTIMATIF** : 38.3 MDT HT (17.0 million €)

Désignation	Sous composante	Coût (MDT)	
Renforcement des réseaux et capacités de pompage et des réserves au complexe Belli	Adductions	7.8	30.9
	Pompage	17.7	
	Réservoirs	5.4	
Infrastructure de séparation des deux conduites des eaux du Nord (traitée et brutes)	Adductions	4.7	7.4
	Réservoirs	2.7	
<b>TOTAL</b>			<b>38.2</b>

**ETAT D'AVANCEMENT DES ETUDES** :

- Etude de faisabilité SOGREAH-STUDI –IDEACONSULT, 2005
- Etude stratégique, SONEDE 2013.
- Etudes d'exécution et DAO en cours par SONEDE

**PLANNING DE REALISATION** :  
(2016-2018)

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## Construction de la station de traitement de Sahel (1/3)

**RESPONSABLE DE MISE EN OEUVRE : SONEDE**

**EXPLOITANT : SONEDE**

**OBJET** : Construction d'une station de traitement des eaux brutes et son raccordement au système de transfert des eaux du Nord au niveau de la région de Sahel

**POPULATION CONCERNEE**: 2.3 million d'habitants

**OBJECTIFS** :

Satisfaire les besoins en eau potable pour la région de Sahel et Sfax

**CONSISTANCE DES TRAVAUX** :

- 1/ Construction d'une station de traitement des eaux brutes de capacité 4 m<sup>3</sup>/s
- 2/ Réalisation d'adduction de raccordement au système de transfert des eaux du Nord,
- 3/ Construction d'une station de pompage

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## Construction de la station de traitement de Sahel (2/3)

**COÛT ESTIMATIF** : 69.2 MDT HT (31.0 million €)

Désignation	Coût (MDT)
Station de traitement (4 m <sup>3</sup> /s)	35.3
Adductions	21.1
Pompage	6.0
Foncier	6.8
<b>TOTAL</b>	<b>69.2</b>

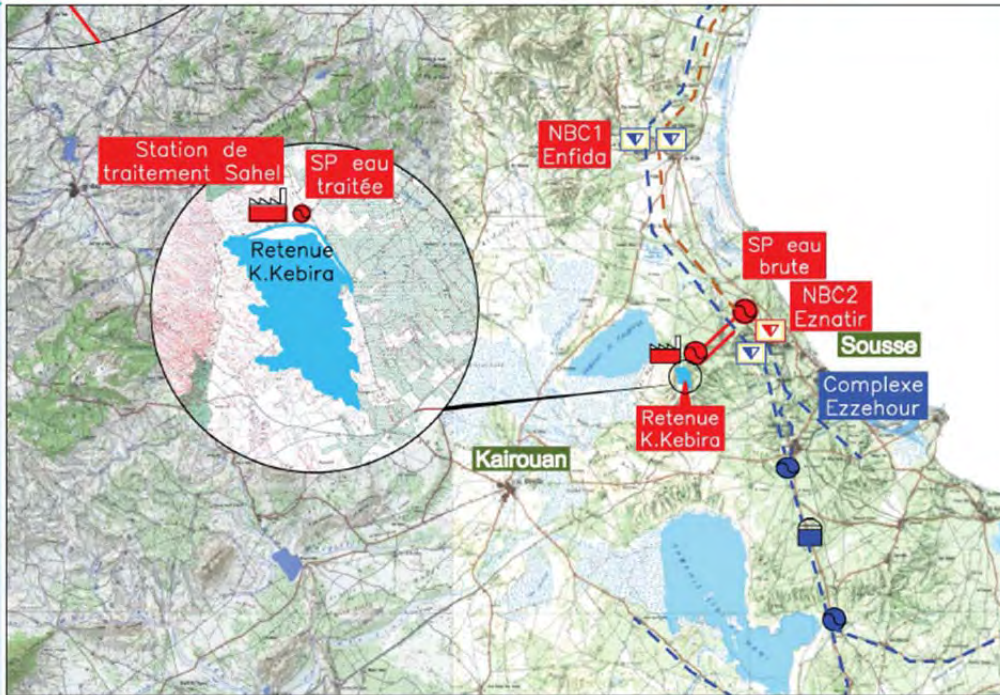
**ETAT D'AVANCEMENT DES ETUDES** :

- Etude de faisabilité faite par la SONEDE en 2013.
- Etudes d'exécution et DAO en cours par SONEDE

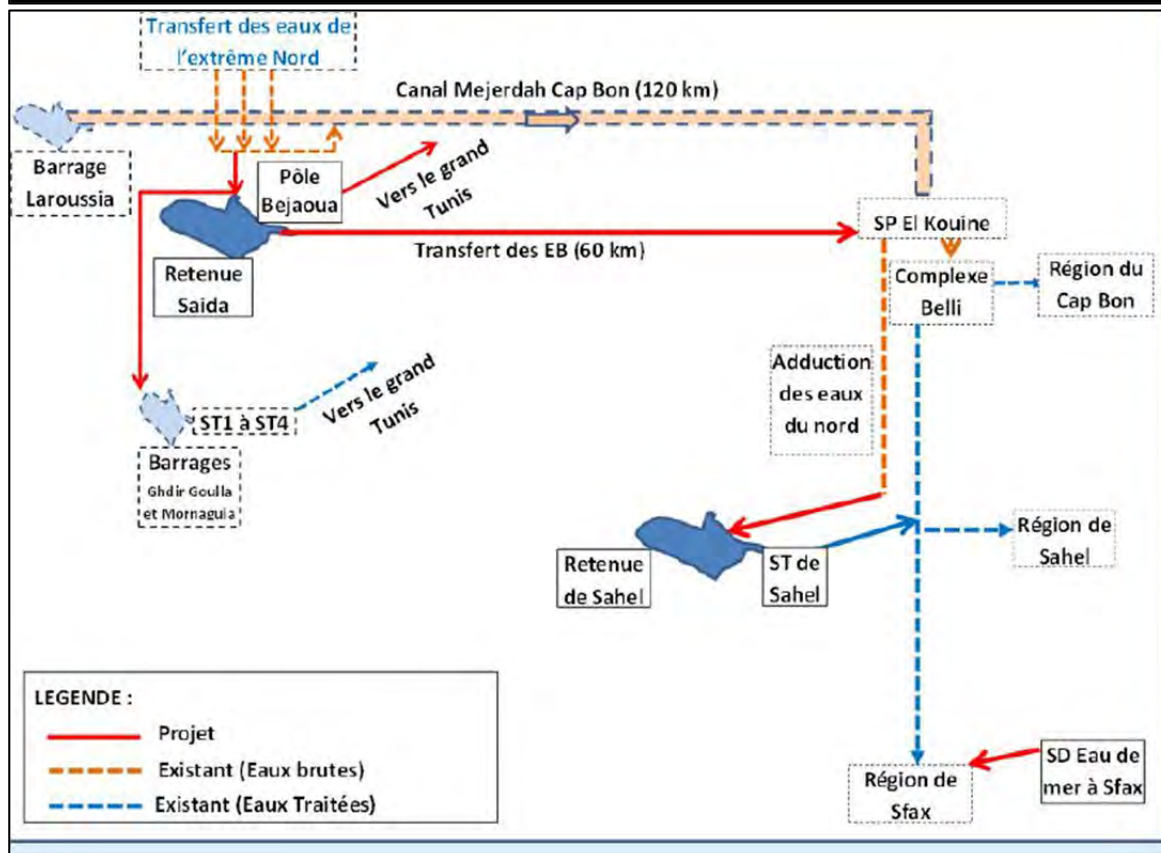
**PLANNING DE REALISATION** :  
(2016-2018)

48

### Construction de la station de traitement de Sahel (3/3)



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## 4.3-1 スファックス大都市圏における既存水道施設

### 目次

1. 概要 -----	4.3-2
2. 地下水 -----	4.3-2
3. ポンプ場 -----	4.3-3
4. 配水池 -----	4.3-3

## 4.3-1 スファックス大都市圏における既存水道施設

### 1 概要

スファックス大都市圏には、本編 3.5 節で記述したように、北部のメジェルダ川を水源とするベリー浄水場から約 200 km を途中でポンプ増圧されながら圧力管で送水されてくる浄水、西部のジェルマ及びスベイトラ地区から約 70 km をポンプで送水されてくる地下水、さらにスファックス域内で汲み上げられる地下水という 3 種の水源がある。それらの浄水は、内陸部にある複数の配水池から高区と低区の配水区に自然流下で配水されている。各配水池の配水対象区域は高区配水区か低区配水区のいずれかであり、さらに細かい配水ブロックには区分されていない。

### 2 地下水

#### (1) 井戸

近年、北部及び西部からの送水システムの上流部における水使用量が増えてきているため、大規模な独自水源を持たないスファックス大都市圏では使用可能水量が減ってきており、2012 年夏期には断水が続き危機的な状況となった。このため、緊急手段として、塩分濃度が高い市内の地下水の利用を目的として SONEDE は井戸を各配水池に掘削し、揚水した地下水を北部広域水道システム系統の浄水や比較的塩分濃度の低いジェルマ・スベイトラ地区の地下水と混合して配水している。SONEDE はそれらのスファックス大都市圏の自己の井戸の利用可能水量を 2013 年現在 491 l/秒 (約 42,400 m<sup>3</sup>/日) と見込んでいる。

#### (2) 地下水処理設備

##### 1) 設置目的、容量

前述したように水供給量の増強を目的として相当数の井戸が新設されている。このうち、PK10 配水池敷地内の井戸及び地下水処理設備を調査した。水量は 60 l/秒 (約 5,200 m<sup>3</sup>/日) とかなりの規模であり、年間 200-250 日稼働している。

スファックス地域には他の配水池等に同様の地下水処理設備が計 5 プラントある。

##### 2) 設備の概要

設備は地下水中の鉄の除去を目的としたもので、エアレーション装置と砂ろ過器の組み合わせである。エアレーション装置は水中の鉄を酸化させるためのものであり、上部より原水である地下水を落下させ、下部より空気を上昇流で送り気液接触させる方式が採用されている。

エアレーション処理水をポンプで砂ろ過器に通水し、酸化された懸濁状の鉄を除去する。

砂ろ過器は圧力式の横型タンク方式であり、ろ過層に蓄積された鉄は定期的な逆洗操作によりろ過器外に排出される。本設備の通水やろ過器の逆洗操作は全て自動で行われている。

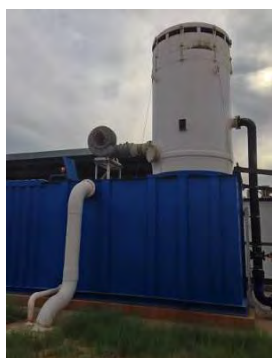


写真1 エアレーション



写真2 砂ろ過器

### 3 ポンプ場

配水区域は比較的標高の低い海岸寄りの低区と標高が比較的高い内陸部の高区の2区域に分けられており、それぞれ複数の配水池から各配水区に分けられている。各配水区域には配水池から自然流下により配水している。したがって、スファックス大都市圏には、送水ポンプ場及び配水ポンプ場は設置されていない。

### 4 配水池

SONEDE はスファックス大都市圏内に多くの配水池を設置している。その内、スファックス市街地を配水対象としている主要な配水池（整備中、計画中含む）を表1に示す。

表1 スファックス大都市圏内主要配水池

配水池名	現容量(m <sup>3</sup> )	対象配水区	HWL (m)	LWL (m)	備考
Bou Merra	500	高区	84.0	79.0	増強計画 Bou Merra_N +1,500m <sup>3</sup>
PK11	22,000	低区	59.0	53.0	5000m <sup>3</sup> x4+1000x2
PK14	10,000	高区	78.8	73.0	5000m <sup>3</sup> x2
PK10	20,000	低区	58.0	52.0	5000m <sup>3</sup> x4
Sidi Salah_Haut	2,500	高区	79.0	73.0	
Sidi Salah_Bas(計画)	-	低区	59.0	53.0	計画 +5,000m <sup>3</sup>

出典：SONEDE資料

上記の内、PK10配水池の現地調査を行い、その運転・維持管理状況の実態について確認した。

#### (1) 水源・水質

受け入れる水源は北部から送水される表流水を原水としてベリー浄水場で処理された浄水、西部のジェルマ及びスベイトラ地区から送水される地下水と敷地内の井戸から揚水される地下水の3つである。

これらの3つの水源から供給される水は、各々の塩分濃度も異なるため、敷地内に設置された混合池で合流・均一化され、配水池4池に貯蔵された後、低区配水区に自然流下で配水されている。塩分濃度（TDS）は、表流水系 1.3-1.4 g/l で、地下水系は 3.3-4 g/l であり、PK10 は水道水基準（2.5 g/l、許容値）を満足する 2-2.1 g/l の水道水を配水している。



写真3 混合池（右側）



写真4 混合池内部

## (2) 配水池の仕様

各配水池は、設置形式は地上式、形状は円筒形、材質は鉄筋コンクリート製である。直射日光により配水池の側壁や天井、配水池貯留水の温度が上昇することを防止するため、配水池の外周及び上部を土で覆い、コンクリート部に直射日光が当たらないようにしている。また、この保護土には植物が植えられ、美観を保持するようにも考慮されている。以上の仕様は SONEDE が設置する配水池の標準仕様となっている。



写真5 配水池



## 第5章 海水淡水化施設の検討

## 5.2-1 海水淡水化施設用地の選定及び送水管ルート

### 目 次

1. 海水淡水化施設用地候補地の検討対象-----	5.2-2
2. 海水淡水化施設用地候補地前面海域の地形と水質-----	5.2-2
3. 用地候補地選定方法-----	5.2-6
4. 用地候補地選定経緯-----	5.2-10

## 5.2-1 海水淡水化施設建設用地の選定及び送水管ルート

### 1. 海水淡水化施設用地候補地の検討対象

本調査では海水淡水化施設の建設用地の選定が調査項目の一つとなっていた。

本調査開始時に、SONEDE は本事業用に選定した 4 個所の海水淡水化施設の建設用地候補地を提案した（表 1 及び図 1 に示す SITE 1～SITE 4）。SONEDE はスファックス中心部からの距離を重視して SITE 1～4 を候補に挙げてきたが、本事業ではその規模から直接取水方式を採用することが考えられるため、前面海域の水深も重要な検討項目と考えられた。その結果、それらの地域は海岸から取水のために適当な水深が得られる地点までの距離が遠いことから、調査開始後に調査団から SITE 5～SITE 7 を追加提案し、これらの 7 地点を併せて評価することにした。

これらの候補地の現地踏査を行った結果、想定される取水地点（海域）までの距離を考慮し、さらに 3 個所（図 1 に示す SITE 5～SITE 7）を追加し、合計 7 個所を対象とし一定の選定基準に従って候補地の絞り込みを行うこととした。

表 1 海水淡水化施設候補地

ID	地名	県	北緯	東経
SITE 1	El Amra Nord	スファックス	34.921381	10.921379
SITE 2	El Amra Sud	スファックス	34.847586	10.885692
SITE 3	Agareb	スファックス	34.617982	10.624981
SITE 4	Chebba Sud	マーディア	35.189466	11.097065
SITE 5	Nakta	スファックス	34.554409	10.594427
SITE 6	Chebba Nord	マーディア	35.258148	11.112843
SITE 7	Mahres	スファックス	34.506152	10.446425

注：表中の緯度と経度は GPS による候補地近辺地域のデータである。

出典：JICA 調査団

### 2. 海水淡水化施設用地候補地前面海域の地形と水質

#### (1) 海底地形

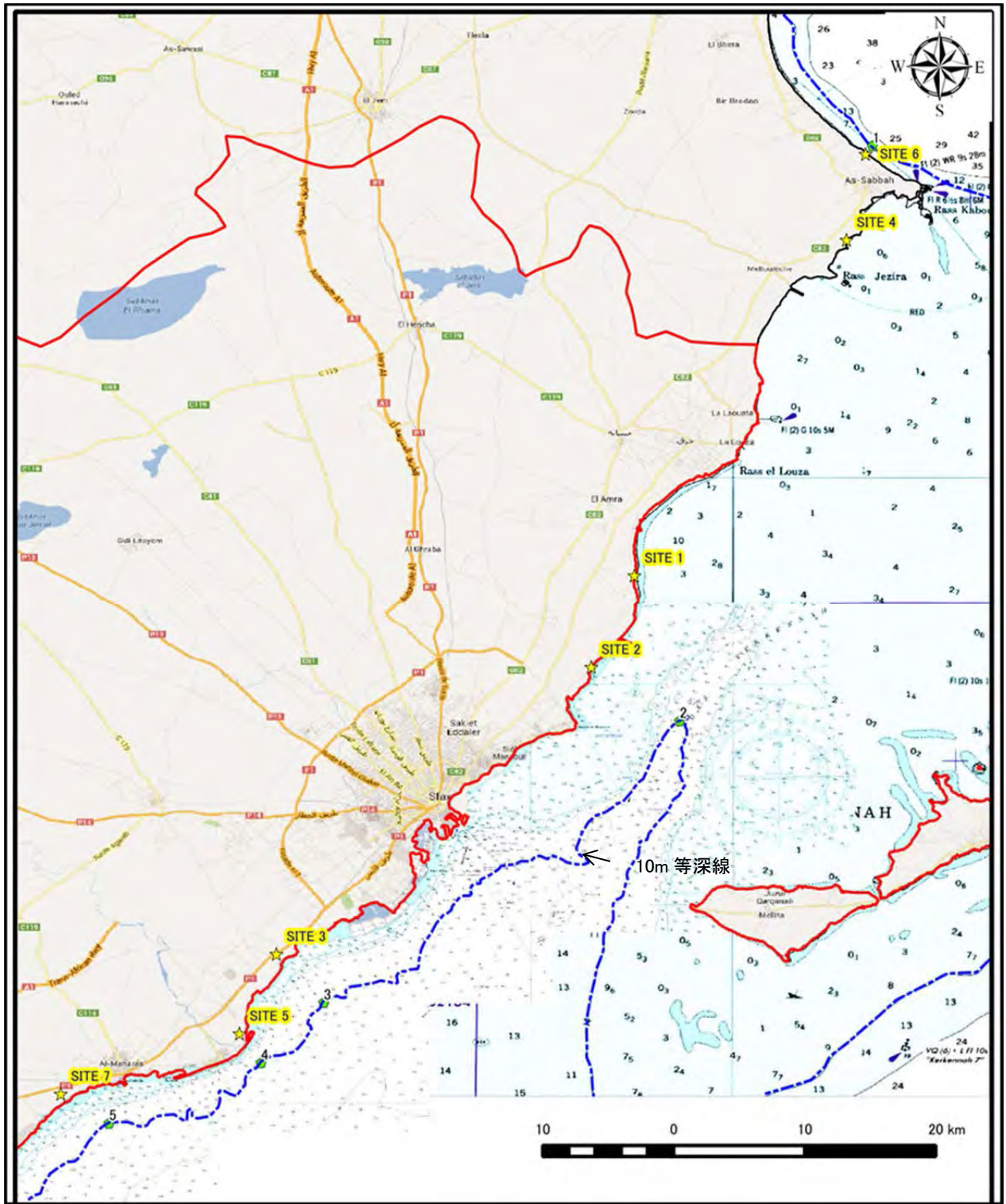
各候補地の位置と共に事業規模から本事業に相当と考えられる直接取水方式において、その取水施設、放流施設の設置に相当と考えられている水深 10m の等深線を図 1 に示す。

スファックス大都市圏中心部の前面海域は遠浅であり、特にその北半分（SITE1, 2, 4 前面海域）では 10m を超える水深は得られない。

各淡水化施設候補地沿岸の海底地形を付属資料：付図 1～4 に示す。

#### (2) 海水水質

海岸部の汚濁問題が生じていたことから、堆積した汚染底泥からの重金属等が溶出している可能性があり、海水淡水化施設建設事業の計画にあたり実際の海水水質を確認する必要がある。そのため、本調査で海水淡水化施設候補地沿岸の海水水質を分析した。



出典：JICA 調査団

図1 海水淡水化施設候補地

海水淡水化施設の取水施設の設置に際して 8m~10m の水深を必要とすること、並びに海水の取水点は水深 5m 前後となることから、各海水淡水化施設候補地点に近い海域で、水深がおおよそ 10m の場所を目安として採水地点を選定し、各地点で 5m 水深から資料を採取した。また、念のため、海底付近の水質についても確認することとし、海底から 50cm 上の位置を選定し、各々 1 点ずつの試料を採取した。試料採取地点を図 2 に示す。なお、試料採取地点 3、4、5 はそれぞれ海水淡水化施設候補地 Nos. 3、5、7 に対応しているが、前述の取水施設設置の条件を満たす地点として、試料採取地点 1 は候補地 No.4 と候補地 No.6、試料採取地点 2 は候補地 No.1 と候補地 No.2 に対応するものとして、合計 5 個所の試料採取地点を選定した。各採水地点の位置情報及び各点における海水水質の分析結果は表 2 に示すとおりである。

各試料とも全蒸発残留物（以下、TDS という。チュニジア国では本分析項目が試料の塩分濃度をほぼ表すものと認識されている。）以外の分析項目については特筆すべき分析結果は示されていない。この海域における TDS は 33000mg/l~38000mg/l 程度と推測していたが、43000mg/l~50000mg/l と高い分析結果が示されている。

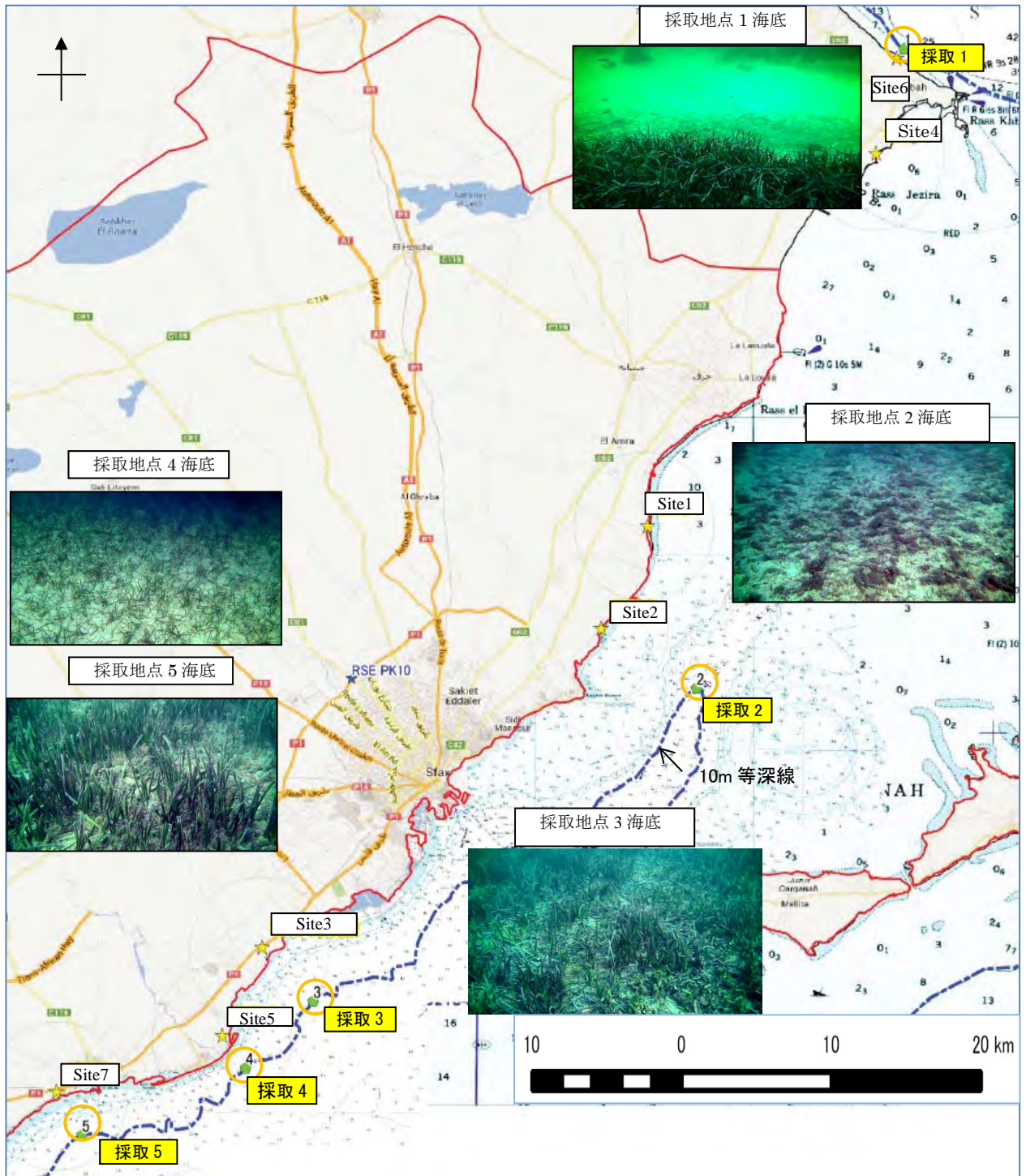
表 2 試料採取地点と海水水質

試料採取地点		1		2		3		4		5	
緯度・経度 (GPS)		N:35.2648413 E:011.1184828		N:34.8085109 E:010.9516900		N:34.5836229 E:010.6553259		N:34.5362839 E:010.6054000		N:34.4905769 E:010.4849709	
分析項目	単位	試料採取深度		試料採取深度		試料採取深度		試料採取深度		試料採取深度	
		5m	~10m	5m	~10m	5m	~10m	5m	~10m	5m	~10m
水温	℃	25	25	26	26	25	24.8	25	24.4	24.9	25
pH	-	7.7	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.7
電気伝導度	mS/cm	47.3	47.6	48.2	48.4	47.7	48.5	47.9	47.4	47.7	47.2
TDS	mg/l	43,282	43,430	43,364	43,547	56,579	45,938	45,471	44,057	50,613	43,092
濁度	NTU	0	0	0	0	0	0	0	0	0	0
SS	mg/l	29	75.5	70	77.5	85.5	78.5	20.5	74.5	67	76.5
Na <sup>+</sup> (Sodium)	mg/l	12,902	12,395	13,072	12,327	13,278	13,141	12,582	15,387	14,433	12,717
Cl <sup>-</sup> (Chloride)	mg/l	22,681	21,650	21,717	21,446	22,661	21,929	2,14065	25,986	25,057	21,6865
SiO <sub>2</sub> (Silica)	mg/l	0.563	0.570	0.313	0.671	0.404	0.301	0.508	0.528	0.755	0.563
B (Boron)	mg/l	0.157	0.529	0.165	0.236	0.987	0.469	0.381	0.315	0.602	0.236
TOC	mg/l	0.43	0.77	<0.1	<0.1	0.88	0.48	0.34	0.28	0.4	0.14

出典：JICA 調査団

### (3) 海底泥質

海底に堆積した底泥が重金属類に汚染されているとの情報を得たことから、海水水質試料採取に際し、同一地点の海底泥質試料を採取し、重金属並びに放射性物質について分析した。結果は表 3 に示すとおりであるが、海水淡水化施設候補地 No.5 の沖合の採取地点 No.4 を除き、いずれの採取地点においても鉛濃度についてやや高濃度の分析結果となっている。海底の泥については、海洋が荒れた際に巻き上げられる可能性もあることから留意が必要である。



出典：JICA 調査団

図 2 海水水質・海底泥質分析試料採取地点

表 3 海底泥質

分析項目	単位	採取 1	採取 2	採取 3	採取 4	採取 5	基準値*
Cu <sup>++</sup> (Copper)	mg/kg	2.28	5.36	6.07	2.78	6.51	≦60
Pb <sup>++</sup> (Lead)	mg/kg	208.79	154.77	127.63	53.28	234.54	≦110
Zn <sup>++</sup> (Zinc)	mg/kg	23.22	20.11	28.92	16.31	46.11	≦365
Cd <sup>++</sup> (Cadmium)	mg/kg	0.04	0.08	0.06	0.06	0.06	≦4
Ni <sup>++</sup> (Nickel)	mg/kg	17.51	30.56	29.63	10.76	41.23	≦45
Cr <sup>++</sup> (Chromium)	mg/kg	7.96	5.05	12.14	11.58	23.36	≦120
Radioactivity	Bq/s	0	0	0	0.198	0.395	≦100
Uranium	Bq/s	ND	ND	ND	ND	ND	≦0.183

\*：チュニジア国における海洋への土砂投棄に係わる基準値（現在、海洋投棄は認められないため数値は参考値）  
出典：JICA 調査団

#### (4) 底生植物

スファックス近海の海底には底生植物の一種で海草のポシドニア【*posidonia*】が生育している。特にケルケナ島付近に多く生育している。スファックスの沿岸においても生育していることを底泥試料採取時に確認している（図 2、3 参照）。海底には原水取水管と濃縮水放流管が建設されることになり、採水及び放流施設設置部並びに管理設のための掘削部分が影響を受ける。しかし、それらの管は海底下に埋設されるため、工事後に年月を経ればその影響は殆ど無くなると推察される。この点については更に調査が必要である。



出典：SONEDE

図 3 *Posidonia* 生育地

### 3. 用地候補地選定方法

海水淡水化施設建設用地候補地の選定方法は以下の通り。

#### (1) 選定方針

##### 1) 検討にあたっての前提条件

海水淡水化施設の候補地の検討にあたっては、プラント規模から判断し「直接取水」を前提とした。その他、ビーチウェル方式等も技術的には存在するが、それらの方法は透水量の不確実性から本事業では選定しないこととした。

## 2) 「選定基準」の作成

### (i) 決定方法

「選定基準」は調査団から基準案を SONEDE に提示し、関係者で議論し決定した。なお、基準作成にあたっては、以下の点に留意した。

- ① 各チェック項目はその重要度が違っているため、各チェック項目への配点数に差をつけた。
- ② これにより、各チェック項目で合格している候補地間の優劣を比較できる。図 1 の左欄に各比較項目間の配点数を併せて示す。

### (ii) 比較項目

下記観点から各候補地の優劣を比較した（図 4 参照）。

- ① 高品質の海水取水の容易性
  - ・ 安定した水質の海水の確保状況
- ② 土地取得の容易性
  - ・ 国有地/私有地
- ③ エネルギー（電力）の供給容易性
  - ・ 電力供給能力
  - ・ 供給基地（変電所等）への距離
- ④ 環境への影響
  - ・ 濃縮水放流の手法確認
  - ・ 生態系への影響の有無
- ⑤ 生産水の既存配水管網への接続容易性
  - ・ 各配水池の位置及び配水量

## 3) 各評価項目内の配点基準

前項 2) に記載の各評価項目の中でも主要な評価項目として #11（海水取水・放水点までの距離）及び #31（電源までの距離）、#51（配水池までの距離）については、その項目内での配点基準を検討した。

評価項目 #11 及び #31 については図 5 及び図 6 に示すように距離別に配点し、評価項目 51 については図 7 に示すように配管敷設予想建設コストに応じて配点した。

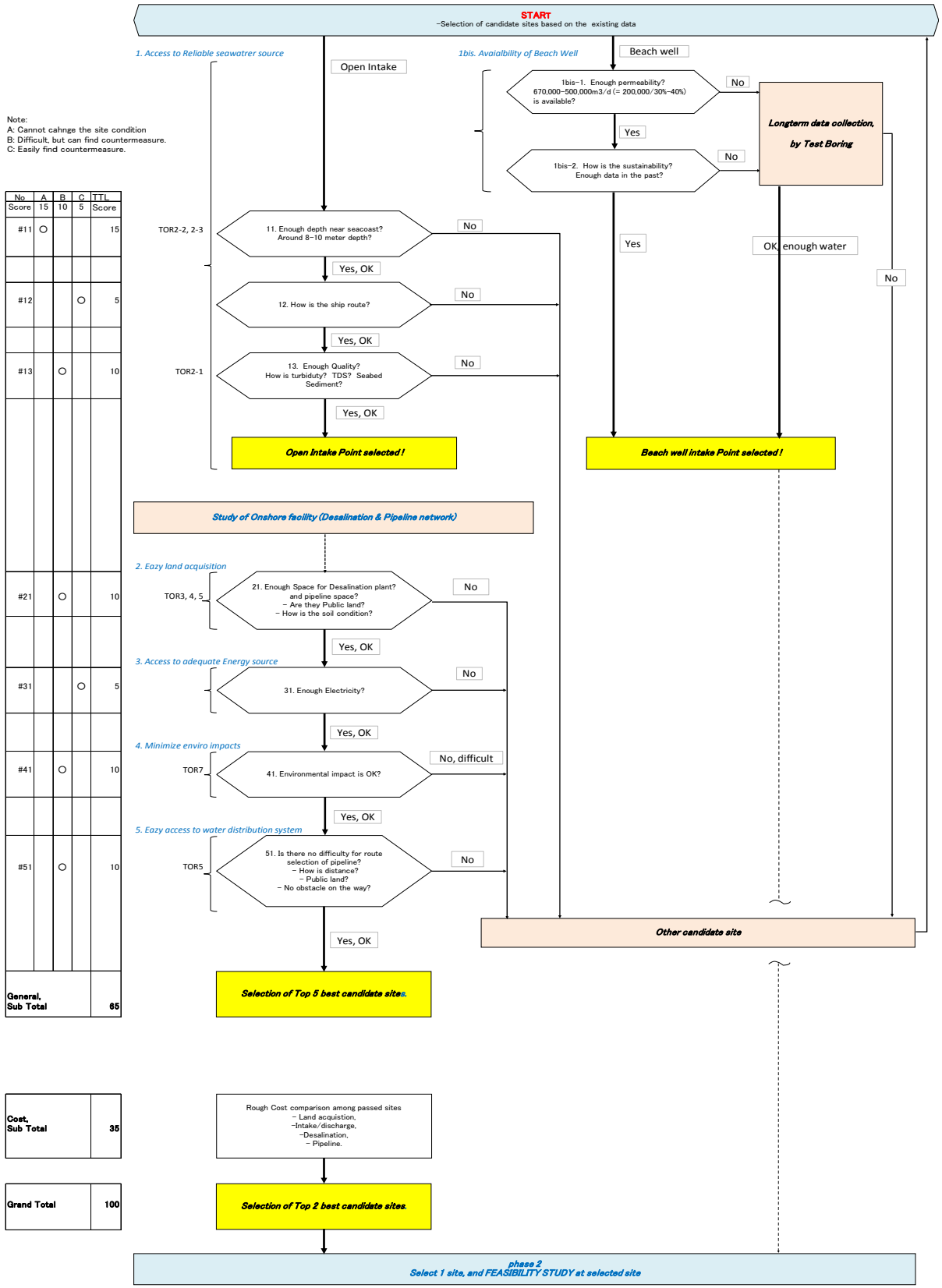
特に、プロジェクト費用の多寡に大きな影響を与える取水・放流点までの距離については、この配点方法を以下の 3 種類のケースで検討し、順位に対する影響度を確認した。

ケース 1： 距離 1km～5km までは 1 点刻みで配点。5km 超～8km までは救済処置的に低点数を付与し、「8km 超は、配点価値なし」とする。

ケース 2： ケース 1 で「5km 超は、配点価値なし」として 1～5km までは 3 点刻みで低下させる。

ケース 3： 1km 刻みで配点し、「15km 超は配点価値なし」とする。





Note:  
A: Cannot change the site condition  
B: Difficult, but can find countermeasure.  
C: Easily find countermeasure.

No	A	B	C	TTL
Score	15	10	5	Score
#11	O			15
#12		O		5
#13		O		10
#21		O		10
#31			O	5
#41		O		10
#51			O	10
<b>General, Sub Total</b>				<b>65</b>

<b>Cost, Sub Total</b>	<b>35</b>
<b>Grand Total</b>	<b>100</b>

出典：JICA 調査団

図 4 選定基準

このケーススタディの結果、どのケースで比較しても、候補地の評点順序に大きな影響がないことが判明した。従って今次評価ではケース1の配点方法を前提に配点し、その後の評価作業を行った。

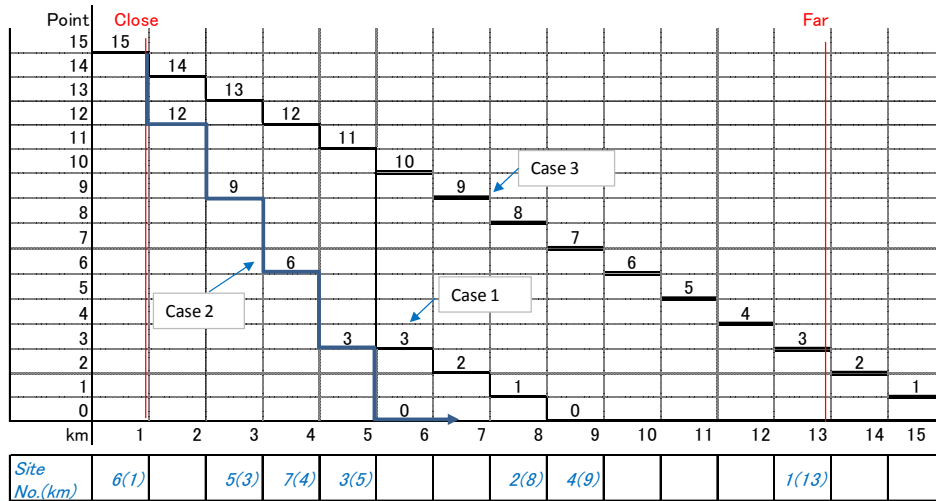


図5 評価項目#11 海水取水点までの距離とケース別評価点数

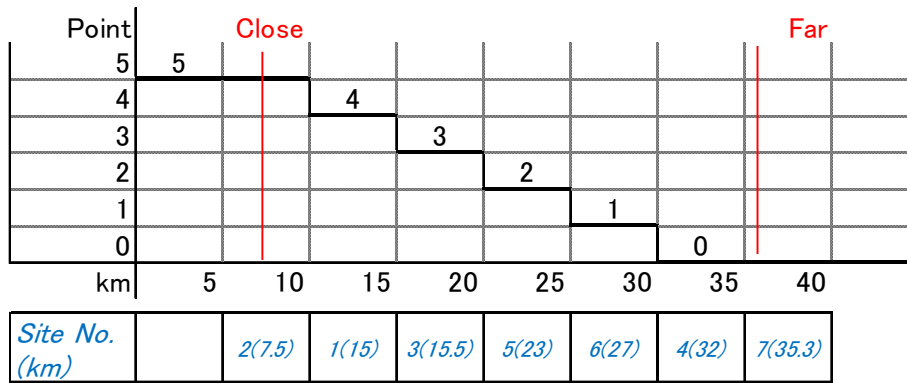


図6 評価項目#31 電源までの距離と評価点数

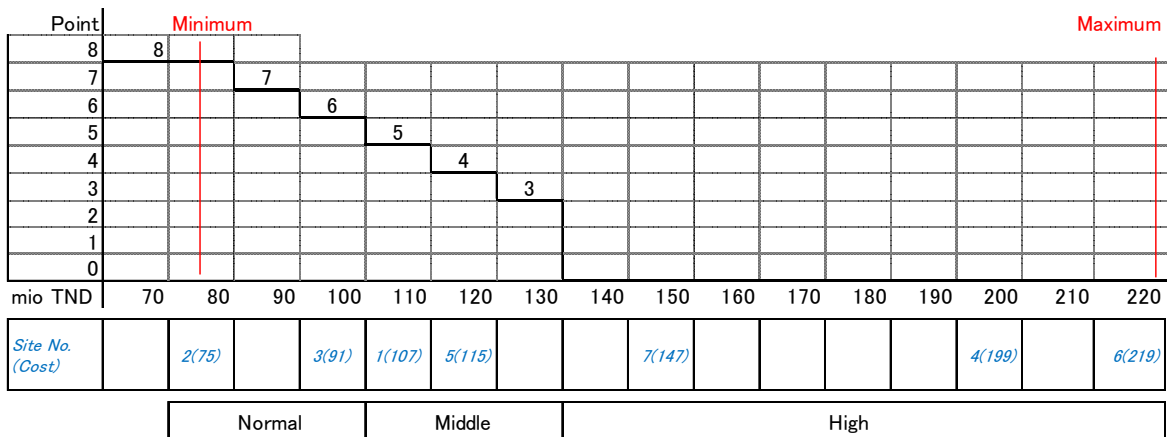


図7 評価項目#51 配水池までの配管敷設コストと評価点数

#### 4. 用地候補地選定経緯

海水淡水化施設サイトには、海水淡水化施設の他、海水受入槽、生産水貯水槽、既存配水池までの送水ポンプ、受変電設備、消耗品貯蔵倉庫、管理棟、駐車場等のスペースが必要になる。今後、各施設のサイズやレイアウト等を検討し必要なスペースを確定するが、この段階では、既存の他施設のスペース等を参考にして、処理能力 200,000m<sup>3</sup>/日の施設用として約 200,000m<sup>2</sup>のスペースを確保できそうな場所を対象にした。

候補地用地の選定にあたっては、机上検討で選ばれた表 1 の SITE 1～SITE 7 の候補地につき、前述の 3 項に示す「選定基準」に従って適否を検討した。

まず本調査フェーズ 1 段階において、第 1 次評価として各候補地の立地条件の相対的な評価を各種観点から行った。その後、第 2 次評価として、第 1 次評価で上位に位置づけられた候補地 4 個所について「建設コスト」と「ライフサイクル評価としての消費電力差」の観点から評価を行い、2 個所に絞りこんだ。

続いて、本調査フェーズ 2 初期段階に、第 2 次評価で選定された 2 個所につき検討し、種々の現地事情等も考慮して、最終候補地を選定した。以下のその経緯を述べる。

##### (1) 第 1 次評価

まず、3. (1) 1) 項の「取水・放水点の位置に関する評価点数付与方法の違い」（図 5）によるケーススタディの評価順位への影響度合いを“Criteria Sensitivity”として感度分析した。

得られた候補地ごとの順位を表 4 の下部のグラフに示す。この図から各ケースとも評価結果に大きな順位変動は発生させないことがわかったので、ケース 1 の方式を評価項目#11 の配点に採用した。

候補地ごとに各評価項目について配点した結果を表 5 に示す。この表が示すように、候補地 1, 2, 4 は低位の評価しか得られていないため今後の検討対象から除外し、高い評価点を得た候補地 3, 5, 6, 7 を 2 次評価の対象地とすることにした。

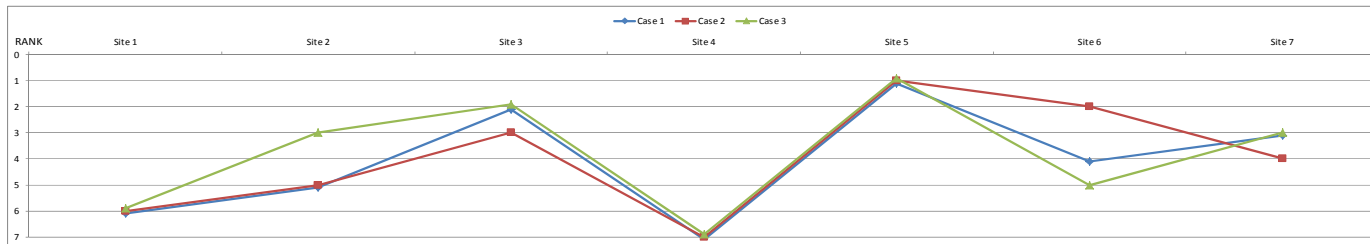
表 5 第 1 次評価結果

No	候補地名	得点 (ケース 1) 65 点満点	適 否	備 考
1	El Amra Nord (Sfax)	37	低位評価	
2	El Amra Sud (Sfax)	41	低位評価	
3	Agareb (Sfax)	51		2 次評価対象
4	Chebba Sud (Mahdia)	29	低位評価	
5	Nakta (Sfax)	53		2 次評価対象
6	Chebba Nord (Mahdia)	48		2 次評価対象
7	Mahres (Sfax)	48		2 次評価対象

表 4 候補地別評価結果

Ref No	Site No.	Point	1	Point Case1	Case2	Case3	2	Point Case1	Case2	Case3	3	Point Case1	Case2	Case3	4	Point Case1	Case2	Case3	5	Point Case1	Case2	Case3	6	Point Case1	Case2	Case3	7	Point Case1	Case2	Case3	Scoring standard			
	Name		El Amra Nord				El Amra Sud								Agareb								Chebba Nord				Mahres							
	Governorates		SFAX				SFAX								SFAX								MAHDIA				SFAX							
0	Distance from Center of SFAX (Straight)		25km				17km					18km											67km				40km							
11	Depth of Intake/Discharge Point	10 meter depth point	15	13km	0	0	3	8km	1	0	8	5km	11	3	11	9 km	0	0	7	3km	13	9	13	1km	15	15	15	4km	12	6	12	Refer to Fig 5.2-2		
12	Ship route	Ferry	4	Care	3		Care	3			OK	4			OK	4				OK	4			OK	4		OK	4				OK: P4, Care: P3		
		Fishing boat	1	Care	0		Care	0			Care	0			Care	0				OK	1			Care	0		OK	1				OK: P1, Care: P0		
13	Seawater Quality	TDS	2		2			2				2				2				2				2			2							
		Contamination of industrial waste water, city sewerage	6	No Possibility? (Close to SFAX city area.)	5		No Possibility? (Close to SFAX city and industrial area.)	4			No Possibility? (Close to SFAX city and industrial area.)	4			No Possibility	6				No Possibility	6			No Possibility	6		No Possibility	6					Far from Big City : P6, Near Big City: P5, Near Big City & Industrial area: P4	
		Sediment at seabed	2	(Far from phosphorous industrial area.)	2		(Far from phosphorous industrial area.)	2			(Close to phosphorous industrial area.)	1			(Far from phosphorous industrial area.)	2				(Far from phosphorous industrial area.)	2			(Far from phosphorous industrial area.)	2		(Far from phosphorous industrial area.)	2					Far: P2, Near: P1	
1bis	Possibility of Beach Well		?				?					?				?							?				?							
21	Land acquisition	Desalination plant (Land ownership)	8	Public	8		Public	8			Public	8			Public (to be confirmed)	7				Public	8			Public	8		Public	8					Public: P8, Public (to be confirmed): P7, Public/Private mix: P6, Private: P3	
	Soil condition	Height from sealevel (meter)	2	1-2m	1		1-2m	1			1-2m	1			1-2m	1				1-2m	1			1-2m	1		1-2m	1					1-5m: P1, 5m<: P2	
		Soil condition	?				?				?				?					?			?				?							
31	Energy	Electricity supply	5	15km	4		7.5km	5			15.5km	3			32km	0				23km	2			27km	1		35.3km	0					Refer to Fig 5.2-3	
41	Environment aspects	Historical Remains		Nothing			Nothing				Nothing				Nothing					Nothing			Nothing			Nothing								
		Wood, Animal, Bird		No impact			No impact				No impact				No impact					No impact			No impact			No impact								
		Sea bed plant, Fish...	8	Middle impact (Posidonies)	4		Middle impact (Posidonies)	4			No impact	8			Middle impact (Posidonies)	4				Small impact (Posidonies)	6			Small impact (Tuna)	6		No impact	8					No: P8, Small: P6, Middle: P4, Impact: P0	
		Sediment pollution		Small impact	0		Small impact	0			Small-Middle impact	1			Small impact	0				Small impact	0			Small impact	0		Small impact	0					Small: P0, Small-Medium: P(-1)	
	Human aspects	Fishing industry	2	Middle	1		Middle	1			Few	2			Middle-Large	1				Few	2			Middle	1		Few	2					OK: P2, If any suspicious: P1, Big problem: P0	
	Impact, during marine facility onstruction	Tourism industry		None			None				None				None					Few				Few			None							
51	Access to distribution system	Cost	8	Middle	5		Normal	8			Normal	6			High	0				Middle	4			High	0		High	0					Refer to Fig 5.2-4	
		Obstacle, at Pipeline route	2		2			2				2				2					2				2			2					If nothing: P2, If serious: P0	
Sub Total	Case 1	Full score	65		37			41				51				29				53				48				48						
	Case 2	Full score	65			37				40			43				29					49				48			42					
	Case 3	Full score	65				40				48			51			36						53			48			48					

note: Figure in red is more than point 45.



## (2) 第2次評価

上記で選定された候補地3、5、6、7について下記の項目について相対的なコストを簡易的に試算した。試算にあたって各項目での留意点を以下に示す。この段階では淡水化部分の回収率は40%として検討した。

### ① 取水・濃縮水放水管建設コスト

- 取水量 500,000m<sup>3</sup>/日、放水量 300,000m<sup>3</sup>/日を前提。
- 取水塔・放水塔を沖合の水深約 10m 地点に敷設。両者は、混合を防ぐために適当な距離を離して設置する。陸上とは取水管・放水管で接続。

### ② 海水淡水化施設

- RO 膜法淡水化プロセスを前提。
- 生産水量：200,000m<sup>3</sup>/日。回収率：40%（取水量 500,000m<sup>3</sup>/日に相当）と仮定。

### ③ 受電系統建設費

- STEG の 150KVA 系統から分岐して施設まで引き込み
- 受電容量：40MW

### ④ 送水ポンプ

- 200,000m<sup>3</sup>/日を送水。
- 低区配水池からさらに高区配水池までの送水ポンプの設置も考慮。

### ⑤ 送水配管建設コスト（付図 5～9、付表 1 参照）

- 計 200,000m<sup>3</sup>/日を既存 5 配水池と計画 1 配水池に送水する配管施設を検討。
- 具体的送水量・ルートは SONEDE と打ち合わせて決定。
- 管路の管径と単価は SONEDE の 2009 年データをベースにインフレ率を考慮。

### ⑥ 送水ポンプ運転費用（便宜的に 20 年間の運転電力費で比較）

- 候補地により送水量と送水圧力の違いで所要電力が違ってくるため、20 年間の送水ポンプに係る電力料金を評価に加えた。

サイト選定用のコスト試算結果を表 6 に示す。なお、同表の金額は立地条件による相対的なコスト比較のために試算したものであり絶対的なコストを示すものではない。また、土地取得費やその整備

費、環境影響評価等のコストは含めていない。

表 6 コスト試算結果

Candidate Site No.		3	5	6	7	
Location Name		Agareb	Nakta	Chebba Nord	Mahres	
Governorates		SFAX	SFAX	MAHDIA	SFAX	
Distance from Center of SFAX (Straight)		18 km	25 km	67 km	40 km	
Distance to 10m deep offshore point		5 km	3 km	1 km	4 km	
CAPEX: Construction Cost (mio JPY)	Intake/Discharge	Intake	6,500	3,000	1,000	4,800
		Outfall	4,000	2,000	600	3,000
	Desalination Plant	25,000	24,000	24,000	24,000	
	Electricity Service Connection	2,870	4,250	4,990	6,470	
	Transmission Pump	1,050	1,070	1,080	1,070	
	Pipeline	5,510	7,030	13,330	8,980	
	Sub Total	44,930	41,350	45,000	48,320	
ratio		100%	92%	100%	108%	

注意：海水淡水化施設は 20 万 m<sup>3</sup>/日の能力と仮定、

表 6 によると、候補地 5 の建設コストが最少で、候補地 3 を基準にした場合の 92% 程度の建設費と予想される。同様に候補地 6, 7 は、それぞれ 100%、108% となっている。

また、その立地条件により送水ポンプの送水量及び送水圧力が違ってくるため、これによる電力費の差も検討した。なお、ここでは相対的な比較をするだけなので、各年に発生する電力代金を現在価値に換算することは省略し、単純に必要な電気代の合計が初期建設コストの差を逆転することがあるかを確認するために、下記の仮定を設定して検討した。

① 運転稼働率：12 か月／年

実際は需要ピーク時の運転が主体になることが予測されるが、ここでは年間を通して稼働を前提とした。

② 比較年数：20 年

実際の設備寿命ではなく、プロジェクトライフとしてフィージビリティ調査でよく使用される 20 年を採用。

検討結果を表 7 に示すが、20 年間合計ベースでも初期建設費の差を逆転するまでは至らない。

表 7 建設費とポンプ電力費用の合計費用

Candidate Site No.	3	5	6	7
CAPEX (Plant construction cost)	44,930	41,350	45,000	48,320
Pump Electric cost x 12months/year x 20years (mio JPY)	4,300	4,570	5,530	4,940
CAPEX + Electric cost for transmission pump	49,230	45,920	50,530	53,260
ratio	100%	93%	103%	108%

上記(1)項の結果から、4 候補地の評価を表 8 にまとめた。

表 8 評価結果

候補地 No.	3	5	6	7
地点名	Agareb	Nakta	Chebba Nord	Mahres
県	Sfax	Sfax	Mahdia	Sfax
スファックス市街部中心からの直線距離	18km	25km	67km	40km
海岸から 10m 水深地点までの距離	5km	3km	1km	4km
土地所有者	公有地	公有地	公有地	公有地
標高	約 2m	約 2m	約 2m	約 2m
建設費(候補地 3 の建設費を 100 とする)	100	92	100	108
評価結果順位	2	1	3	4

表 8 に示すように、コスト面からは候補地#5 が最安価であり、#3 と#6 がそれに続くが、#6 はスファックス県外の用地ということから、調査団は#5 を最有力候補地、#3 を次位候補地として推薦した。この 2 箇所はいずれも公有地である海岸用地 (DPM: Domaine Public Maritime) 内に位置し、海岸用地を管理する APAL の使用許可が必要である。

### (3) 決定候補地

上記フェーズ 1 段階では、本事業の実施が決定されていなかったため、用地候補地選定の具体化が進んでいなかったこともあり、関係省庁に個別に相談することまでは行わず相対的な比較のみで前記 (2) の結論に至った。

フェーズ 1 の調査結果として、本事業の必要性が認められたため、本調査フェーズ 2 の初期段階にチュニジア国側関係者と共に各種検討を行った。有力候補地として選ばれていた#5 と#3 について精査を行い、改めて関係省庁に土地取得の可能性を打診する段階に入った。

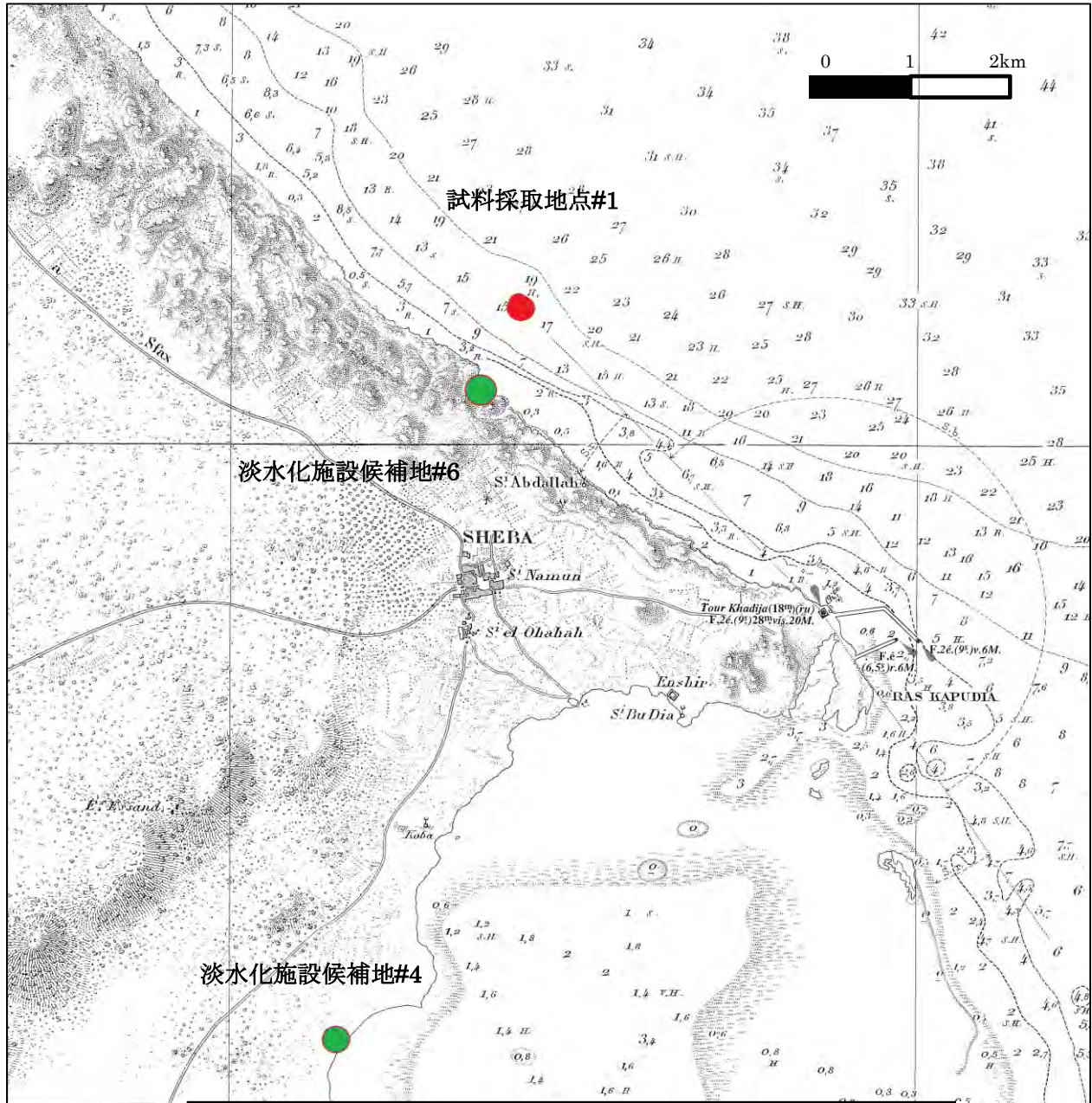
この時点で、当該公有地の管理に関与している APAL や ANPE にも使用可否について問い合わせたところ、APAL から、候補地#5 は、近隣の砂洲状海岸の形状保持と既存海水浴場等の観光資源に近接しているという二つの理由によりその使用は許可できないという見解が示された。そこで、次位候補地#3 が改めて検討された。候補地#3 は APAL の設定する海岸用地 (DPM: Domaine Public Maritime) 内にそのほとんどが含まれており、特に他の事業計画と干渉するところはなかったため、その使用が許可されることになった。その後の APAL の詳細な検討により、若干西南側に移動させた地域 (図 8 参照。) が正式な使用可能地として提示されたため、当該地を起点に海洋取水管・放水管、海水淡水化施設、生産水送水配管等の検討を行うことになった。本事業の環境影響評価報告書に対する ANPE の承認が得られてから APAL の正式な使用許可が下りることになる。



出所：APAL/SONEDE/JICA 調査団

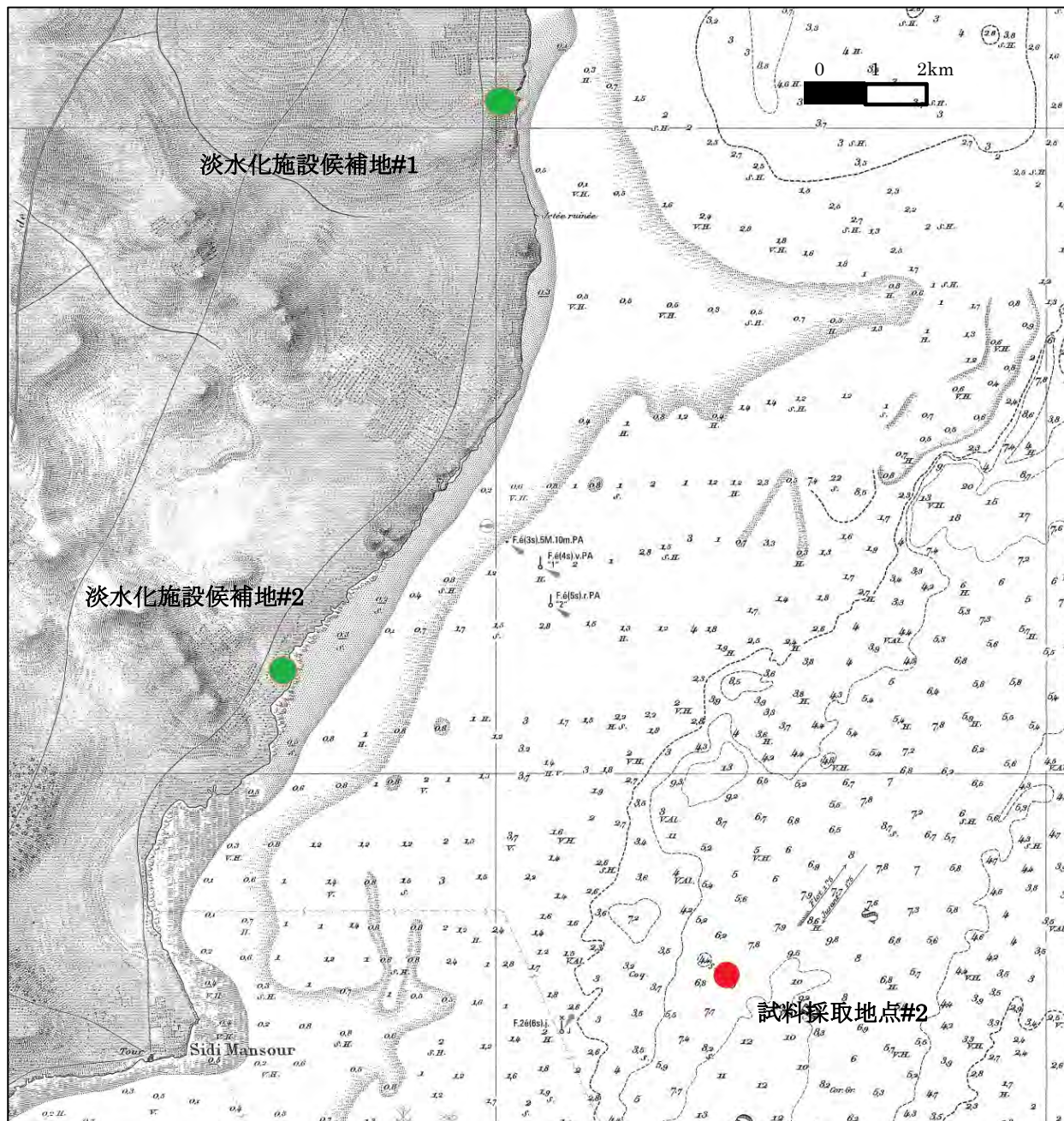
図 8 APAL からの使用許可用地





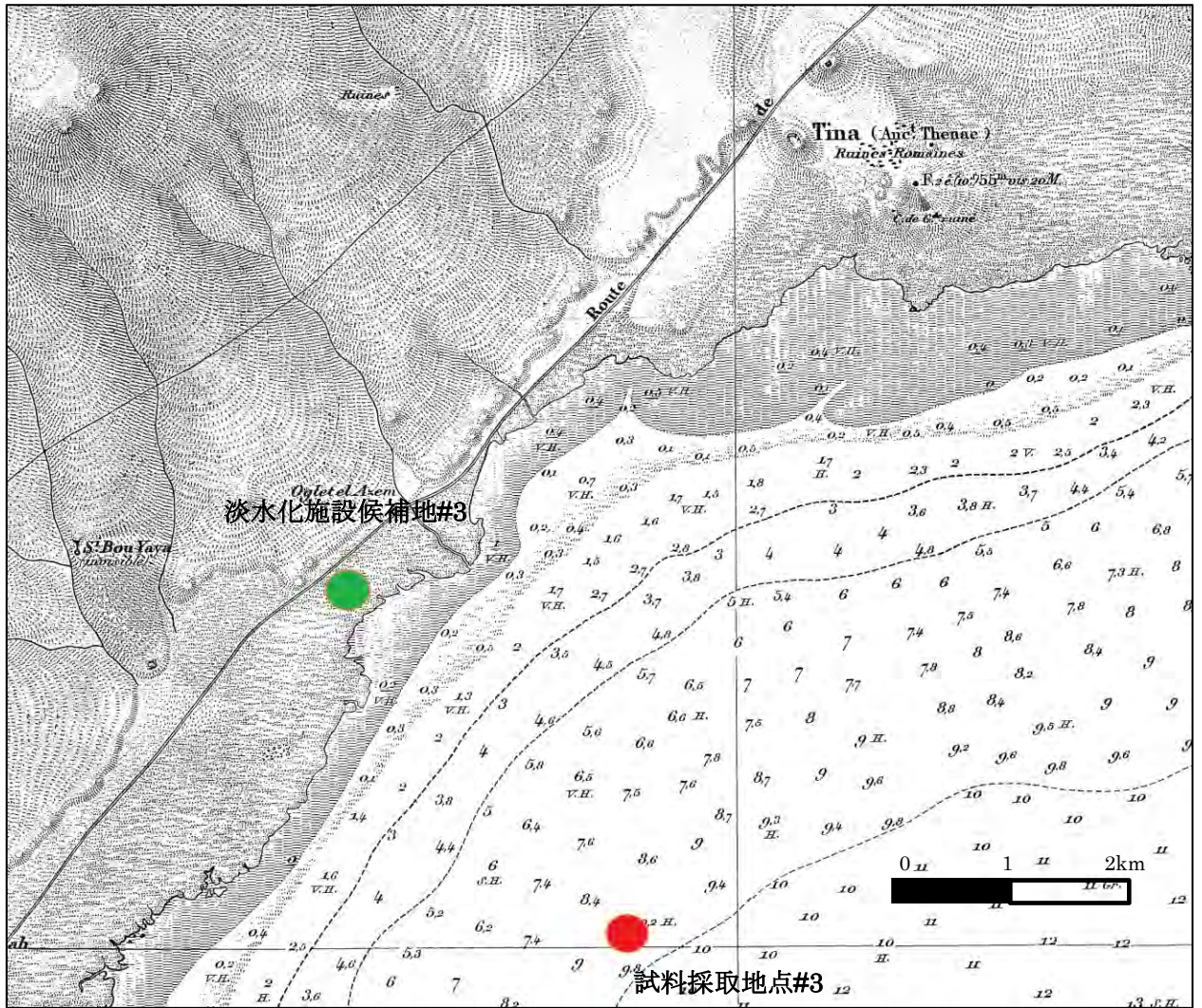
ID	Location	Latitude	Longitude
Site 4	Chebba Sud	N:35.189466	E:011.097065
Site 6	Chebba Nord	N:35.258148	E:011.112843
Sampling Point 1	-	N:35.2648413	E:011.1184828

付図1 海水淡水化施設候補地と水質泥質分析試料採取地点(1)



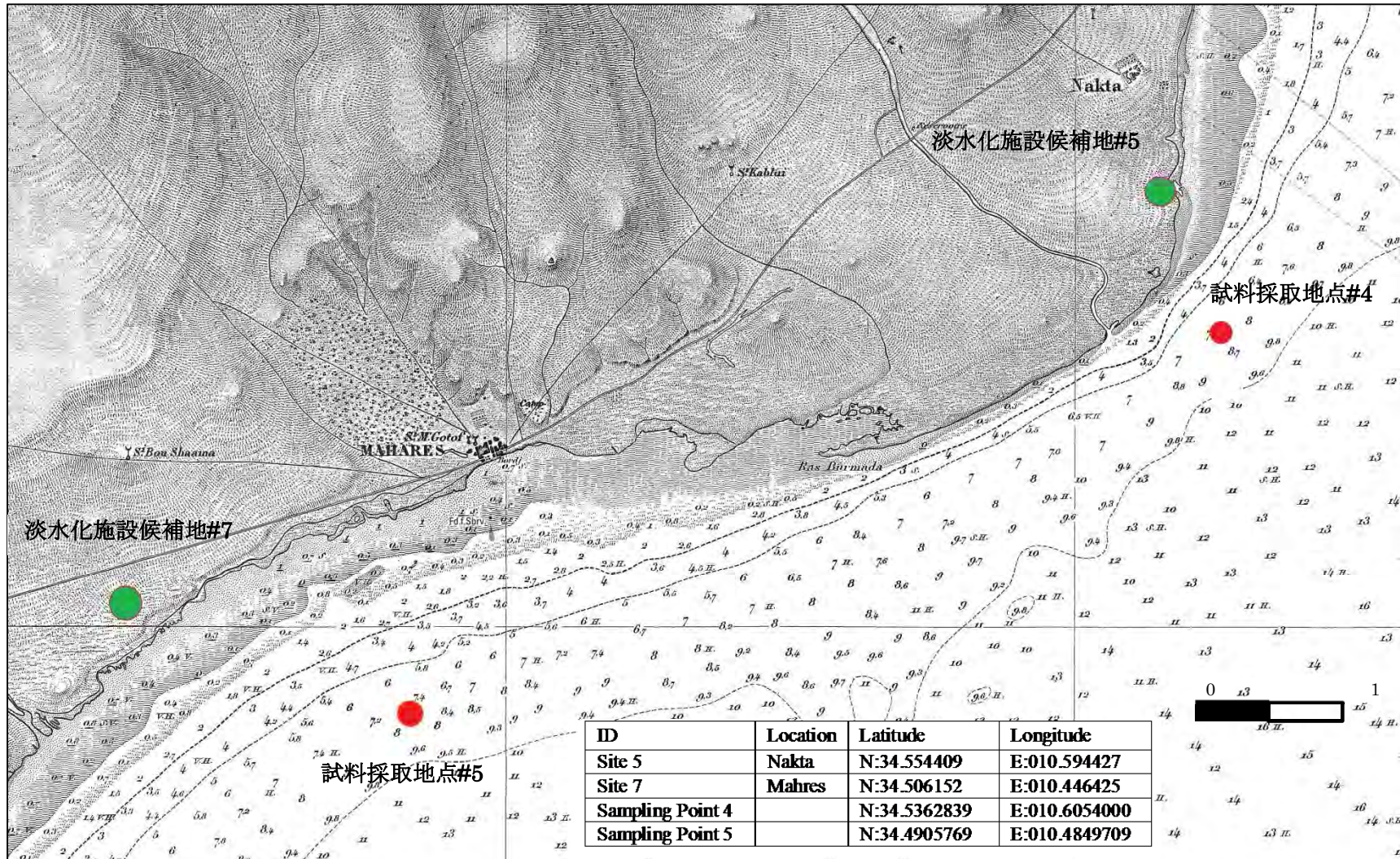
ID	Location	Latitude	Longitude
Site 1	El Amra Nord	N: 34.921381	E: 010.921379
Site 2	El Amra Sud	N: 34.847586	E: 010.885692
Sampling Point 2	-	N: 34.8085109	E: 010.9516900

付図 2 海水淡水化施設候補地と水質泥質分析試料採取地点(2)



ID	Location	Latitude	Longitude
Site 3	Agareb	N: 34.617982	E: 010.624981
Sampling Point 3	-	N:34.5836229	E:010.6553259

付図 3 海水淡水化施設候補地と水質泥質分析試料採取地点(3)



付図 4 海水淡水化施設候補地と水質泥質分析試料採取地点(4)



Google earth



— Pipeline Route from Site 1 and Site 2

P1 Pumping Station

付図 5 候補地からのケース別送水管ルート (1)

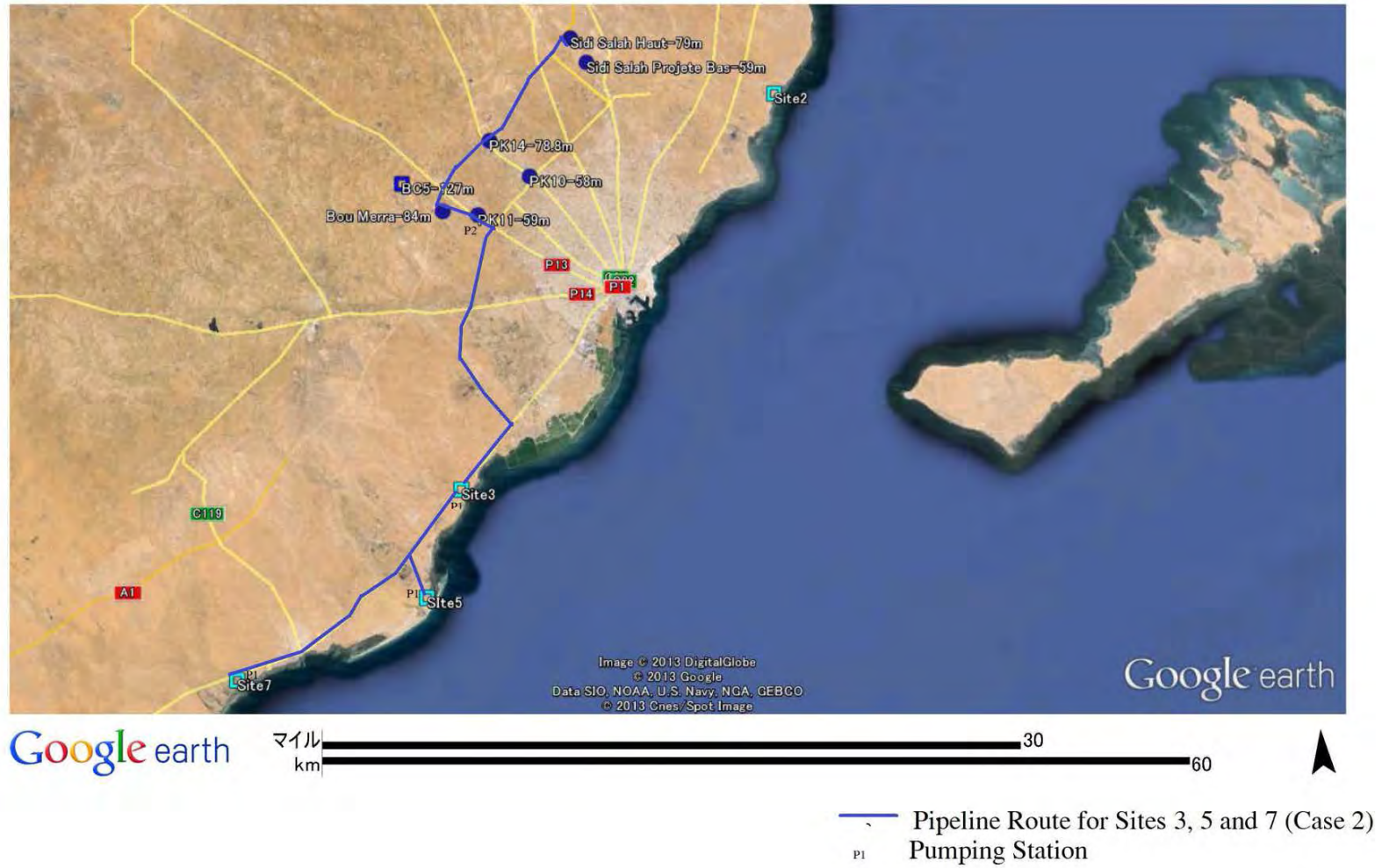


Google earth



— Pipeline Route for Site 3, 5 and 7 (Case 1)  
P1 Pumping Station

付図 6 候補地からのケース別送水管ルート (2)



付図 7 候補地からのケース別送水管ルート (3)



Google earth



— Pipekine Route for Site 4 and 6 (Case 1)  
P1 Pumping Station

付図 8 候補地からのケース別送水管ルート (4)





— Pipeline Route for Site 4 and 6 (Case 2)  
P1 Pumping Station

付図 9 候補地からのケース別送水管ルート (5)

付表 1 候補地からのケース別送水管費用

Pumpig Stations & Pipeline for Each Site (1)														
Site 1	P. St.	km	mm	m <sup>3</sup> /d	m/s	H-W	0/00	m		TND/m	1000TND	Elevation	Q (m <sup>3</sup> /d)	
		Length	Dia.	Q	V	C	Grade	Head Loss	Unit C.	Amount	Amount		Q	Q
Site - Main Road	1	9.0	1600	200,000	1.15	136	0.58	5.19		2,721	24,489	Sidi Salah H	79m	16,000
Main R.		17.8	1600	200,000	1.15	136	0.58	10.27		2,721	48,434	Sidi Salah B	59m	37,000
Main R. - S. Salah B		4.0	800	53,000	1.22	136	1.45	5.79	21.25	879	3,516	PK14	79m	32,000
S. Salah B - S. Salah H	2	2.3	500	16,000	0.94	136	1.56	3.58	3.58	429	987	PK10	58m	55,000
Mai. R.		7.8	1400	147,000	1.11	136	0.63	4.88		2,193	17,105	Bou Merra	84m	16,000
Mai R. - PK10		0.1	1000	87,000	1.28	136	1.22	0.12	20.47	1,229	123	PK11	59m	44,000
PK10 - PK14	3	4.3	800	32,000	0.74	136	0.57	2.45	2.45	879	3,780			200,000
Mai. R.		4.5	1000	60,000	0.88	136	0.61	2.76		1,229	5,531	Pump St.1	200,000	83m
Mai R. - PK11		1.2	1000	60,000	0.88	136	0.61	0.74	23.84	1,229	1,475	Pump St.2	16,000	29m
PK11 - Bou Merra	4	3.0	500	16,000	0.94	136	1.56	4.67	4.67	429	1,287	Pump St.3	32,000	29m
		54.0									106,726	Pump St.4	16,000	35m
<b>Site 2</b>														
Site 2	P. St.	km	mm	m <sup>3</sup> /d	m/s	H-W	0/00	m		TND/m	1000TND	Elevation	Q (m <sup>3</sup> /d)	
		Length	Dia.	Q	V	C	Grade	Head Loss	Unit C.	Amount	Amount		Q	Q
Site - Main Road	1	5.8	1600	200,000	1.15	136	0.58	3.35		2,721	15,782	Sidi Salah H	79m	16,000
Main R.		9.3	1600	200,000	1.15	136	0.58	5.37		2,721	25,305	Sidi Salah B	59m	37,000
Main R. - S. Salah B		4.0	800	53,000	1.22	136	1.45	5.79	14.50	879	3,516	PK14	79m	32,000
S. Salah B - S. Salah H	2	2.3	500	16,000	0.94	136	1.56	3.58	3.58	429	987	PK10	58m	55,000
Mai. R.		7.8	1400	147,000	1.11	136	0.63	4.88		2,193	17,105	Bou Merra	84m	16,000
Mai R. - PK10		0.1	1000	87,000	1.28	136	1.22	0.12	13.72	1,229	123	PK11	59m	44,000
PK10 - PK14	3	4.3	800	32,000	0.74	136	0.57	2.45	2.45	879	3,780			200,000
Mai. R.		4.5	1000	60,000	0.88	136	0.61	2.76		1,229	5,531	Pump St.1	200,000	77m
Mai R. - PK11		1.2	1000	60,000	0.88	136	0.61	0.74	17.09	1,229	1,475	Pump St.2	16,000	29m
PK11 - Bou Merra	4	3.0	500	16,000	0.94	136	1.56	4.67	4.67	429	1,287	Pump St.3	32,000	29m
		42.3									74,890	Pump St.4	16,000	35m
<b>Site 3 Case 1</b>														
Site 3 Case 1	P. St.	km	mm	m <sup>3</sup> /d	m/s	H-W	0/00	m		TND/m	1000TND	Elevation	Q (m <sup>3</sup> /d)	
		Length	Dia.	Q	V	C	Grade	Head Loss	Unit C.	Amount	Amount		Q	Q
Site - Main Road	1	0.0	1600	200,000	1.15	136	-	0.00		2,721	0	Sidi Salah H	79m	16,000
Main R.		21.6	1600	200,000	1.15	136	0.58	12.45		2,721	58,692	Sidi Salah B	59m	37,000
Main R. - PK11		1.2	800	60,000	1.38	136	1.82	2.18	14.63	879	1,055	PK14	79m	32,000
PK11 - Bou Merra	2	3.0	500	16,000	0.94	136	1.56	4.67	4.67	429	1,287	PK10	58m	55,000
Main R.		4.5	1400	147,000	1.11	136	0.63	2.82		2,193	9,869	Bou Merra	84m	16,000
Main R. - PK10		0.1	1000	87,000	1.28	136	1.22	0.12	15.39	1,229	123	PK11	59m	44,000
PK10 - PK14	3	4.3	800	32,000	0.74	136	0.57	2.45	2.45	879	3,780			200,000
Mai. R.		7.8	1000	53,000	0.78	136	0.49	3.81		1,229	9,586	Pump St.1	200,000	80m
Main R. - S. Salah B		4.0	1000	53,000	0.78	136	0.49	1.95	21.02	1,229	4,916	Pump St.2	16,000	35m
S. Salah B - S. Salah H	4	2.3	500	16,000	0.94	136	1.56	3.58	3.58	429	987	Pump St.3	32,000	29m
		48.8									90,294	Pump St.4	16,000	29m

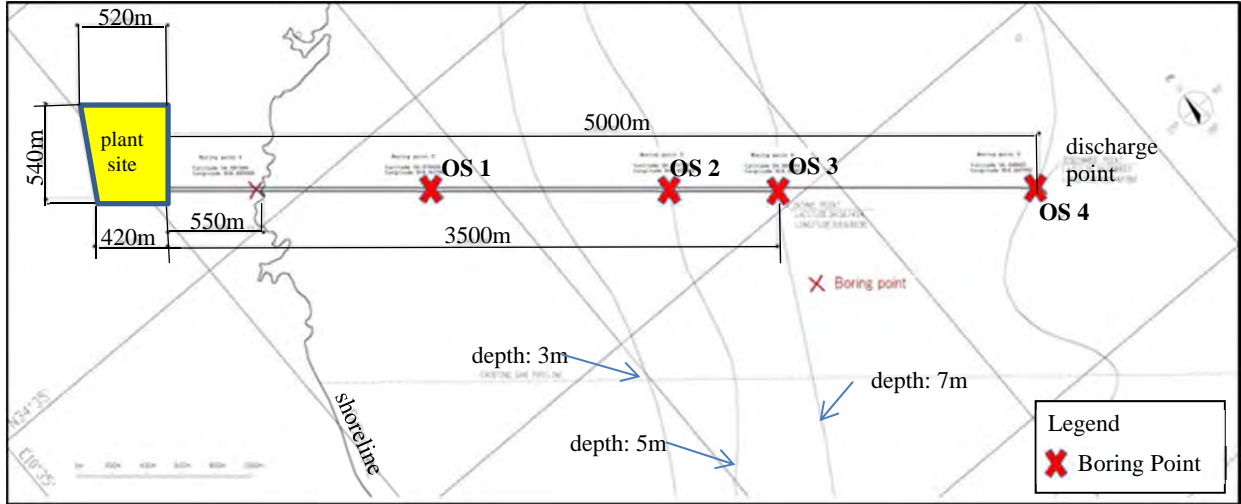
Pumpig Stations & Pipeline for Each Site (2)													
Site 3 Case 2													
		km	mm	m <sup>3</sup> /d	m/s	H-W	0/00	m		TND/m	1000TND		
	P. St.	Length	Dia.	Q	V	C	Grade	Head Loss		Unit C.	Amount		Elevation Q (m <sup>3</sup> /d)
Site - Main Road	1	0.0	1600	200,000	1.15	136	-	0.00		2,721	0	Sidi Salah H	79m 16,000
Main R.		21.6	1600	200,000	1.15	136	0.58	12.45		2,721	58,692	Sidi Salah B	37,000
Main R. - PK11		1.2	1600	200,000	1.15	136	0.58	0.69	13.14	2,721	3,265	PK14	79m 32,000
PK11 - Bou Merra	2	3.0	1400	156,000	1.17	137	0.69	2.07		2,193	6,579	PK10	55,000
Bou Merra - PK14 jct		6.2	1400	140,000	1.05	138	0.56	3.45		2,193	13,597	Bou Merra	84m 16,000
PK14 jct - PK14		0.5	1000	87,000	1.28	139	1.17	0.59		1,229	615	PK11	59m 44,000
PK14 jct - Sidi Salah Hault		9.9	1000	53,000	0.78	136	0.49	4.83	10.35	1,229	12,167		200,000
		42.4									94,914	Pump St.1	200,000 73m
												Pump St.2	156,000 36m
Site 4 Case 1													
		km	mm	m <sup>3</sup> /d	m/s	H-W	0/00	m		TND/m	1000TND		
	P. St.	Length	Dia.	Q	V	C	Grade	Head Loss		Unit C.	Amount		Elevation Q (m <sup>3</sup> /d)
Site - Main R.1	1	1.0	1600	200,000	1.15	136	0.58	0.58		2,721	2,721	Mahrouga	132m 200,000
Main R.1		5.7	1600	200,000	1.15	136	0.58	3.29		2,721	15,510	Sidi Salah H	79m 16,000
Main R2		24.7	1600	200,000	1.15	136	0.58	14.25		2,721	67,209	PK14	79m 32,000
Main R3 Jebeniana (40m)		1.0	1600	200,000	1.15	136	0.58	0.58	18.70	2,721	2,721	Bou Merra	84m 16,000
Jebeniana Mahrouga (132m)		14.5	1600	200,000	1.15	137	0.57	8.26	8.26	2,721	39,455		264,000
Mahrouga - S.Salah H		13.5	1000	103,300	1.52	136	1.68	22.64	22.64	1,229	16,592		Q (m <sup>3</sup> /d) Head
S.Salah H - S.Salah B		2.3	500	35,000	2.06	137	6.53	15.02	37.66	429	987	Pump St.1	200,000 160
S.Salah H - PK14 jct		9.9	1000	74,700	1.10	138	0.90	8.87		1,229	12,167		
PK14 jct - PK14		0.2	500	44,000	2.59	139	9.71	1.94	33.45	429	86		
PK14 jct - Bou Merra		6.2	1000	61,300	0.90	140	0.61	3.75	35.26	1,229	7,620		
		79.0									165,066		管路用に私有地を 15 kmにわたり買収せねばならず、また、ポンプ揚程がかなり高いため推奨できない。
Site 4 Case 2													
		km	mm	m <sup>3</sup> /d	m/s	H-W	0/00	m		TND/m	1000TND		
	P. St.	Length	Dia.	Q	V	C	Grade	Head Loss		Unit C.	Amount		Elevation Q (m <sup>3</sup> /d)
Site - Main R.1	1	1.0	1600	200,000	1.15	136	0.58	0.58		2,721	2,721	Sidi Salah H	79m 16,000
Main R.1		5.7	1600	200,000	1.15	136	0.58	3.29		2,721	15,510	Sidi Salah B	59m 37,000
Main R2		24.7	1600	200,000	1.15	136	0.58	14.25		2,721	67,209	PK14	79m 32,000
Main R3		22.2	1600	200,000	1.15	136	0.58	12.81		2,721	60,406	PK10	58m 55,000
Main R4		7.1	1600	200,000	1.15	136	0.58	4.10		2,721	19,319	Bou Merra	84m 16,000
Main R. - S. Salah B		4.0	800	53,000	1.22	136	1.45	5.79	40.81	879	3,516	PK11	59m 44,000
S. Salah B - S. Salah H	2	2.3	500	16,000	0.94	136	1.56	3.58	3.58	429	987		200,000
Mai. R.		7.8	1400	147,000	1.11	136	0.63	4.88		2,193	17,105		Q (m <sup>3</sup> /d) Head
Mai R. - PK10		0.1	1000	87,000	1.28	136	1.22	0.12	40.03	1,229	123	Pump St.1	200,000 103m
PK10 - PK14	3	4.3	800	32,000	0.74	136	0.57	2.45	2.45	879	3,780	Pump St.2	16,000 29m
Mai. R.		4.5	1000	60,000	0.88	136	0.61	2.76		1,229	5,531	Pump St.3	32,000 29m
Mai R. - PK11		1.2	1000	60,000	0.88	136	0.61	0.74	43.41	1,229	1,475	Pump St.4	16,000 35m
PK11 - Bou Merra	4	3.0	500	16,000	0.94	136	1.56	4.67	4.67	429	1,287		
		87.9									198,968		

Pumpig Stations & Pipeline for Each Site (3)													
Site 5 Case 1													
		km	mm	m <sup>3</sup> /d	m/s	H-W	0/00		m	TND/m	1000TND		
	P. St.	Length	Dia.	Q	V	C	Grade	Head Loss		Unit C.	Amount	Elevation	Q (m <sup>3</sup> /d)
Site - Main Road	1	3.1	1600	200,000	1.15	136	0.58	1.79		2,721	8,435	Sidi Salah H	79m 16,000
Main R.		27.7	1600	200,000	1.15	136	0.58	15.97		2,721	75,290	Sidi Salah B	59m 37,000
Main R. - PK11		1.2	800	60,000	1.38	136	1.82	2.18	19.94	879	1,055	PK14	79m 32,000
PK11 - Bou Merra	2	3.0	500	16,000	0.94	136	1.56	4.67	4.67	429	1,287	PK10	58m 55,000
Main R.		4.5	1400	147,000	1.11	136	0.63	2.82		2,193	9,869	Bou Merra	84m 16,000
Main R. - PK10		0.1	1000	87,000	1.28	136	1.22	0.12	20.69	1,229	123	PK11	59m 44,000
PK10 - PK14	3	4.3	800	32,000	0.74	136	0.57	2.45	2.45	879	3,780		200,000
Mai. R.		7.8	1000	53,000	0.78	136	0.49	3.81		1,229	9,586	Pump St.1	200,000 86m
Main R. - S. Salah B		4.0	1000	53,000	0.78	136	0.49	1.95	26.33	1,229	4,916	Pump St.2	16,000 35m
S. Salah B - S. Salah H	4	2.3	500	16,000	0.94	136	1.56	3.58	3.58	429	987	Pump St.3	32,000 29m
		58.0									115,327	Pump St.4	16,000 29m
Site 5 Case 2													
	P. St.	Length	Dia.	Q	V	C	Grade	Head Loss		Unit C.	Amount	Elevation	Q (m <sup>3</sup> /d)
Site - Main Road	1	3.1	1600	200,000	1.15	136	0.58	1.79		2,721	8,435	Sidi Salah H	79m 16,000
Main R.		27.7	1600	200,000	1.15	136	0.58	15.97		2,721	75,290	Sidi Salah B	37,000
Main R. - PK11		1.2	1600	200,000	1.15	136	0.58	0.69	18.45	2,721	3,265	PK14	79m 32,000
PK11 - Bou Merra	2	3.0	1400	156,000	1.17	137	0.69	2.07		2,193	6,579	PK10	55,000
Bou Merra - PK14 jct		6.2	1400	140,000	1.05	138	0.56	3.45		2,193	13,597	Bou Merra	84m 16,000
PK14 jct - PK14		0.5	1000	87,000	1.28	139	1.17	0.59		1,229	615	PK11	59m 44,000
PK14 jct - Sidi Salah Hault		9.9	1000	53,000	0.78	136	0.49	4.83	10.35	1,229	12,167		200,000
		51.6									119,948	Pump St.1	200,000 78m
												Pump St.2	156,000 36m
Site 6 Case 1													
	P. St.	Length	Dia.	Q	V	C	Grade	Head Loss		Unit C.	Amount	Elevation	Q (m <sup>3</sup> /d)
Site - Main R.1	1	8.2	1600	200,000	1.15	136	0.58	4.73		2,721	22,312	Mahrouga	132m 200,000
Main R.1		5.7	1600	200,000	1.15	136	0.58	3.29		2,721	15,510	Sidi Salah H	79m 16,000
Main R2		24.7	1600	200,000	1.15	136	0.58	14.25		2,721	67,209	PK14	79m 32,000
Main R3 Jebeniana (40m)		1.0	1600	200,000	1.15	136	0.58	0.58	22.85	2,721	2,721	Bou Merra	84m 16,000
Jebeniana Mahrouga (132m)		14.5	1600	200,000	1.15	137	0.57	8.26	8.26	2,721	39,455		264,000
Mahrouga - S.Salah H		13.5	1000	103,300	1.52	136	1.68	22.64	22.64	1,229	16,592		Q (m <sup>3</sup> /d) Head
S.Salah H - S.Salah B		2.3	500	35,000	2.06	137	6.53	15.02	37.66	429	987	Pump St.1	200,000 160m
S.Salah H - PK14 jct		9.9	1000	74,700	1.10	138	0.90	8.87		1,229	12,167		
PK14 jct - PK14		0.2	500	44,000	2.59	139	9.71	1.94	33.45	429	86		
PK14 jct - Bou Merra		6.2	1000	61,300	0.90	140	0.61	3.75	35.26	1,229	7,620		
		86.2									184,657		

管路用に私有地を 15 km にわたり買  
取せねばならず、また、ポンプ揚程が  
かなり高いため推奨できない。

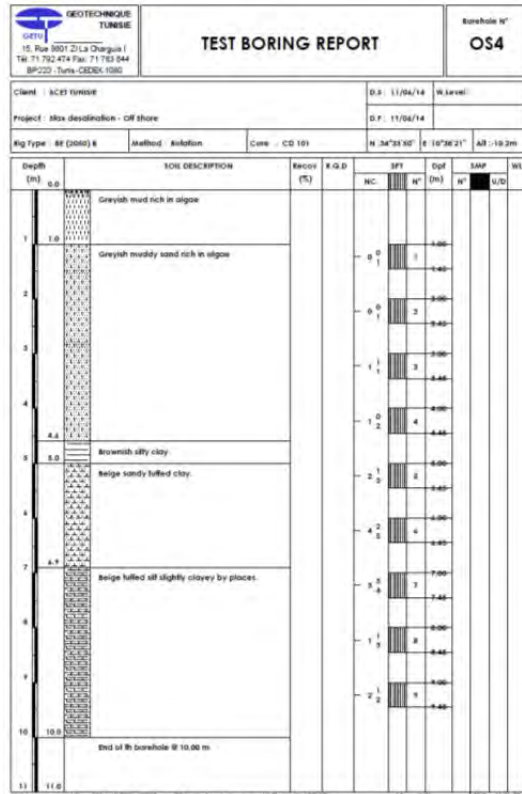
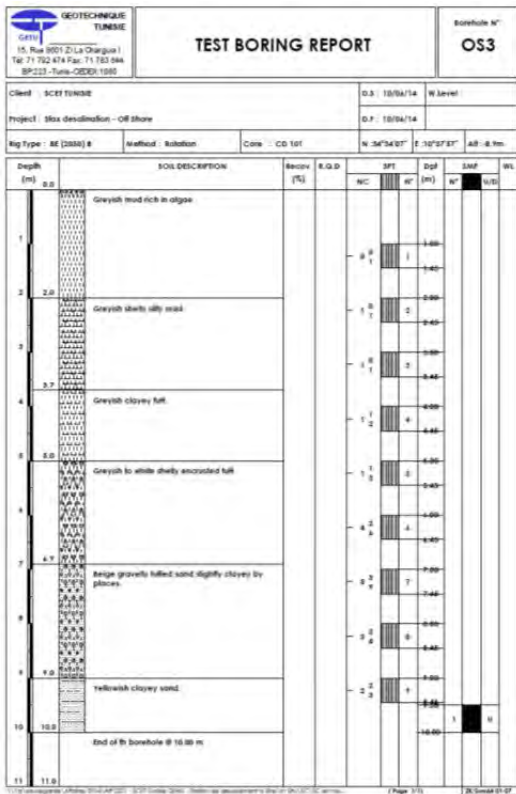
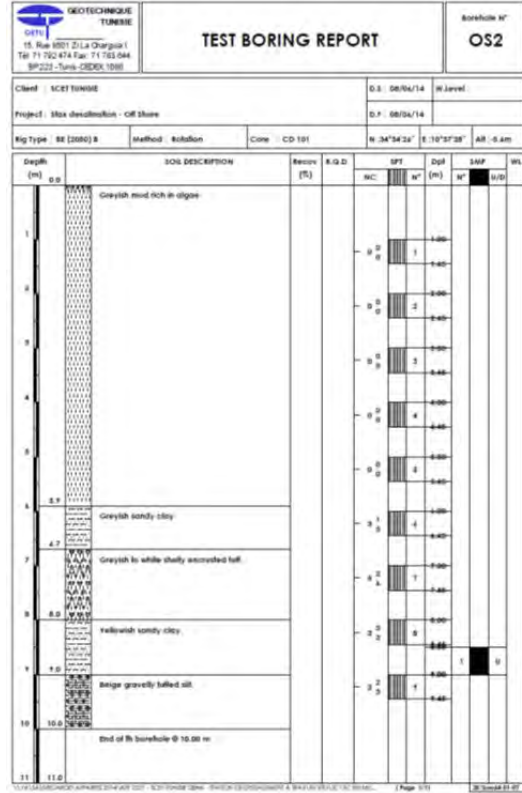
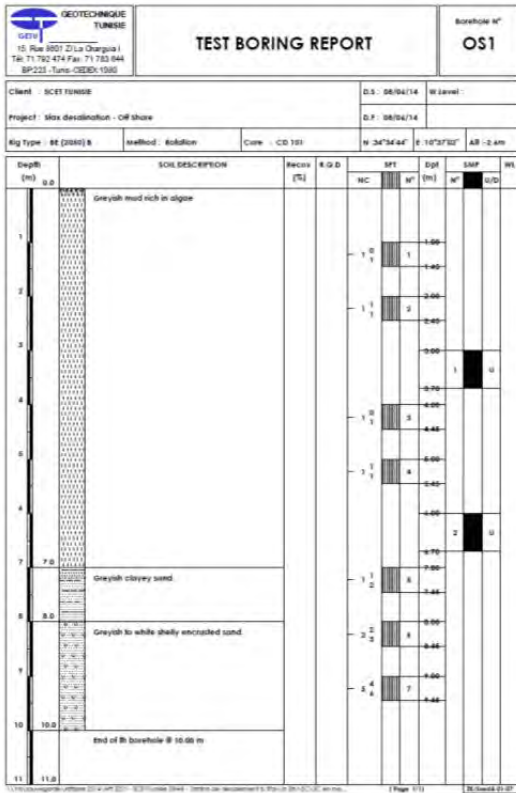
Pumpig Stations & Pipeline for Each Site (4)														
Site 6 Case 2		km	mm	m <sup>3</sup> /d	m/s	H-W	0/00	m	TND/m	1000TND				
	P. St.	Length	Dia.	Q	V	C	Grade	Head Loss	Unit C.	Amount		Elevation	Q (m <sup>3</sup> /d)	
Site - Main R.1	1	8.2	1600	200,000	1.15	136	0.58	4.73	2,721	22,312	Sidi Salah H	79m	16,000	
Main R.1		5.7	1600	200,000	1.15	136	0.58	3.29	2,721	15,510	Sidi Salah B	59m	37,000	
Main R2		24.7	1600	200,000	1.15	136	0.58	14.25	2,721	67,209	PK14	79m	32,000	
Main R3		22.2	1600	200,000	1.15	136	0.58	12.81	2,721	60,406	PK10	58m	55,000	
Main R4		7.1	1600	200,000	1.15	136	0.58	4.10	2,721	19,319	Bou Merra	84m	16,000	
Main R. - S. Salah B		4.0	800	53,000	1.22	136	1.45	5.79	44.97	879	3,516	PK11	59m	44,000
S. Salah B - S. Salah H	2	2.3	500	16,000	0.94	136	1.56	3.58	3.58	429	987		200,000	
Mai. R.		7.8	1400	147,000	1.11	136	0.63	4.88		2,193	17,105		Q (m <sup>3</sup> /d) Head	
Mai R. - PK10		0.1	1000	87,000	1.28	136	1.22	0.12	44.19	1,229	123	Pump St.1	200,000	107m
PK10 - PK14	3	4.3	800	32,000	0.74	136	0.57	2.45	2.45	879	3,780	Pump St.2	16,000	29m
Mai. R.		4.5	1000	60,000	0.88	136	0.61	2.76		1,229	5,531	Pump St.3	32,000	29m
Mai R. - PK11		1.2	1000	60,000	0.88	136	0.61	0.74	47.56	1,229	1,475	Pump St.4	16,000	35m
PK11 - Bou Merra	4	3.0	500	16,000	0.94	136	1.56	4.67	4.67	429	1,287			
		95.1									<b>218,559</b>			
Site 7 Case 1		km	mm	m <sup>3</sup> /d	m/s	H-W	0/00	m	TND/m	1000TND				
	P. St.	Length	Dia.	Q	V	C	Grade	Head Loss	Unit C.	Amount		Elevation	Q (m <sup>3</sup> /d)	
Site - Main Road	1	0.0	1600	200,000	1.15	136	0.00	0.00		2,721	0	Sidi Salah H	79m	16,000
Main R.		42.5	1600	200,000	1.15	136	0.58	24.51		2,721	115,561	Sidi Salah B	59m	37,000
Main R. - PK11		1.2	800	60,000	1.38	136	1.82	2.18	26.69	879	1,055	PK14	79m	32,000
PK11 - Bou Merra	2	3.0	500	16,000	0.94	136	1.56	4.67	4.67	429	1,287	PK10	58m	55,000
Main R.		4.5	1400	147,000	1.11	136	0.63	2.82		2,193	9,869	Bou Merra	84m	16,000
Main R. - PK10		0.1	1000	87,000	1.28	136	1.22	0.12	27.45	1,229	123	PK11	59m	44,000
PK10 - PK14	3	4.3	800	32,000	0.74	136	0.57	2.45	2.45	879	3,780		200,000	
Mai. R.		7.8	1000	53,000	0.78	136	0.49	3.81		1,229	9,586	Pump St.1	200,000	86m
Main R. - S. Salah B		4.0	1000	53,000	0.78	136	0.49	1.95	33.08	1,229	4,916	Pump St.2	16,000	35m
S. Salah B - S. Salah H	4	2.3	500	16,000	0.94	136	1.56	3.58	3.58	429	987	Pump St.3	32,000	29m
		69.7									<b>147,163</b>	Pump St.4	16,000	29m
Site 7 Case 2		km	mm	m <sup>3</sup> /d	m/s	H-W	0/00	m	TND/m	1000TND				
	P. St.	Length	Dia.	Q	V	C	Grade	Head Loss	Unit C.	Amount		Elevation	Q (m <sup>3</sup> /d)	
Site - Main Road	1	0.0	1600	200,000	1.15	136	0.00	0.00		2,721	0	Sidi Salah H	79m	16,000
Main R.		42.5	1600	200,000	1.15	136	0.58	24.51		2,721	115,561	Sidi Salah B		37,000
Main R. - PK11		1.2	1600	200,000	1.15	136	0.58	0.69	25.20	2,721	3,265	PK14	79m	32,000
PK11 - Bou Merra	2	3.0	1400	156,000	1.17	137	0.69	2.07		2,193	6,579	PK10		55,000
Bou Merra - PK14 jct		6.2	1400	140,000	1.05	138	0.56	3.45		2,193	13,597	Bou Merra	84m	16,000
PK14 jct - PK14		0.5	1000	87,000	1.28	139	1.17	0.59		1,229	615	PK11	59m	44,000
PK14 jct - Sidi Salah Hault		9.9	1000	53,000	0.78	136	0.49	4.83	10.35	1,229	12,167		200,000	
		63.3									151,783	Pump St.1	200,000	85m
												Pump St.2	156,000	36m

### 5.3-1 海底地質調査



出典：JICA 調査団

海底地質調査地点



出典 : JICA 調査団

### 海底地質調査結果

### 5.3-2 取水管、放流管及び次亜塩素酸ナトリウム注入管の管径計算

取水管・放流管：HDPE 管仕様の場合の管径試算

**Project name: Tunisia, Sfax desalination plant project**  
**Calculation: Headloss**

**Intake**

HDPE x 2		HDPE x 1	
Allowable head loss: Less than 2mH		Allowable head loss: Less than 2mH	

Total flow rate Q= 444,445 m3/day= 5,144 m3/sec  
 Pipeline No. Pn= 2 Capacity 100%  
 Design flow rate/line Qp= 2,572 m3/sec

Roughness coefficient n= 0.016  
 Additional thickness Id= 0 mm  
 Specific weight of seawater yw= 10.1 kN/m3  
 Anode No. An= pcs  
 Anode section area Aa= m2  
 Chlori pipe support No. Cn= pcs (Assumed setting interval 2m )  
 Chlori pipe OD Dc= mm (4inch)  
 Chlori pipe section area Ac= m2  
 Chlori support section area As= m2

**Brine Discharge**

HDPE x 1	
Allowable head loss: Less than 3mH	

Total flow rate Q= 244,445 m3/day= 2,829 m3/sec  
 Pipeline No. Pn= 1 Capacity 100%  
 Design flow rate/line Qp= 2,829 m3/sec

Roughness coefficient n= 0.012  
 Additional thickness Id= 0 mm  
 Specific weight of seawater yw= 10.1 kN/m3  
 Anode No. An= pcs  
 Anode section area Aa= m2

Nozzle no. Nn= 4 nozzles  
 Nozzle dia Dn= 0.55 m  
 Flow rate per one nozzle Qn= 0.707 m3/sec  
 放水流速 Vn= 3 m/sec

	PipeLife	KWH	KWH	PipeLife	PipeLife	KWH	KWH	KWH
		2,020	2,240		Max	2,690	2,804	2,920 推定外径
Pipe ND (mm) D=	2,100	1,800	2,000	2,300	2,500	2,400	2,500	2,600
SDR	17	--	--	17	17	--	--	--
Pipe thickness(mm) t=	123.5	110	120	135.3	147.1	145	152	160
Pipe Inner Diameter (mm) Dc=	1,853	1,800	2,000	2,029	2,206	2,400	2,500	2,600
Pipe section area(m <sup>2</sup> ) Ap=	2.697	2.545	3.142	3.235	3.821	4.524	4.909	5.309
Flow section area(m <sup>2</sup> ) Acp=	2.697	2.545	3.142	3.235	3.821	4.524	4.909	5.309
Flow velocity(m/sec) V=	0.954	1.011	0.819	0.795	0.673	1.137	1.048	0.969
Wetted perimeter(m) S=	5.821	5.655	6.283	6.376	6.93	7.54	7.854	8.168
Hydraulic radius(m) R=	0.463	0.45	0.5	0.507	0.551	0.6	0.625	0.65
Pipeline length(m) L=	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
Inlet headloss(m) h <sub>i</sub> =	0.046	0.052	0.034	0.032	0.023	0.066	0.056	0.048
Coefficient of friction	50.43	52.382	45.517	44.681	39.988	35.694	33.803	32.081
Friction headloss(m) h <sub>f</sub> =	2.342	2.732	1.558	1.441	0.924	2.354	1.894	1.537
Coefficient of anode	0	0	0	0	0	0	0	0
Anode headloss(m) h <sub>a</sub> =	0	0	0	0	0	0	0	0
Bend pipe headloss(m) h <sub>b</sub> =	0	0	0	0	0	0	0	0
Coefficient of chlori support	0	0	0	0	0	0	0	0
Chlori support headloss(m) h <sub>s</sub> =	0	0	0	0	0	0	0	0
Outlet headloss(m) h <sub>o</sub> =	0.046	0.052	0.034	0.032	0.023	0.066	0.056	0.048
<b>Total headloss(m) H=</b>	2.434	2.836	1.626	1.505	0.97	2.486	2.006	1.633

	PipeLife	PipeLife	KWH	KWH
			2,020	2,240
Pipe ND (mm) D=	2,000	2,100	1,800	2,000
SDR	17	17	--	--
Pipe thickness(mm) t=	117.6	123.5	110	120
Pipe ID (mm) Dc=	1,765	1,853	1,800	2,000
Pipe section area(m <sup>2</sup> ) Ap=	2.446	2.697	2.545	3.142
Flow section area(m <sup>2</sup> ) Acp=	2.446	2.697	2.545	3.142
Flow velocity(m/sec) V=	1.157	1.049	1.112	0.9
Wetted perimeter(m) S=	5.544	5.821	5.655	6.283
Hydraulic radius(m) R=	0.441	0.463	0.45	0.5
Pipeline length(m) L=	4,400	4,400	4,400	4,400
Inlet headloss(m) h <sub>i</sub> =	0.068	0.056	0.063	0.041
Coefficient of friction	36.996	34.671	36.013	31.293
Friction headloss(m) h <sub>f</sub> =	2.527	1.947	2.272	1.293
Bend pipe headloss(m) h <sub>b</sub> =	0	0	0	0
Coefficient of anode	0	0	0	0
Anode headloss(m) h <sub>a</sub> =	0	0	0	0
Nozzle outlet headloss(m) h <sub>n</sub> =	0.689	0.689	0.689	0.689
Discharge head headloss(m) h <sub>s</sub> =	0.068	0.056	0.063	0.041
<b>Total headloss(m) H=</b>	3.352	2.748	3.087	2.064

この圧損許容

圧損過多	対象	対象	圧損過少
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取水管・放流管：鋼管仕様の場合の管径試算

Project name: Tunisia, Sfax desalination plant project  
Calculation: Headloss

Intake
Coated steel with cathodic protection
Allowable head loss : Less than 2mH

Brine Discharge
Coated steel with cathodic protection
Allowable head loss : Less than 3 mH

Total flow rate	Q= 444,445 m3/day= 5.144 m3/sec
Pipeline No.	Pn= 1
Design flow rate/line	Q p = 5.144 m3/sec

Total flow rate	Q= 244,445 m3/day= 2.829 m3/sec
Pipeline No.	Pn= 1
Design flow rate/line	Q p = 2.829 m3/sec

Roughness coefficient	n= 0.016	
Additional thickness	ld= 0 mm	
Specific weight of seawater	γw= 10.1 kN/m3	
Anode No.	An= 450 pcs	Design life 10years
Anode section area	Aa= 0.0204 m2	
Chlori pipe support No.	Cn= 1,800 pcs	(Assumed setting interval 2m )
Chlori pipe OD	Dc= 114 mm	(4inch)
Chlori pipe section area	Ac= 0.0103 m2	
Chlori support section area	As= 0.033 m2	

Roughness coefficient	n= 0.012	
Additional thickness	ld= 0 mm	
Specific weight of seawater	γw= 10.1 kN/m3	
Anode No.	An= 550 pcs	Design life 10years
Anode section area	Aa= 0.0204 m2	

Nozzle no.	Nn= 4 nozzles
Nozzle dia	Dn= 0.55 m
Flow rate per one nozzle	Qn= 0.707 m3/sec
放水流速	Vn= 3 m/sec

Outer diameter	2,828
wall thickness	14.0

Pipe ND (mm)	D= 2,700	2,800	2,900
Pipe Inner Diameter (mm)	Dc= 2,700	2,800	2,900
Pipe section area(m <sup>2</sup> )	Ap= 5.726	6.158	6.605
Flow section area(m <sup>2</sup> )	Acp= 5.716	6.148	6.595
Flow velocity(m/sec)	V= 0.9	0.837	0.78
Wetted perimeter(m)	S= 8.84	9.155	9.469
Hydraulic radius(m)	R= 0.647	0.672	0.696
Pipeline length(m)	L= 3,600	3,600	3,600
Inlet headloss(m)	h <sub>e</sub> = 0.041	0.036	0.031
Coefficient of friction	32.279	30.688	29.286
Friction headloss(m)	h <sub>f</sub> = 1.334	1.097	0.909
Coefficient of anode	12.24	13.161	14.123
Anode headloss(m)	h <sub>c</sub> = 0.506	0.47	0.438
Bend pipe headloss(m)	h <sub>b</sub> = 0	0	0
Coefficient of chlori support	10.392	9.662	9.007
Chlori support headloss(m)	h <sub>s</sub> = 0.429	0.345	0.28
Outlet headloss(m)	h <sub>s</sub> = 0.041	0.036	0.031
<b>Total headloss(m)</b>	H= 2.351	1.984	1.689

対象

Outer diameter	1,920
wall thickness	10.0

Pipe ND (mm)	D= 1,800	1,900	2,000
Pipe Inner Diameter (mm)	Dc= 1,800	1,900	2,000
Pipe section area(m <sup>2</sup> )	Ap= 2.5447	2.835	3.142
Flow section area(m <sup>2</sup> )	Acp= 2.5447	2.835	3.142
Flow velocity(m/sec)	V= 1.112	0.998	0.9
Wetted perimeter(m)	S= 5.655	5.969	6.283
Hydraulic radius(m)	R= 0.45	0.475	0.5
Pipeline length(m)	L= 4,400	4,400	4,400
Inlet headloss(m)	h <sub>e</sub> = 0.063	0.051	0.041
Coefficient of friction	36.013	33.508	31.293
Friction headloss(m)	h <sub>f</sub> = 2.272	1.703	1.293
Bend pipe headloss(m)	h <sub>b</sub> = 0	0	0
Coefficient of anode	12.108	13.491	14.96
Anode headloss(m)	h <sub>c</sub> = 0.764	0.686	0.618
Nozzle outlet headloss(m)	h <sub>n</sub> = 0.689	0.689	0.689
Discharge head headloss(m)	h <sub>s</sub> = 0.063	0.051	0.041
<b>Total headloss(m)</b>	H= 3.851	3.18	2.682

対象

取水管内径と損失水頭の関係

Summary of intake pipe specification							
Material			HDPE			Steel	
Manufacturer			Uponor	PipeLife	Agru	Many	
Head Quarter			Finland	Norway	Austria	many	
Application	Targeted head loss	Adjusted at,	Inner dia	Outer dia	Outer dia	Inner dia	
Intake	2.0 mH	Number of pipes	1	1	1	1	
		Outer Dia	mm	2,804	(Max2,500)		2,828
		Wall thickness	mm	152	--		14
		Inner Dia	mm	<b>2,500</b>	--		<b>2,800</b>
		Expected delta H	mH	2.01	--		1.98
		Number of pipes		2	2	2	
		Outer Dia	mm	2,240	<b>2,300</b>	<b>(Max 2,250)</b>	
		Wall thickness	mm	120	135.3		
		Inner Dia	mm	<b>2,000</b>	2,029		
		Expected delta H	mH	1.63	1.51		
Note: Specification of products is based on their catalogue, etc.			Stabdard Products	Adjusted at Inner	Ajusted at Outer	Ajusted at Outer	
				1,600	1,600		
				1,800	1,800		
				2,000	2,000		
					2,100		
				2,200		2,250	
					2,300	(MAX)	
				2,400			
					2,500		
				2,600	(MAX)		
	2,800						
	3,000						
	(MAX)						

濃縮水放流管内径と損失水頭の関係

Summary of discharge pipe specification							
Material				HDPE			Steel
Manufacturer				Uponor	PipeLife	Agru	Many
Head Quarter				Finland	Norway	Austria	many
Application	Targeted head loss	Adjusted at,		Inner dia	Outer dia	Outer dia	Inner dia
Brine discharge	3.0 mH	Number of pipes		1	1	1	1
		Outer Dia	mm	2,020	<b>2,100</b>	Available	1,920
		Wall thickness	mm	110	123.5		10.0
		Inner Dia	mm	<b>1,800</b>	1,853		<b>1,900</b>
		Expected delta H	mH	3.09	2.75	3.18	
Note: Specification of products is based on their catalogue, etc.		Stabdard Products	Adjusted at Inner	Ajusted at Outer	Ajusted at Outer		
			1,600	1,600			
			1,800	1,800			
			2,000	2,000			
				2,100			
			2,200		2,250		
			2,400	2,300	(MAX)		
				2,500			
			2,600	(MAX)			
			2,800				
			3,000				
			(MAX)				

出典：JICA 調査団

**次亜塩素酸ナトリウム注入管管径計算**

**計算条件:**

薬品濃度: 次亜塩素酸ナトリウム2mg/Lの注入率。

流量: 次亜塩素酸ナトリウム溶液(濃度5,000mg/L)。

注入次亜塩素酸ナトリウム量  $0.88889\text{m}^3/\text{day}$  (=取水量 $444,445\text{m}^3/\text{day} \times 2\text{mg/L} / 1,000,000$ )

注入次亜塩素酸ナトリウム溶液量  $0.0021\text{m}^3/\text{sec}$  (= $0.88889\text{m}^3/\text{day} / (5,000/1,000,000)\text{mg/L} = 177.8\text{m}^3/\text{day}$ )

管材質: PVCもしくはHDPE (取水口での噴射ノズル管はFRP巻き補強したPVC)

粗度係数: 小口径管であるため、Hazen-Williams式により摩擦損失を算定。PVC等プラスチック管の流量係数としてC=120を採用。

$$h_f = \frac{10.67 L Q^{1.85}}{C^{1.85} d^{4.87}}$$

$$d^{4.87} = (10.67 \times L \times Q^{1.85}) / (C^{1.85} \times h_f)$$

ここで

hf:	配管長さL(メートル)での圧力損失, m (圧力水頭)	8
L:	配管長さ, m(メートル)	3600
Q:	流量, $\text{m}^3/\text{s}$	0.0021
C:	粗度係数	120
d:	配管の内径, m(メートル)	

$$d^{4.87} = 0.0000076$$

$$d = 89 \text{ mm} \quad \text{4インチ管内径 約100mm}$$

## 第 6 章 水道施設計画



(2)スファクス大都市圏各水源TDS濃度(mg/L)(上段:日付、下段:TDS濃度mg/L)

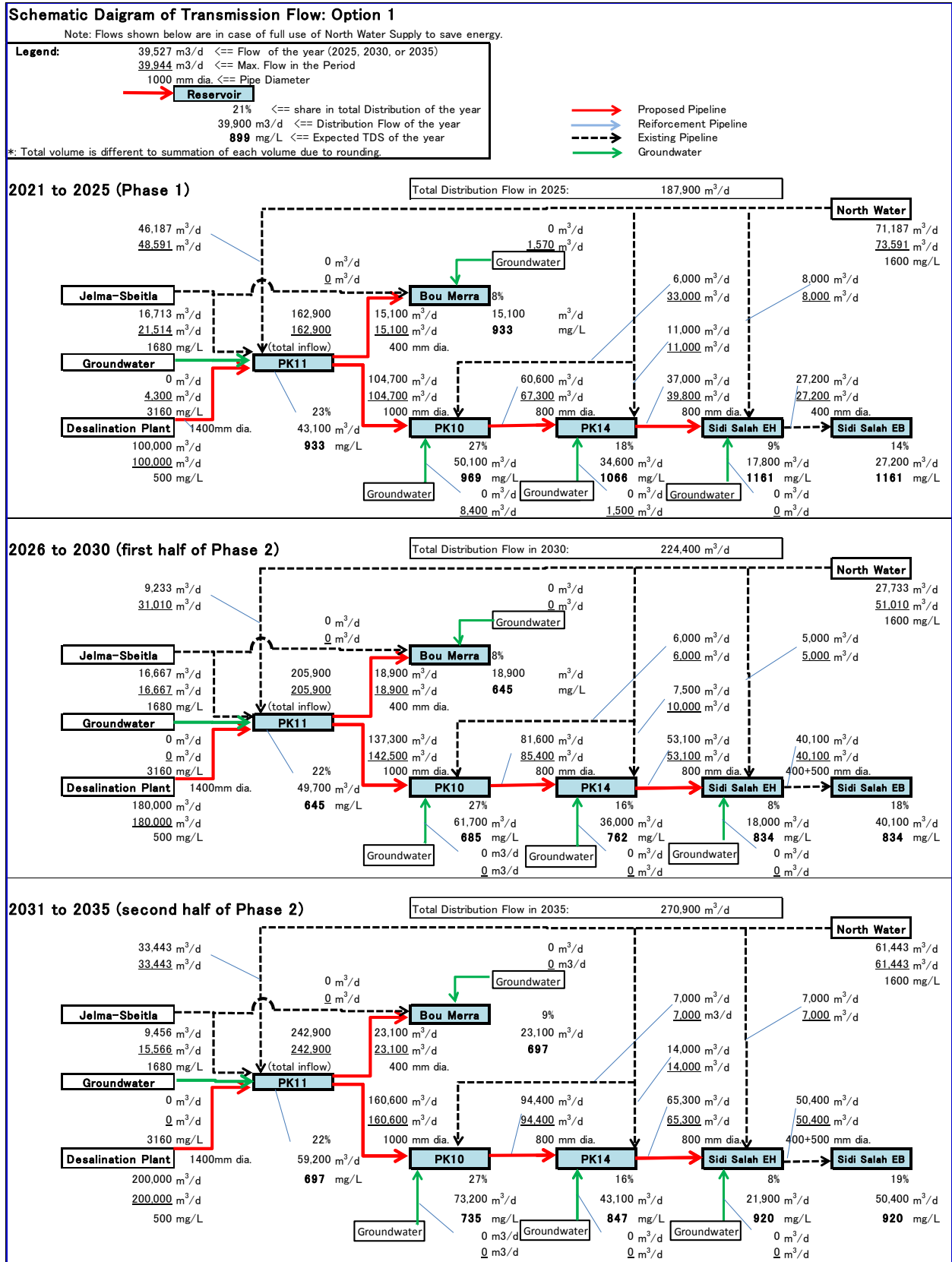
Site	北部広域水道	Jelma	Sbeitla	井戸 PK13	井戸 PK15	井戸 Sidi Salah	Forage Heicha	Forage Jebeniana	Forage Mahrouga	Forage Saint Louis	Forage Sidi Boukthir	Forage Sidi Allouch Agureb	
2012	1月	30 1130	30 1540	30 1536									
	2月												
	3月				5 2988			1 3154	1 3460				
	4月										5 3978		
	5月						14 3138						
	6月												
	7月	10 1430	10 1502										
	8月	3 1110			9 3142		3 3101	7 3104	7 3476			6 3908	
	9月												
	10月	4 1900											
	11月						19 3176						
	12月												
平均	1392.5	1521	1536			3138.33	3129	3468			3943		
2013	1月	23 1290	23 1430	23 1772									
	2月				19 3092		14 3162	18 3588	18 3486				
	3月								11 3846		11 4054		
	4月	8 1828	8 1524	10 1848									
	5月					13 3110	27 3156						
	6月												
	7月	16 1582	16 1676	16 1944									
	8月						23 3172	26 3634	29 3514	26 3842	29 3660		29 2950
	9月				5 3198	5 3202							
	10月	4 1668	4 1644	4 1918									
	11月						22 3152						
	12月												
平均	1592	1568.5	1870.5	3145	3156	3160.5	3611	3500	3844	3660	4054	2950	
2014	1月												
	2月	4 1928	4 1616	4 1856				17 3610	17 3598				
	3月												
	4月	8 1296	8 1600	10 1790	19 3088		4 3208						
	平均	1612	1608	1823	3088		3208	3610	3598				

北部水道	Jelma	Sbeitla	井戸
平均	平均	平均	平均
1598.67	31Mm3	16.1Mm3	3154
say <b>1600</b>	1581.67	1854.67	say <b>3160</b>
		1674.99	
		say <b>1680</b>	

出典：SONEDE

## 6.1-2 各オプションの送水概念図

### (1) オプション1





## (2) オプション2

### Schematic Diagram of Transmission Flow Option 2

Note: Flows shown below are in case of full use of North Water Supply to save energy.

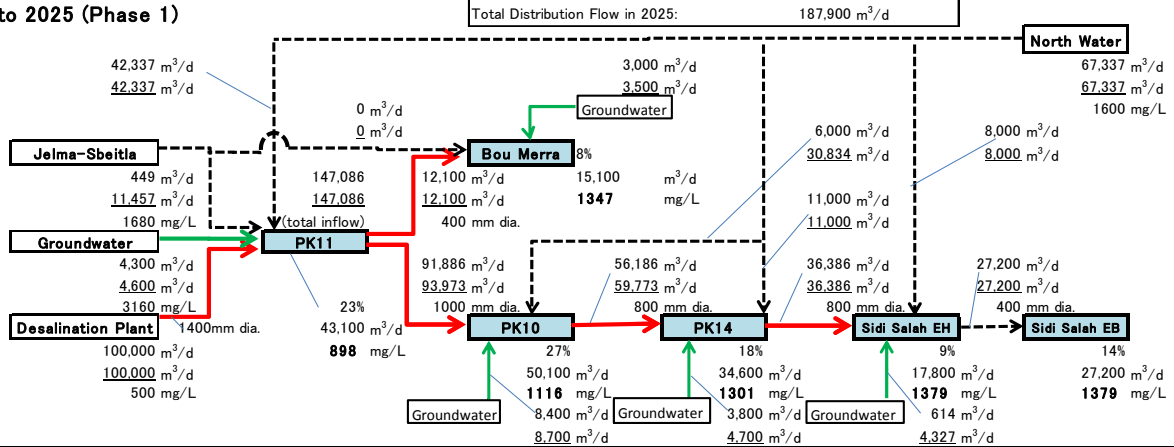
**Legend:**

- 39,527 m<sup>3</sup>/d <= Flow of the year (2025, 2030, or 2035)
- 39,944 m<sup>3</sup>/d <= Max. Flow in the Period
- 1000 mm dia. <= Pipe Diameter
- Reservoir
- 21% <= share in total Distribution of the year
- 39,900 m<sup>3</sup>/d <= Distribution Flow of the year
- 899 mg/L <= Expected TDS of the year

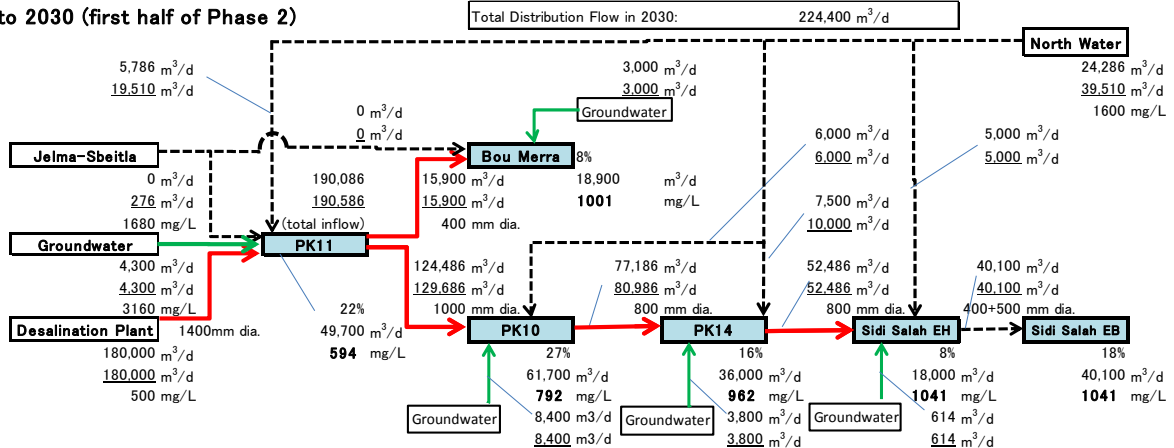
\*: Total volume is different to summation of each volume due to rounding.

- Proposed Pipeline
- Reinforcement Pipeline
- Existing Pipeline
- Groundwater

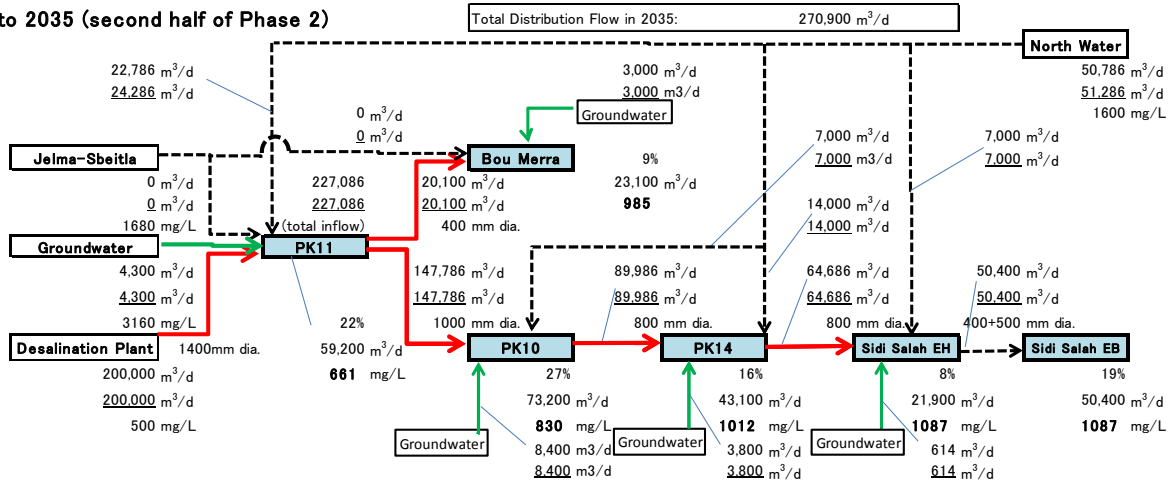
#### 2021 to 2025 (Phase 1)



#### 2026 to 2030 (first half of Phase 2)



#### 2031 to 2035 (second half of Phase 2)



### (3) オプション3

#### Schematic Diagram of Transmission Flow: Option 3

Note: Flows shown below are in case of full use of North Water Supply to save energy.

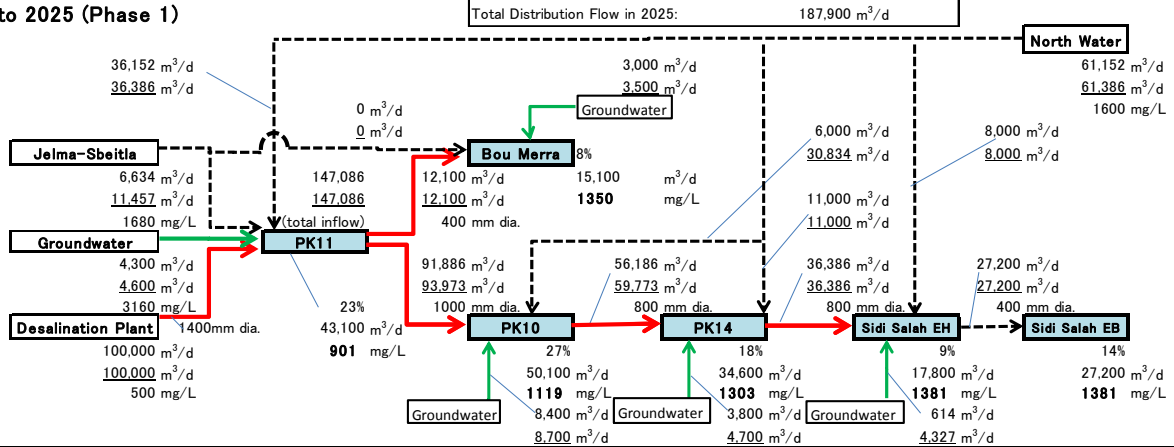
**Legend:**

- 39,527 m<sup>3</sup>/d <= Flow of the year (2025, 2030, or 2035)
- 39,944 m<sup>3</sup>/d <= Max. Flow in the Period
- 1000 mm dia. <= Pipe Diameter
- Reservoir
- 21% <= share in total Distribution of the year
- 39,900 m<sup>3</sup>/d <= Distribution Flow of the year
- 899 mg/L <= Expected TDS of the year

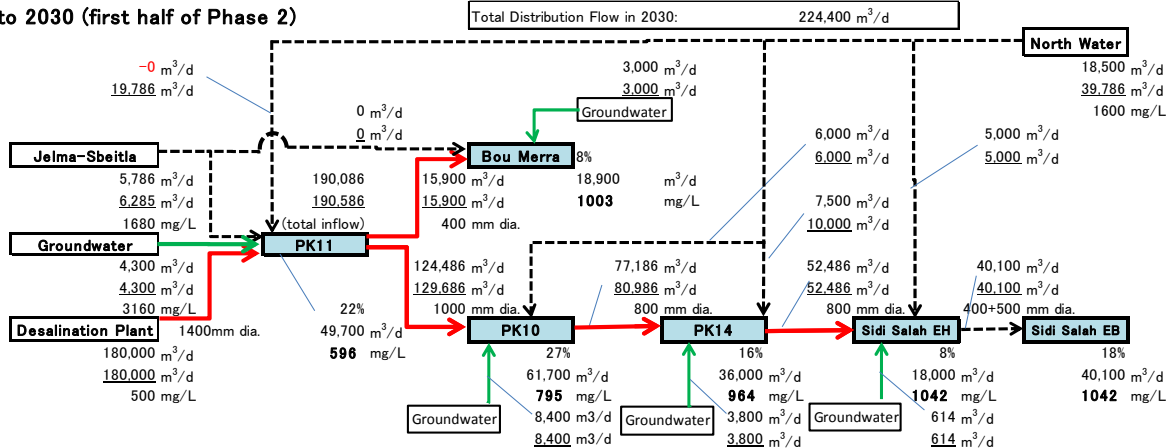
\*: Total volume is different to summation of each volume due to rounding.

- Proposed Pipeline
- Reinforcement Pipeline
- Existing Pipeline
- Groundwater

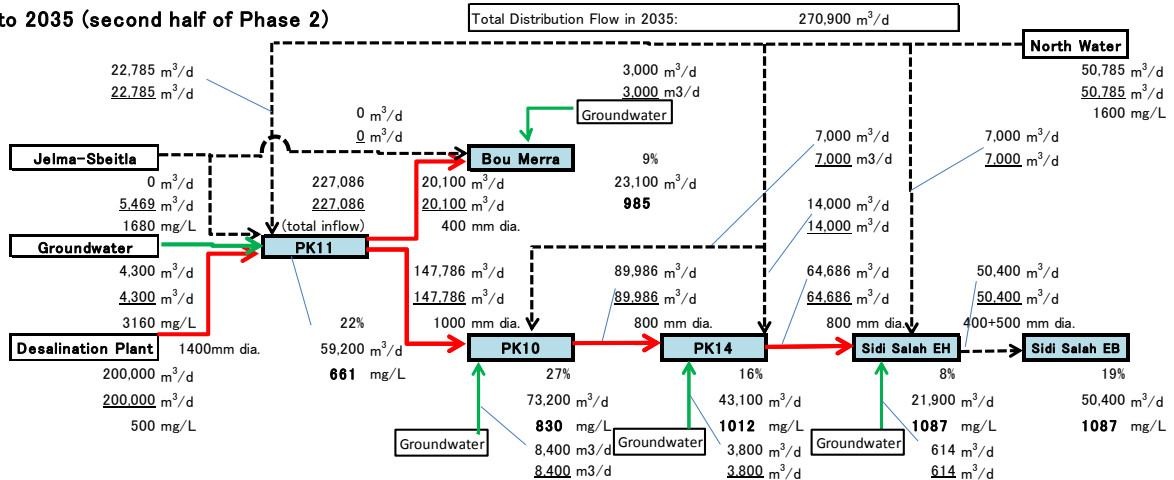
#### 2021 to 2025 (Phase 1)



#### 2026 to 2030 (first half of Phase 2)



#### 2031 to 2035 (second half of Phase 2)



### 6.1-3 オプション1及び2の各配水池配水量内訳と計画TDS濃度

Allocation of Water Source and TDS Concentrations by Reservoir (Option 1: Groundwater; maximum reduction, Jelma-Sbeitla & North; possible reduction)

Phase	Actual				Pre-Construction							Phase 1				Phase 2											
	Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
<b>Available Quantity from Water Sources</b>																											
<b>North Water Transmission System</b>																											
Jelma-Sbeitla Groundwater Trans. System																											
Groundwater in Greater Sfax																											
<b>Total Distribution Volume (m³/d)</b>																											
<b>PK11 (distribution flow*)</b>																											
Wells																											
North Water																											
Jelma-Sbeitla Water																											
Sfax Desalination																											
<b>Mixed Water Transmission</b>																											
Total																											
TDS (mg/l)																											
<b>Bou Merra (max. dist. flow*)</b>																											
Wells																											
North Water																											
Jelma-Sbeitla Water																											
<b>Mixed Water Transmission</b>																											
Total																											
TDS (mg/l)																											
<b>PK10 (max. distribution flow*)</b>																											
Wells																											
North Water																											
Jelma-Sbeitla Water																											
<b>Mixed Water Transmission</b>																											
Total																											
TDS (mg/l)																											
<b>PK14 (max. distribution flow*)</b>																											
Wells																											
North Water																											
Jelma-Sbeitla Water																											
<b>Mixed Water Transmission</b>																											
Total																											
TDS (mg/l)																											
<b>Sidi Salah EH (max. dist. flow*)</b>																											
Wells																											
North Water																											
Jelma-Sbeitla Water																											
<b>Mixed Water Transmission</b>																											
Total																											
TDS (mg/l)																											
<b>Sidi Salah EB (max. dist. flow*)</b>																											
Wells																											
North Water																											
Jelma-Sbeitla Water																											
<b>Mixed Water (thru SS EH)</b>																											
Total																											
TDS (mg/l)																											

6.1-6



各配水池計画 TDS 濃度：オプション 1

**Allocation of Water Source and TDS Concentrations by Reservoir**  
**(Option 1: Groundwater; maximum reduction, Jelma-Sbeitla & North; possible reduction)**

**TDS Concentration of Each Reservoir**

TDS(mg/l)	Phase 1						
Reservoir	2020	2021	2022	2023	2024	2025	
PK11	1,800	1,861	784	935	901	933	
Bou Merra	2,293	2,243	784	1,188	901	933	
PK10	1,888	1,906	1,048	1,131	940	969	
PK14	1,822	1,820	1,141	1,204	1,046	1,066	
Sidi Salah EH	1,835	1,810	1,215	1,204	1,151	1,161	
Sidi Salah EB	1,835	1,810	1,215	1,204	1,151	1,161	
Highest TDS	2,293	2,243	<b>1,215</b>	1,204	1,151	1,161	< 1,215
Lowest TDS	1,800	1,810	784	935	901	933	
Highest/Lowest	127%	124%	<b>155%</b>	129%	128%	124%	< 155%
Desalination Q	0	0	90,000	100,000	100,000	100,000	

TDS(mg/l)	Phase 2-1					
Reservoir	2026	2027	2028	2029	2030	
PK11	755	698	633	637	645	
Bou Merra	755	698	633	637	645	
PK10	797	741	633	637	685	
PK14	899	847	633	721	762	
Sidi Salah EH	958	907	684	800	834	
Sidi Salah EB	958	907	684	800	834	
Highest TDS	<b>958</b>	907	684	800	834	< 958
Lowest TDS	755	698	633	637	645	
Highest/Lowest	127%	<b>130%</b>	108%	126%	129%	< 130%
Desalination Q	135,000	150,000	180,000	180,000	180,000	

TDS(mg/l)	Phase 2-2					
Reservoir	2031	2032	2033	2034	2035	
PK11	653	686	723	662	697	
Bou Merra	653	686	723	662	697	
PK10	693	723	757	697	735	
PK14	829	852	875	819	847	
Sidi Salah EH	892	934	952	897	920	
Sidi Salah EB	892	934	952	897	920	
Highest TDS	892	934	<b>952</b>	897	920	< 952
Lowest TDS	653	686	723	662	697	
Highest/Lowest	<b>137%</b>	136%	132%	136%	132%	< 137%
Desalination Q	180,000	180,000	180,000	200,000	200,000	

各配水池計画 TDS 濃度：オプション 2

**Allocation of Water Source and TDS Concentrations by Reservoir  
(Option 2: Groundwater; 20% Reduction, Jelma-Sbeitla; GW 100% Reduction)**

**TDS Concentration of Each Reservoir**

TDS(mg/l)	Phase 1						
Reservoir	2020	2021	2022	2023	2024	2025	
PK11	1,800	1,861	729	888	866	898	
Bou Merra	2,293	2,243	1,286	1,464	1,344	1,347	
PK10	1,888	1,906	1,213	1,109	1,097	1,116	
PK14	1,822	1,820	1,395	1,283	1,294	1,301	
Sidi Salah EH	1,835	1,810	1,457	1,487	1,379	1,379	
Sidi Salah EB	1,835	1,810	1,457	1,487	1,379	1,379	
Highest TDS	2,293	2,243	1,457	<b>1,487</b>	1,379	1,379	< 1,487
Lowest TDS	1,800	1,810	729	888	866	898	
Highest/Lowest	127%	124%	<b>200%</b>	168%	159%	154%	< 200%
Desalination Q	0	0	90,000	100,000	100,000	100,000	

TDS(mg/l)	Phase 2-1					
Reservoir	2026	2027	2028	2029	2030	
PK11	709	647	596	585	594	
Bou Merra	1,171	1,101	1,038	1,012	1,001	
PK10	932	867	752	747	792	
PK14	1,126	1,066	860	929	962	
Sidi Salah EH	1,192	1,134	926	1,014	1,041	
Sidi Salah EB	1,192	1,134	926	1,014	1,041	
Highest TDS	<b>1,192</b>	1,134	1,038	1,014	1,041	< 1,192
Lowest TDS	709	647	596	585	594	
Highest/Lowest	168%	<b>175%</b>	174%	173%	175%	< 175%
Desalination Q	135,000	150,000	180,000	180,000	180,000	

TDS(mg/l)	Phase 2-2					
Reservoir	2031	2032	2033	2034	2035	
PK11	606	642	683	622	661	
Bou Merra	995	1,008	1,030	964	985	
PK10	803	829	858	796	830	
PK14	1,020	1,036	1,051	992	1,012	
Sidi Salah EH	1,089	1,118	1,128	1,072	1,087	
Sidi Salah EB	1,089	1,118	1,128	1,072	1,087	
Highest TDS	1,089	1,118	<b>1,128</b>	1,072	1,087	< 1,128
Lowest TDS	606	642	683	622	661	
Highest/Lowest	<b>180%</b>	174%	165%	172%	165%	< 180%
Desalination Q	180,000	180,000	180,000	200,000	200,000	

## 第 8 章 環境社会配慮

8.7-1 環境チェックリスト

分類	環境項目	主なチェック事項	Yes: Y No: N	具体的な環境社会配慮 (Yes/Noの理由、根拠、緩和策等)
1 許認可・説明	(1)EIAおよび環境許認可	(a) 環境アセスメント報告書 (EIAレポート)等は作成済みか。 (b) EIAレポート等は当該国政府により承認されているか。 (c) EIAレポート等の承認は付帯条件を伴うか。付帯条件がある場合は、その条件は満たされるか。 (d) 上記以外に、必要な場合には現地の所管官庁からの環境に関する許認可は取得済みか。	(a)N (b)N (c)- (d)N	(a) 送電線施設を含んだEIA調査 (環境影響評価) は2015年2月～9月にSONEDEで実施予定。 (b) EIAレポートはANPE (環境保護庁) にて2015年12月までに承認される予定。EIAのTORは既にANPEにて承認済み。 (c) 現在は該当なし。 (d) 海岸用地の利用でのコンセッション許可は2016年9月取得予定。また、本プロジェクトはSONEDEが実施するが、送電線設備はSTEG (チュニジア電力・ガス供給公社) が建設する。ただし、送電線設備費用はSONEDE負担であるため、それに関するSONEDE・STEG間の手続きが始まっており、STEGからの見積もりを得て、本プロジェクト費用に反映された。
	(2)現地ステークホルダーへの説明	(a) プロジェクトの内容および影響について、情報公開を含めて現地ステークホルダーに適切な説明を行い、理解を得ているか。 (b) 住民等からのコメントを、プロジェクト内容に反映させたか。	(a)Y (b)Y	(a) 2014年5月22日第1回目のステークホルダー協議を行った。プロジェクトの希望、スコーピング、影響の概略等説明済み。EIA実施時、2015年に改めて行う予定。送電線設備計画についてはSTEGが行うが、SONEDEは送電線設備に関する概要説明・アンケートを関係地方の代表者に配り、その結果を計画に反映する予定。 (b) 住民等からのコメントを記録の上、補償計画内容等に反映済み。
	(3)代替案の検討	(a) プロジェクト計画の複数の代替案は (検討の際、環境・社会に係る項目も含めて) 検討されているか。	(a)Y	(a) 候補地及び淡水化プロセス等に対して、ゼロ案を含めて、環境・社会項目を考慮し、代替案の比較検討を行った。
2 汚染対策	(1)大気質	(a) 消毒用塩素の貯蔵設備、注入設備からの塩素による大気汚染はあるか。 (b) 作業環境における塩素は当該国の労働安全基準等と整合するか。	(a)N (b)Y	(a) 液状の塩素あるいは次亜塩素酸ソーダ等を利用するため、事故による漏洩を除けば大気汚染はない。 (b) 海水淡水化設備及び送水設備はチュニジア国労働安全基準を満足する仕様で計画される。
	(2)水質	(a) 施設稼働に伴って発生する排水のSS、BOD、COD、pH等の項目は当該国の排水基準等と整合するか。 (b) 未処理水に重金属が含まれているか。 (c) 盛土部、切土部等の表土露出部からの土壌流出によって周辺河川下流水域の水質が悪化するか。水質悪化が生じる場合、対策が用意されるか。	(a)Y (b)N (c)N	(a) 海水淡水化の放流水はチュニジア国海域排出基準NT106-002に整合する。 (b) 海水淡水化の放流水にある重金属のほとんどは取水された海水から来ており、100/45=2.22倍程度濃縮されたものであるが、上記排水基準に適合する (例: Zn++_海水=38ug/l×2.22=85ug/l_放流水<10,000ug/l_NT106-002)。 (c) 送電線計画はSTEGによるが、150kVの送電線網から架空高圧線を引き込むことになると考える。鉄塔間隔は400m程度となり、スファックス周辺の平坦な地形のオリーブ畑に建設される予定であるため、土工及び樹木伐採は必要とせず、水質・水象には影響しない。
	(3)廃棄物	(a) 施設稼働に伴って発生する汚泥等の廃棄物は当該国の規定に従って適切に処理・処分されるか。	(a)Y	(a) 使用するRO膜は200 m <sup>3</sup> /年の廃棄量となり、焼却処分できる廃棄物である。
	(4)騒音・振動	(a) ポンプ施設等からの騒音・振動は当該国の基準等と整合するか。	(a)Y	(a) ポンプ施設は既存配水池敷地で建屋の中に計画されるため、周辺環境への騒音・振動の影響はない。
	(5)地盤沈下	(a) 大量の地下水汲み上げを行う場合、地盤沈下が生じる恐れがあるか。	(a)N	(a) 海水のみ利用するため、地盤沈下の可能性はない。



8.7-1 環境チェックリスト

分類	環境項目	主なチェック事項	Yes: Y No: N	具体的な環境社会配慮 (Yes/Noの理由、根拠、緩和策等)
3 自然 環境	(1)保護区	(a) サイト及び処理水放流先は当該国の法律・国際条約等に定められた保護区内に立地するか。プロジェクトが保護区に影響を与えるか。	(a)N	(a) 本プロジェクトは“KneissIslands”SPAMI保護区及びRAMSAR保護区となっているティナ塩田も含まない。
	(2)生態系	(a) サイト及び処理水放流先は原生林、熱帯の自然林、生態学的に重要な生息地（珊瑚礁、マングローブ湿地、干潟等）を含むか。 (b) サイトは当該国の法律・国際条約等で保護が必要とされる貴重種の生息地を含むか。 (c) 生態系への重大な影響が懸念される場合、生態系への影響を減らす対策はなされるか。 (d) プロジェクト及びプロジェクトによる取水（地表水、地下水）が、河川等の水域環境に影響を及ぼすか。水生生物等への影響を減らす対策はなされるか。 (e) 野生生物及び家畜の移動経路の遮断、生息地の分断等に対する対策はなされるか。 (f) 事業実施に伴う森林破壊や密猟、砂漠化、湿原の乾燥等は生じるか。外来種（従来その地域に生息していなかった種）、病害虫等が移入し、生態系が乱される恐れはあるか。これらに対する対策は用意されるか。 (g) 未開発地域に建設する場合、新たな地域開発に伴い自然環境が大きく損なわれるか。	(a)Y (b)Y (c)Y (d)N (e)N (f)N (g)N	(a) 底生植物のある海に取水・放流管を建設する計画となり、塩分濃度の高い放流水が底生植物のある場所に放流される。 (b) 底生植物posidonia oceanicaはバルセロナ条約にて保護が必要とされている。 (c) 底生植物への影響は重大な影響とは評価されていないが、塩分濃度を希釈できる放流塔が計画され、更にoffsetで緩和策が計画される。 (d) 海水取水塔は水深8mに建設され、海底から2～3mの位置で取水し、取水速度は0.2m/s以下となり、魚及び水生生物を吸込まない設計となる。また、取水管及び排水管は全長で埋めており、潮流の流れには影響しない。 (e) 送電線計画はSTEGによるが、架空高圧電線となると考える。鉄塔間隔は400m程度となり、野生生物及び家畜の移動経路の遮断、生息地を分断しない。 (f) 送電線はスファックス周辺の平坦な地形のオーリーブ畑に建設される予定であるため、土工及び樹木伐採は必要とせず、既存の生態系には影響しない。 (g) 送電線は既に開発された環境の中（オーリーブ畑）に建設される予定。
	(3)水象	(a) プロジェクトによる取水（地下水、地表水）が地表水、地下水の流れに悪影響を及ぼすか。	(a)N	(a) 海水のみ利用するため、地下水の流れには影響がない。
	(4)地形・地質	(a) 送配電線ルート上に土砂崩壊や地滑りが生じそうな地質の悪い場所はあるか。悪い場合は工法等で適切な処置が考慮されるか。 (b) 盛土、切土等の土木作業によって、土砂崩壊や地滑りは生じるか。土砂崩壊や地滑りを防ぐための適切な対策が考慮されるか。 (c) 盛土部、切土部、土捨て場、土砂採取場からの土壌流出は生じるか。土砂流出を防ぐための適切な対策がなされるか。	(a, b, c) N	(a, b, c) 送電線ルートは現在（2014年12月）不明であり、STEGによるが、海水淡水化設備から15.5kmの半径の中の地域は緩やかに標高5m～100m程度に上がっており（平均勾配は0.6%）、土滑りの危険はなく、架空高圧送電線の建設は大規模な土工を必要としない。
4 社会 環境	(1)住民移転-1	(a) プロジェクトの実施に伴い非自発的住民移転は生じるか。生じる場合は、移転による影響を最小限とする努力がなされるか。 (b) 移転する住民に対し、移転前に補償・生活再建対策に関する適切な説明が行われるか。 (c) 住民移転のための調査がなされ、再取得価格による補償、移転後の生活基盤の回復を含む移転計画が立てられるか。	(a)N (b)Y (c)Y	(a) 淡水化施設は海岸用地（公有地）に設置されるため、住民移転は不要である。また、ポンプ場、配水池等は既存配水池の敷地に設置されるため、住民移転は不要である。送水管は基本的に道路沿い、道路範囲内に設置されるため、住民移転は不要であるが、用地取得は数箇所必要となる（例：サージタンク）。送電線のルートは住民移転を避けるように計画されるが、40本の鉄塔の用地取得が必要となる。 (b) 住民移転は計画されないが、プロジェクト等の説明を目的としたステークホルダー協議を既に行った。更にEIA実施際にステークホルダー協議・住民説明会を行う予定。 (c) 住民移転は計画されないが、チュニジア国法律での用地取得に関わる補償は再取得価格と整合し、補償計画が立てられている。

8.7-1 環境チェックリスト

分類	環境項目	主なチェック事項	Yes: Y No: N	具体的な環境社会配慮 (Yes/Noの理由、根拠、緩和策等)
4 社会 環境	(1) 住民移転-2	(d) 補償金の支払いは移転前に行われるか。 (e) 補償方針は文書で策定されているか。 (f) 移転住民のうち特に女性、子供、老人、貧困層、少数民族・先住民族等の社会的弱者に適切な配慮がなされた計画か。 (g) 移転住民について移転前の合意は得られるか。 (h) 住民移転を適切に実施するための体制は整えられるか。十分な実施能力と予算措置が講じられるか。 (i) 移転による影響のモニタリングが計画されるか。 (j) 苦情処理の仕組みが構築されているか。	(d)Y (e)Y (f)- (g)- (h)Y (i)Y (j)Y	(d) チュニジア国法律では補償支払は用地取得の前提となる。 (e) 住民移転・用地取得補償方針等は本準備調査レポートに記載してある。 (f) 住民移転は計画されないため、該当なし。 (g) 住民移転は計画されないため、該当なし。 (h) 海水淡水化設備及び送水設備の用地取得はSONEDEの法務局にて実施され、送電線設備の用地取得はSTEGにて実施され、民事裁判等も含んだ体制が整えられる。十分な予算が準備できるよう本プロジェクトでの用地取得費用を把握し、本準備調査レポートに記載してある。 (i) 用地取得の進捗状況等をモニタリング計画（体制及びモニタリングフォーム）で計画している。 (j) チュニジア国法律では、用地取得に関わる苦情メカニズムが構築されている。
	(2) 生活・生計	(a) プロジェクトにより住民の生活に対し悪影響が生じるか。必要場合は影響を緩和する配慮が行われるか。 (b) プロジェクトによる取水（地表水、地下水）が、既存の水利用、水域利用に影響を及ぼすか。 (c) 他の地域からの人口流入により病気の発生（HIV等の感染症を含む）の危険があるか。必要に応じて適切な公衆衛生への配慮は行われるか。 (d) 鉄塔等による電波障害は生じるか。著しい電波障害が予想される場合は、適切な対策が考慮されるか。 (e) 送電線を建設することによる線下補償等が国内法に従い実施されるか。	(a)Y (b)N (c)N (d)N (e)Y	(a) 取水・放流水管の建設工事は漁業活動に影響する。活動時間の損失に合わせた補償計画を行う予定。 (b) 海水のみの取水となるため、既存の水利用には影響しない。 (c) スファックス大都市圏は既に人口ではチュニジア国2番目の都市として開発されてきており、他の地域から急激な人口流入は想定されず、今後も発展に応じて整備されるため、人口流入による病気の発生は問題とはならない。 (d) 送電線対象地域には既に他の高圧送電線があり、新設備は現状の電波状況に影響しない予定。 (e) 送電線設備工事はSTEGにて実施され、チュニジア国法律による用地取得及び補償手続きが実施される。
	(3) 文化遺産	(a) プロジェクトにより、考古学的、歴史的、文化的、宗教的に貴重な遺産、史跡等を損なう恐れはあるか。また、当該国の国内法上定められた措置が考慮されるか。	(a)N	(a) 本プロジェクトはローマ遺跡のあるティナ公園を含まない。プロジェクト用地には登録された遺跡は含まれていない。
	(4) 景 観	(a) 特に配慮すべき景観が存在する場合、それに対し悪影響を及ぼすか。影響がある場合には必要な対策は取られるか。	(a)N	(a) 海水淡水化施設の候補地は観光地でない上、施設は景観には影響しない。候補地は観光地でなく、既存高圧送電線が存在している環境のため、送電線設備が景観に及ぼす影響は小さい。
	(5) 少数民族、先住民族	(a) 当該国の少数民族、先住民族の文化、生活様式への影響を軽減する配慮がなされているか。 (b) 少数民族、先住民族の土地及び資源に関する諸権利は尊重されるか。	(a)- (b)-	(a) プロジェクト対象地域には少数民族及び先住民族がいない。 (b) 該当なし。
	(6) 労働環境	(a) プロジェクトにおいて遵守すべき当該国の労働環境に関する法律が守られるか。 (b) 労働災害防止に係る安全設備の設置、有害物質の管理等、プロジェクト関係者へのハード面での安全配慮が措置されているか。 (c) 安全衛生計画の策定や作業員等に対する安全教育（交通安全や公衆衛生を含む）の実施等、プロジェクト関係者へのソフト面での対応が計画・実施されるか。 (d) プロジェクトに関する警備要員が、プロジェクト関係者・地域住民の安全を侵害することのないよう、適切な措置が講じられるか。	(a)Y (b)Y (c)Y (d)Y	(a) SONEDE及びSTEGがプロジェクトを実施するため、チュニジア国の労働環境に関する法律が守られる。 (b) 既にSONEDEにて運営されている淡水化施設を参考にして、本計画の設計を行った上、危険のある施設は計画されない。 (c) 完成した設備をSONEDEに引き渡す段階で、設備メーカーが運転・維持管理等に関しての研修を行う予定。 (d) 閉鎖された敷地内での警備であり、基本的に出入り口にある警備室において、勤務時間終了際に、護身用品等を警備室に置いてから帰ることとなる。

8.7-1 環境チェックリスト

分類	環境項目	主なチェック事項	Yes: Y No: N	具体的な環境社会配慮 (Yes/Noの理由、根拠、緩和策等)
5 その他	(1) 工事中の影響	(a) 工事中の汚染（騒音、振動、濁水、粉じん、排ガス、廃棄物等）に対して緩和策が用意されるか。 (b) 工事により自然環境（生態系）に悪影響を及ぼすか。また、影響に対する緩和策が用意されるか。 (c) 工事により社会環境に悪影響を及ぼすか。また、影響に対する緩和策が用意されるか。 (d) 工事による道路渋滞は発生するか、また影響に対する緩和策が用意されるか。	(a)Y (b)Y (c)Y (d)N	(a) 取水・放流水管のための海底掘削工事の際に濁水対策が計画されている。 (b) 取水・放流水管のための海底掘削工事によって、底生植物が減少または消滅する可能性がある。緩和策（オフセット）として、漁礁の設置が計画されている。 (c) 取水・放流水管の建設により、漁業活動へ影響が生じるため、活動時間の損失に合わせた補償計画が立てられる。 (d) 送水管は道路沿いに設置する予定であるが、作業範囲は車道部を含まないため、渋滞は発生しない。
	(2) モニタリング	(a) 上記の環境項目のうち、影響が考えられる項目に対して、事業者のモニタリングが計画・実施されるか。 (b) 当該計画の項目、方法、頻度等がどのように定められているか。 (c) 事業者のモニタリング体制（組織、人員、機材、予算等とそれらの継続性）は確立されるか。 (d) 事業者から所管官庁等への報告の方法、頻度等は規定されているか。	(a)Y (b)Y (c)Y (d)Y	(a) 水質及び海底植物への影響に対する、工事中及び供用時でのモニタリング計画を実施する予定。 (b) 水質の項目及び調査方法はチュニジア国基準に基づき、海底植物の項目及びモニタリング調査方法はチュニジア国海洋技術研究所の方法による。モニタリング頻度は工事中及び供用時毎に調整され、影響の確認及び発生を把握できるように設定される。 (c) SONEDEを中心とした、ANPE（環境保護庁）、海洋技術研究所、農業漁業組合により、モニタリング体制が確立される。 (d) SONEDEのPIU（本プロジェクト実施部）を利用できる。報告方法及び頻度を規定するモニタリングフォームが準備されている。
6 留意点	他の環境チェックリストの参照	(a) 必要な場合は、ダム、河川に係るチェックリストの該当チェック事項も追加して評価すること。	(a)N	(a) 本チェックリストは上水道及び送変電・配電のチェックリストを利用し作成した。
	環境チェックリスト使用上の注意	(a) 必要な場合には、越境または地球規模の環境問題への影響も確認する（廃棄物の越境処理、酸性雨、オゾン層破壊、地球温暖化の問題に係る要素が考えられる場合等）。	(a)N	(a) 越境または地球規模の環境問題への影響はない。

注1) 表中『当該国の基準』については、国際的に認められた基準と比較して著しい乖離がある場合には、必要に応じ対応策を検討する。

当該国において現在規制が確立されていない項目については、当該国以外（日本における経験も含めて）の適切な基準との比較により検討を行う。

注2) 環境チェックリストはあくまでも標準的な環境チェック項目を示したものであり、事業および地域の特性によっては、項目の削除または追加を行う必要がある。

## 第9章 用地取得・住民移転

## 9.10-1 送電線建設に係る住民説明配付資料

SONEDEからスファックス県県長への調査実施依頼文書: 2014/12/12

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スファックス県県長からの回答FAX: 2015/02/04

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تونس في 12 ديسمبر 2014

إلى السيد والي صفاقس

29036

**الموضوع:** - مشروع إنجاز محطة تحلية مياه البحر بسعة 200 ألف متر مكعب في اليوم بصفاقس الكبرى  
- حول ربط المحطة بالكهرباء

**المصاحب:** - ملحق عدد 1 حول المسار الأولي لخط الجهد العالي،

- ملحق عدد 2 حول وثيقة استشارة (الملاحظات و التساؤلات حول المشروع)

- ملحق عدد 3 حول العناصر الأساسية للمشروع،

تحية طيبة وبعد،

في إطار تدعيم تزويد صفاقس الكبرى بالماء الصالح للشرب، كما تعلمون برمجت الشركة الوطنية لاستغلال وتوزيع المياه إنجاز محطة لتحلية مياه البحر بسعة 100 ألف متر مكعب في اليوم كمرحلة أولى. وتبعا لذلك ستقوم الشركة التونسية للكهرباء و الغاز بجلب الطاقة الكهربائية اللازمة لكافة المنشآت التابعة للمشروع عن طريق مد خط كهربائي جهد عالي.

كما نفيد سيدتكم علما بأن الشركة التونسية للكهرباء و الغاز تقوم حاليا بإعداد الدراسات الضرورية لتحديد مسار خط الجهد العالي لربط محطة التحلية بالكهرباء. وعند الانتهاء من هذه الدراسة و تحديد المسار النهائي، سيتم إنجاز دراسة المؤثرات البيئية التي ستشمل منشآت محطة التحلية وخط الكهرباء ذات الجهد العالي من قبل مكتب دراسات مختص. وخلال الدراسة البيئية سيتم تنظيم يوم إعلامي للعموم قصد شرح كل تفاصيل المشروع و خاصة الجزء المتعلق بربط المحطة بالكهرباء.

وبهدف الإعلام المسبق للسكان المعنيين بهذا المشروع، تجدون هذا ملخصا للعناصر الأساسية للمشروع (ملحق عدد 3). كما نطلب من سيادتكم مدنا بملاحظاتكم و تساؤلاتكم بخصوص عناصر المشروع وذلك طبقا لوثيقة الاستشارة المصاحبة (ملحق عدد 2).

وحتى تتمكن من إدراج ملاحظاتكم في الدراسة البيئية للمشروع، الرجاء موافاتنا بإجاباتكم في أقرب الآجال. تقبلوا سيدي الوالي فائق عبارات التقدير و الاحترام.



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البريد الإلكتروني

## 9.10-1 送電線建設に係る住民説明配付資料

SONEDEからスファックス県県長への調査実施依頼文書: 2014/12/12

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تونس في 12 ديسمبر 2014

إلى السيد والي صفاقس

29036

**الموضوع:** - مشروع إنجاز محطة تحلية مياه البحر بسعة 200 ألف متر مكعب في اليوم بصفاقس الكبرى  
- حول ربط المحطة بالكهرباء

**المصاحب:** - ملحق عدد 1 حول المسار الأولي لخط الجهد العالي،

- ملحق عدد 2 حول وثيقة استشارة (الملاحظات و التساؤلات حول المشروع)

- ملحق عدد 3 حول العناصر الأساسية للمشروع،

تحية طيبة وبعد،

في إطار تدعيم تزويد صفاقس الكبرى بالماء الصالح للشرب، كما تعلمون برمجت الشركة الوطنية لاستغلال وتوزيع المياه إنجاز محطة لتحلية مياه البحر بسعة 100 ألف متر مكعب في اليوم كمرحلة أولى. وتبعا لذلك ستقوم الشركة التونسية للكهرباء و الغاز بجلب الطاقة الكهربائية اللازمة لكافة المنشآت التابعة للمشروع عن طريق مد خط كهربائي جهد عالي.

كما نفيد سيدتكم علما بأن الشركة التونسية للكهرباء و الغاز تقوم حاليا بإعداد الدراسات الضرورية لتحديد مسار خط الجهد العالي لربط محطة التحلية بالكهرباء. وعند الانتهاء من هذه الدراسة و تحديد المسار النهائي، سيتم إنجاز دراسة المؤثرات البيئية التي ستشمل منشآت محطة التحلية وخط الكهرباء ذات الجهد العالي من قبل مكتب دراسات مختص. وخلال الدراسة البيئية سيتم تنظيم يوم إعلامي للعموم قصد شرح كل تفاصيل المشروع و خاصة الجزء المتعلق بربط المحطة بالكهرباء.

وبهدف الإعلام المسبق للسكان المعنيين بهذا المشروع، تجدون هذا ملخصا للعناصر الأساسية للمشروع (ملحق عدد 3). كما نطلب من سيادتكم مدنا بملاحظاتكم و تساؤلاتكم بخصوص عناصر المشروع وذلك طبقا لوثيقة الاستشارة المصاحبة (ملحق عدد 2).

وحتى تتمكن من إدراج ملاحظاتكم في الدراسة البيئية للمشروع، الرجاء موافاتنا بإجاباتكم في أقرب الآجال. تقبلوا سيدي الوالي فائق عبارات التقدير و الاحترام.



شارع سليمان بن سليمان  
المطار II - تونس، 2092  
Av. Slimane Ben Slimane  
El Manar II - Tunis 2092

Tel : 71 789 2008  
البريد الإلكتروني  
E-mail : sonede@sonede.com.tn

البيتر التجاري: 8 د ش R.C. : 11892008  
Matrique Fiscal : 4455 J/A/M/000  
البريد الإلكتروني



Tunis, December 12, 2014.

To the attention of the Governor of Sfax

**Subject** : - Seawater desalination plant construction project with a capacity of 200,000 m<sup>3</sup>/d in the Grand Sfax.

- Connection of the desalination station to the HV power network of STEG

**PJ** : -Annex N°1 : Preliminary outline of the high voltage power line,

-Annex N°2: Survey form (comments and questions),

-Annex N°3: Project's key components.

Greetings,

In the framework of reinforcing the drinking water supply throughout the Grand Sfax, SONEDE has planned a construction project of a seawater desalination station with a capacity of 100,000 m<sup>3</sup>/d for the first phase. Electrical power required for the Project's different components will be transferred by means of a high voltage electrical line that will be built by STEG.

We would like to inform you that STEG is currently preparing all studies required for the choice of the high voltage power line's outline, which will feed power to the desalination station. Once all details are determined, an impact study covering the desalination plant and the high voltage line will be conducted by a specialized Consultant. In the course of this impact study, an open-to-the public information day will be held to explain the project's details and mainly the part related to the connection of the desalination plant to the HV power network.

Nevertheless, in order to provide preliminary information to concerned populations, we are summarizing below the project's key components (Annex 3) and we ask you to please share with us your comments or possible questions about these components, according to the Survey Form attached herewith (Annex 2).

In order to reflect all different statements and opinions about the Project and those that will be collected during the impact study, we hope to receive your answer in the near future.

Please accept Mr. Governor our best regards.

**Studies Central Manager**

**Adnen BOUBAKER**

(Attached 1) STEG Transmission line



Source: STEG

**Annex 2 Comments and questions concerning the Desalination Plant in Sfax**

Recipient: Sfax Agency, SONEDE

To the kind attention of Mr. Youssef Shel (email: [y.shel@sonede.com.tn](mailto:y.shel@sonede.com.tn), fax: 74297335)

Or Mr. Charfeddine Sliti (email: [c.sliti@sonede.com.tn](mailto:c.sliti@sonede.com.tn), fax: 71494185)

My comments about the Project of the Plant and the construction of the high voltage transmission line are the following:

I have the following comment:

.....

.....

.....

I don't have any comment

I have the following question:

.....

.....

.....

I have no question

Date: December ..., 2014

Name : M /Ms.....

Function/Title :.....

Delegation :.....

Occupation/Employment:.....

Tel:.....Fax:.....

Email:.....@.....

**Annex 3**  
**Seawater Desalination Plant Construction Project of Sfax**  
**Key Components:**

**1 Desalination Installations**

1.1 Components

- Seawater Desalination Plant
- Transmission pipelines (from the plant to water tanks)

1.2 Desalination Plant

- Ultimate Capacity: 200,000m<sup>3</sup>/day (phase I , 100,000m<sup>3</sup>/day)
- Location: Sfax Governorate, Delegation of Agareb, on the shore across from British Gas

1.3 Expected Results

- Increase the quantity of drinking water
- Improve the quality of drinking water

1.4 Expected operation date

- In the course of 2020

**2 Power Installations**

2.1 Required power: 40MW (phase I , 20MW)

2.2 Supply method (under study)

- The required power will be transmitted up to the Plant by means of a high voltage line from STEG's existing electrical lines (existing 150 kV line starting from Sfax towards the West)

**3 - Impacts induced by the high voltage line and compensation method**

3.1 Expected impacts

- The outline of the high voltage line has not been determined yet ; however the line will likely be oriented towards the North on an approximate distance of 16 km to join existing lines. The line will be mainly crossing olive groves, and no significant impact on buildings is expected (the temporary outline is shown in the Annex).

### 3.2 Compensation method

- Nearly 40 electrical towers will be required for the line construction. The acquisition of lands required for the installation of electrical towers will be carried out by STEG.
- Compensations for the acquisition of lands will be carried out according to the Tunisian Law which is in compliance with the Donor's guidelines in this regard.

## 4 Comments on this document

4.1 Please fill in the attached Annex 2 to share your possible comments and questions. If you have no comment and no question, please fill in the attached Annex 2 with the statements: "No Comments, No questions".

4.2 Recipient: SONEDE, Sfax Regional Department or Desalination and Environment Department.

4.3 Deadline: December 31, 2014

Annex 2 related to comments may be filled in by the regional and local authorities (Delegation, Equipment, telecoms, ONAS ...) or any other person that is likely to be affected by the passage of the high voltage power line.

スファックス県県長の回答：

(疑問はない、とチェック。)

04-02-2015 17:49

GOUVERNORAT DE Sfax  
Tél. NO. : 216 (1 494185

74 403 625 P.01/01  
04 Feb. 2015 11:37 P 3

Annexe 2 : Commentaires et questions à propos du projet de la station de dessalement de Sfax

Destinataire: Direction régionale de Sfax ou Direction de dessalement et d'environnement (SONEDE), [s.sidi@sonede.com.tn](mailto:s.sidi@sonede.com.tn), fax: 74297335  
Ou M. Charfeddine Silti (email : [c.silti@sonede.com.tn](mailto:c.silti@sonede.com.tn) fax : 71494185)

Mes commentaires à propos du projet de la centrale et de la construction de la ligne à haute tension sont les suivants:

J'ai le commentaire suivant:

.....

.....

.....

Je n'ai pas de commentaire

J'ai la question suivante:

.....

.....

.....

Je n'ai pas de question

Date: le ..... décembre 2014

Nom: M /Mme.....

Fonction/Titre : .....

Délégation : .....

Occupation/Emploi: .....

Tel: ..... Fax: .....

Email: ..... @ .....

Signature: *محمد شابي*

Stamp: *وزارة الداخلية*

Stamp: *مديرية سfax*

## 第 10 章 事業実施計画

## 10.3-1 コンサルティングサービスの TOR (案)

### **Sfax Sea Water Desalination Plant Construction Project in the Republic of Tunisia Terms of Reference on Consulting Service**

#### **1. Background**

One half of Tunisia belongs to semi-dry climate. The annual average of the rainfall is about a little less than 500mm. Consequently, groundwater contributes to about 40% of water intake. The water supply system in Tunisia has been developed in accordance with an economic growth of 4% in average during the last 15 years. The service area of water supply covers 97.8% in total, i.e. 100% of urban areas, 93.4% of rural areas (SONEDE, 2012). In Tunisia, the Ministry of Agriculture defines the water sector policy. Water supply in rural area is based on the communal faucet method and is operated by the Ministry of Agriculture. SONEDE (Société Nationale d'Exploitation et de Distribution des Eaux) is responsible for water supply in urban areas and in some rural areas using individual supply systems including water supply for domestic use and development, and the maintenance of conveyance and transmission systems.

Greater Sfax is the second largest city in Tunisia with an approximate population of about 621000. Water supply volume amounts to about 190,000m<sup>3</sup>/day for SONEDE's coverage area with a served population of about 810,000 in 2012. Because of rapid increase in population at 1.37% per annum over the last ten years, it is projected that serious water shortage will happen in 2018, and the development of a new water source is requested. Greater Sfax currently relies on groundwater in the central-western region for its water supply. However, it is projected that water supply from the region will be decreased in order to spare groundwater resources in the central-western regions and the increase of demand in the region. In order to cope with this situation, it is requested to develop water resource only for Sfax governorate and to provide related infrastructure. SONEDE studied the construction of a sea water desalination plant in Sfax in the feasibility study for water supply in south regions conducted in 2005.

SONEDE also prepared the Strategic Plan in 2013 to enhance water supply capacity and to improve water quality by 2030. In the plan, the Sfax Desalination Plant Construction Project was planned. In this framework, the preparatory survey was conducted with JICA funding. Based on the survey, this project was formulated.

#### **2. Objectives of Consulting Services**

The objective of the consulting services is to provide design, evaluation of bids, and construction supervision ensuring the design and the construction quality and fairness, and achieving the efficient project implementation.

#### **3. Scope of Consulting Services**

The scope of consulting services on Sfax Sea Water Desalination Plant Construction Project in the Republic of Tunisia cover designing, tender assistance, and management of construction services for 7



lots and eight (08) contracts. Each lot is explained below followed by a description of services to provide:

(1) Project Component

The project consists of 7 lots. Each lot is explained as follows:

i) Lot 1: Construction of the Seawater Desalination Plant

(a) Sea Water Desalination Plant

- a1) Land Acquisition: Approximately 20ha
- a2) Desalination Method: Reverse Osmosis Membrane Method (RO)
- a3) Treated Water: 100,000m<sup>3</sup>/d
- a4) RO Units: 25,000m<sup>3</sup>/day × 4 units
- a5) Transmission Pump Facility 100,000m<sup>3</sup>/d
- a6) Required Electricity: Approximately 20MVA

(b) Sea Water Intake Pipe

- b1) Intake Volume: 222,200m<sup>3</sup>/d (capable of flowing 444,400 m<sup>3</sup>/d for Phase 2)
- b2) Pipe Material: HDPE
- b3) φ2000mm x 2 (HDPE), L=3.6km (Buried Pipe: 3.2 km offshore, and 0.4 km onshore))
- b4) Transmission pump facility 100,000 m<sup>3</sup>/d
- b5) Submerged Water Intake Tower 2 units

(c) Brine Effluent Pipe

- c1) Effluent Volume: 122,000m<sup>3</sup>/d (capable of flowing 244,000 m<sup>3</sup>/d for Phase 2)
- c2) Pipe Material: HDPE
- c3) φ1800mm, L=4.4km (Buried Pipe: 4.0 km offshore, 0.4 km onshore))
- c4) Submerged Water Effluent Tower 1 unit

ii) Lot 2: Procurement of Pipes

(a) Procurement of Pipe for Transmission to be installed for Lot 4

- a1) Pipe Material: Ductile Cast Iron Pipe
- a2) φ1400mm: L=26.1km (Desalination Plant - PK11 Reservoir)
- a3) φ1000mm: L=6.1km (PK10 Reservoir)
- a4) φ800mm: L=4.8km (PK10 Reservoir—PK14 Reservoir)
- a5) φ800mm: L=9.4km (PK14 Reservoir—Sidi Salah EH Reservoir)
- a6) φ400mm: L=2.9km (PK11 Reservoir—Bou Merra Reservoir)

This lot can be subject of two contracts (sub-lot 2.1 and sub-lot 2.2)

iii) Lot 3: Procurement of Valves and Other Equipment

(a) Procurement of valves and other equipment to be installed for Lot 4

iv) Lot 4: Installation of Pipeline including valves and other equipment

- (a) Construction of Transmission Pipeline and valves whose materials are procured through Lot 2 and Lot 3.
  - (b) Construction of One-Way Surge Tanks or other anti-water-hammer equipment
    - b1) Desalination Plant Site - PK11 Reservoir  
Tank dimension: diameter 10m x height 15m, site: 20m x 30m x 2 locations
- v) Lot 5: Construction of Reservoir
- (a) Construction of Reservoir
    - a1) Capacity of 5,000m<sup>3</sup> existing precinct of Bou Merra Reservoir
  - (b) Construction of Receiving and Mixing Chambers
    - b1) PK11: 9.0 W x 15.0 L x 5.0 D
    - b2) Bou Merra: 4.0W x 3.0L x 5.0D
    - b3) PK10: 7.0W x 10.0L x 5.0D
    - b4) PK14: 7.0W x 7.0L x 5.0D
    - b5) Sidi Salah EH: 6.0W x 5.0L x 5.0D

(internal dimension; W: width, L: length, D: water depth; unit: m)
- vi) Lot 6: Construction of Pumping Stations
- (a) Pumping Station
    - a1) Relay Pumping Station: 3 (in PK10, PK11, and PK14 Reservoir Sites)
- vii) Lot 7: Power Transmission Construction and Power Connection Works(Executed by STEG)
- (a) Construction of electrical power supply facility necessary for the Sea Water Desalination Plant
    - a1) power line
    - a2) power line tower
    - a3) facility for transformation of energy
    - a4) other necessary facilities
  - (b) Electrical power connection work (pumping stations of Pk10, Pk11 and Pk14)
  - (c) Assistance for the installation of Sea Water Desalination Plant electrical facility

The Consultants shall include the following items as subjects in their engineering works required for the facilities stipulated in (1) Project Component:

- (a) Associated reservoirs, all piping, valves, special parts, pumping mains, overflow pipeline, scour pipes etc. in construction of pumping stations;
- (b) Associated inlet chamber, over flow pipeline, pumping main and other ancillary structures in construction of pumping stations;
- (c) Roads and other networks, street lighting, water supply, sanitation, fencing compound wall, etc., within the premises of the water treatment plant and reservoirs; and
- (d) River/Canal crossings, pipe supports, cradle support, thrust and anchor blocks, valve chambers, road crossings, fabrication of manholes, expansion joints, and installation of valves along the outline.

(2) Detailed description of the consulting services

Design and preparation of bidding documents

- 1) The Consultant shall perform the duties for designing and preparation of the bidding documents according to contracts to be signed between SONEDE and the Consultant. The conceptual design for Lots 1 and 6, and the detailed design for Lots 2 to 5 and Lot 7 shall be performed by the responsibility of the Consultant. Standard Bidding Documents of JICA shall be applied for International Competitive Bidding. The Consultant shall function with the authorities and responsibilities of the Engineer in case it is provided in this Project's Contract Documents. In this context, the Consultant shall;
  - a) Prepare hydraulic, structural, mechanical and electrical systems designs;
  - b) Prepare specifications for civil works, mechanical and electrical equipment, including instrumentation, control and regulation systems;
  - c) Prepare tender drawings for civil work;
  - d) Prepare general arrangement drawings incorporating equipment layout, piping layout and instrumentation and control schemes for tender purpose;
  - e) Prepare technical specifications for electrical drawings such as single line diagrams, equipment layout, cable networks layout, and lighting networks layout;
  - f) Prepare cost estimate for civil works and mechanical and electrical equipment and works;
  - g) Prepare process flow sheets, process design, process criteria, hydraulic diagram and design; civil and structural design criteria, mechanical and electrical and instrumentation system requirements;
  - h) Conduct surge suppression studies and recommend appropriate surge protection system; and
  - i) Design arrival hydraulic structures and calculation of needs.
  
- 2) The Consultant shall carry out process design and engineering studies for Lot 1 including the following:
  - a) Prepare conceptual design (i.e. process, hydraulic, mechanical and electrical equipment designs);
  - b) Prepare specifications;
  - c) Prepare sea water desalination plant flow chart with its different levels;
  - d) Prepare sea water desalination plant preliminary hydraulics with control levels;
  - e) Prepare sea water desalination plant implantation plans; and
  - f) Prepare process and hydraulic designs, parameters, structural design criteria, mechanical and electrical system requirements.
  
- 3) The Consultants shall provide assistance in Pre-Qualification (PQ) for Lot 1 (based on the JICA's standard document related to prequalification). The Consultant shall assist SONEDE to;
  - a) Define technical and financial requirements, capacity and/or experience for PQ criteria taking into consideration technical features of the Project;
  - b) Prepare PQ documents in accordance with the Standard Prequalification Documents under

- Japanese ODA Loans;
- c) Carry out PQ announcement, addendum/corrigendum, and clarifications to bidders' queries;
  - d) Evaluate PQ applications in accordance with the criteria set forth in PQ documents; and
  - e) Prepare a PQ evaluation report for approval by the competent committee.
- 4) The Consultants shall provide assistance in preparation of bidding documents. The Consultant shall assist SONEDE to;
- a) Prepare bidding documents in accordance with the latest version of Standard Bidding Documents under Japanese ODA Loans for Procurement ("PLANT" for Lots 1 and 6, "GOODS" for Lot 2, "WORKS" for Lots 4 and 7), together with all relevant technical document such as specifications, drawings and other documents, which are prepared during the detailed design period; and
  - b) Prepare bidding documents which include i) the clauses that the Contractors is to comply with the requirement of the Environmental Management Plan (EMP) and JICA Guidelines for environmental and social considerations (April 2010) (JICA Environmental Guidelines), ii) the specification clearly stipulating the safety requirements in accordance with the laws and regulations in Tunisia, relevant international standards (including guidelines of international organization), if any, and also in consideration of "the Guidance for the Management of Safety for Construction Works in Japanese ODA Projects of JICA," iii) the requirement to furnish a safety plan to meet the safety requirements, iv) the requirement for the personnel for key positions to include an accident prevention officer, and v) the requirement to submit method statements of safety to SONEDE and the consultant at the construction stage.

#### Tendering Assistance

The Consultants shall provide assistance to the tendering procedure listed below in accordance with the JICA Guidelines for Procurement under Japanese ODA Loans (April 2012). The Consultant shall assist SONEDE to;

- a) Carry out issuing bid advertising, conducting pre-bid conferences, issuing codicils, and clarifications to bidders' inquiries;
- b) Evaluate bids in accordance with the criteria set forth in the bidding documents. In such evaluation, the Consultant shall carefully confirm that bidders' submissions in their technical proposal including, but not limited to, site organization, mobilization schedule, method statement, construction schedule, safety plan, and EMP have been prepared in harmony each other and will meet such requirements set forth in applicable laws and regulations, specifications and other parts of the bidding documents;
- c) Prepare bid evaluation reports for approval of the competent committee;
- d) Carry out contract negotiation by preparing agenda and facilitating negotiations including preparation of minutes of negotiation meeting; and
- e) Prepare a draft and final contract agreement.

### Construction Supervision

#### 1) Lots 1 and 6

The Consultant shall perform his duties during the implementation period of the contracts to be executed by SONEDE and the Contractors (Lots 1 and 6). In this context, the Consultant shall;

- a) Act as SONEDE's Representative to execute construction supervision and contract administration services in accordance with the power and authority to be delegated by SONEDE;
- b) Provide assistance to SONEDE concerning variations and claims which are to be ordered/issued at the initiative of SONEDE;
- c) Advise SONEDE on resolution of any dispute with the Contractors;
- d) Issue instructions, approvals and notices as appropriate;
- e) Provide recommendations to SONEDE for acceptance of the Contractor's performance security, advance payment security and required insurances;
- f) Assess adequacy of all inputs such as materials, labor and equipment provided by the Contractors;
- g) Check and approve the Contractors' method of work, including site organization, program of performance, quality assurance system, safety plan and environmental monitoring plan so that the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract are to be duly respected;
- h) Monitor as appropriate physical and financial progress, and take appropriate action to expedite progress if necessary, so that the time for completion set forth in the contract will be duly respected;
- i) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions;
- j) Review and approve the Contractor's design for the works to be constructed, working drawings, shop drawings and drawings for temporary works;
- k) Liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated;
- l) Carry out field inspections on the Contractor's setting out of the works in relation to original points, lines and levels of reference specified in the contract;
- m) Organize, as necessary, management meetings with the Contractors to review the arrangements for future work. Prepare and deliver minutes of such meetings to SONEDE and the Contractors;
- n) Supervise the works so that all the contractual requirements are met by the Contractor, including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. Confirm that an accident prevention officer proposed by the Contractor is duly assigned at the project site;
- o) Supervise field tests, sampling and laboratory test to be carried out by the Contractors;
- p) Inspect construction methods, equipment to be used, workmanship at the site, and attend factory inspection and manufacturing tests in accordance with SONEDE's Requirements;
- q) Verify payment applications submitted by the Contractor;
- r) Coordinate the works among different contractors employed for the Project;

- s) Modify the Employer's Requirements as may be necessary in accordance with the actual site conditions, and issue variation orders with the approval of SONEDE (including necessary actions in relation to the works performed by other contractors working for other projects or other facility operators, if any);
- t) Carry out timely reporting to SONEDE for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied;
- u) Inspect, verify and comment on claims issued by the Contractors;
- v) Supervise Pre-commissioning carried out by the Contractors, check and comment on the Contractor's Pre-commissioning report, and suggest the Completion Certificate as specified in the contract;
- w) Supervise Commissioning and Guarantee Test carried out by the Contractors, check and comment on the Contractor's report on the Commissioning and Guarantee Test, and suggest the Operational Acceptance Certificate as specified in the Contract;
- x) Provide periodic inspection services during defect liability period and if any defects are noted, instruct first SONEDE and second the Contractors to rectify;
- y) Check and suggest the approval of as-built drawings prepared by the Contractors; and
- z) Check and suggest the approval of the operation and maintenance manual prepared by the Contractor.

2) Lots 4 and 5

The Consultant shall perform his duties during the contract implementation period of the contracts to be executed by SONEDE and the Contractors (Lots 4 and 5). In this context, the Consultant shall;

- a) Act as SONEDE's Representative to execute construction supervision and contract administration services in accordance with the power and authority delegated by SONEDE;
- b) Provide assistance to SONEDE concerning variations and claims which are to be ordered/issued at the initiative of SONEDE;
- c) Advise SONEDE on resolution of any dispute with the Contractor;
- d) Issue instructions and notices, and suggest approvals as appropriate;
- e) Provide recommendation to SONEDE for acceptance of the Contractors' safety plan, performance security, advance payment security and required insurances;
- f) Evaluate compliance of all inputs such as equipment, working staff, and materials provided by the Contractors;
- g) Provide commencement order to the Contractors;
- h) Check and approve the Contractors' method of work, including site organization, program of performance, quality assurance system, safety plan, method statement of safety and environmental monitoring plan so that the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract are to be duly respected;
- i) Regularly monitor physical and financial progress, and take appropriate action to expedite progress if necessary, so that the time for completion set forth in the contract will be duly respected by the Contractor;
- j) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue

any necessary clarifications or instructions. Issue further drawings and give instructions to the Contractors for any works which may not be sufficiently detailed in the contract documents, if any;

- k) Review and approve the Contractor's working drawings, shop drawings and drawings for temporary works;
- l) Liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated;
- m) Carry out field inspections on the Contractor's setting out of the works in relation to original points, lines and levels of reference specified in the contract;
- n) Organize, as necessary, management meetings with the Contractors to review the arrangements for future work. Prepare and deliver minutes of such meetings to SONEDE and the Contractors;
- o) Supervise the works so that all the contractual requirements are met by the Contractors, including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. Confirm that an accident prevention officer proposed by the Contractors is duly assigned at the project site. Require the contractors to take appropriate remedies if any questions are recognized regarding the safety measures;
- p) Supervise field tests, sampling and laboratory test to be carried out by the Contractors;
- q) Inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the specifications;
- r) Survey and measure the work output performed by the Contractors verify statements submitted by the Contractor and issue payment certificates such as interim payment certificates and final payment certificate as specified in the contract;
- s) Coordinate the works among different contractors employed for the Project;
- t) Modify the designs, technical specifications and drawings, relevant calculations and cost estimates as may be necessary in accordance with the actual site conditions, and issue variation orders (including necessary actions in relation to the works performed by other contractors working for other projects, if any);
- u) Carry out timely reporting to SONEDE for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied;
- v) Inspect, verify and approve or disapprove claims issued by the parties to the contract (i.e. SONEDE and Contractors) in accordance with the civil works contract;
- w) Perform the inspection of the works, including Test on Completion, and to issue certificates such as the Taking-Over Certificate, Performance Certificate as specified in the contract;
- x) Supervise the preliminary operation conducted by the Contractors, check and approve the initial operation report issued by the Contractors and issue the completion report as specified in the Contract;
- y) Supervise commissioning and carry out tests during the commissioning, if applicable;
- z) Provide periodic and/or continuous inspection services during defects notification period and if any defects are noted, instruct the Contractors to rectify;
- aa) Prepare as-build drawings for the parts of the works constructed in accordance with the design provided by SONEDE;
- ab) Check and certify as-built drawings for the parts of the works designed by the Contractors, if

any; and

ac) Prepare an operation and maintenance manual for the works constructed in the Project.

3) Lot 7

The Consultant shall perform the following tasks throughout the execution of the Contract between SONEDE and STEG (Lot 7). In this regard, the Consultant shall;

- a) Monitor the progress of works carried out by STEG; and
- b) Coordination with STEG.

Safety measures

The Consultants shall;

- a) Review the safety plans submitted by the contractors securing the safety during the construction. (Refer to Paragraph (2), Section 4.02 Scope of the Project and of the Consulting Services of the Guidelines for the Employment of Consultants under Japanese ODA Loans, March 2009), and require them to submit the revision if necessary; and
- b) Confirm that an accident prevention officer proposed by the contractor is duly assigned at the project site during the supervision of the construction works and ensure the work is carried out according to the safety plan as well as the safety measures prescribed in the Program. If Consultants recognize any questions regarding the safety measures in general including the ones mentioned above, the Consultants shall requires the contractors to make appropriate improvements.

Facilitation of implementation of Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP)

The Consultant shall;

- a) Update EMP as appropriate;
- b) Assist SONEDE in dissemination and explanation of additionally confirmed and identified environmental issues to public including holding public consultations;
- c) During the preparation of bidding documents, clearly identify environmental responsibilities as explained in the EIA and EMP;
- d) Assist SONEDE to review the Construction Contractor's Environmental Program to be prepared by the contractor in accordance with EMP, relevant plans and JICA Environmental Guidelines and to make recommendations to SONEDE regarding any necessary amendments for its approval;
- e) Assist SONEDE to implement the measures identified in the EMP;
- f) Monitor the effectiveness of EMP and negative impacts on environment caused by the construction works and provide technical advice, including a feasible solution, so that SONEDE can improve situation when necessary;
- g) Assist SONEDE in monitoring the compliance with conditions stated in the Environmental Permit Certification (EPC) and the requirements under EMP and JICA Environmental Guidelines;
- h) Assist SONEDE in the capacity building of SONEDE staff on environmental management



through on-the-job training on environmental assessment techniques, mitigation measure planning, supervision and monitoring, and reporting.

#### Technology transfer

The Consultant shall carry out the technology transfer as an important aspect in design and supervision works. The Consultant shall provide the opportunity to SONEDE officers and staffs to be involved in the working team of the Consultant during the designing, contract administration and supervision works for their capacity building wherever possible. If requested by SONEDE, the Consultant shall brief and demonstrate the survey and design procedure, the construction supervision and contract management process and procedures. The consultant shall assist SONEDE and its staff to build their capacity as a part of on the job training under the Project.

#### **4. Man-Month Schedule and Expected Time Schedule**

The consultants will be engaged over 87 months as a consulting service period. The team shall comprise Foreign and Local Professional Staff with man-month presented below.

No	Position	Man-Month			
		DD <sup>1)</sup>	TA <sup>2)</sup>	CS <sup>3)</sup>	Total
<b>Foreign Professional Staff</b>					
1	Team Leader	12.0	10.0	35.5	57.5
2	Desalination Plant Process Engineer	9.0	4.0	18.5	31.5
3	Civil Engineer	12.0	4.0	33.0	49.0
4	Pipeline Engineer	12.0	1.5	28.0	41.5
5	Mechanical Engineer (Desalination Plant)	4.0	3.5	9.5	17.0
6	Mechanical Engineer (Transmission Pumps)	3.0	2.0	7.0	12.0
7	Electrical Engineer	3.0	3.5	9.0	15.5
8	Instrumentation Engineer	3.0	2.0	9.0	14.0
9	Structural Engineer	6.0	0.0	2.0	8.0
10	Contract Specialist	5.0	5.5	5.0	15.5
11	Quantity Surveyor	4.0	0.0	34.0	38.0
12	Specification specialist	4.0	0.0	0.0	4.0
<b>Subtotal: Foreign Professional Staff</b>		<b>77.0</b>	<b>36.0</b>	<b>190.5</b>	<b>303.5</b>
<b>Local Professional Staff</b>					
1	Deputy Team Leader	13.0	14.0	36.5	63.5
2	Environmental Specialist	2.0	1.0	38.0	41.0
3	Geo-technical Engineer	3.0	0.0	3.0	6.0
<b>Lot 1. Construction of Sea Water Desalination Plant</b>					
4	Resident Engineer 1 / Civil Engineer (1) for Lot 1	9.0	0.0	48.0	57.0
5	Civil Engineer (2) for Lot 1	0.0	0.0	29.0	29.0
6	Mechanical Engineer for Lot 1, 6	4.0	0.0	9.0	13.0
7	Electrical Engineer for Lot 1, 6, 7	3.0	0.0	9.0	12.0
8	Structural Engineer for Lot 1, 4, 5, 6	4.0	0.0	3.0	7.0

9	Architect	4.0	0.0	4.0	8.0
10	Building Utilities Engineer	3.0	0.0	4.0	7.0
11	Quantity Surveyor for Lot 1	0.0	0.0	33.0	33.0
Lot 2 & 3 Procurement of Pipes / Valves and Other Equipment Lot 4. Construction of Pipeline					
12	Resident Engineer 2 / Civil Engineer (1) for Lot 2, 3, 4	12.0	0.0	33.0	45.0
13	Civil Engineer (2) for Lot 2, 3, 4	10.0	0.0	32.0	42.0
14	Procurement Specialist	4.0	0.0	0.0	4.0
15	Quantity Surveyor for Lot 2, 3, 4	0.0	0.0	32.0	32.0
Lot 5 & 6. Reservoirs/Pump Facility Construction					
16	Resident Engineer 3 / Civil Engineer (1) for Lot 5, 6	8.0	0.0	33.0	41.0
17	Civil Engineer (2) for Lot 5, 6	6.0	0.0	30.0	36.0
18	Quantity Surveyor for Lot 5, 6	0.0	0.0	30.0	30.0
<b>Subtotal: Local Professional Staff</b>		85.0	15.0	406.5	506.5
Local support staff					
1	Assistant Engineer	13.0	14.0	69.0	96.0
2	Inspector/Surveyor	0.0	0.0	156.0	156.0
3	CAD Operator	60.0	0.0	36.0	96.0
4	Interpreter/Translator	29.0	16.0	86.0	131.0
5	Office Manager	13.0	14.0	36.0	63.0
6	Accountant	12.0	0.0	36.0	48.0
7	Clerk	12.0	0.0	36.0	48.0
8	Office Boy	13.0	14.0	36.0	63.0
<b>Subtotal: Local Support Staff</b>		152.0	58.0	491.0	701.0
<b>Total Technical and support staff</b>		314.0	109.0	1088.0	1511.0

- 1) Conceptual Design and Detailed Design
- 2) Tendering Assistance
- 3) Construction Supervision

All technical and support staff required for the mission must be provided by the Consultant and includes the following profiles.

It is envisaged that the Consultant will provide adequate Technical and Administrative supporting staff. It is the Consultant's responsibility to select the optimum team and to propose the professionals which are believed to the best meets and needs of SONEDE without exceeding total man-month proposed for each category.

## 5. Basic professional requirements of key expert

The key expert requirements with qualification and experience for each position are given in the table below.

- (1) Foreign Professional Staff

Position	Minimum requirement
Team Leader	<p><u>Education</u> Master Degree in civil engineering or construction management, or a national-registered professional engineer in his country.</p> <p><u>Professional Experience</u> At least 20 years professional experience including 18 years at least in infrastructure. Experience of team leader for 5 or more projects in the field of water and sewerage, each of which is amounted at a project cost of more than 30 million US dollars.</p>
Desalination Plant Process Engineer	<p><u>Education</u> Master Degree in civil engineering or a national-registered professional engineer in his country.</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years as a plant process engineer. Experience on desalination plant for 2 or more projects.</p>
Civil Engineer	<p><u>Education</u> Master Degree in civil engineering or a national-registered professional engineer in his country.</p> <p><u>Professional Experience</u> At least 10 years' professional experience including at least 8 years in development. Experience during construction period for 3 or more projects in the field of water and sewerage.</p>
Pipeline Engineer	<p><u>Education</u> E Bachelor's Degree in civil engineering or mechanical engineering..</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years in the field of pipeline design/construction. Experience during construction period of pipeline for 3 or more projects with a total period of 3 or more years.</p>
Mechanical Engineer (Desalination Plant)	<p><u>Education</u> Bachelor's Degree in civil engineering or mechanical engineering.</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years of experience in the design and/or construction of water treatment plants. Experience on desalination plant for 2 or more projects.</p>
Mechanical Engineer (Transmission Pumps)	<p><u>Education</u> Bachelor's Degree in mechanical engineering.</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years in the design and/or construction of pumping stations. Experience during construction period of pumping station for 3 or more projects with a total period of 3 or more years.</p>
Electrical Engineer	<p><u>Education</u> Bachelor's Degree in electrical engineering.</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years in the design and/or construction of desalination plants and pumping station. Experience during construction period of desalination plant and pumping station for 5 or more projects with a total period of 3 or more years.</p>
Instrumentation Engineer	<p><u>Education</u> Bachelor's Degree in electrical engineering.</p> <p><u>Professional Experience</u></p>

	At least 10 years professional experience including at least 8 years in instrumentation engineering for any plant. Experience in the operation of desalination plant on 3 or more years.
Structural Engineer	<u>Education</u> Master Degree in civil engineering or a national-registered professional engineer in his country. <u>Professional Experience</u> At least 10 years professional experience including at least 8 years in the design and/or construction of desalination plant and pumping stations. Experience during construction period of desalination plants and pumping stations for 5 or more projects with a total period of 3 or more years.
Contract Specialist	<u>Education</u> Bachelor's Degree in engineering or related field. <u>Professional Experience</u> At least 10 years professional experience including at least 8 years as a contract specialist for any type of plants or infrastructure development. At least 5 or more projects as a contract specialist.
Quantity Surveyor	<u>Education</u> Bachelor's Degree in engineering or related field. <u>Professional Experience</u> At least 10 years professional experience including at least 8 years as a quantity surveyor or relevant specialist for any type of plants or infrastructure development. At least 5 or more projects for surveying quantity.
Specification Specialist	<u>Education</u> Bachelor's Degree in engineering or related field. <u>Professional Experience</u> Preferably more than 10 years, at least 8 years' professional experience as a specification specialist or engineer for any type of plants or infrastructure development. At least 5 or more projects as a specification specialist.

(2) Local Professional Staff

Position	Minimum requirement
(responsible for all lots)	
Deputy Team Leader	<u>Education</u> Master Degree in civil engineering or construction management, or a national-registered professional engineer in his country. <u>Professional Experience</u> At least 20 years professional experience of infrastructure development. Experience of team leader for 5 or more projects in the field of water and sewerage.
Environmental Specialist	<u>Education</u> Master Degree in civil/environmental engineering or related fields, or a national-registered professional engineer in his country. <u>Professional Experience</u> At least 20 years professional experience of environmental infrastructure development. Experience during construction period for 5 or more projects in the field of water and sewerage.
Geo-technical Engineer	<u>Education</u> Bachelor's Degree in civil engineering or related fields. <u>Professional Experience</u>

	At least 10 years professional experience of geo-technical engineering.
(responsible for Lot 1. Desalination Plant) (Additional responsibility to Mechanical Engineer for Lot 6, and Electrical Engineer for Lots 6 and 7)	
Resident Engineer 1 / Civil Engineer (1) for Lot 1	<u>Education</u> Master Degree in civil engineering or a national-registered professional engineer in his country. <u>Professional Experience</u> At least 15 years professional experience of civil engineering work. Preferably 5 years experience in the field of water supply during construction period.
Civil Engineer (2) for Lot 1	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 10 years professional experience of civil engineering work. Preferably 5 years experience in the field of water supply during construction period.
Mechanical Engineer for Lot 1, 6	<u>Education</u> Bachelor's Degree in mechanical engineering. <u>Professional Experience</u> At least 5 years professional experience related to design and/or construction of pumping stations. Experience during construction period of pumping station for 3 or more projects with a total period of 3 or more years.
Electrical Engineer for Lot 1, 6, 7	<u>Education</u> Bachelor's Degree in electrical engineering. <u>Professional Experience</u> At least 5 years professional experience related to the design and/or construction of desalination plants and pumping stations. Experience during construction period of desalination plant and pumping station for 3 or more projects with a total period of 3 or more years.
Structural Engineer	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 10 years' professional experience related to design and/or construction of desalination plants and pumping stations. Experience during construction period of desalination plant and pumping station for 5 or more projects with a total period of 3 or more years.
Architect	<u>Education</u> Bachelor's Degree in architecture. <u>Professional Experience</u> At least 10 years' professional experience related to the construction design of any plant and pumping station. Preferably experience on 5 or more projects with a total period of 3 or more years.
Building Utilities Engineer	<u>Education</u> Bachelor's Degree in any engineering or related fields. <u>Professional Experience</u> At least 5 years' professional experience related to design and construction management of building utilities at any plant and pumping station. Preferably experience on 3 or more projects with a total period of 3 or more years.
Quantity Surveyor for Lot 1	<u>Education</u> Bachelor's Degree in civil engineering or relevant. <u>Professional Experience</u>

	At least 10 years' professional experience of infrastructure development. Experience during construction period for 5 or more projects in the field of water and sewerage.
(responsible for Lot 4. Pipeline Installation, and Lots 2 and 3)	
Resident Engineer 2 / Civil Engineer (1) for Lot 2, 3, 4	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 15 years' professional experience of civil engineering work. Preferably 5 years' experience in the field of water supply during construction period.
Civil Engineer (2) for Lot 2, 3, 4	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 10 years' professional experience of civil engineering work. Preferably 5 years' experience in the field of water supply during construction period.
Procurement Expert	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 10 years' professional experience including 8 years at least in civil engineering work. Preferably 5 years' experience in the field of water supply during construction period.
Quantity Surveyor for Lot 2, 3, 4	<u>Education</u> Bachelor's Degree in civil engineering or relevant. <u>Professional Experience</u> At least 10 years' professional experience of infrastructure development. Experience during construction period for 5 or more projects in the field of water and sewerage.
(responsible for Lots 5 and 6. Reservoirs / Pump Facility Construction)	
Resident Engineer 3 / Civil Engineer (1) for Lot 5, 6	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 15 years' professional experience of civil engineering work. Preferably 5 years' experience in the field of water supply during construction period.
Civil Engineer (2) for Lot 5, 6	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 10 years' professional experience of civil engineering work. Preferably 5 years' experience in the field of water supply during construction period.
Quantity Surveyor for Lot 5, 6	<u>Education</u> Bachelor's Degree in civil engineering or relevant. <u>Professional Experience</u> At least 10 years professional experience of infrastructure development. Experience during construction period for 5 or more projects in the field of water and sewerage.

## 6. Task of Professional Staff

### (1) Foreign Professional Staff

## 1) Team Leader

- a) Shall take the overall responsibility, and shall represent the project Consultant's Team in all matters relating to the performance of services, coordinating with all other consultant's staff to deliver excellent product during the stipulated time schedule;
- b) Shall oversee, and supervise the Consultant's services;
- c) Assume direct responsibility for day-to-day consulting services including day-to-day management of all consultants' staff and co-ordination among and with them;
- d) Review existing studies / documents and other resources available and formulate the best implementation approach including programmatic project schedule;
- e) Develop and implement quality assurance program;
- f) Recommend contract payments;
- g) Review, analyze and make recommendations to SONEDE concerning variations and claims which are to be ordered/issued by SONEDE;
- h) Recommend to issue the commencement order to the Contractors;
- i) Evaluation of time extension claims and make recommendations;
- j) Provide recommendation to SONEDE for acceptance of the Contractor Performance security, advance payment security and required insurances;
- k) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and recommend issuing any necessary clarifications or instructions;
- l) Review, verify and further detail the design of the works, recommend to approve the Contractors' working drawings and if necessary, issue further drawings and/or give instructions to the Contractor;
- m) Review and recommend to approve the proposals submitted by the Contractors;
- n) Make necessary design changes and amendments at site;
- o) Provide guidance for unforeseen matters;
- p) Progress reporting;
- q) Prepare institutional arrangement and training program for O&M;
- r) Certify all the drawings, BOQs, cost estimates and specifications;
- s) Ensure the safety conditions at work sites;
- t) Supervise commissioning, and carry out testing during commissioning;
- u) Review O&M manuals; and
- v) Develop a course module on project management including project coordination, contract administration, over-all supervision over the implementation of the project and conduct 3 days Project Management Training Course for SONEDE's project staff.

## 2) Desalination Plant Process Engineer

- a) Prepare conceptual design of the desalination process including the flow chart with levels;
- b) Prepare the specifications of the desalination process;
- c) Evaluate the proposed unit of the desalination plant;
- d) Supervise the installation procedure of the unit; and
- e) Assist the commissioning and guarantee test of the desalination plant, and evaluate the performance of the plant's equipment.

### 3) Civil Engineer

- a) Direct civil engineers assigned as national professional staff for any his/her responsible work;
- b) Prepare specifications of civil engineering works;
- c) Evaluate the proposed desalination plant, pipe installation, and reservoir work;
- d) Supervise civil work for desalination plant, pipe installation, and reservoir work;
- e) Assess the applicability of products proposed by the contractors;
- f) Attend the test operation of mechanical and electrical equipment;
- g) Evaluate the performance of the water transmission system; and
- h) Support training on O&M on facility related to facilities and civil engineering works.

### 4) Pipeline Engineer

- a) Direct the civil engineer for Lot 1 assigned as national professional staff regarding his/her responsible work;
- b) Prepare specifications related to pipes;
- c) Evaluate the proposed pipe materials and installation;
- d) Supervise pipeline installation work;
- e) Assess the applicability of products proposed by the contractors;
- f) Attend the test and commencement of pipeline operation; and
- g) Support training on O&M on pipeline facility.

### 5) Mechanical Engineer (Desalination Plant)

- a) Direct the mechanical engineer assigned as national professional staff for any his/her responsible work;
- b) Assist Team Leader for preparing O&M manuals on desalination plant;
- c) Prepare specifications of mechanical equipment and works;
- d) Evaluate the proposed mechanical facilities at the desalination plant;
- e) Assess the applicability of product proposed by the contractors related to desalination plant;
- f) Supervise the installation works of mechanical equipment for desalination plant;
- g) Attend the commissioning and guarantee test of mechanical equipment for desalination plant; and
- h) Support training on O&M on mechanical equipment for desalination plant.

### 6) Mechanical Engineer (Transmission Pumps)

- a) Direct the mechanical engineer assigned as national professional staff for any his/her responsible work;
- b) Assist Team Leader for preparing O&M manuals on transmission pumps;
- c) Prepare specifications of mechanical equipment and works;
- d) Evaluate the proposed mechanical facilities of transmission pumps;
- e) Assess the applicability of product proposed by the contractors related to transmission pumps;
- f) Supervise the installation works of mechanical equipment for transmission pumps;
- g) Attend the test operation of mechanical equipment for transmission pumps; and
- h) Support training on O&M on mechanical equipment for transmission pumps.



7) Electrical Engineer

- a) Direct the electrical engineer assigned as national professional staff for any his/her responsible work;
- b) Assist Team Leader for preparing O&M manuals related to electrical equipment;
- c) Prepare a specification of electrical equipment and works;
- d) Evaluate the proposed electrical equipment at desalination plant and of transmission pumps;
- e) Assess the applicability of product proposed by the contractors;
- f) Supervise the installation works of electrical equipment;
- g) Attend the test operation and guarantee test of electrical equipment; and
- h) Support training on O&M on electrical equipment.

8) Instrumentation Engineer

- a) Conduct conceptual design on instrumentation system of desalination plant and transmission pumps;
- b) Prepare technical specifications of instrumentation systems;
- c) Evaluate the proposed instrumentation system for the desalination plant and transmission pumps; and
- d) Attend the commissioning and guarantee test of the desalination plant and transmission pumps, and evaluate the performance of the instrumentation system.

9) Structural Engineer

- a) Conduct structural design on desalination plant and transmission pumps for a contract of design - build construction;
- b) Prepare specifications related to the structural design;
- c) Identify the necessary soil investigations required for the structural design and administer that work; and
- d) Provide necessary advice to implement all construction works in order to comply with the design code.

10) Specification / Contract Specialist

- a) Prepare bidding documents including prequalification documents;
- b) Evaluate the bidders' proposals;
- c) Carry out activities described in and/or that follows from the activities described in the scope of work related to procurement and contract management; and those assigned by Team Leader;
- d) Review Guidelines for preparation of Bid documents, and contracts for all lots of the project; and
- e) Proactively anticipate and carry out any other activity as per the scope of work.

11) Cost Estimation / Quantity Surveyor

- a) Estimate cost for each lot;
- b) Evaluate financial proposals;
- c) Review BOQs according to Guideline of SONEDE;
- d) Prepare work standards and material / day work schedules;
- e) Evaluate relevant documents for contractors' claims and variations; and

- f) Evaluate and report to Team Leader on the progress of the works and periodical payment requested by Contractors.

**(2) Local Professional Staff  
(responsible for all lots)**

1) Deputy Team Leader

- a) Support Team Leader;
- b) Inform data/report from national professional staff to Team Leader; and
- c) Supervise all National Professional Staff.

2) Environmental Specialist

- a) Review conceptual design based on the result of EIA;
- b) Update Environmental Management Plan (EMP) if necessary;
- c) Assist SONEDE to implement the measure identified in EMP;
- d) Monitor the works on the view point of the EMP and negative impacts on environment caused by the construction works;
- e) Assist SONEDE in monitoring the compliance with the requirements under the EMP, JICA Environmental Guidelines and the Tunisian Regulations; and
- f) Prepare report for environment and social environment and submit it to SONEDE.

3) Geo-technical Engineer

- a) Prepare a document for geo-technical conditions on site based on the existing data;
- b) Evaluate the foundation design of facilities; and
- c) Review geo-technical conditions on site, and foundation design of facilities.

**(responsible for Lot 1. Desalination Plant)**

4) Resident Engineer 1 / Civil Engineer (1) for Lot 1

- a) Conduct conceptual design of civil works for sea water desalination plant;
- b) Supervise civil work for Intake/Discharge at the level of the Desalination Plant;
- c) Assess the applicability of product proposed by the contractors;
- d) Attend the test operation, commissioning and guarantee test of desalination plant;
- e) Evaluate the performance of the desalination system; and
- f) Support training on O&M of facilities related to civil engineering work.

5) Civil Engineer (2) for Lot 1

- a) Conduct conceptual design of civil works for intake and brine effluent pipe;
- b) Assess the applicability of product proposed by the contractors;
- c) Attend the test operation of the desalination system;
- d) Evaluate the performance of the desalination system; and
- e) Support training for O&M on facility related to civil engineering work.

6) Mechanical Engineer (for Lots 1, 6)

- a) Conduct conceptual design of mechanical engineering works for Lot 1 and 6;
- b) Direct the mechanical engineer assigned as national professional staff for any his/her responsible work;
- c) Assist Team Leader for preparing O&M manuals on mechanical equipment;
- d) Assess the applicability of products proposed by the contractors related to mechanical equipment;
- e) Supervise the installation works of mechanical equipment;
- f) Attend the test operation of mechanical equipment;
- g) Evaluate the performance of the mechanical equipment; and
- h) Support training for O&M on mechanical equipment.

7) Electrical Engineer (for Lots 1, 6, 7)

- a) Conduct conceptual design of mechanical engineering works for Lot 1, 6 and 7;
- b) Assist Team Leader for preparing O&M manuals related to electrical equipment;
- c) Assess the applicability of product proposed by the contractors;
- d) Supervise the installation works of electrical equipment;
- e) Attend the test operation of electrical equipment;
- f) Evaluate the performance of the electrical equipment; and
- g) Support training for O&M on electrical equipment.

8) Structural Engineer

- a) Conduct conceptual design of structural engineering works;
- b) Identify the necessary soil investigations required for the structural design and administer that work; and
- c) Provide necessary advice to implement all construction works in order to comply with the design code.

9) Architect

- a) Conduct conceptual design of architect works;
- b) Review building design in consideration of energy efficiency and operational environment;
- c) Supervise building construction ensuring safety condition; and
- d) Evaluate and approve the applicability of the building.

10) Building Utilities Engineer

- a) Conduct conceptual design of building utilities in consideration of energy efficiency and operational environment;
- b) Supervise building utility construction ensuring safety condition; and
- c) Attend the building utility tests, and report to Team Leader.

11) Quantity Surveyor for Lot 1

- a) Review BOQs according to Guideline of SONEDE;
- b) Preparation of work standards and material / day work schedules;

- c) Evaluate relevant documents for contractors' claims and variations; and
- d) Evaluate and report to Team Leader for the progress of the works and periodical payment requested by Contractors.

**(responsible for Lots 2, 3, 4. Pipeline Installation)**

12) Resident Engineer 2 / Civil Engineer (1) for Lots 2, 3, 4

- a) Prepare a design for civil engineering works of Lot 4;
- b) Calculate the work volume and estimate costs;
- c) Assess the applicability of product proposed by the contractors;
- d) Attend the test operation of the transmission system;
- e) Evaluate the performance of the transmission system; and
- f) Support training on O&M on facility related to civil engineering work.

13) Civil Engineer (2) for Lots 2, 3, 4

- a) Prepare a design for civil engineering works of Lot 4;
- b) Calculate the work volume and estimate costs;
- c) Assess the applicability of product proposed by the contractors;
- d) Attend the test operation of the transmission system;
- e) Evaluate the performance of the transmission system; and
- f) Support training on O&M on facility related to civil engineering work.

14) Procurement Specialist for Lots 2, 3, 4

- a) Prepare detailed design, specifications and BoQ for transmission pipelines.

15) Quantity Surveyor for Lots 2, 3, 4

- a) Review BOQs according to SONEDE's guidelines;
- b) Preparation of work standards and material / day work schedules;
- c) Evaluate relevant documents for contractors' claims and variations; and
- d) Evaluate and report to Team Leader for the progress of the works and periodical payment requested by Contractors.

**(responsible for Lots 5, 6. Reservoirs / Pump Facility Construction)**

16) Resident Engineer 3 / Civil Engineer (1) for Lots 5, 6

- a) Conduct conceptual design of civil works for Lot 6;
- b) Supervise civil work for reservoir and pump facilities;
- c) Assess the applicability of product proposed by the contractors;
- d) Attend the test operation of mechanical and electrical equipment;
- e) Evaluate the performance of the transmission system; and
- f) Support training for O&M on facility related to civil engineering work,

17) Civil Engineer (2) for Lots 5, 6

- a) Conduct conceptual design of civil works for Lot 6;

- b) Assess the applicability of product proposed by the contractors;
- c) Attend the test operation of mechanical and electrical equipment;
- d) Evaluate the performance of the transmission system; and
- e) Support training on O&M on facility related to civil engineering work.

18) Quantity Surveyor for Lots 5, 6

- a) Review BOQs according to Guideline of SONEDE;
- b) Preparation of work standards and material / day work schedules;
- c) Evaluate relevant documents for contractors' claims and variations; and
- d) Evaluate and report to Team Leader for the progress of the works and periodical payment requested by Contractors.

## 7. Reporting

Within the scope of consulting services, the Consultant shall prepare and submit reports and documents to SONEDE as shown below. The Consultant shall provide electronic copy of each of these reports.

*(Example)*

Category	Type of Report	Timing	No. of Copies
Consultancy Services	Inception Report	Within 1 month after commencement of the services	10
	Monthly Progress Report	Every month	10
	Quarterly Progress Report	Every quarter	10
	Project Completion Report (for submission to JICA)	At the end of Services	10
Tender Assistance	Bid Evaluation Report (Technical & Price)	After evaluation of Bids	15 each
Construction Supervision	Quality Control Report	Every month	10
	Completion Report (and As-built Drawings, if any)	At the end of the Project	5
Training	Training Plan	At appropriate timing in accordance with the Inception Report	10
	Training Execution and Evaluation Report	Within 1 month after training	10
Environment and Social Safeguard	Environmental Monitoring Report	Every quarter	10
	Land Acquisition Monitoring Report	Every month	10
	Environmental and Social Safeguard Evaluation Report	At the end of the Project	20
Other Report	Technical Report	As required or upon request	As required

Contents to be included in each report are as follows:

*(Monthly Progress report and Inception report)*

- a) Monthly Progress Report: Describes briefly and concisely all activities and progress for the

previous month by the 10th day of each month. Problems encountered or anticipated will be clearly stated, together with actions to be taken or recommendations on remedial measures for correction. Also indicates the work to be performed during the coming month.

- b) Inception Report: To be submitted within 1 month after the commencement of the services, presenting the methodologies, schedule, organization, etc.

*(Detailed Design/ Conceptual Design)*

- a) Project Definition Report (20 copies), to be submitted in the 3<sup>rd</sup> month after the commencement of services, presenting the design criteria and standards.
- b) Draft Detailed Design/ Conceptual Design Report (20 copies), to be submitted in the 8<sup>th</sup> month for Lot 1 and the 11<sup>th</sup> month for Lots 2 to 6, after the commencement of services, presenting detailed engineering design and conceptual design.
- c) Cost Estimate Report (20 copies), to be submitted in the 9<sup>th</sup> month for Lot 1, and the 12<sup>th</sup> month for Lots 2 to 6, after the commencement of services, presenting detailed cost estimates.
- d) Final Detailed Design/ Conceptual Design Report (20 copies), to be submitted in the 9<sup>th</sup> month for Lot 1, and the 11<sup>th</sup> month for Lots 2 to 6 after the commencement of services, compiling all the items carried out during services.
- e) Final Design Report (20 copies), to be submitted in the 12th month after the commencement of services, finalizing detailed design, cost estimate, bid plan, bid evaluation criteria, technical evaluation criteria and bidding documents through the incorporation of comments on the Draft Design Report, provided by SONEDE
- f) Pre-qualification Document Report (20 copies), to be submitted in the 3<sup>rd</sup> month after the commencement of the services, presenting the pre-qualification documents for Lot 1 and its evaluation criteria.
- g) Pre-qualification Evaluation Report (15 copies) to present the results of the evaluation and to select the qualified applicants.
- h) Bidding Document Report (20 copies), to be submitted in the 9<sup>th</sup> month for Lot 1, and the 12<sup>th</sup> month for Lots 2 to 6, after the commencement of the services, presenting the bidding documents and bid evaluation criteria.

*(Tender Assistance)*

- a) Bid Evaluation Report (Technical) (15 copies) to present the results of technical evaluation and to recommend the qualified applicants.
- b) Bid Evaluation Report (Financial) (15 copies) to present the results of the tenders to select the qualified applicants with lowest evaluated price bid .

*(Assistance in Environment Monitoring)*

- a) Environmental Monitoring Report (10 copies), to be submitted at every three (3) months after the commencement of the services, presenting the environmental impacts and implementation of environmental mitigation measures during and [at the completion of / after] the construction stage. Environmental monitoring forms attached as Appendix # will be filled and attached to the Report.
- b) Land Acquisition Report (10 copies), to be submitted at every month during land acquisition period.
- c) Environmental and Social Safeguard Evaluation Report (20 copies), to be submitted by the end of the consulting services, presenting the EMP and EMoP prepared.

*(Construction Supervision)*

- a) Quarterly Progress Report (15 copies), to be submitted at every three (3) months during construction, presenting the progress status of the Project.
- b) Operation and Maintenance Manual (20 copies) containing technical procedures for the appropriate operation and maintenance of all project facilities.
- c) Construction Completion Report (20 copies), to be submitted within three (3) month after completion of construction, which comprises a full size of as-built drawings for all the structures and facilities completed, and the final details of the construction completed together with all data, records, material tests results, field books.

## **10.3-2 コンサルティングサービスの TOR (案) (実施設計を含まない) Tendering Assistance & Construction Supervision**

### **Sfax Sea Water Desalination Plant Construction Project in the Republic of Tunisia Terms of Reference on Consulting Service**

#### **1. Background**

One half of Tunisia belongs to semi-dry climate. The annual average of the rainfall is about a little less than 500mm. Consequently, groundwater contributes to about 40% of water intake. The water supply system in Tunisia has been developed in accordance with an economic growth of 4% in average during the last 15 years. The service area of water supply covers 97.8% in total, i.e. 100% of urban areas, 93.4% of rural areas (SONEDE, 2012). In Tunisia, the Ministry of Agriculture defines the water sector policy. Water supply in rural area is based on the communal faucet method and is operated by the Ministry of Agriculture. SONEDE (Société Nationale d'Exploitation et de Distribution des Eaux) is responsible for water supply in urban areas and in some rural areas using individual supply systems including water supply for domestic use and development, and the maintenance of conveyance and transmission systems.

Greater Sfax is the second largest city in Tunisia with an approximate population of about 621000. Water supply volume amounts to about 190,000m<sup>3</sup>/day for SONEDE's coverage area with a served population of about 810,000 in 2012. Because of rapid increase in population at 1.37% per annum over the last ten years, it is projected that serious water shortage will happen in 2018, and the development of a new water source is requested. Greater Sfax currently relies on groundwater in the central-western region for its water supply. However, it is projected that water supply from the region will be decreased in order to spare groundwater resources in the central-western regions and the increase of demand in the region. In order to cope with this situation, it is requested to develop water resource only for Sfax governorate and to provide related infrastructure. SONEDE studied the construction of a sea water desalination plant in Sfax in the feasibility study for water supply in south regions conducted in 2005.

SONEDE also prepared the Strategic Plan in 2013 to enhance water supply capacity and to improve water quality by 2030. In the plan, the Sfax Desalination Plant Construction Project was planned. In this framework, the preparatory survey was conducted with JICA funding. Based on the survey, this project was formulated.

#### **2. Objectives of Consulting Services**

The objective of the consulting services is to provide assistance to the bidding process and construction supervision ensuring the design and the construction quality and fairness, and achieving the efficient project implementation.

#### **3. Scope of Consulting Services**

The scope of consulting services on Sfax Sea Water Desalination Plant Construction Project in the



Republic of Tunisia cover tender assistance, and management of construction services for 7 lots and eight (08) contracts. Each lot is explained below followed by a description of services to provide:

(1) Project Component

The project consists of 7 lots. Each lot is explained as follows:

i) Lot 1: Construction of the Seawater Desalination Plant

(a) Sea Water Desalination Plant

- a1) Land Acquisition: Approximately 20ha
- a2) Desalination Method: Reverse Osmosis Membrane Method (RO)
- a3) Treated Water: 100,000m<sup>3</sup>/d
- a4) RO Units: 25,000m<sup>3</sup>/day × 4 units
- a5) Transmission Pump Facility 100,000m<sup>3</sup>/d
- a6) Required Electricity: Approximately 20MVA

(b) Sea Water Intake Pipe

- b1) Intake Volume: 222,200m<sup>3</sup>/d (capable of flowing 444,400 m<sup>3</sup>/d for Phase 2)
- b2) Pipe Material: HDPE
- b3) φ2000mm x 2 (HDPE), L=3.6km (Buried Pipe: 3.2 km offshore, and 0.4 km onshore))
- b4) Transmission pump facility 100,000 m<sup>3</sup>/d
- b5) Submerged Water Intake Tower 2 units

(c) Brine Effluent Pipe

- c1) Effluent Volume: 122,000m<sup>3</sup>/d (capable of flowing 244,000 m<sup>3</sup>/d for Phase 2)
- c2) Pipe Material: HDPE
- c3) φ1800mm, L=4.4km (Buried Pipe: 4.0 km offshore, 0.4 km onshore))
- c4) Submerged Water Effluent Tower 1 unit

ii) Lot 2: Procurement of Pipes

(a) Procurement of Pipe for Transmission to be installed for Lot 4

- a1) Pipe Material: Ductile Cast Iron Pipe
- a2) φ1400mm: L=26.1km (Desalination Plant - PK11 Reservoir)
- a3) φ1000mm: L=6.1km (PK10 Reservoir)
- a4) φ800mm: L=4.8km (PK10 Reservoir—PK14 Reservoir)
- a5) φ800mm: L=9.4km (PK14 Reservoir—Sidi Salah EH Reservoir)
- a6) φ400mm: L=2.9km (PK11 Reservoir—Bou Merra Reservoir)

This lot can be subject of two contracts (sub-lot 2.1 and sub-lot 2.2)

iii) Lot 3: Procurement of Valves and Other Equipment

(a) Procurement of valves and other equipment to be installed for Lot 4

iv) Lot 4: Installation of Pipeline including valves and other equipment

- (a) Construction of Transmission Pipeline and valves whose materials are procured through Lot 2 and Lot 3.
- (b) Construction of One-Way Surge Tanks or other anti-water-hammer equipment
  - b1) Desalination Plant Site - PK11 Reservoir  
Tank dimension: diameter 10m x height 15m, site: 20m x 30m x 2 locations
- v) Lot 5: Construction of Reservoir
  - (a) Construction of Reservoir
    - a1) Capacity of 5,000m<sup>3</sup> existing precinct of Bou Merra Reservoir
  - (b) Construction of Receiving and Mixing Chambers
    - b1) PK11: 9.0 W x 15.0 L x 5.0 D
    - b2) Bou Merra: 4.0W x 3.0L x 5.0D
    - b3) PK10: 7.0W x 10.0L x 5.0D
    - b4) PK14: 7.0W x 7.0L x 5.0D
    - b5) Sidi Salah EH: 6.0W x 5.0L x 5.0D

(internal dimension; W: width, L: length, D: water depth; unit: m)
- vi) Lot 6: Construction of Pumping Stations
  - (a) Pumping Station
    - a1) Relay Pumping Station: 3 (in PK10, PK11, and PK14 Reservoir Sites)
- vii) Lot 7: Power Transmission Construction and Power Connection Works (Executed by STEG)
  - (a) Construction of electrical power supply facility necessary for the Sea Water Desalination Plant
    - a1) power line
    - a2) power line tower
    - a3) facility for transformation of energy
    - a4) other necessary facilities
  - (b) Electrical power connection work (pumping stations of Pk10, Pk11 and Pk14)
  - (c) Assistance for the installation of Sea Water Desalination Plant electrical facility
- (2) Detailed description of the consulting services

Tendering Assistance

The Consultants shall provide assistance to the tendering procedure listed below in accordance with the JICA Guidelines for Procurement under Japanese ODA Loans (April 2012). The Consultant shall assist SONEDE to;

- a) Evaluate bids in accordance with the criteria set forth in the bidding documents. In such evaluation, the Consultant shall carefully confirm that bidders' submissions in their technical proposal including, but not limited to, site organization, mobilization schedule, method statement, construction schedule, safety plan, and EMP have been prepared in harmony each other and will meet such requirements set forth in applicable laws and regulations, specifications and other parts of the bidding documents;

- b) Prepare bid evaluation reports for approval of the competent committee;
- c) Assist SONEDE in contract negotiation by preparing agenda and facilitating negotiations including preparation of minutes of negotiation meeting; and
- d) Prepare a draft and final contract agreement.

Construction Supervision

1) Lots 1 and 6

The Consultant shall perform his duties during the implementation period of the contracts to be executed by SONEDE and the Contractors (Lots 1 and 6). In this context, the Consultant shall;

- a) Act as SONEDE's Representative to execute construction supervision and contract administration services in accordance with the power and authority to be delegated by SONEDE;
- b) Provide assistance to SONEDE concerning variations and claims which are to be ordered/issued at the initiative of SONEDE;
- c) Advise SONEDE on resolution of any dispute with the Contractors;
- d) Issue instructions, approvals and notices as appropriate;
- e) Provide recommendations to SONEDE for acceptance of the Contractor's performance security, advance payment security and required insurances;
- f) Assess adequacy of all inputs such as materials, labor and equipment provided by the Contractors;
- g) Check and approve the Contractors' method of work, including site organization, program of performance, quality assurance system, safety plan and environmental monitoring plan so that the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract are to be duly respected;
- h) Monitor as appropriate physical and financial progress, and take appropriate action to expedite progress if necessary, so that the time for completion set forth in the contract will be duly respected;
- i) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions;
- j) Review and approve the Contractor's design for the works to be constructed, working drawings, shop drawings and drawings for temporary works;
- k) Liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated;
- l) Carry out field inspections on the Contractor's setting out of the works in relation to original points, lines and levels of reference specified in the contract;
- m) Organize, as necessary, management meetings with the Contractors to review the arrangements for future work. Prepare and deliver minutes of such meetings to SONEDE and the Contractors;
- n) Supervise the works so that all the contractual requirements are met by the Contractor, including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. Confirm that an accident prevention officer proposed by the Contractor is duly assigned at the project site;

- o) Supervise field tests, sampling and laboratory test to be carried out by the Contractors;
- p) Inspect construction methods, equipment to be used, workmanship at the site, and attend factory inspection and manufacturing tests in accordance with SONEDE's Requirements;
- q) Verify payment applications submitted by the Contractor;
- r) Coordinate the works among different contractors employed for the Project;
- s) Modify the Employer's Requirements as may be necessary in accordance with the actual site conditions, and issue variation orders with the approval of SONEDE (including necessary actions in relation to the works performed by other contractors working for other projects or other facility operators, if any);
- t) Carry out timely reporting to SONEDE for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied;
- u) Inspect, verify and comment on claims issued by the Contractors;
- v) Supervise Pre-commissioning carried out by the Contractors, check and comment on the Contractor's Pre-commissioning report, and suggest the Completion Certificate as specified in the contract;
- w) Supervise Commissioning and Guarantee Test carried out by the Contractors, check and comment on the Contractor's report on the Commissioning and Guarantee Test, and suggest the Operational Acceptance Certificate as specified in the Contract;
- x) Provide periodic inspection services during defect liability period and if any defects are noted, instruct first SONEDE and second the Contractors to rectify;
- y) Check and suggest the approval of as-built drawings prepared by the Contractors; and
- z) Check and suggest the approval of the operation and maintenance manual prepared by the Contractor.

2) Lots 4 and 5

The Consultant shall perform his duties during the contract implementation period of the contracts to be executed by SONEDE and the Contractors (Lots 4 and 5). In this context, the Consultant shall;

- a) Act as SONEDE's Representative to execute construction supervision and contract administration services in accordance with the power and authority delegated by SONEDE;
- b) Provide assistance to SONEDE concerning variations and claims which are to be ordered/issued at the initiative of SONEDE;
- c) Advise SONEDE on resolution of any dispute with the Contractor;
- d) Issue instructions and notices, and suggest approvals as appropriate;
- e) Provide recommendation to SONEDE for acceptance of the Contractors' safety plan, performance security, advance payment security and required insurances;
- f) Evaluate compliance of all inputs such as equipment, working staff, and materials provided by the Contractors;
- g) Provide commencement order to the Contractors;
- h) Check and approve the Contractors' method of work, including site organization, program of performance, quality assurance system, safety plan, method statement of safety and environmental monitoring plan so that the requirements set forth in the applicable laws and

- regulations, the specifications or other parts of the contract are to be duly respected;
- i) Regularly monitor physical and financial progress, and take appropriate action to expedite progress if necessary, so that the time for completion set forth in the contract will be duly respected by the Contractor;
  - j) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions. Issue further drawings and give instructions to the Contractors for any works which may not be sufficiently detailed in the contract documents, if any;
  - k) Review and approve the Contractor's working drawings, shop drawings and drawings for temporary works;
  - l) Liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated;
  - m) Carry out field inspections on the Contractor's setting out of the works in relation to original points, lines and levels of reference specified in the contract;
  - n) Organize, as necessary, management meetings with the Contractors to review the arrangements for future work. Prepare and deliver minutes of such meetings to SONEDE and the Contractors;
  - o) Supervise the works so that all the contractual requirements are met by the Contractors, including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. Confirm that an accident prevention officer proposed by the Contractors is duly assigned at the project site. Require the contractors to take appropriate remedies if any questions are recognized regarding the safety measures;
  - p) Supervise field tests, sampling and laboratory test to be carried out by the Contractors;
  - q) Inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the specifications;
  - r) Survey and measure the work output performed by the Contractors verify statements submitted by the Contractor and issue payment certificates such as interim payment certificates and final payment certificate as specified in the contract;
  - s) Coordinate the works among different contractors employed for the Project;
  - t) Modify the designs, technical specifications and drawings, relevant calculations and cost estimates as may be necessary in accordance with the actual site conditions, and issue variation orders (including necessary actions in relation to the works performed by other contractors working for other projects, if any);
  - u) Carry out timely reporting to SONEDE for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied;
  - v) Inspect, verify and approve or disapprove claims issued by the parties to the contract (i.e. SONEDE and Contractors) in accordance with the civil works contract;
  - w) Perform the inspection of the works, including Test on Completion, and to issue certificates such as the Taking-Over Certificate, Performance Certificate as specified in the contract;
  - x) Supervise the preliminary operation conducted by the Contractors, check and approve the initial operation report issued by the Contractors and issue the completion report as specified in the Contract;
  - y) Supervise commissioning and carry out tests during the commissioning, if applicable;

- z) Provide periodic and/or continuous inspection services during defects notification period and if any defects are noted, instruct the Contractors to rectify;
  - aa) Prepare as-built drawings for the parts of the works constructed in accordance with the design provided by SONEDE;
  - ab) Check and certify as-built drawings for the parts of the works designed by the Contractors, if any; and
  - ac) Prepare an operation and maintenance manual for the works constructed in the Project.
- 3) Lot 7
- The Consultant shall perform the following tasks throughout the execution of the Contract between SONEDE and STEG (Lot 7). In this regard, the Consultant shall;
- a) Monitor the progress of works carried out by STEG; and
  - b) Coordination with STEG.

Safety measures

The Consultants shall;

- a) Review the safety plans submitted by the contractors securing the safety during the construction. (Refer to Paragraph (2), Section 4.02 Scope of the Project and of the Consulting Services of the Guidelines for the Employment of Consultants under Japanese ODA Loans, March 2009), and require them to submit the revision if necessary; and
- b) Confirm that an accident prevention officer proposed by the contractor is duly assigned at the project site during the supervision of the construction works and ensure the work is carried out according to the safety plan as well as the safety measures prescribed in the Program. If Consultants recognize any questions regarding the safety measures in general including the ones mentioned above, the Consultants shall requires the contractors to make appropriate improvements.

Facilitation of implementation of Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP)

The Consultant shall;

- a) Update EMP as appropriate;
- b) Assist SONEDE in dissemination and explanation of additionally confirmed and identified environmental issues to public including holding public consultations;
- c) During the preparation of bidding documents, clearly identify environmental responsibilities as explained in the EIA and EMP;
- d) Assist SONEDE to review the Construction Contractor's Environmental Program to be prepared by the contractor in accordance with EMP, relevant plans and JICA Environmental Guidelines and to make recommendations to SONEDE regarding any necessary amendments for its approval;
- e) Assist SONEDE to implement the measures identified in the EMP;
- f) Monitor the effectiveness of EMP and negative impacts on environment caused by the construction works and provide technical advice, including a feasible solution, so that

SONEDE can improve situation when necessary;

- g) Assist SONEDE in monitoring the compliance with conditions stated in the Environmental Permit Certification (EPC) and the requirements under EMP and JICA Environmental Guidelines;
- h) Assist SONEDE in the capacity building of SONEDE staff on environmental management through on-the-job training on environmental assessment techniques, mitigation measure planning, supervision and monitoring, and reporting.

#### Technology transfer

The Consultant shall carry out the technology transfer as an important aspect in design and supervision works. The Consultant shall provide the opportunity to SONEDE officers and staffs to be involved in the working team of the Consultant during the designing, contract administration and supervision works for their capacity building wherever possible. If requested by SONEDE, the Consultant shall brief and demonstrate the survey and design procedure, the construction supervision and contract management process and procedures. The consultant shall assist SONEDE and its staff to build their capacity as a part of on the job training under the Project.

#### **4. Man-Month Schedule and Expected Time Schedule**

The consultants will be engaged over 74 months as a consulting service period. The team shall comprise Foreign and Local Professional Staff with man-month presented below.

No	Position	Man-Month			
		DD <sup>1)</sup>	TA <sup>2)</sup>	CS <sup>3)</sup>	Total
<b>Foreign Professional Staff</b>					
1	Team Leader	-	10.0	35.5	45.5
2	Desalination Plant Process Engineer	-	4.0	18.5	22.5
3	Civil Engineer	-	4.0	33.0	37.0
4	Pipeline Engineer	-	1.5	28.0	29.5
5	Mechanical Engineer (Desalination Plant)	-	3.5	9.5	13.0
6	Mechanical Engineer (Transmission Pumps)	-	2.0	7.0	9.0
7	Electrical Engineer	-	3.5	9.0	12.5
8	Instrumentation Engineer	-	2.0	9.0	11.0
9	Structural Engineer	-	0.0	2.0	2.0
10	Contract Specialist	-	5.5	5.0	10.5
11	Quantity Surveyor	-	0.0	34.0	34.0
<b>Subtotal: Foreign Professional Staff</b>		-	36.0	190.5	226.5
<b>Local Professional Staff</b>					
1	Deputy Team Leader	-	14.0	36.5	50.5
2	Environmental Specialist	-	1.0	38.0	39.0
3	Geo-technical Engineer	-	0.0	3.0	3.0
Lot 1. Construction of Sea Water Desalination Plant					
4	Resident Engineer 1 / Civil Engineer (1) for Lot 1	-	0.0	48.0	48.0

5	Civil Engineer (2) for Lot 1	-	0.0	29.0	29.0
6	Mechanical Engineer for Lot 1, 6	-	0.0	9.0	9.0
7	Electrical Engineer for Lot 1, 6, 7	-	0.0	9.0	9.0
8	Structural Engineer for Lot 1, 4, 5, 6	-	0.0	3.0	3.0
9	Architect	-	0.0	4.0	4.0
10	Building Utilities Engineer	-	0.0	4.0	4.0
11	Quantity Surveyor for Lot 1	-	0.0	33.0	33.0
Lot 2 & 3 Procurement of Pipes / Valves and Other Equipment Lot 4. Construction of Pipeline					
12	Resident Engineer 2 / Civil Engineer (1) for Lot 2, 3, 4	-	0.0	33.0	33.0
13	Civil Engineer (2) for Lot 2, 3, 4	-	0.0	32.0	32.0
14	Quantity Surveyor for Lot 2, 3, 4	-	0.0	32.0	32.0
Lot 5 & 6. Reservoirs/Pump Facility Construction					
15	Resident Engineer 3 / Civil Engineer (1) for Lot 5, 6	-	0.0	33.0	33.0
16	Civil Engineer (2) for Lot 5, 6	-	0.0	30.0	30.0
17	Quantity Surveyor for Lot 5, 6	-	0.0	30.0	30.0
<b>Subtotal: Local Professional Staff</b>		-	15.0	406.5	421.5
Local support staff					
1	Assistant Engineer	-	14.0	69.0	83.0
2	Inspector/Surveyor	-	0.0	156.0	156.0
3	CAD Operator	-	0.0	36.0	36.0
4	Interpreter/Translator	-	13.0	69.0	82.0
5	Office Manager	-	14.0	36.0	50.0
6	Accountant	-	0.0	36.0	36.0
7	Clerk	-	0.0	36.0	36.0
8	Office Boy	-	14.0	36.0	50.0
<b>Subtotal: Local Support Staff</b>		-	55.0	474.0	529.0
<b>Total Technical and support staff</b>		-	106.0	1071.0	1177.0

- 1) Conceptual Design/Detailed Design: to be conducted by SONEDE
- 2) Tendering Assistance
- 3) Construction Supervision

All technical and support staff required for the mission must be provided by the Consultant and includes the following profiles.

It is envisaged that the Consultant will provide adequate Technical and Administrative supporting staff. It is the Consultant's responsibility to select the optimum team and to propose the professionals which are believed to the best meets and needs of SONEDE without exceeding total man-month proposed for each category.

## 5. Basic professional requirements of key expert

The key expert requirements with qualification and experience for each position are given in the table



below.

(1) Foreign Professional Staff

Position	Minimum requirement
Team Leader	<p><u>Education</u> Master Degree in civil engineering or construction management, or a national-registered professional engineer in his country.</p> <p><u>Professional Experience</u> At least 20 years professional experience including 18 years at least in infrastructure. Experience of team leader for 5 or more projects in the field of water and sewerage, each of which is amounted at a project cost of more than 30 million US dollars.</p>
Desalination Plant Process Engineer	<p><u>Education</u> Master Degree in civil engineering or a national-registered professional engineer in his country.</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years as a plant process engineer. Experience on desalination plant for 2 or more projects.</p>
Civil Engineer	<p><u>Education</u> Master Degree in civil engineering or a national-registered professional engineer in his country.</p> <p><u>Professional Experience</u> At least 10 years' professional experience including at least 8 years in development. Experience during construction period for 3 or more projects in the field of water and sewerage.</p>
Pipeline Engineer	<p><u>Education</u> E Bachelor's Degree in civil engineering or mechanical engineering..</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years in the field of pipeline design/construction. Experience during construction period of pipeline for 3 or more projects with a total period of 3 or more years.</p>
Mechanical Engineer (Desalination Plant)	<p><u>Education</u> Bachelor's Degree in civil engineering or mechanical engineering.</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years of experience in the design and/or construction of water treatment plants. Experience of desalination plant for 2 or more projects.</p>
Mechanical Engineer (Transmission Pumps)	<p><u>Education</u> Bachelor's Degree in mechanical engineering.</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years in the design and/or construction of pumping stations. Experience during construction period of pumping station for 3 or more projects with a total period of 3 or more years.</p>
Electrical Engineer	<p><u>Education</u> Bachelor's Degree in electrical engineering.</p> <p><u>Professional Experience</u> At least 10 years professional experience including at least 8 years in the design and/or construction of desalination plants and pumping station. Experience during construction period of desalination plant and pumping</p>

	station for 5 or more projects with a total period of 3 or more years.
Instrumentation Engineer	<u>Education</u> Bachelor's Degree in electrical engineering. <u>Professional Experience</u> At least 10 years professional experience including at least 8 years in instrumentation engineering for any plant. Experience in the operation of desalination plant on 3 or more years.
Structural Engineer	<u>Education</u> Master Degree in civil engineering or a national-registered professional engineer in his country. <u>Professional Experience</u> At least 10 years professional experience including at least 8 years in the design and/or construction of desalination plant and pumping stations. Experience during construction period of desalination plants and pumping stations for 5 or more projects with a total period of 3 or more years.
Contract Specialist	<u>Education</u> Bachelor's Degree in engineering or related field. <u>Professional Experience</u> At least 10 years professional experience including at least 8 years as a contract specialist for any type of plants or infrastructure development. At least 5 or more projects as a contract specialist.
Quantity Surveyor	<u>Education</u> Bachelor's Degree in engineering or related field. <u>Professional Experience</u> At least 10 years professional experience including at least 8 years as a quantity surveyor or relevant specialist for any type of plants or infrastructure development. At least 5 or more projects for surveying quantity.

(2) Local Professional Staff

Position	Minimum requirement
(responsible for all lots)	
Deputy Team Leader	<u>Education</u> Master Degree in civil engineering or construction management, or a national-registered professional engineer in his country. <u>Professional Experience</u> At least 20 years professional experience of infrastructure development. Experience of team leader for 5 or more projects in the field of water and sewerage.
Environmental Specialist	<u>Education</u> Master Degree in civil/environmental engineering or related fields, or a national-registered professional engineer in his country. <u>Professional Experience</u> At least 20 years professional experience of environmental infrastructure development. Experience during construction period for 5 or more projects in the field of water and sewerage.
Geo-technical Engineer	<u>Education</u> Bachelor's Degree in civil engineering or related fields. <u>Professional Experience</u> At least 10 years professional experience of geo-technical engineering.
(responsible for Lot 1. Desalination Plant)	

(Additional responsibility to Mechanical Engineer for Lot 6, and Electrical Engineer for Lots 6 and 7)	
Resident Engineer 1 / Civil Engineer (1) for Lot 1	<p><u>Education</u> Master Degree in civil engineering or a national-registered professional engineer in his country.</p> <p><u>Professional Experience</u> At least 15 years professional experience of civil engineering work. Preferably 5 years experience in the field of water supply during construction period.</p>
Civil Engineer (2) for Lot 1	<p><u>Education</u> Bachelor's Degree in civil engineering.</p> <p><u>Professional Experience</u> At least 10 years professional experience of civil engineering work. Preferably 5 years experience in the field of water supply during construction period.</p>
Mechanical Engineer for Lot 1, 6	<p><u>Education</u> Bachelor's Degree in mechanical engineering.</p> <p><u>Professional Experience</u> At least 5 years professional experience related to design and/or construction of pumping stations. Experience during construction period of pumping station for 3 or more projects with a total period of 3 or more years.</p>
Electrical Engineer for Lot 1, 6, 7	<p><u>Education</u> Bachelor's Degree in electrical engineering.</p> <p><u>Professional Experience</u> At least 5 years professional experience related to the design and/or construction of desalination plants and pumping stations. Experience during construction period of desalination plant and pumping station for 3 or more projects with a total period of 3 or more years.</p>
Structural Engineer	<p><u>Education</u> Bachelor's Degree in civil engineering.</p> <p><u>Professional Experience</u> At least 10 years' professional experience related to design and/or construction of desalination plants and pumping stations. Experience during construction period of desalination plant and pumping station for 5 or more projects with a total period of 3 or more years.</p>
Architect	<p><u>Education</u> Bachelor's Degree in architecture.</p> <p><u>Professional Experience</u> At least 10 years' professional experience related to the construction design of any plant and pumping station. Preferably experience on 5 or more projects with a total period of 3 or more years.</p>
Building Utilities Engineer	<p><u>Education</u> Bachelor's Degree in any engineering or related fields.</p> <p><u>Professional Experience</u> At least 5 years' professional experience related to design and construction management of building utilities at any plant and pumping station. Preferably experience on 3 or more projects with a total period of 3 or more years.</p>
Quantity Surveyor for Lot 1	<p><u>Education</u> Bachelor's Degree in civil engineering or relevant.</p> <p><u>Professional Experience</u> At least 10 years' professional experience of infrastructure development. Experience during construction period for 5 or more projects in the field of</p>

	water and sewerage.
(responsible for Lot 4. Pipeline Installation, and Lots 2 and 3)	
Resident Engineer 2 / Civil Engineer (1) for Lot 2, 3, 4	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 15 years' professional experience of civil engineering work. Preferably 5 years' experience in the field of water supply during construction period.
Civil Engineer (2) for Lot 2, 3, 4	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 10 years' professional experience of civil engineering work. Preferably 5 years' experience in the field of water supply during construction period.
Quantity Surveyor for Lot 2, 3, 4	<u>Education</u> Bachelor's Degree in civil engineering or relevant. <u>Professional Experience</u> At least 10 years' professional experience of infrastructure development. Experience during construction period for 5 or more projects in the field of water and sewerage.
(responsible for Lots 5 and 6. Reservoirs / Pump Facility Construction)	
Resident Engineer 3 / Civil Engineer (1) for Lot 5, 6	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 15 years' professional experience of civil engineering work. Preferably 5 years' experience in the field of water supply during construction period.
Civil Engineer (2) for Lot 5, 6	<u>Education</u> Bachelor's Degree in civil engineering. <u>Professional Experience</u> At least 10 years' professional experience of civil engineering work. Preferably 5 years' experience in the field of water supply during construction period.
Quantity Surveyor for Lot 5, 6	<u>Education</u> Bachelor's Degree in civil engineering or relevant. <u>Professional Experience</u> At least 10 years professional experience of infrastructure development. Experience during construction period for 5 or more projects in the field of water and sewerage.

## 6. Task of Professional Staff

### (1) Foreign Professional Staff

#### 1) Team Leader

- a) Shall take the overall responsibility, and shall represent the project Consultant's Team in all matters relating to the performance of services, coordinating with all other consultant's staff to deliver excellent product during the stipulated time schedule;
- b) Shall oversee, and supervise the Consultant's services;
- c) Assume direct responsibility for day-to-day consulting services including day-to-day

management of all consultants' staff and co-ordination among and with them;

- d) Review existing studies / documents and other resources available and formulate the best implementation approach including programmatic project schedule;
- e) Develop and implement quality assurance program;
- f) Recommend contract payments;
- g) Review, analyze and make recommendations to SONEDE concerning variations and claims which are to be ordered/issued by SONEDE;
- h) Recommend to issue the commencement order to the Contractors;
- i) Evaluation of time extension claims and make recommendations;
- j) Provide recommendation to SONEDE for acceptance of the Contractor Performance security, advance payment security and required insurances;
- k) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and recommend issuing any necessary clarifications or instructions;
- l) Review, verify and further detail the design of the works, recommend to approve the Contractors' working drawings and if necessary, issue further drawings and/or give instructions to the Contractor;
- m) Review and recommend to approve the proposals submitted by the Contractors;
- n) Make necessary design changes and amendments at site;
- o) Provide guidance for unforeseen matters;
- p) Progress reporting;
- q) Prepare institutional arrangement and training program for O&M;
- r) Certify all the drawings, BOQs, cost estimates and specifications;
- s) Ensure the safety conditions at work sites;
- t) Supervise commissioning, and carry out testing during commissioning;
- u) Review O&M manuals; and
- v) Develop a course module on project management including project coordination, contract administration, over-all supervision over the implementation of the project and conduct 3 days Project Management Training Course for SONEDE's project staff.

## 2) Desalination Plant Process Engineer

- a) Evaluate the proposed unit of the desalination plant;
- b) Supervise the installation procedure of the unit; and
- c) Assist the commissioning and guarantee test of the desalination plant, and evaluate the performance of the plant's equipment.

## 3) Civil Engineer

- a) Direct civil engineers assigned as national professional staff for any his/her responsible work;
- b) Evaluate the proposed desalination plant, pipe installation, and reservoir work;
- c) Supervise civil work for desalination plant, pipe installation, and reservoir work;
- d) Assess the applicability of products proposed by the contractors;
- e) Attend the test operation of mechanical and electrical equipment;
- f) Evaluate the performance of the water transmission system; and
- g) Support training on O&M on facility related to facilities and civil engineering works.

#### 4) Pipeline Engineer

- a) Direct the civil engineer for Lot 1 assigned as national professional staff regarding his/her responsible work;
- b) Evaluate the proposed pipe materials and installation;
- c) Supervise pipeline installation work;
- d) Assess the applicability of products proposed by the contractors;
- e) Attend the test and commencement of pipeline operation; and
- f) Support training on O&M on pipeline facility.

#### 5) Mechanical Engineer (Desalination Plant)

- a) Direct the mechanical engineer assigned as national professional staff for any his/her responsible work;
- b) Assist Team Leader for preparing O&M manuals on desalination plant;
- c) Evaluate the proposed mechanical facilities at the desalination plant;
- d) Assess the applicability of product proposed by the contractors related to desalination plant;
- e) Supervise the installation works of mechanical equipment for desalination plant;
- f) Attend the commissioning and guarantee test of mechanical equipment for desalination plant; and
- g) Support training on O&M on mechanical equipment for desalination plant.

#### 6) Mechanical Engineer (Transmission Pumps)

- a) Direct the mechanical engineer assigned as national professional staff for any his/her responsible work;
- b) Assist Team Leader for preparing O&M manuals on transmission pumps;
- c) Evaluate the proposed mechanical facilities of transmission pumps;
- d) Assess the applicability of product proposed by the contractors related to transmission pumps;
- e) Supervise the installation works of mechanical equipment for transmission pumps;
- f) Attend the test operation of mechanical equipment for transmission pumps; and
- g) Support training on O&M on mechanical equipment for transmission pumps.

#### 7) Electrical Engineer

- a) Direct the electrical engineer assigned as national professional staff for any his/her responsible work;
- b) Assist Team Leader for preparing O&M manuals related to electrical equipment;
- c) Evaluate the proposed electrical equipment at desalination plant and of transmission pumps;
- d) Assess the applicability of product proposed by the contractors;
- e) Supervise the installation works of electrical equipment;
- f) Attend the test operation and guarantee test of electrical equipment; and
- g) Support training on O&M on electrical equipment.

#### 8) Instrumentation Engineer

- a) Evaluate the proposed instrumentation system for the desalination plant and transmission pumps;

and

- b) Attend the commissioning and guarantee test of the desalination plant and transmission pumps, and evaluate the performance of the instrumentation system.

9) Structural Engineer

- a) Provide necessary advice to implement all construction works in order to comply with the design code.

10) Contract Specialist

- a) Evaluate the bidders' proposals;
- b) Carry out activities described in and/or that follows from the activities described in the scope of work related to procurement and contract management; and those assigned by Team Leader; and
- c) Proactively anticipate and carry out any other activity as per the scope of work.

11) Cost Estimation / Quantity Surveyor

- a) Evaluate financial proposals;
- b) Review BOQs according to Guideline of SONEDE;
- c) Prepare work standards and material / day work schedules;
- d) Evaluate relevant documents for contractors' claims and variations; and
- e) Evaluate and report to Team Leader on the progress of the works and periodical payment requested by Contractors.

**(2) Local Professional Staff**

**(responsible for all lots)**

1) Deputy Team Leader

- a) Support Team Leader;
- b) Inform data/report from national professional staff to Team Leader; and
- c) Supervise all National Professional Staff.

2) Environmental Specialist

- a) Review conception design based on the result of EIA;
- b) Update Environmental Management Plan (EMP) if necessary;
- c) Assist SONEDE to implement the measure identified in EMP;
- d) Monitor the works on the view point of the EMP and negative impacts on environment caused by the construction works;
- e) Assist SONEDE in monitoring the compliance with the requirements under the EMP, JICA Environmental Guidelines and the Tunisian Regulations; and
- f) Prepare report for environment and social environment and submit it to SONEDE.

3) Geo-technical Engineer

- a) Evaluate the foundation design of facilities; and
- b) Review geo-technical conditions on site, and foundation design of facilities.

**(responsible for Lot 1. Desalination Plant)**

4) Resident Engineer 1 / Civil Engineer (1) for Lot 1

- a) Supervise civil work for Intake/Discharge at the level of the Desalination Plant;
- b) Assess the applicability of product proposed by the contractors;
- c) Attend the test operation, commissioning and guarantee test of desalination plant;
- d) Evaluate the performance of the desalination system; and
- e) Support training on O&M of facilities related to civil engineering work.

5) Civil Engineer (2) for Lot 1

- a) Assess the applicability of product proposed by the contractors;
- b) Attend the test operation of the desalination system;
- c) Evaluate the performance of the desalination system; and
- d) Support training for O&M on facility related to civil engineering work.

6) Mechanical Engineer (for Lot 1, 6)

- a) Direct the mechanical engineer assigned as national professional staff for any his/her responsible work;
- b) Assist Team Leader for preparing O&M manuals on mechanical equipment;
- c) Assess the applicability of products proposed by the contractors related to mechanical equipment;
- d) Supervise the installation works of mechanical equipment;
- e) Attend the test operation of mechanical equipment;
- f) Evaluate the performance of the mechanical equipment; and
- g) Support training for O&M on mechanical equipment.

7) Electrical Engineer (for Lot 1, 6, 7)

- a) Assist Team Leader for preparing O&M manuals related to electrical equipment;
- b) Assess the applicability of product proposed by the contractors;
- c) Supervise the installation works of electrical equipment;
- d) Attend the test operation of electrical equipment;
- e) Evaluate the performance of the electrical equipment; and
- f) Support training for O&M on electrical equipment.

8) Structural Engineer

- a) Identify the necessary soil investigations required for the structural design and administer that work; and
- b) Provide necessary advice to implement all construction works in order to comply with the design code.

9) Architect

- a) Review building design in consideration of energy efficiency and operational environment;



- b) Supervise building construction ensuring safety condition; and
- c) Evaluate and approve the applicability of the building.

10) Building Utilities Engineer

- a) Supervise building utility construction ensuring safety condition; and
- b) Attend the building utility tests, and report to Team Leader.

11) Quantity Surveyor for Lot 1

- a) Evaluate relevant documents for contractors' claims and variations; and
- b) Evaluate and report to Team Leader for the progress of the works and periodical payment requested by Contractors.

**(responsible for Lots 2, 3, 4. Pipeline Installation)**

12) Resident Engineer 2 / Civil Engineer (1) for Lot 2, 3, 4

- a) Assess the applicability of product proposed by the contractors;
- b) Attend the test operation of the transmission system;
- c) Evaluate the performance of the transmission system; and
- d) Support training on O&M on facility related to civil engineering work.

13) Civil Engineer (2) for Lot 2, 3, 4

- a) Assess the applicability of product proposed by the contractors;
- b) Attend the test operation of the transmission system;
- c) Evaluate the performance of the transmission system; and
- d) Support training on O&M on facility related to civil engineering work.

14) Quantity Surveyor for Lot 2, 3, 4

- a) Evaluate relevant documents for contractors' claims and variations; and
- b) Evaluate and report to Team Leader for the progress of the works and periodical payment requested by Contractors.

**(responsible for Lot 5, 6. Reservoirs / Pump Facility Construction)**

15) Resident Engineer 3 / Civil Engineer (1) for Lot 5, 6

- a) Supervise civil work for reservoir and pump facilities;
- b) Assess the applicability of product proposed by the contractors;
- c) Attend the test operation of mechanical and electrical equipment;
- d) Evaluate the performance of the transmission system; and
- e) Support training for O&M on facility related to civil engineering work,

16) Civil Engineer (2) for Lot 5, 6

- a) Assess the applicability of product proposed by the contractors;
- b) Attend the test operation of mechanical and electrical equipment;
- c) Evaluate the performance of the transmission system; and

- d) Support training on O&M on facility related to civil engineering work.

17) Quantity Surveyor for Lot 5, 6

- a) Evaluate relevant documents for contractors' claims and variations; and  
 b) Evaluate and report to Team Leader for the progress of the works and periodical payment requested by Contractors.

**7. Reporting**

Within the scope of consulting services, the Consultant shall prepare and submit reports and documents to SONEDE as shown below. The Consultant shall provide electronic copy of each of these reports.

*(Example)*

Category	Type of Report	Timing	No. of Copies
Consultancy Services	Inception Report	Within 1 month after commencement of the services	10
	Monthly Progress Report	Every month	10
	Quarterly Progress Report	Every quarter	10
	Project Completion Report (for submission to JICA)	At the end of Services	10
Tender Assistance	Bid Evaluation Report (Technical & Price)	After evaluation of Bids	15 each
Construction Supervision	Quality Control Report	Every month	10
	Completion Report (and As-built Drawings, if any)	At the end of the Project	5
Training	Training Plan	At appropriate timing in accordance with the Inception Report	10
	Training Execution and Evaluation Report	Within 1 month after training	10
Environment and Social Safeguard	Environmental Monitoring Report	Every quarter	10
	Land Acquisition Monitoring Report	Every month	10
	Environmental and Social Safeguard Evaluation Report	At the end of the Project	20
Other Report	Technical Report	As required or upon request	As required

Contents to be included in each report are as follows:

*(Monthly Progress report and Inception report)*

- a) Monthly Progress Report: Describes briefly and concisely all activities and progress for the previous month by the 10th day of each month. Problems encountered or anticipated will be clearly stated, together with actions to be taken or recommendations on remedial measures for

correction. Also indicates the work to be performed during the coming month.

- b) Inception Report: To be submitted within 1 month after the commencement of the services, presenting the methodologies, schedule, organization, etc.

*(Tender Assistance)*

- a) Bid Evaluation Report (technical) (15 copies) to present the results of technical evaluation and to recommend the qualified applicants.
- b) Bid Evaluation Report (price) (15 copies) to present the results of the tender to select the qualified applicants with lowest evaluated price bid.

*(Assistance in Environment Monitoring)*

- a) Environmental Monitoring Report (10 copies), to be submitted at every three (3) months after the commencement of the services, presenting the environmental impacts and implementation of environmental mitigation measures during and [at the completion of / after] the construction stage. Environmental monitoring forms attached as Appendix # will be filled and attached to the Report.
- b) Land Acquisition Monitoring Report (10 copies), to be submitted at every month during land acquisition period.
- c) Environmental and Social Safeguard Evaluation Report (20 copies), to be submitted by the end of the consulting services, presenting the EMP and EMoP prepared.

*(Construction Supervision)*

- a) Quarterly Progress Report (15 copies), to be submitted at every three (3) months during construction, presenting the progress status of the Project.
- b) Operation and Maintenance Manual (20 copies) containing technical procedures for the appropriate operation and maintenance of all project facilities.
- c) Construction Completion Report (20 copies), to be submitted within three (3) month after completion of construction, which comprises a full size of as-built drawings for all the structures and facilities completed, and the final details of the construction completed together with all data, records, material tests results, field books.

## 10.5-1 積算資料

T1	総計	-----	10.5-2
L1	海水淡水化施設	-----	10.5-5
L2-1	送水管管材調達（管径 1400 mm及び 1000 mm）	-----	10.5-34
L2-2	送水管管材調達（管径 1000 mm未満）	-----	10.5-35
L3	バルブその他機器調達	-----	10.5-36
L4	送水管建設	-----	10.5-37
L5	配水池建設	-----	10.5-44
L6	ポンプ場建設	-----	10.5-51
L7	電力引き込み線建設	-----	10.5-71

**T1 Cost Estimates Total**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Lot 1 Desalination Plant (ICB)</b>	including intake/discharge									
Intake & Discharge Facilities		Ls	1		4,420,968,000		74,815,000	8,986,179,000	147,266,000	L1-1
Desalination Plant		Ls	1		8,785,042,000		84,084,000	13,915,848,000	228,054,000	L1-2
Transmission Pump Facility		Ls	1		738,940,000		5,327,000	1,063,994,000	17,437,000	L1-3
Guarantee Test		Ls	1		218,003,000		26,916,000	1,860,417,000	30,489,000	L1-4
<b>Lot 1 Sub-Total</b>					<b>14,162,953,000</b>		<b>191,142,000</b>	<b>25,826,438,000</b>	<b>423,245,000</b>	
	FCP:LCP				55%		45%			
<b>Lot 2-1 Pipe Procurement (ICB) 1000 &amp; 1400</b>										
Transmission Pipe Material		Ls	1		2,189,020,000		3,986,000	2,432,246,000	39,860,000	L2-1
<b>Lot 2-1 Sub-Total</b>					<b>2,189,020,000</b>		<b>3,986,000</b>	<b>2,432,245,720</b>	<b>39,860,000</b>	
	FCP:LCP				90%		10%			
<b>Lot 2-2 Pipe Procurement (ICB) less than 1000</b>										
Transmission Pipe Material		Ls	1		435,557,000		793,000	483,945,860	7,931,000	L2-2
<b>Lot 2-2 Sub-Total</b>					<b>435,557,000</b>		<b>793,000</b>	<b>483,945,860</b>	<b>7,931,000</b>	
	FCP:LCP				90%		10%			
<b>Lot 2 Sub-Total</b>					<b>2,624,577,000</b>		<b>4,779,000</b>	<b>2,916,191,580</b>	<b>47,791,000</b>	
	FCP:LCP				90%		10%			

**T1 Cost Estimates Total**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Lot 3 Valve and Other Equipment Procurement (LCB)</b>										
Valve Material		Ls	1		510,792,000		930,000	567,540,600	9,301,000	L3
<b>Lot 3 Sub-Total</b>					<b>510,792,000</b>		<b>930,000</b>	<b>567,540,600</b>	<b>9,301,000</b>	
	FCP:LCP				90%		10%			
<b>Lot 4 Pipe Installation (ICB)</b>										
Transmission Pipe Installatiom		Ls	1		0		40,270,000	2,457,275,400	40,270,000	L4-1
Valve Installation		Ls	1		0		615,000	37,527,300	615,000	L4-2
Pipe Jacking		Ls	1		0		4,369,000	266,596,380	4,369,000	L4-3
Surge Tank	10mx15mx2	Ls	1		40,430,000		2,262,000	178,457,240	2,925,000	L4-4
<b>Lot 4 Sub-Total</b>					<b>40,430,000</b>		<b>47,516,000</b>	<b>2,939,856,320</b>	<b>48,179,000</b>	
	FCP:LCP				1%		99%			
<b>Lot 5 Reservoirs Construction (LCB)</b>										
Mixing Chmber	PK11	Ls	1		0		1,501,000	91,591,020	1,501,000	L5-1
Mixing Chmber	Bou Merra	Ls	1		0		281,000	17,146,620	281,000	L5-2
Mixing Chmber	PK10	Ls	1		0		560,000	34,171,200	560,000	L5-3
Mixing Chmber	PK14	Ls	1		0		472,000	28,801,440	472,000	L5-4
Mixing Chmber	Sidi Salah EH	Ls	1		0		319,000	19,465,000	319,000	L5-5
Reservoir	Bou Merra 5 000m3	Ls	1		0		1,890,000	115,327,800	1,890,000	L5-6
<b>Lot 5 Sub-Total</b>					<b>0</b>		<b>5,023,000</b>	<b>306,503,460</b>	<b>5,023,000</b>	
	FCP:LCP				0%		100%			

**T1 Cost Estimates Total**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Lot 6 Pump Facilities Construction (ICB)</b>										
PK11 (for PK10 & Bou Merrra)		Ls	1		789,808,000		6,059,000	1,159,528,000	19,002,000	L6-1
PK10 (for PK14)		Ls	1		469,333,000		4,543,000	746,546,860	12,234,000	L6-2
Pk14 (for Sidi Salah EH)		Ls	1		306,074,000		3,167,000	499,324,340	8,183,000	L6-3
<b>Lot 6 Sub-Total</b>					<b>1,565,215,000</b>		<b>13,769,000</b>	<b>2,405,399,380</b>	<b>39,420,000</b>	
	FCP:LCP				65%		35%			
<b>Lot 7 Power Supply Line (by STEG)</b>										
Power Supply Line Construction	150kV - 15km	Ls	1		0		4,350,000	265,437,000	4,350,000	L7-1
Travées		Ls	1		0		2,400,000	146,448,000	2,400,000	L7-2
Assistance		Ls	1		0		533,000	32,523,660	533,000	L7-3
<b>Lot 7 Sub-Total</b>					<b>0</b>		<b>7,283,000</b>	<b>444,408,660</b>	<b>7,283,000</b>	
	FCP:LCP				0%		100%			
Total Cost					18,903,967,000		270,442,000	35,406,337,840	580,242,000	
<b>Total Cost (rounded)</b>					<b>18,903,967,000</b>		<b>270,442,000</b>	<b>35,406,338,000</b>	<b>580,242,000</b>	
	FCP:LCP				53%		47%			

**L1 Desalination Plant**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Intake & Discharge Facilities		Ls	1		4,420,968,000		74,815,000	8,986,179,000	147,266,000	L1-1
Desalination Plant		Ls	1		8,785,042,000		84,084,000	13,915,848,000	228,054,000	L1-2
Transmission Pump Facility		Ls	1		738,940,000		5,327,000	1,063,994,000	17,437,000	L1-3
Guarantee Test (for Desalination Plant)		Ls	1		218,003,000		26,916,000	1,860,417,000	30,489,000	L1-4 12months
<b>Total</b>					14,162,953,000		191,142,000			
<b>Total Cost (rounded)</b>	<b>to T1</b>				<b>14,162,953,000</b>		<b>191,142,000</b>	<b>25,826,438,000</b>	<b>423,245,000</b>	<b>L1</b>
	FCP:LCP				55%		45%			

10.5-5



### L1-1 Intake & Discharge Facilities

Exchange Rate: 1.00US\$= 119.60JPY      1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)	LC Portion (TND)	Total		Reference
						(JPY)	(equiv. TND)	
Intake & Discharge Pipelines	HDPE 2000mm x 2	Ls	1	4,420,968,000	67,193,000	8,521,085,000	139,644,000	L1-1-1
Intake Pit	42x20x8.3m	Ls	1	0	6,037,000	368,378,000	6,037,000	L1-1-2      Work
Outfall Pit	22x7.8x11m	Ls	1	0	1,585,000	96,717,000	1,585,000	L1-1-3      Work
<b>Total</b>				4,420,968,000	74,815,000			
<b>Total Cost (Rounded)</b>	<b>to L1</b>			<b>4,420,968,000</b>	<b>74,815,000</b>	<b>8,986,179,000</b>	<b>147,266,000</b>	<b>L1-1</b>
	FCP:LCP			49%	51%			

### L1-1-1 Intake & Discharge Pipelines

Exchange Rate: 1.00US\$= 119.60JPY    1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)	LC Portion (TND)	Total		Reference
						(JPY)	(equiv. TND)	
Pipe material								
Intake HDPE φ2000mm (ID)	3600m×2lines	Ls	1	2,782,676,160	0	2,782,676,160	45,602,690	ID: Internal Diameter
Discharge HDPE φ1800mm (ID)	4400m	Ls	1	1,458,292,000	0	1,458,292,000	23,898,591	ID: Internal Diameter
Intake head	Type TK-2000 x 2 heads	Ls	1	0	3,528,000	215,278,560	3,528,000	cost
Discharge head	Multi Nozzle 1800	Ls	1	0	1,960,000	119,599,200	1,960,000	cost
Intake Pipe Assembly	3600m×2	Ls	1	0	4,403,000	268,671,060	4,403,000	
Discharge Pipe Assembly	4400m	Ls	1	0	2,285,000	139,430,700	2,285,000	
Pipe Material sub-total				4,240,968,160	12,176,000	4,983,947,680	81,677,281	
Pipe Installation								
Intake Pipe	ID2000x3600x2	Ls	1	0	5,179,000	316,022,580	5,179,000	
Discharge Pipe	ID1800x4400x1	Ls	1	0	3,105,000	189,467,100	3,105,000	
Intake head	Type TK-2000 x 2	Ls	1	0	94,000	5,735,880	94,000	
Discharge head	Multi Nozzle 1800	Ls	1	0	47,000	2,867,940	47,000	
Pipe Installation sub-total				0	8,425,000	514,093,500	8,425,000	Work
On-shore part civil work	& backfilling	Ls	1	0	7,559,000	461,250,000	7,559,000	L1-1-1-1    Work
Off-shore part civil work	& backfilling	Ls	1	180,000,000	31,857,000	2,123,914,000	34,807,000	L1-1-1-2    Work
Other Miscellaneous. Work	15% of Work	Ls	1	0	7,176,150	437,888,673	7,176,150	2
Total				4,420,968,160	67,193,150			
<b>Total Cost (Rounded)</b>	<b>to L1-1</b>			<b>4,420,968,000</b>	<b>67,193,000</b>	<b>8,521,085,000</b>	<b>139,644,000</b>	<b>L1-1-1</b>
	FCP:LCP			52%	48%			

**L1-1-1 On-shore Pipeline Civil Work**

49000

Exchange Rate: 1.00US\$= 119.60JPY 1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation	sandy soil	m <sup>3</sup>	23,500	0	0	16.500	387,750	23,660,505	387,750	
Backfilling	excavated soil	m <sup>3</sup>	16,700	0	0	11.000	183,700	11,209,374	183,700	
Surplus Soil Transport		m <sup>3</sup>	6,800	0	0	23.100	157,080	9,585,022	157,080	
Foundation	Gravel	m <sup>3</sup>	2,900	0	0	74.800	216,920	13,236,458	216,920	Material, Placing,
Sheet Pile	IV Type L=17m	ton	2,717	0	0	1760.000	4,781,920	291,792,758	4,781,920	purchase x 80% (scrap 20%) x
Sheet Pile Driving		pcs	2,100	0	0	280.500	589,050	35,943,831	589,050	
Sheet Pile Removal		pcs	2,100	0	0	56.100	117,810	7,188,766	117,810	20% of driving
Tie-rod, waling and H pile		ton	475	0	0	1536.700	729,933	44,540,512	729,933	purchase x 80% (scrap 20%)
Anchor Pile Driving	H300 L=12m	pcs	420	0	0	230.000	96,600	5,894,532	96,600	
Anchor Pile Removal		pcs	420	0	0	46.000	19,320	1,178,906	19,320	20% of driving
Tie-rod & waling Setting		ton	119	0	0	1560.000	185,640	11,327,753	185,640	
Tie-rod & waling Removal		ton	119	0	0	780.000	92,820	5,663,876	92,820	50% of driving
Total					0		7,558,543			
<b>Total Cost (Rounded)</b>	<b>to L1-1-1</b>				<b>0</b>		<b>7,559,000</b>	<b>461,250,000</b>	<b>7,559,000</b>	<b>L1-1-1-1</b>
	FCP:LCP				0%		100%			

10.5-8

**L1-1-1-2 Off-shore Pipeline Civil Work**

Exchange Rate: 1.00US\$= 119.60JPY 1.000TND= 61.02JPY

Items	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation	sandy soil	m <sup>3</sup>	389,600	0	0	27.400	10,675,040	651,390,941	10,675,040	
Backfilling	excavated soil	m <sup>3</sup>	288,000	0	0	27.400	7,891,200	481,521,024	7,891,200	
Surplus Soil Transport		m <sup>3</sup>	101,600	0	0	9.800	995,680	60,756,394	995,680	
Foundation Material & Placing	Gravel	m <sup>3</sup>	28,300	0	0	96.000	2,716,800	165,779,136	2,716,800	
Foundation Levelling	Gravel	m <sup>2</sup>	40,400	0	0	92.100	3,720,840	227,045,657	3,720,840	
Armour Stone	Rubble Stone	m <sup>3</sup>	55,600	0	0	94.100	5,231,960	319,254,199	5,231,960	
Turbid Water Protection Barrier	floating silt curtains	lot	1	180,000,000	180,000,000	327,761.390	327,761	200,000,000	3,277,614	
Artificial Reef	Concrete Blocks	lot	1	0	0	297,922.000	297,922	18,179,200	297,922	
<b>Total</b>					180,000,000		31,857,203			
<b>Total Cost (Rounded)</b>	<b>to L1-1-1</b>				<b>180,000,000</b>		<b>31,857,000</b>	<b>2,123,914,000</b>	<b>34,807,000</b>	<b>L1-1-1-2</b>
	FCP:LCP				8%		92%			

**L1-1-2 Intake Pit**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

10.5-10

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pile driving work	300x300, L = 10m Including Materials	m	740	0	0	77.000	56,980	3,476,920	56,980	74pcs x 10m
Pile Head Treatment	300x300	pcs	74	0	0	4.400	326	19,893	326	
Excavation		m <sup>3</sup>	10,660	0	0	16.500	175,890	10,732,808	175,890	
Backfilling		m <sup>3</sup>	3,065	0	0	11.000	33,715	2,057,289	33,715	
Surplus Soil Transport		m <sup>3</sup>	7,595	0	0	23.100	175,445	10,705,654	175,445	
Gravel		m <sup>3</sup>	171	0	0	74.800	12,791	780,507	12,791	
Lean Concrete		m <sup>3</sup>	86	0	0	440.000	37,840	2,308,997	37,840	
Reinforced Concrete		m <sup>3</sup>	3,070	0	0	935.000	2,870,450	175,154,859	2,870,450	
Formwork		m <sup>2</sup>	4,063	0	0	62.700	254,750	15,544,845	254,750	
Rebar Fabrication and Assembly		ton	614	0	0	1,320.000	810,480	49,455,490	810,480	200kg/m3
Sheet Pile Driving	Type IV 17m	pcs	340	0	0	280.500	95,370	5,819,477	95,370	
Sheet Pile removing	Type IV 17m	pcs	340	0	0	56.100	19,074	1,163,895	19,074	20% of driving
Sheet Pile	Type IV 17m	ton	440	0	0	0.000	0	0	0	reuse of sheet pile used for on-shore pipe civil work
Waling and Strut Installation	H300*300*10*15	ton	118	0	0	1,430.000	168,740	10,296,515	168,740	
Waling and Strut Removal	H300*300*10*15	ton	118	0	0	715.000	84,370	5,148,257	84,370	
Waling & Strut	H300*300*10*15	ton	118	0	0	286.000	33,748	2,059,303	33,748	purchase x 20%
Other Miscellaneous Work	25% of Structure Work	Ls	1		0		1,207,492	73,681,162	1,207,492	
Total					0		6,037,461			
<b>Total Cost (Rounded)</b>	<b>to L1-1</b>				<b>0</b>		<b>6,037,000</b>	<b>368,378,000</b>	<b>6,037,000</b>	<b>L1-1-2</b>
	FCP:LCP				0%		100%			

**L1-1-3 Outfall Pit**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

10-5-11

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pile driving work	300x300, L = 10m Including Materials	m	180	0	0	77.000	13,860	845,737	13,860	18pcs x 10m
Pile Head Treatment	300x300	pcs	18	0	0	4.400	79	4,821	79	
Excavation		m <sup>3</sup>	2,853	0	0	16.500	47,075	2,872,517	47,075	
Backfilling		m <sup>3</sup>	1,237	0	0	11.000	13,607	830,299	13,607	
Surplus Soil Transport		m <sup>3</sup>	1,616	0	0	23.100	37,330	2,277,877	37,330	
Gravel		m <sup>3</sup>	41	0	0	74.800	3,067	187,148	3,067	
Lean Concrete		m <sup>3</sup>	20	0	0	440.000	8,800	536,976	8,800	
Reinforced Concrete		m <sup>3</sup>	778	0	0	935.000	727,430	44,387,779	727,430	
Formwork		m <sup>2</sup>	1,265	0	0	62.700	79,316	4,839,862	79,316	
Rebar Fabrication and Assembly		ton	156	0	0	1,320.000	205,920	12,565,238	205,920	200kg/m3
Sheet Pile Driving	Type IV 17m	pcs	189	0	0	280.500	53,015	3,234,975	53,015	
Sheet Pile removing	Type IV 17m	pcs	189	0	0	56.100	10,603	646,995	10,603	20% of driving
Sheet Pile	Type IV 17m	ton	245	0	0	0.000	0	0	0	reuse of sheet pile used for on-shore pipe civil work
Waling and Strut Installation	H300*300*10*15	ton	28	0	0	1,430.000	40,040	2,443,241	40,040	
Waling and Strut Removal	H300*300*10*15	ton	28	0	0	715.000	20,020	1,221,620	20,020	
Waling & Strut	H300*300*10*15	ton	28	0	0	286.000	8,008	488,648	8,008	purchase x 20%
Other Miscellaneous Work	25% of Structure Work	Ls	1		0		317,043	19,345,964	317,043	
Total					0		1,585,213			
<b>Total Cost (Rounded)</b>	<b>to L1-1</b>				<b>0</b>		<b>1,585,000</b>	<b>96,717,000</b>	<b>1,585,000</b>	<b>L1-1-3</b>
	FCP:LCP				0%		100%			

**L1-2 Desalination Plant**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Foundation		Ls	1		0		4,817,000	293,933,000	4,817,000	L1-2-1
Buildings		Ls	1		774,904,000		39,576,000	3,189,832,000	52,275,000	L1-2-2
Desalination Plant		Ls	1		6,661,213,000		18,819,000	7,809,548,000	127,983,000	L1-2-3
Filtered Water Tank	15mx50mx5mH	Ls	1		0		1,737,000	105,992,000	1,737,000	L1-2-4
Drain Tank	15m38mx5mH	Ls	1		0		1,316,000	80,302,000	1,316,000	L1-2-5
Brine Tank	12mx40mx5mH	Ls	1		0		1,132,000	69,075,000	1,132,000	L1-2-6
Water Reservoir	V=5,000m3 x 5	Ls	1		0		10,640,000	649,253,000	10,640,000	L1-2-7
In-yard Pipe		Ls	1		0		2,145,000	130,888,000	2,145,000	L1-2-8
Electrical Facilities		Ls	1		1,348,925,000		3,902,000	1,587,025,000	26,008,000	L1-2-9
<b>Total</b>					8,785,042,000		84,084,000			
<b>Total Cost (Rounded)</b>	<b>to L1</b>				<b>8,785,042,000</b>		<b>84,084,000</b>	<b>13,915,848,000</b>	<b>228,054,000</b>	<b>L1-2</b>
	FCP:LCP				63%		37%			

10.5-12

**L1-2-1 Foundation for Equipment**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Foundation</b>										
Dual Media & Polishing Filter	18x70x0.3m height		4							
Pile Driving Work	500x500, L = 10m Including Materials	m	2,500	0	0	110.000	275,000	16,780,500	275,000	L=250pcs×10m
Pile Head Treatment	500x500	pcs	250	0	0	6.600	1,650	100,683	1,650	
Reinforced Concrete		m <sup>3</sup>	1,512	0	0	935.000	1,413,720	86,265,194	1,413,720	
Formwork		m <sup>2</sup>	53	0	0	62.700	3,323	202,776	3,323	
Rebar Fabrication and Assembly		ton	257	0	0	1,320.000	339,293	20,703,647	339,293	Rebar/Concrete = 170kg/m3
Cartridge Filter	3x6x0.3m height		4							
Reinforced Concrete		m <sup>3</sup>	22	0	0	935.000	20,570	1,255,181	20,570	
Formwork		m <sup>2</sup>	6	0	0	62.700	376	22,956	376	
Rebar Fabrication and Assembly		ton	4	0	0	1,320.000	4,937	301,244	4,937	Rebar/Concrete = 170kg/m3
High Pressure Pump	3x8x0.3m height		4							
Reinforced Concrete		m <sup>3</sup>	29	0	0	935.000	27,115	1,654,557	27,115	
Formwork		m <sup>2</sup>	7	0	0	62.700	439	26,782	439	
Rebar Fabrication and Assembly		ton	5	0	0	1,320.000	6,508	397,094	6,508	Rebar/Concrete = 170kg/m3
RO system	6x10x0.3m height		4							
Reinforced Concrete		m <sup>3</sup>	72	0	0	935.000	67,320	4,107,866	67,320	
Formwork		m <sup>2</sup>	10	0	0	62.700	627	38,260	627	
Rebar Fabrication and Assembly		ton	12	0	0	1,320.000	16,157	985,888	16,157	Rebar/Concrete = 170kg/m3
<b>Ground levelling</b>		m <sup>3</sup>	200,000	0	0	13.200	2,640,000	161,092,800	2,640,000	
Total					0		4,817,034			
<b>Total Cost (Rounded)</b>	<b>to L1-2</b>				<b>0</b>		<b>4,817,000</b>	<b>293,933,000</b>	<b>4,817,000</b>	<b>L1-2-1</b>
	FCP:LCP				0%		100%			

10.5-13



**L1-2-2 Building (Desalination Plant)**

Exchange Rate: 1.00US\$= 119.60JPY 1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Pre-treatment system Building</b>										
Structure	130x80x7.5m height	m <sup>2</sup>	10,400	24,667	256,536,800	1155.000	12,012,000	989,509,040	16,216,143	Structure
overhead crane& misc. work		Ls	1		128,268,400		6,006,000	494,754,520	8,108,071	Structure x 50%
waterproofing		m <sup>2</sup>	10,400	0	0	42.900	446,160	27,224,683	446,160	
Pile Driving Work	500x500, L = 20m Including Materials	m	11,560	0	0	110.000	1,271,600	77,593,032	1,271,600	L=578pcs×20m
Pile Head Treatment	500x500	pcs	578	0	0	6.600	3,815	232,779	3,815	
<b>sub-total</b>					<b>384,805,200</b>		<b>19,739,575</b>	<b>1,589,314,054</b>	<b>26,045,789</b>	
<b>RO system Building</b>										
Structure	630x86x12m height	m <sup>2</sup>	5,418	24,667	133,645,806	1155.000	6,257,790	515,496,152	8,447,987	Structure
overhead crane& misc. work		Ls	1		66,822,903		3,128,895	257,748,076	4,223,993	Structure x 50%
waterproofing		m <sup>2</sup>	5,418	0	0	42.900	232,432	14,183,013	232,432	
Pile Driving Work	500x500, L = 20m Including Materials	m	6,020	0	0	110.000	662,200	40,407,444	662,200	L=301pcs×20m
Pile Head Treatment	500x500	pcs	301	0	0	6.600	1,987	121,222	1,987	
<b>sub-total</b>					<b>200,468,709</b>		<b>10,283,304</b>	<b>827,955,907</b>	<b>13,568,599</b>	

10.5-14

**L1-2-2 Building (Desalination Plant)**

Exchange Rate: 1.00US\$= 119.60JPY 1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Administration Building</b>										
Structure	16x40x8m height	m <sup>2</sup>	1,800	49,335	88,803,000	2310.000	4,158,000	342,524,160	5,613,310	three stories 200%
Pile Driving Work	500×500, L = 20m Including Materials	m	840	0	0	110.000	92,400	5,638,248	92,400	L=42pcs×20m
Pile Head Treatment	500×500	pcs	42	0	0	6.600	277	16,915	277	
<b>sub-total</b>					<b>88,803,000</b>		<b>4,250,677</b>	<b>348,179,323</b>	<b>5,705,987</b>	
<b>Warehouse Building</b>										
Structure	50x20x5m height	m <sup>2</sup>	1,000	19,981	19,981,000	990.000	990,000	80,390,800	1,317,450	Structure
overhead crane& misc. work		Ls	1		9,990,500		495,000	40,195,400	658,725	Structure x 50%
ground improvement	1m x 100kg/m3	m <sup>3</sup>	1,000	0	0	41.000	41,000	2,501,820	41,000	
<b>sub-total</b>					<b>29,971,500</b>		<b>1,526,000</b>	<b>123,088,020</b>	<b>2,017,175</b>	
<b>GIS Sub-station Building</b>										
Structure-1	15x11x7.5m height	m <sup>2</sup>	165	24,667	4,070,055	1155.000	190,575	15,698,942	257,275	Structure
overhead crane& misc. work	for Structure 1	Ls	1		2,035,028		95,288	7,849,471	128,638	Structure x 50%
Structure-2	(15x20+7x20)x5m height	m <sup>2</sup>	440	24,667	10,853,480	1155.000	508,200	41,863,844	686,068	
waterproofing		m <sup>2</sup>	605	0	0	42.900	25,955	1,583,744	25,955	
Pile Driving Work	500×500, L = 20m Including Materials	m	680	0	0	110.000	74,800	4,564,296	74,800	L=34pcs×20m
Pile Head Treatment	500×500	pcs	34	0	0	6.600	224	13,693	224	
<b>sub-total</b>					<b>16,958,563</b>		<b>895,041</b>	<b>71,573,989</b>	<b>1,172,960</b>	

10.5-15

**L1-2-2 Building (Desalination Plant)**

Exchange Rate: 1.00US\$= 119.60JPY      1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Intake Sub-station Building</b>										
Structure	36x24x5m height	m <sup>2</sup>	864	24,667	21,312,288	1155.000	997,920	82,205,366	1,347,187	
waterproofing		m <sup>2</sup>	864	0	0	42.900	37,066	2,261,743	37,066	
Pile Driving Work	500×500, L = 20m Including Materials	m	960	0	0	110.000	105,600	6,443,712	105,600	L=48pcs×20m
Pile Head Treatment	500×500	pcs	48	0	0	6.600	317	19,331	317	
<b>sub-total</b>					<b>21,312,288</b>		<b>1,140,902</b>	<b>90,930,152</b>	<b>1,490,170</b>	
<b>RO Sub-station Building</b>										
Structure	54x24x5m height	m <sup>2</sup>	1,296	24,667	31,968,432	1155.000	1,496,880	123,308,050	2,020,781	
waterproofing		m <sup>2</sup>	1,296	0	0	42.900	55,598	3,392,614	55,598	
Pile Driving Work	500×500, L = 20m Including Materials	m	1,440	0	0	110.000	158,400	9,665,568	158,400	L=72pcs×20m
Pile Head Treatment	500×500	pcs	72	0	0	6.600	475	28,997	475	
<b>sub-total</b>					<b>31,968,432</b>		<b>1,711,354</b>	<b>136,395,229</b>	<b>2,235,254</b>	
<b>Gate Keeper House</b>	<b>5x5x4m height</b>	<b>m<sup>2</sup></b>	<b>25</b>	<b>24,667</b>	<b>616,675</b>	<b>1155.000</b>	<b>28,875</b>	<b>2,378,628</b>	<b>38,981</b>	
Total					774,904,367		39,575,728			
<b>Total Cost (Rounded)</b>	<b>to L1-2</b>				<b>774,904,000</b>		<b>39,576,000</b>	<b>3,189,832,000</b>	<b>52,275,000</b>	<b>L1-2-2</b>
	FCP:LCP				24%		76%			

10.5-16

**L1-2-3 Desalination Plant**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= #####

Items	Specification	Unit	Qt'ty	FC Portion (JPY)	LC Portion (TND)	Total		Reference
						(JPY)	(equiv. TND)	
<b>Pre-treatment system</b>								
Feed Pump		units	5	142,500,000	122,900	149,999,358	2,458,200	
Backwash Pump		units	3	26,600,000	22,900	27,997,358	458,823	
Air wash Blower		units	3	4,800,000	4,100	5,050,182	82,763	
Drain Pump		units	2	142,500,000	122,900	149,999,358	2,458,200	
Dual media Filter		units	24	931,000,000	803,000	979,999,060	16,060,293	
Polishing Filter		units	16	617,500,000	532,600	649,999,252	10,652,233	
Valves		Ls	1	216,600,000	186,800	227,998,536	3,736,456	
Pipes		Ls	1	456,000,000	393,300	479,999,166	7,866,260	
<b>sub-total</b>				<b>2,537,500,000</b>	<b>2,188,500</b>	<b>2,671,042,270</b>	<b>43,773,228</b>	
<b>RO system</b>								
RO Feed Pump		units	5	142,500,000	122,900	149,999,358	2,458,200	
Cartridge Filter		units	10	78,000,000	67,300	82,106,646	1,345,569	
Booster Pump		units	6	110,200,000	95,100	116,003,002	1,901,065	
High Pressure Pump		units	5	456,000,000	393,300	479,999,166	7,866,260	
Pressure Exchanger Unit		units	4	330,600,000	285,200	348,002,904	5,703,096	

**L1-2-3 Desalination Plant**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= #####

Items	Specification	Unit	Qt'ty	FC Portion (JPY)	LC Portion (TND)	Total		Reference
						(JPY)	(equiv. TND)	
RO Unit		Ls	1	1,121,000,000	966,900	1,180,000,238	19,337,926	
Chemical dosing system (Pre-treatment)		Ls	1	15,500,000	13,400	16,317,668	267,415	NaClO, FeCl3
Chemical dosing system (After-treatment)		Ls	1	17,800,000	15,400	18,739,708	307,108	
Cleaning Pump		units	2	19,000,000	16,400	20,000,728	327,773	
Valves		Ls	1	173,000,000	149,200	182,104,184	2,984,336	
Pipes		Ls	1	332,500,000	286,800	350,000,536	5,735,833	
Stages		Ls	1	97,000,000	83,700	102,107,374	1,673,343	
<b>sub-total</b>				<b>2,893,100,000</b>	<b>2,495,600</b>	<b>3,045,381,512</b>	<b>49,907,924</b>	
<b>Electrical system</b>								
Panels for pre-treatment		Ls	1	86,000,000	74,200	90,527,684	1,483,574	
Panels for RO		Ls	1	340,000,000	293,300	357,897,166	5,865,244	
Panels for others		Ls	1	140,000,000	120,800	147,371,216	2,415,130	
Instruments		Ls	1	232,500,000	200,500	244,734,510	4,010,726	
<b>sub-total</b>				<b>798,500,000</b>	<b>688,800</b>	<b>840,530,576</b>	<b>13,774,674</b>	

10.5-18

**L1-2-3 Desalination Plant**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= #####

Items	Specification	Unit	Qt'ty	FC Portion (JPY)	LC Portion (TND)	Total		Reference
						(JPY)	(equiv. TND)	
<b>Engineering Work</b>								
Mechanical design		Ls	1	137,000,000	0	137,000,000	2,245,166	
Electrical design		Ls	1	90,000,000	0	90,000,000	1,474,926	
<b>sub-total</b>				<b>227,000,000</b>	<b>0</b>	<b>227,000,000</b>	<b>3,720,092</b>	
<b>Installation</b>								
Mechanical for pre-treatment		Ls	1	80,131,000	5,252,800	400,656,856	6,565,992	15% of Pre-treatment system
Mechanical for RO		Ls	1	91,361,000	5,989,000	456,809,780	7,486,230	15% of RO system
Electrical installation		Ls	1	33,621,000	2,203,900	168,102,978	2,754,883	20% of RO system
<b>sub-total</b>				<b>205,113,000</b>	<b>13,445,700</b>	<b>1,025,569,614</b>	<b>16,807,105</b>	
Total				6,661,213,000	18,818,600			
<b>Total Cost (Rounded)</b>	<b>to L1-2</b>			<b>6,661,213,000</b>	<b>18,819,000</b>	<b>7,809,548,000</b>	<b>127,983,000</b>	<b>L1-2-3</b>
	FCP:LCP			85%	15%			

**L1-2-4 Break Tank 15mx50mx5mH (V=3,000m3)**

Exchange Rate: 1.00US\$= 119.60JPY 1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pile Driving Work	500×500, L = 30m Including Materials	m	1,080	0	0	110.000	118,800	7,249,176	118,800	L=36pcs×30m
Pile Head Treatment	500×500	pcs	36	0	0	6.600	238	14,498	238	
Excavation		m <sup>3</sup>	530	0	0	16.500	8,745	533,620	8,745	
Backfilling		m <sup>3</sup>	80	0	0	11.000	880	53,698	880	
Surplus Soil Transportation		m <sup>3</sup>	450	0	0	23.100	10,395	634,303	10,395	
Gravel		m <sup>3</sup>	75	0	0	74.700	5,603	341,865	5,603	
Concrete		m <sup>3</sup>	75	0	0	440.000	33,000	2,013,660	33,000	1
Reinforced Concrete		m <sup>3</sup>	889	0	0	935.000	831,215	50,720,739	831,215	2
Formwork		m <sup>2</sup>	2,230	0	0	62.700	139,821	8,531,877	139,821	3
Rebar Fabrication and Assembly		ton	151	0	0	1,320.000	199,492	12,172,977	199,492	4 Rebar/Concrete = 170kg/m3
Waterproofing		m <sup>2</sup>	1,400	0	0	42.900	60,060	3,664,861	60,060	
Scaffolding		m <sup>2</sup>	260	0	0	107.800	28,028	1,710,269	28,028	
Other Miscellaneous works		Ls	1		0		300,882	18,359,814	300,882	sum of (1~4) x 25%
Total					0		1,737,158			
<b>Total Cost (Rounded)</b>	<b>to L1-2</b>				<b>0</b>		<b>1,737,000</b>	<b>105,992,000</b>	<b>1,737,000</b>	<b>L1-2-4</b>
	FCP:LCP				0%		100%			

**L1-2-5 Drain Tank 15mx38mx5mH**

Exchange Rate: 1.00US\$= 119.60JPY 1.000TND= 61.02JPY

10.5-21

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pile Driving Work	500×500, L = 30m Including Materials	m	780	0	0	110.000	85,800	5,235,516	85,800	L=26pcs×30m
Pile Head Treatment	500×500	pcs	26	0	0	6.600	172	10,471	172	
Excavation		m <sup>3</sup>	408	0	0	16.500	6,732	410,787	6,732	
Backfilling		m <sup>3</sup>	66	0	0	11.000	726	44,301	726	
Surplus Soil Transportation		m <sup>3</sup>	342	0	0	23.100	7,900	482,070	7,900	
Gravel		m <sup>3</sup>	57	0	0	74.700	4,258	259,817	4,258	
Concrete		m <sup>3</sup>	57	0	0	440.000	25,080	1,530,382	25,080	1
Reinforced Concrete		m <sup>3</sup>	668	0	0	935.000	624,580	38,111,872	624,580	2
Formwork		m <sup>2</sup>	1,790	0	0	62.700	112,233	6,848,458	112,233	3
Rebar Fabrication and Assembly		ton	114	0	0	1320.000	149,899	9,146,849	149,899	4 Rebar/Concrete = 170kg/m3
Waterproofing		m <sup>2</sup>	1,100	0	0	42.900	47,190	2,879,534	47,190	
Scaffolding		m <sup>2</sup>	220	0	0	107.800	23,716	1,447,150	23,716	
Other Miscellaneous Works		Ls	1		0		227,948	13,909,390	227,948	sum of (1~4) x 25%
Total					0		1,316,234			
<b>Total Cost (Rounded)</b>	<b>to L1-2</b>				<b>0</b>		<b>1,316,000</b>	<b>80,302,000</b>	<b>1,316,000</b>	<b>L1-2-5</b>
	FCP:LCP				0%		100%			



**L1-2-6 Brine Tank 12mx40mx5mH**

Exchange Rate: 1.00US\$= 119.60JPY 1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pile Driving Work	500×500, L = 30m Including Materials	m	540	0	0	110.000	59,400	3,624,588	59,400	L=18pcs×30m
Pile Head Treatment	500×500	pcs	18	0	0	6.600	119	7,249	119	
Excavation		m <sup>3</sup>	353	0	0	16.500	5,825	355,411	5,825	
Backfilling		m <sup>3</sup>	65	0	0	11.000	715	43,629	715	
Surplus Soil Transportation		m <sup>3</sup>	288	0	0	23.100	6,653	405,954	6,653	
Gravel		m <sup>3</sup>	48	0	0	74.700	3,586	218,793	3,586	
Concrete		m <sup>3</sup>	48	0	0	440.000	21,120	1,288,742	21,120	1
Reinforced Concrete		m <sup>3</sup>	576	0	0	935.000	538,560	32,862,931	538,560	2
Formwork		m <sup>2</sup>	1,640	0	0	62.700	102,828	6,274,565	102,828	3
Rebar Fabrication and Assembly		ton	98	0	0	1,320.000	129,254	7,887,103	129,254	4 Rebar/Concrete = 170kg/m3
Waterproofing		m <sup>2</sup>	1,000	0	0	42.900	42,900	2,617,758	42,900	
Scaffolding		m <sup>2</sup>	210	0	0	107.800	22,638	1,381,371	22,638	
Other Miscellaneous Works		Ls	1		0		197,941	12,078,335	197,941	sum of (1~4) x 25%
Total					0		1,131,538			
<b>Total Cost (Rounded)</b>	<b>to L1-2</b>				<b>0</b>		<b>1,132,000</b>	<b>69,075,000</b>	<b>1,132,000</b>	<b>L1-2-6</b>
	FCP:LCP				0%		100%			

10.5-22

**L1-2-7 Product Water Tank (V=5,000m<sup>3</sup> x 5)**

Exchange Rate: 1.00US\$= 119.60JPY      1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amoun	Unit Price	Amount	(JPY)	(equiv.)	
Pile Driving Work	φ 500, L = 30m Including Materials	m	2,160	0	0	110.000	237,600	14,498,352	237,600	L=72pcs×30m
Pile Head Treatment	φ 500	pcs	72	0	0	6.600	475	28,997	475	
Excavation		m <sup>3</sup>	2,036	0	0	16.500	33,594	2,049,906	33,594	
Backfilling		m <sup>3</sup>	428	0	0	11.000	4,708	287,282	4,708	
Surplus Soil Transportation		m <sup>3</sup>	1,608	0	0	23.100	37,145	2,266,576	37,145	
Gravel		m <sup>3</sup>	241	0	0	74.700	18,003	1,098,525	18,003	
Concrete		m <sup>3</sup>	161	0	0	440.000	70,840	4,322,657	70,840	1
Reinforced Concrete		m <sup>3</sup>	930	0	0	935.000	869,550	53,059,941	869,550	2
Formwork		m <sup>2</sup>	3,500	0	0	62.700	219,450	13,390,839	219,450	3
Rebar Fabrication and Assembly		ton	158	0	0	1,320.000	208,692	12,734,386	208,692	4 Rebar/Concrete = 170kg/m <sup>3</sup>
Waterproofing		m <sup>2</sup>	1,500	0	0	42.900	64,350	3,926,637	64,350	
Scaffolding		m <sup>2</sup>	200	0	0	107.800	21,560	1,315,591	21,560	
Other Miscellaneous Works		Ls	1		0		342,133	20,876,956	342,133	sum of (1~4) x      25%
Total Cost/1unit					0		2,128,100			
Total Cost/5units					0		10,640,499			
<b>Total Cost (Rounded)</b>	<b>to L1-2</b>				<b>0</b>		<b>10,640,000</b>	<b>649,253,000</b>	<b>10,640,000</b>	<b>L1-2-7 for 5 units</b>
	FCP:LCP				0%		100%			

10.5-23

**L1-2-8 In-Yard Pipelines**

Exchange Rate: 1.00US\$= 119.60JPY     1.000TND= 61.02JPY

Diameter(mm)	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
1200	HDPE	m	250	0	0	1,481	370,250	22,592,655	370,250	Local Market
1400	HDPE	m	420	0	0	1,906	800,688	48,857,982	800,688	Local Market
1800	HDPE	m	320	0	0	3,045	974,400	59,457,888	974,400	Local Market
including materials and works										
Total					0		2,145,338			
<b>Total Cost (Rounded)</b>	to L1-2				<b>0</b>		<b>2,145,000</b>	<b>130,888,000</b>	<b>2,145,000</b>	<b>L1-2-8</b>
	FCP:LCP				0%		100%			

10.5-24

**L1-2-9 Electrical Facility for Desalination Plant**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>150kV GIS Sub-station and Power Supply Facilities</b>										
										GIS: Gas Insulated Switchgear
150kV Gas Insulated Switchgear		lot	1	136,000,000	136,000,000	393,000	393,000	160,000,000	2,622,091	1
Power Transformer	oil type 40MVAx2	lot	1	255,000,000	255,000,000	737,000	737,000	300,000,000	4,916,421	2
30kV Switchgear		lot	1	42,500,000	42,500,000	123,000	123,000	50,000,000	819,403	3
Power Cable		lot	1	127,500,000	127,500,000	369,000	369,000	150,000,000	2,458,210	4
Earthing System		lot	1	8,500,000	8,500,000	25,000	25,000	10,000,000	163,881	5
Control & Protection		lot	1	170,000,000	170,000,000	492,000	492,000	200,000,000	3,277,614	6
Other Miscellaneous Works		lot	1		73,950,000		214,000	87,008,280	1,425,898	7. Sum of (1~6) x 10%
<b>150kV Sub-station total</b>	<b>to Total</b>				<b>813,450,000</b>		<b>2,353,000</b>	<b>957,030,000</b>	<b>15,683,874</b>	<b>a. sum of (1~7)</b>
	FCP:LCP				85%		15%			
<b>Intake Facilities Sub-station and Power Supply Facilities</b>										
<b>30kV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>36,720,000</b>		<b>105,895</b>	<b>43,200,000</b>	<b>707,965</b>	<b>8</b>
30kV DS, LA Panel		set	1	4,250,000	4,250,000	12,000	12,000	5,000,000	81,940	DS: Disconnecting Switch LA: Lightning Arrester
30kV VT Panel		set	1	4,250,000	4,250,000	12,000	12,000	5,000,000	81,940	VT: Voltage Transformer
30kV VCB Panel		set	1	7,225,000	7,225,000	20,895	20,895	8,500,000	139,299	VCB: Vacuum Circuit Breaker
30kV/6kV Transformer	oil type 4MVA	set	1	20,995,000	20,995,000	61,000	61,000	24,700,000	404,785	
<b>6kV &amp; LV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>128,945,000</b>		<b>372,327</b>	<b>151,700,000</b>	<b>2,486,070</b>	<b>9 LV: Low Voltage</b>
6kV VCB Panel		set	8	4,845,000	38,760,000	14,000	112,000	45,600,000	747,296	
6kV VT Panel		set	1	3,825,000	3,825,000	11,000	11,000	4,500,000	73,746	
Intake Pump Panel	6kV VFD 240kW	set	5	10,200,000	51,000,000	29,400	147,000	60,000,000	983,284	VFD: Variable Frequency Drive
LV Transformer	dry type 500kVA	set	1	7,225,000	7,225,000	21,000	21,000	8,500,000	139,299	
LV Main Switchgear	5 units	set	1	11,050,000	11,050,000	31,957	31,957	13,000,000	213,045	

10.5-25

**L1-2-9 Electrical Facility for Desalination Plant**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
MCC for Intake-1	5 units	set	1	14,535,000	14,535,000	42,000	42,000	17,100,000	280,236	MCC: Motor Control Centre
Local Panel		set	10	255,000	2,550,000	737	7,370	3,000,000	49,164	
<b>Instrumentation &amp; Monitoring</b>		<b>Ls</b>	<b>1</b>		<b>62,985,000</b>		<b>182,636</b>	<b>74,100,000</b>	<b>1,214,356</b>	<b>10</b>
Intake Flow -1	electro-magnetic 2000mm	set	2	11,305,000	22,610,000	32,694	65,388	26,600,000	435,923	
Brine Discharge Flow -1	electro-magnetic 1800mm	set	1	10,115,000	10,115,000	29,253	29,253	11,900,000	195,018	
Water Level	Ultrasonic	set	2	680,000	1,360,000	1,967	3,934	1,600,000	26,221	
Water Quality	Turbidity, pH, Electric Conductivity	set	3	1,275,000	3,825,000	3,687	11,061	4,500,000	73,746	
Instrumentation Panel		set	1	2,550,000	2,550,000	7,000	7,000	3,000,000	49,164	
PLC Panel		set	2	6,375,000	12,750,000	18,500	37,000	15,000,000	245,821	PLC: Programmable Logic Controller
Remote SCADA		set	1	8,500,000	8,500,000	25,000	25,000	10,000,000	163,881	
UPS	10kVA	set	1	1,275,000	1,275,000	4,000	4,000	1,500,000	24,582	UPS: Uninterruptive Power Supply
<b>Other Miscellaneous Works</b>		<b>Ls</b>	<b>1</b>		<b>22,865,000</b>		<b>66,000</b>	<b>26,892,320</b>	<b>440,713</b>	<b>11</b> Sum of (8-10) x <b>10%</b>
<b>Intake Sub-station total</b>	<b>to Total</b>				<b>251,515,000</b>		<b>726,858</b>	<b>295,868,000</b>	<b>4,848,705</b>	<b>b. sum of (8-11)</b>
	FCP:LCP				85%		15%			
<b>RO Facilities Sub-station and Power Supply Facilities</b>										
<b>30kV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>124,950,000</b>		<b>361,790</b>	<b>147,000,000</b>	<b>2,409,046</b>	<b>12</b>
30kV DS, LA Panel		set	2	4,250,000	8,500,000	12,500	25,000	10,000,000	163,881	
30kV VT Panel		set	2	4,250,000	8,500,000	12,500	25,000	10,000,000	163,881	
30kV VCB Panel		set	2	7,225,000	14,450,000	20,895	41,790	17,000,000	278,597	
30kV/6kV Transformer	oil type 15MVA	set	2	46,750,000	93,500,000	135,000	270,000	110,000,000	1,802,688	
<b>6kV &amp; LV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>80,495,000</b>		<b>232,957</b>	<b>94,700,000</b>	<b>1,551,950</b>	<b>13</b>
6kV VCB Panel		set	11	4,845,000	53,295,000	14,000	154,000	62,700,000	1,027,532	

10.5-26

**L1-2-9 Electrical Facility for Desalination Plant**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
6kV VT Panel		set	2	3,825,000	7,650,000	11,000	22,000	9,000,000	147,493	
LV Transformer	dry type 250kVA	set	2	4,250,000	8,500,000	12,500	25,000	10,000,000	163,881	
LV Main Switchgear	5 units	set	1	11,050,000	11,050,000	31,957	31,957	13,000,000	213,045	
<b>Other Miscellaneous Works</b>		<b>Ls</b>	<b>1</b>		<b>20,545,000</b>		<b>59,000</b>	<b>24,145,180</b>	<b>395,693</b>	<sup>14</sup> Sum of (12,13) x 10%
<b>RO Facilities Sub-station total</b>	<b>to Total</b>	<b>Ls</b>	<b>1</b>		<b>225,990,000</b>		<b>653,747</b>	<b>265,881,642</b>	<b>4,357,287</b>	<b>c. sum of (12-14)</b>
	FCP:LCP				85%		15%			
<b>SCADA System</b>										
Central SCADA		lot	1	29,750,000	29,750,000	86,000	86,000	35,000,000	573,582	15
PLC for RO		lot	1	12,750,000	12,750,000	37,000	37,000	15,000,000	245,821	16
Remote SCADA for RO		lot	1	8,500,000	8,500,000	25,000	25,000	10,000,000	163,881	17
UPS	20kVA	set	1	1,700,000	1,700,000	5,000	5,000	2,000,000	32,776	18
Other Miscellaneous Works		Ls	1		5,270,000		15,000	6,185,300	101,365	<sup>19</sup> Sum of (15-18) x 10%
<b>SCADA System total</b>	<b>to Total</b>	<b>Ls</b>	<b>1</b>		<b>57,970,000</b>		<b>168,000</b>	<b>68,221,360</b>	<b>1,118,016</b>	<b>d. sum of (15-19)</b>
	FCP:LCP				85%		15%			
Total					1,348,925,000		3,901,605			sum of (a,b,c,d)
<b>Total Cost (Rounded)</b>	<b>to L1-2</b>				<b>1,348,925,000</b>		<b>3,902,000</b>	<b>1,587,025,000</b>	<b>26,008,000</b>	<b>L1-2-9</b>
	FCP:LCP				85%		15%			

10.5-27

**L1-3 Transmission Pump Facility**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Buildings		Ls	1		64,234,000		3,378,000	270,360,000	4,431,000	L1-3-1
Mechanical Facilities		Ls	1		269,897,000		780,000	317,493,000	5,203,000	L1-3-2
Electrical Facilities		Ls	1		404,809,000		1,169,000	476,141,000	7,803,000	L1-3-3
<b>Total</b>					738,940,000		5,327,000			
<b>Total Cost (Rounded)</b>	<b>to L1</b>				<b>738,940,000</b>		<b>5,327,000</b>	<b>1,063,994,000</b>	<b>17,437,000</b>	<b>L1-3</b>
	FCP:LCP				69%		31%			

10.5-28

**L1-3-1 Building (Transmission Pump House)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Transmission Pump House</b>										
Structure	51.8x19.2x5.8m height	m <sup>2</sup>	995	24,667	24,543,998	1155.000	1,149,225	94,669,708	1,551,454	Structure
Miscellaneous work		Ls	1		4,908,800		229,845	18,933,942	310,291	Structure x 20%
waterproofing		m <sup>2</sup>	995	0	0	42.900	42,686	2,604,669	42,686	
Pile Driving Work	500x500, L = 20m Including Materials	m	1,120	0	0	110.000	123,200	7,517,664	123,200	L=56pcsx20m
Pile Head Treatment	500x500	pcs	56	0	0	6.600	370	22,553	370	
<b>sub-total</b>				<b>0</b>	<b>29,452,798</b>		<b>1,545,325</b>	<b>123,748,536</b>	<b>2,028,001</b>	
<b>Transmission Sub-station Building</b>										
Structure	36x24x5m height	m <sup>2</sup>	864	24,667	21,312,577	1155.000	997,920	82,205,656	1,347,192	
waterproofing		m <sup>2</sup>	864	0	0	42.900	37,066	2,261,743	37,066	
Pile Driving Work	500x500, L = 20m Including Materials	m	960	0	0	110.000	105,600	6,443,712	105,600	L=48pcsx20m
Pile Head Treatment	500x500	pcs	48	0	0	6.600	317	19,331	317	
<b>sub-total</b>					<b>21,312,577</b>		<b>1,140,586</b>	<b>90,911,111</b>	<b>1,489,858</b>	
<b>Generator Building</b>										
Structure		m <sup>2</sup>	364	24,667	8,978,910	1155.000	420,420	34,632,938	567,567	Structure
over head crane& misc.		Ls	1		4,489,455		210,210	17,316,469	283,784	Structure x 50%
waterproofing		m <sup>2</sup>	364	0	0	42.900	15,616	952,864	15,616	
Pile Driving Work	500x500, L = 20m Including Materials	m	420	0	0	110.000	46,200	2,819,124	46,200	L=21pcsx20m
Pile Head Treatment	500x500	pcs	21	0	0	6.600	139	8,457	139	
<b>sub-total</b>					<b>13,468,365</b>		<b>692,584</b>	<b>55,729,853</b>	<b>913,306</b>	
Total					64,233,740		3,378,495			
<b>Total Cost (Rounded)</b>	<b>to L1-3</b>				<b>64,234,000</b>		<b>3,378,000</b>	<b>270,360,000</b>	<b>4,431,000</b>	<b>L1-3-1</b>
	FCP:LCP				24%		76%			



**L1-3-2 Mechanical Facility for Transmission Pump (100,000 m3/d)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= #####

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Transmission pump station</b>	<b>Plant Site - PK11</b>									
Transmission Pump	34.8m3/min x 95m	set	3	57,962,000	173,886,000	167,600	502,800	204,566,856	3,352,456	
Suction Valve	Dia. 500mm	set	3	1,845,000	5,535,000	5,300	15,900	6,505,218	106,608	
Check Valve	Dia. 500mm	set	3	2,769,000	8,307,000	8,000	24,000	9,771,480	160,136	
Discharge Valve	Dia. 500mm	set	3	3,668,000	11,004,000	10,600	31,800	12,944,436	212,134	Motorized
Maintenance Valve	Dia. 500mm	set	3	1,845,000	5,535,000	5,300	15,900	6,505,218	106,608	
Maintenance Valve	Dia. 1400 mm	set	2	5,477,000	10,954,000	15,800	31,600	12,882,232	211,115	Butterfly Valve
Pump Lifting Equipment	suspension crane: 5 ton	set	1	19,472,000	19,472,000	56,300	56,300	22,907,426	375,408	
Pipes		lot	1	35,204,000	35,204,000	101,800	101,800	41,415,836	678,726	
Total					269,897,000		780,100			
<b>Total Cost (Rounded)</b>	<b>to L1-3</b>				<b>269,897,000</b>		<b>780,000</b>	<b>317,493,000</b>	<b>5,203,000</b>	<b>L1-3-2</b>
	FCP:LCP				85%		15%			

### L1-3-3 Electrical Facility for Transmission Pump

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Transmission Sub-station and Power Supply Facilities</b>										
<b>30kV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>49,725,000</b>		<b>142,895</b>	<b>58,500,000</b>	<b>958,702</b>	<b>1</b>
30kV DS, LA Panel		set	1	4,250,000	4,250,000	12,000	12,000	5,000,000	81,940	DS: Disconnecting Switch LA: Lightning Arrester
30kV VT Panel		set	1	4,250,000	4,250,000	12,000	12,000	5,000,000	81,940	VT: Voltage Transformer
30kV VCB Panel		set	1	7,225,000	7,225,000	20,895	20,895	8,500,000	139,299	VCB: Vacuum Circuit Breaker
30kV/6kV Transformer	oil type 10MVA	set	1	34,000,000	34,000,000	98,000	98,000	40,000,000	655,523	
<b>6kV &amp; LV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>142,587,500</b>		<b>412,327</b>	<b>167,750,000</b>	<b>2,150,115</b>	<b>2</b> LV: Low Voltage
6kV VCB Panel		set	6	4,845,000	29,070,000	14,000	84,000	34,200,000	560,472	
6kV VT Panel		set	1	3,825,000	3,825,000	11,000	11,000	4,500,000	73,746	
Transmission Pump Panel		set	3	23,800,000	71,400,000	68,667	206,000	84,000,000	1,376,598	VFD: Variable Frequency Drive
LV Transformer	dry type 500kVA	set	1	7,225,000	7,225,000	21,000	21,000	8,500,000	139,299	
LV Main Switchgear	5 units	set	1	11,050,000	11,050,000	31,957	31,957	13,000,000	213,045	
MCC for Transmission-1	6 units	set	1	17,467,500	17,467,500	51,000	51,000	20,550,000	336,775	MCC: Motor Control Centre
Local Panel		set	10	255,000	2,550,000	737	7,370	3,000,000	49,164	
<b>Instrumentation &amp; Monitoring</b>		<b>Ls</b>	<b>1</b>		<b>41,395,000</b>		<b>119,717</b>	<b>48,700,000</b>	<b>363,814</b>	<b>3</b>
Transmission Flow	electro-magnetic 1400mm	set	1	7,820,000	7,820,000	22,616	22,616	9,200,000	150,770	
Water Level	Ultrasonic	set	5	680,000	3,400,000	1,967	9,835	4,000,000	65,552	
Water Quality	Turbidity, pH, Res. Chlorine	set	4	1,275,000	5,100,000	3,687	14,748	6,000,000	98,328	
Instrumentation Panel		set	1	2,550,000	2,550,000	7,375	7,375	3,000,000	49,164	
PLC Panel		set	2	6,375,000	12,750,000	18,437	36,874	15,000,000	245,821	Programmable Logic Controller

**L1-3-3 Electrical Facility for Transmission Pump**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<i>Remote SCADA</i>		<i>set</i>	<i>1</i>	8,500,000	8,500,000	24,582	24,582	10,000,000	163,881	
<i>UPS</i>	<i>10kVA</i>	<i>set</i>	<i>1</i>	1,275,000	1,275,000	3,687	3,687	1,500,000	24,582	UPS: Uninterruptive Power
<b>Other Miscellaneous Works</b>		<b>Ls</b>	<b>1</b>		<b>23,371,000</b>		<b>67,000</b>	<b>27,459,340</b>	<b>450,006</b>	<b>4</b> Sum of (1~3) x <b>10%</b>
<b>Transmission Sub-station total</b>	<b>to Total</b>	<b>Ls</b>	<b>1</b>		<b>257,078,500</b>		<b>741,939</b>	<b>302,351,618</b>	<b>4,954,959</b>	<b>a. sum of (1~4)</b>
	FCP:LCP				85%		15%			
<b>Emergency Power Facilities</b>										
<i>Stand-by Generator</i>	<i>Diesel 2000kVA</i>	<i>set</i>	<i>1</i>	129,200,000	129,200,000	374,000	374,000	152,000,000	2,490,987	5
<i>DC Power</i>		<i>set</i>	<i>2</i>	1,275,000	2,550,000	3,500	7,000	3,000,000	49,164	6
<i>UPS</i>	<i>10kVA</i>	<i>set</i>	<i>2</i>	1,275,000	2,550,000	3,500	7,000	3,000,000	49,164	7
<i>Other Miscellaneous Works</i>		<i>Ls</i>	<i>1</i>	13,430,000	13,430,000	39,000	39,000	15,809,780	259,092	8 Sum of (5~7) x <b>10%</b>
<b>Emergency Power Facilities total</b>	<b>to Total</b>	<b>Ls</b>	<b>1</b>		<b>147,730,000</b>		<b>427,000</b>	<b>173,785,540</b>	<b>2,848,010</b>	<b>b. sum of (5~8)</b>
	FCP:LCP				85%		15%			
Total					404,808,500		1,168,939			a+b
<b>Total Cost (Rounded)</b>	<b>to L1-3</b>				<b>404,809,000</b>		<b>1,169,000</b>	<b>476,141,000</b>	<b>7,803,000</b>	<b>L1-3-3</b>
	FCP:LCP				85%		15%			

**L1-4 Guarantee Test (for Desalination Plant for 12 Months)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Power Cost</b>	<b>provisional</b>	<b>month</b>	<b>12</b>	0	<b>0</b>	1,885,380	<b>22,625,000</b>	<b>1,380,578,000</b>	<b>22,625,008</b>	(Demand+Consumption) for 90,000m3/day in average
<b>Chemicals</b>	<b>provisional</b>	<b>month</b>	<b>12</b>	11,843,982	<b>142,128,000</b>	0	<b>0</b>	<b>142,128,000</b>	<b>2,329,204</b>	for 90,000m3/day in average
NaClO, FeCl3, Na2S2O5, Antiscalant, NaOH										
<b>RO Membrane Unit Replacement</b>		Ls	-	0	<b>0</b>	0	<b>0</b>	<b>0</b>	<b>0</b>	No charged replacement because of 3 years guarantee
<b>Remuneration</b>										
Foreign Engineer	5 persons	MM	30	2,412,500	72,375,000	0	0	72,375,000	1,186,087	Manager 12, Plant 12, Mech 2, Elec 2, Instrument 2
Local Engineer	2 persons	MM	24	0	0	13,500	324,000	19,770,480	324,000	Mechanical , Electrical
Support/Administrative Staff	30 persons	MM	360	0	0	10,000	3,600,000	219,672,000	3,600,000	8, guards 4, ope.supervisor 4, operator 8
<b>sub-total</b>					<b>72,375,000</b>		<b>3,924,000</b>	<b>311,817,480</b>	<b>5,110,087</b>	
<b>Direct Cost</b>										Accommodation and per diem, Travel for Foreign Engineer
International Travel		trip	5	700,000	3,500,000	0	0	3,500,000	57,358	
Accommodation & Per Diem of Foreign Engineer		MM	30	0	0	8,000	240,000	14,644,800	240,000	
Accommodation & Per Diem of Local Engineer		MM	24	0	0	4,800	115,200	7,029,504	115,200	
Communication		M	12	0	0	1,000	12,000	732,240	12,000	
<b>sub-total</b>					<b>3,500,000</b>		<b>367,200</b>	<b>25,906,544</b>	<b>424,558</b>	
Total					218,003,000		26,916,200			
<b>Total Cost (Rounded)</b>	<b>to L1</b>				<b>218,003,000</b>		<b>26,916,000</b>	<b>1,860,417,000</b>	<b>30,489,000</b>	<b>L1-4</b>
	FCP:LCP				12%		88%			

**L2-1 Transmission Pipe Material (1000mm & 1400mm) (ICB)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pipe Material	Dia 1000mm DIP	m	6,070	32,041	194,491,043	58.344	354,148	216,101,158	3,541,481	1. PK11 - PK10
Pipe Material	Dia 1400mm DIP	m	26,280	56,673	1,489,370,430	103.196	2,711,990	1,654,856,033	27,119,896	2. Plant - PK11
Pipe Fittings Material		Ls	1		505,158,442		919,841	561,287,157	9,198,413	Sum of (1 & 2) x 30%
<b>Total</b>					2,189,019,914		3,985,979			
<b>Total (Rounded)</b>	<b>to T1</b>				<b>2,189,020,000</b>		<b>3,986,000</b>	<b>2,432,246,000</b>	<b>39,860,000</b>	<b>L2-1</b>
	FCP:LCP				90%		10%			

10.5-34

**L2-2 Transmission Pipe Material (Less than 1000mm) (ICB)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pipe Material	Dia 400mm DIP	m	2,860	7,677	21,955,005	13.978	39,978	24,394,451	399,778	1. PK11- Bou Merra
Pipe Material	Dia 800mm DIP	m	9,360	22,095	206,810,945	40.233	376,581	229,789,939	3,765,813	2. PK14 - Sidi Salah EH
Pipe Material	Dia 800mm DIP	m	4,810	22,095	106,277,847	40.233	193,521	118,086,496	1,935,210	3. PK10 - PK14
Pipe Fittings Material		Ls	1		100,513,139		183,024	111,681,266	1,830,240	Sum of (1~3) x 30%
<b>Total</b>					435,556,936		793,104			
<b>Total (Rounded)</b>	<b>to T1</b>				<b>435,557,000</b>		<b>793,000</b>	<b>483,946,000</b>	<b>7,931,000</b>	<b>L2-2</b>
	FCP:LCP				90%		10%			

**L3 Valves Material (LCB)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Air Valve Material	Dia 100mm	pcs	6	82,039	492,235	149.385	896	546,928	8,963	
Air Valve Material	Dia 150mm	pcs	29	193,116	5,600,362	351.644	10,198	6,222,625	101,977	
Air Valve Material	Dia 200mm	pcs	64	471,609	30,182,959	858.751	54,960	33,536,621	549,600	
Butterfly Valve Material	Dia 400mm	pcs	3	1,063,373	3,190,118	1,936.292	5,809	3,544,575	58,089	2,860m/1,000m
Butterfly Valve Material	Dia 800mm	pcs	10	2,585,604	25,856,041	4,708.118	47,081	28,728,934	470,812	9,360m/1,000m
Butterfly Valve Material	Dia 800mm	pcs	5	2,585,604	12,928,020	4,708.118	23,541	14,364,467	235,406	4,810m/1,000m
Butterfly Valve Material	Dia 1000mm	pcs	12	4,113,777	49,365,319	7,490.762	89,889	54,850,355	898,891	6,070m/500m
Butterfly Valve Material	Dia 1400mm	pcs	53	6,842,165	362,634,744	12,458.875	660,320	402,927,493	6,603,204	26,280m/500m
Gate Valve Material	Dia 75mm	pcs	6	42,455	254,729	77.306	464	283,032	4,638	
Gate Valve Material	Dia 150mm	pcs	29	96,591	2,801,149	175.883	5,101	3,112,388	51,006	
Gate Valve Material	Dia 300mm	pcs	64	273,219	17,486,037	497.504	31,840	19,428,930	318,403	
<b>Total</b>					510,791,713		930,099			
<b>Total (Rounded)</b>	<b>to T1</b>				<b>510,792,000</b>		<b>930,000</b>	<b>567,541,000</b>	<b>9,301,000</b>	<b>L3</b>
	FCP:LCP				90%		10%			

10.5-36

**L4 Pipe Installation (ICB)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Transmission Pipe Installatiom		Ls	1		0		40,270,000	2,457,275,400	40,270,000	L4-1
Valve Installation		Ls	1		0		615,000	37,527,300	615,000	L4-2
Pipe Jacking		Ls	1		0		4,369,000	266,596,380	4,369,000	L4-3
Surge Tank	10mx15mx2	Ls	1		40,430,000		2,262,000	178,457,240	2,924,570	L4-4
Total					40,430,000		47,516,000			
<b>Total (Rounded)</b>	<b>to T1</b>				<b>40,430,000</b>		<b>47,516,000</b>	<b>2,939,856,000</b>	<b>48,179,000</b>	<b>L4</b>
	FCP:LCP				1%		99%			

10.5-37



### L4-1 Transmission Pipe Installation

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pipe Installation	Dia 400mm DIP	m	2,860	0	0	121.780	348,291	21,252,705	348,291	1.PK11- Bou Merra
Pipe Installation	Dia 800mm DIP	m	9,360	0	0	436.360	4,084,330	249,225,792	4,084,330	2.PK14 - Sidi Salah EH
Pipe Installation	Dia 800mm DIP	m	4,810	0	0	436.360	2,098,892	128,074,365	2,098,892	3.PK10 - PK14
Pipe Installation	Dia 1000mm DIP	m	6,070	0	0	549.140	3,333,280	203,396,733	3,333,280	4.PK11 - PK10
Pipe Installation	Dia 1400mm DIP	m	26,280	0	0	821.440	21,587,443	1,317,265,784	21,587,443	5.Plant - PK11
Pipe Fittings Installation		Ls	1		0		1,572,612	95,960,769	1,572,612	Sum of (1~5) x 5%
Pipe Connecting	Dia 400mm DIP	joint	477	0	0	110.000	52,470	3,201,719	52,470	2,860m/6m
Pipe Connecting	Dia 800mm DIP	joint	1,560	0	0	264.000	411,840	25,130,477	411,840	9,360m/6m
Pipe Connecting	Dia 800mm DIP	joint	802	0	0	264.000	211,728	12,919,643	211,728	4,810m6m
Pipe Connecting	Dia 1000mm DIP	joint	1,012	0	0	330.000	333,960	20,378,239	333,960	6,070m6m
Pipe Connecting	Dia 1400mm DIP	joint	4,380	0	0	660.000	2,890,800	176,396,616	2,890,800	26,280m/6m
Miscellaneous Works		Ls	1		0		3,692,564	225,320,284	3,692,564	Sum of other items x 10%
Total					0		40,269,918			
<b>Total (Rounded)</b>	<b>to L4</b>				<b>0</b>		<b>40,270,000</b>	<b>2,457,275,000</b>	<b>40,270,000</b>	<b>L4-1</b>
	FCP:LCP				0%		100%			

**L4-2 Valves Installation**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Air Valve Installation	Dia 100mm	pcs	6	0	0	550.000	3,300	201,366	3,300	2,860m/500m
Air Valve Installation	Dia 150mm	pcs	29	0	0	660.000	19,140	1,167,923	19,140	(9,360m+4810m)/500m
Air Valve Installation	Dia 200mm	pcs	64	0	0	770.000	49,280	3,007,066	49,280	(6,070m+26,280m)/500m
Butterfly Valve Installation	Dia 400mm	pcs	3	0	0	1,100.000	3,300	201,366	3,300	2,860m/1,000m
Butterfly Valve Installation	Dia 800mm	pcs	10	0	0	2,420.000	24,200	1,476,684	24,200	9,360m/1,000m
Butterfly Valve Installation	Dia 800mm	pcs	5	0	0	2,420.000	12,100	738,342	12,100	4,810m/1,000m
Butterfly Valve Installation	Dia 1000mm	pcs	12	0	0	2,970.000	35,640	2,174,753	35,640	6,070m/500m
Butterfly Valve Installation	Dia 1400mm	pcs	53	0	0	3,520.000	186,560	11,383,891	186,560	26,280m/500m
Gate Valve Installation	Dia 75mm	pcs	6	0	0	550.000	3,300	201,366	3,300	
Gate Valve Installation	Dia 150mm	pcs	29	0	0	660.000	19,140	1,167,923	19,140	
Gate Valve Installation	Dia 300mm	pcs	64	0	0	880.000	56,320	3,436,646	56,320	
MiscellaneousWorks		Ls	1		0		206,140	12,578,663	206,140	Sum of other items x 50%
Total					0		615,120			
<b>Total (Rounded)</b>	<b>to L4</b>				<b>0</b>		<b>615,000</b>	<b>37,527,000</b>	<b>615,000</b>	<b>L4-2</b>
	FCP:LCP				0%		100%			

**L4-3 Pipe Jacking**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pipe Jacking	Dia 400mm	lot	1	0	0	1,100.000	55,000	3,356,100	55,000	unit price x 50m/lot PK11 - Bou Merra
Pipe Jacking	Dia 800mm	lot	5	0	0	2,420.000	605,000	36,917,100	605,000	unit price x 50m/lot PK14 - SSEH
Pipe Jacking	Dia 800mm	lot	1	0	0	2,420.000	121,000	7,383,420	121,000	unit price x 50m/lot PK10 - PK14
Pipe Jacking	Dia 1000mm	lot	5	0	0	2,970.000	742,500	45,307,350	742,500	unit price x 50m/lot PK11 - PK10
Pipe Jacking	Dia 1400mm	lot	11	0	0	3,850.000	2,117,500	129,209,850	2,117,500	unit price x 50m/lot Plant - PK11
Other Works		Ls	1		0		728,200	44,434,764	728,200	Sum of Other Items x 20%
Total					0		4,369,200			
<b>Total (Rounded)</b>	<b>to L4</b>				<b>0</b>		<b>4,369,000</b>	<b>266,596,000</b>	<b>4,369,000</b>	<b>L4-3</b>
	FCP:LCP				0%		100%			

**L4-4 Surge Tank**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>1200 m3 (10m dia x 15m H)</b>	<b>1200m3/Tank x 2 tanks</b>									Plant - PK11
Structure	<b>2 tanks</b>	tank	2	0	0	1,031,000	2,062,000	125,823,240	2,062,000	L4-4-1
Piping	<b>for 2 tanks</b>	lot	2	20,215,000	40,430,000	100,000	200,000	52,634,000	862,570	L4-4-2
Total					40,430,000		2,262,000			
<b>Total (Rounded)</b>	<b>to L4</b>				<b>40,430,000</b>		<b>2,262,000</b>	<b>178,457,000</b>	<b>2,925,000</b>	<b>L4-4</b>
	FCP:LCP				23%		77%			

10.5-41

**L4-4-1 Structure of Surge Tank**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
1200 m3 (10m dia x 15m H)										
Excavation		m <sup>3</sup>	937	0	0	16.500	15,461	943,430	15,461	
Backfilling/Filling		m <sup>3</sup>	408	0	0	11.000	4,488	273,858	4,488	
Waste Soil Removal		m <sup>3</sup>	529	0	0	23.100	12,220	745,664	12,220	
Gravel		m <sup>3</sup>	35	0	0	74.800	2,618	159,750	2,618	
Waterproofing		m <sup>2</sup>	110	0	0	42.900	4,719	287,953	4,719	
Formwork		m <sup>2</sup>	1,758	0	0	62.700	110,227	6,726,052	110,227	
Lean Concrete		m <sup>3</sup>	17	0	0	440.000	7,480	456,430	7,480	
Reinforced Concrete		m <sup>3</sup>	686	0	0	935.000	641,410	39,138,838	641,410	
Scaffolding		m <sup>2</sup>	1,289	0	0	107.800	138,954	8,478,973	138,954	
Other Miscellaneous Works	incl. Rebar	Ls	1		0		93,758	5,721,095	93,758	Sum of above items x 10%
<b>Total</b>	1200 m3				0		1,031,335			for 1200m3
<b>Total (Rounded)</b>	<b>to L4-4</b>				<b>0</b>		<b>1,031,000</b>	<b>62,912,000</b>	<b>1,031,000</b>	<b>L4-4-1 per tank</b>
	FCP:LCP				0%		100%			

**L4-4-2 Piping for Surge Tank φ10x15m**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
piping for φ10x15m One-way Surge Tank										
Butterfly Valve Materials	Dia. 800mm	set	4	2,585,604	10,342,416	4,708.118	18,832	11,491,545	188,324	
Check Valve Materials	Dia. 800mm	set	2	2,585,604	5,171,208	4,708.118	9,416	5,745,772	94,162	
Pipe Materials	Dia. 800mm	m	30	22,095	662,856	40.233	1,207	736,507	12,070	
Pipe Materails	Dia. 600mm	m	100	14,018	1,401,809	25.526	2,553	1,557,593	25,526	
Butterfly Valve Installation	Dia. 800mm	set	4	0	0	2,420.000	9,680	590,674	9,680	
Check Valve Installation	Dia. 800mm	set	2	0	0	2,420.000	4,840	295,337	4,840	
Pipe Installation	Dia. 800mm	m	30	0	0	436.360	13,091	798,813	13,091	
Joint Connection	Dia. 800mm	joint	5	0	0	440.000	2,200	134,244	2,200	
Pipe Installation	Dia. 600mm	m	100	0	0	193.090	19,309	1,178,235	19,309	
Joint Connection	Dia. 600mm	joint	17	0	0	330.000	5,610	342,322	5,610	
Other Miscellaneous Works	15%	lot	1		2,636,743		13,011	3,430,656	56,222	15% of above total
<b>Total</b>					20,215,032		99,749			
<b>Total (Rounded)</b>	<b>to L4-4</b>				<b>20,215,000</b>		<b>100,000</b>	<b>26,317,000</b>	<b>431,000</b>	<b>L4-4-2 per Tank</b>
	FCP:LCP				77%		23%			

**L5 Reservoirs Construction**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Mixing Chamber (PK11)		Ls	1		0		1,501,000	91,591,020	1,501,000	L5-1
Mixing Chamber (Bou Merra)		Ls	1		0		281,000	17,146,620	281,000	L5-2
Mixing Chamber (PK10)		Ls	1		0		560,000	34,171,200	560,000	L5-3
Mixing Chamber (PK14)		Ls	1		0		472,000	28,801,440	472,000	L5-4
Mixing Chamber (Sidi Salah EH)		Ls	1		0		319,000	19,465,380	319,000	L5-5
Distribution Reservoir (Bou Merra, V=5,000 m3)		Ls	1		0		1,890,000	115,327,800	1,890,000	L5-6
<b>Total</b>					0		5,023,000			
<b>Total Cost (Rounded)</b>	<b>to T1</b>				<b>0</b>		<b>5,023,000</b>	<b>306,503,000</b>	<b>5,023,000</b>	<b>L5</b>
	FCP:LCP				0%		100%			

**L5-1 Mixing Chamber (PK11)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	280	0	0	16.500	4,620	281,912	4,620	
Backfilling/Filling		m <sup>3</sup>	5048	0	0	11.000	55,528	3,388,319	55,528	
Waste Soil Removal		m <sup>3</sup>	230	0	0	23.100	5,313	324,199	5,313	
Gravel		m <sup>3</sup>	59	0	0	74.800	4,413	269,281	4,413	
Waterproofing		m <sup>2</sup>	582	0	0	42.900	24,968	1,523,547	24,968	
Formwork		m <sup>2</sup>	2280	0	0	62.700	142,956	8,723,175	142,956	
Lean Concrete		m <sup>3</sup>	29	0	0	440.000	12,760	778,615	12,760	
Reinforced Concrete		m <sup>3</sup>	970	0	0	935.000	906,950	55,342,089	906,950	
Reinforcement Bar		ton	97.0	0	0	1320.000	128,040	7,813,001	128,040	100kg/m3
Scaffolding		m <sup>2</sup>	729	0	0	107.800	78,586	4,795,318	78,586	
Other Miscellaneous Works		Ls	1		0		136,413	8,323,946	136,413	above items x 10%
Above quantities includes those for Valve Chamber										
Total					0		1,500,547			
<b>Total Cost (Rounded)</b>	<b>to L5</b>				<b>0</b>		<b>1,501,000</b>	<b>91,591,000</b>	<b>1,501,000</b>	<b>L5-1</b>
	FCP:LCP				0%		100%			

10.5-45



**L5-2 Mixing Chamber (Bou Merra)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	183	0	0	16.500	3,020	184,280	3,020	
Backfilling/Filling		m <sup>3</sup>	48	0	0	11.000	528	32,219	528	
Waste Soil Removal		m <sup>3</sup>	136	0	0	23.100	3,142	191,725	3,142	
Gravel		m <sup>3</sup>	15	0	0	74.800	1,122	68,464	1,122	
Waterproofing		m <sup>2</sup>	165	0	0	42.900	7,079	431,961	7,079	
Formwork		m <sup>2</sup>	670	0	0	62.700	42,009	2,563,389	42,009	
Lean Concrete		m <sup>3</sup>	7	0	0	440.000	3,080	187,942	3,080	
Reinforced Concrete		m <sup>3</sup>	159	0	0	935.000	148,665	9,071,538	148,665	
Reinforcement Bar		ton	15.9	0	0	1320.000	20,988	1,280,688	20,988	100kg/m3
Scaffolding		m <sup>2</sup>	243	0	0	107.800	26,195	1,598,419	26,195	
Other Miscellaneous Works		Ls	1		0		25,583	1,561,062	25,583	Sum of above items 10%
Above quantities includes those for Valve Chamber										
Total					0		281,411			
<b>Total Cost (Rounded)</b>	<b>to L5</b>				<b>0</b>		<b>281,000</b>	<b>17,147,000</b>	<b>281,000</b>	<b>L5-2</b>
	FCP:LCP				0%		100%			

10.5-46

**L5-3 Mixing Chamber (PK10)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	93	0	0	16.500	1,535	93,666	1,535	
Backfilling/Filling		m <sup>3</sup>	393	0	0	11.000	4,323	263,789	4,323	
Waste Soil Removal		m <sup>3</sup>	72	0	0	23.100	1,663	101,476	1,663	
Gravel		m <sup>3</sup>	31	0	0	74.800	2,319	141,505	2,319	
Waterproofing		m <sup>2</sup>	339	0	0	42.900	14,543	887,414	14,543	
Formwork		m <sup>2</sup>	1,122	0	0	62.700	70,349	4,292,696	70,349	
Lean Concrete		m <sup>3</sup>	16	0	0	440.000	7,040	429,581	7,040	
Reinforced Concrete		m <sup>3</sup>	343	0	0	935.000	320,705	19,569,419	320,705	
Reinforcement Bar		ton	34.3	0	0	1320.000	45,276	2,762,742	45,276	100kg/m3
Scaffolding		m <sup>2</sup>	387	0	0	107.800	41,719	2,545,693	41,719	
Other Miscellaneous Works		Ls	1		0		50,947	3,108,798	50,947	Sum of above items x 10%
Above quantities includes those for Valve Chamber										
Total					0		560,419			
<b>Total Cost (Rounded)</b>	<b>to L5</b>				<b>0</b>		<b>560,000</b>	<b>34,171,000</b>	<b>560,000</b>	<b>L5-3</b>
	FCP:LCP				0%		100%			

10.5-47

**L5-4 Mixing Chamber (PK14)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	93	0	0	16.500	1,535	93,666	1,535	
Backfilling/Filling		m <sup>3</sup>	465	0	0	11.000	5,115	312,117	5,115	
Waste Soil Removal		m <sup>3</sup>	72	0	0	23.100	1,663	101,476	1,663	
Gravel		m <sup>3</sup>	26	0	0	74.800	1,945	118,684	1,945	
Waterproofing		m <sup>2</sup>	272	0	0	42.900	11,669	712,042	11,669	
Formwork		m <sup>2</sup>	962	0	0	62.700	60,317	3,680,543	60,317	
Lean Concrete		m <sup>3</sup>	13	0	0	440.000	5,720	349,034	5,720	
Reinforced Concrete		m <sup>3</sup>	285	0	0	935.000	266,475	16,260,305	266,475	
Reinforcement Bar		ton	28.5	0	0	1320.000	37,620	2,295,572	37,620	100kg/m3
Scaffolding		m <sup>2</sup>	342	0	0	107.800	36,868	2,249,685	36,868	
Other Miscellaneous Works		Ls	1		0		42,893	2,617,313	42,893	Sum of above items x 10%
Above quantities includes those for Valve Chamber										
Total					0		471,820			
<b>Total Cost (Rounded)</b>	<b>to L5</b>				<b>0</b>		<b>472,000</b>	<b>28,801,000</b>	<b>472,000</b>	<b>L5-4</b>
	FCP:LCP				0%		100%			

10.5-48

**L5-5 Mixing Chamber (Sidi Salah EH)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	248	0	0	16.500	4,092	249,694	4,092	
Backfilling/Filling		m <sup>3</sup>	48	0	0	11.000	528	32,219	528	
Waste Soil Removal		m <sup>3</sup>	200	0	0	23.100	4,620	281,912	4,620	
Gravel		m <sup>3</sup>	19	0	0	74.800	1,421	86,709	1,421	
Waterproofing		m <sup>2</sup>	196	0	0	42.900	8,408	513,056	8,408	
Formwork		m <sup>2</sup>	754	0	0	62.700	47,276	2,884,782	47,276	
Lean Concrete		m <sup>3</sup>	10	0	0	440.000	4,400	268,488	4,400	
Reinforced Concrete		m <sup>3</sup>	178	0	0	935.000	166,430	10,155,559	166,430	
Reinforcement Bar		t	18	0	0	1320.000	23,496	1,433,726	23,496	100kg/m3
Scaffolding		m <sup>2</sup>	275	0	0	107.800	29,645	1,808,938	29,645	
Other Miscellaneous Works	incl. Rebar	Ls	1		0		29,032	1,771,508	29,032	Sum of above items x 10%
Above quantities includes those for Valve Chamber										
Total					0		319,348			
<b>Total Cost (Rounded)</b>	<b>to L5</b>				<b>0</b>		<b>319,000</b>	<b>19,465,000</b>	<b>319,000</b>	<b>L5-5</b>
	FCP:LCP				0%		100%			

**L5-6 Distribution Reservoir (Bou Merra, V=5,000m3)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pile Driving Work		m	0	0	0	110.000	0	0	0	
Pile Head Treatment		pcs	0	0	0	6.600	0	0	0	
Excavation		m <sup>3</sup>	2,036	0	0	16.500	33,594	2,049,906	33,594	
Backfilling		m <sup>3</sup>	428	0	0	11.000	4,708	287,282	4,708	
Surplus Soil Transport		m <sup>3</sup>	1,608	0	0	23.100	37,145	2,266,576	37,145	
Gravel		m <sup>3</sup>	241	0	0	74.800	18,027	1,099,995	18,027	
Concrete		m <sup>3</sup>	161	0	0	440.000	70,840	4,322,657	70,840	structure
Reinforced Concrete		m <sup>3</sup>	930	0	0	935.000	869,550	53,059,941	869,550	structure
Formwork		m <sup>2</sup>	3,500	0	0	62.700	219,450	13,390,839	219,450	structure
Rebar Fabrication and Assembly		t	158	0	0	1320.000	208,692	12,734,386	208,692	Rebar/Concrete = 170kg/m3
Waterproofing		m <sup>2</sup>	1,500	0	0	42.900	64,350	3,926,637	64,350	
Scaffolding		m <sup>2</sup>	200	0	0	107.800	21,560	1,315,591	21,560	
Other Miscellaneous Works		Ls	1				342,133	20,876,956	342,133	Structure x 25%
Total					0		1,890,049			
<b>Total Cost (Rounded)</b>	<b>to L5</b>				<b>0</b>		<b>1,890,000</b>	<b>115,328,000</b>	<b>1,890,000</b>	<b>L5-6</b>
	FCP:LCP				0%		100%			

10.5-50

**Lot 6 Pump Facilities Construction (ICB)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
PK11 (for PK10 & Bou Merra)		Ls	1		789,808,000		6,059,000	1,159,528,180	19,002,428	L6-1
PK10 (for PK14)		Ls	1		469,333,000		4,543,000	746,546,860	12,234,462	L6-2
Pk14 (for Sidi Salah EH)		Ls	1		306,074,000		3,167,000	499,324,340	8,182,962	L6-3
<b>Total</b>					1,565,215,000		13,769,000			
<b>Total Cost (Rounded)</b>	<b>to T1</b>				<b>1,565,215,000</b>		<b>13,769,000</b>	<b>2,405,399,000</b>	<b>39,420,000</b>	<b>L6</b>
	FCP:LCP				65%		35%			

10.5-51

**L6-1 Pumping Facilities (PK11)**

Exchange Rate: 1.00US\$= 119.60JPY      1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pumping Station		Ls	1		0		3,070,000	187,331,400	3,070,000	L6-1-1
Sub-Station		Ls	1		0		706,000	43,080,120	706,000	L6-1-2
Mechanical Work (incl. Air Chamber)		Ls	1		423,054,000		1,223,000	497,681,460	8,156,038	L6-1-3
Electrical Work		Ls	1		366,754,000		1,060,000	431,435,200	7,070,390	L6-1-4
Total					789,808,000		6,059,000			
<b>Total Cost (Rounded)</b>	<b>to L6</b>				<b>789,808,000</b>		<b>6,059,000</b>	<b>1,159,528,000</b>	<b>19,002,000</b>	<b>L6-1</b>
	FCP:LCP				68%		32%			

**L6-1-1 Pump Station (PK11)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	5,928	0	0	16.500	97,812	5,968,488	97,812	
Backfilling/Filling		m <sup>3</sup>	2,862	0	0	11.000	31,482	1,921,032	31,482	
Waste Soil Removal		m <sup>3</sup>	3,066	0	0	23.100	70,825	4,321,742	70,825	
Gravel		m <sup>3</sup>	180	0	0	74.800	13,464	821,573	13,464	
Waterproofing		m <sup>2</sup>	726	0	0	42.900	31,145	1,900,468	31,145	
Formwork		m <sup>2</sup>	5,702	0	0	62.700	357,515	21,815,565	357,515	
Lean Concrete		m <sup>3</sup>	266	0	0	440.000	117,040	7,141,781	117,040	
Reinforced Concrete		m <sup>3</sup>	1,665	0	0	935.000	1,556,775	94,994,411	1,556,775	
Scaffolding		m <sup>2</sup>	3,540	0	0	107.800	381,612	23,285,964	381,612	
Other Miscellaneous Works	incl. Rebar	Ls	1		0		265,767	16,217,102	265,767	Sum of above items x 10%
Engineering Cost		Ls	1		0		146,172	8,919,406	146,172	Sum of other items x 5%
<b>Total</b>					0		3,069,609			
<b>Sub-Total (rounded)</b>	<b>to L6-1</b>				<b>0</b>		<b>3,070,000</b>	<b>187,331,000</b>	<b>3,070,000</b>	<b>L6-1-1</b>
	FCP:LCP				0%		100%			

10.5-53



**L6-1-2 Sub-station (PK11)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	248	0	0	16.500	4,092	249,694	4,092	
Backfilling/Filling		m <sup>3</sup>	57	0	0	11.000	627	38,260	627	
Waste Soil Removal		m <sup>3</sup>	191	0	0	23.100	4,412	269,220	4,412	
Gravel		m <sup>3</sup>	66	0	0	74.800	4,937	301,256	4,937	
Waterproofing		m <sup>2</sup>	366	0	0	42.900	15,701	958,075	15,701	
Formwork		m <sup>2</sup>	1,627	0	0	62.700	102,013	6,224,833	102,013	
Lean Concrete		m <sup>3</sup>	121	0	0	440.000	53,240	3,248,705	53,240	
Reinforced Concrete		m <sup>3</sup>	323	0	0	935.000	302,005	18,428,345	302,005	
Scaffolding		m <sup>2</sup>	1,156	0	0	107.800	124,617	7,604,129	124,617	
Other Miscellaneous Works	incl. Rebar	Ls	1		0		61,164	3,732,252	61,164	Sum of above items x 10%
Engineering Cost		Ls	1		0		33,640	2,052,738	33,640	Sum of other items x 5%
Total					0		706,449			
<b>Total Cost (Rounded)</b>	<b>to L6-1</b>				<b>0</b>		<b>706,000</b>	<b>43,080,000</b>	<b>706,000</b>	<b>L6-1-2</b>
	FCP:LCP				0%		100%			

10.5-54

**L6-1-3 Mechanical Facility for PK11 Pump Station**

Foreign Portion: 85%, Local Portion: 15% (Installation)

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Intermediate transmission pump station</b>										
<b>PK11-1</b>	PK11-B,Merra									
Transmission Pump	6.7m3/min x 61m	set	3	37,095,000	111,285,000	107,000	321,000	130,872,000	2,144,739	
Inlet Valve	Dia. 300mm	set	3	910,000	2,730,000	3,000	9,000	3,279,000	53,736	
Check Valve	Dia. 200 mm	set	3	224,000	672,000	1,000	3,000	855,000	14,012	
Discharge Valve	Dia. 200 mm	set	3	2,142,000	6,426,000	6,000	18,000	7,524,000	123,304	Motorized
Maintenance Valve	Dia. 200 mm	set	3	570,000	1,710,000	1,600	4,800	2,003,000	32,825	
Maintenance Valve	Dia. 400 mm	set	2	1,420,000	2,840,000	4,000	8,000	3,328,000	54,539	Butterfly Valve
Pipes		lot	1	18,849,000	18,849,000	55,000	55,000	22,205,000	363,897	
<b>sub-total</b>					<b>144,512,000</b>		<b>418,800</b>	<b>170,066,000</b>	<b>2,787,053</b>	
<b>Air Chamber (Mechanical)</b>	<b>approx, 3m3 ( φ 1.5 x 1.7m)</b>	<b>lot</b>	<b>1</b>		<b>3,213,000</b>		<b>9,292</b>	<b>3,780,000</b>	<b>61,947</b>	

**L6-1-3 Mechanical Facility for PK11 Pump Station**

Foreign Portion: 85%, Local Portion: 15% (Installation)

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>PK11-2</b>	PK11-PK10									
Transmission Pump	37.1m3/min x 38m	set	4	46,369,000	185,476,000	134,000	536,000	218,183,000	3,575,598	
Inlet Valve	Dia. 500 mm	set	4	1,845,000	7,380,000	5,000	20,000	8,600,000	140,937	
Check Valve	Dia. 500 mm	set	4	2,769,000	11,076,000	8,000	32,000	13,029,000	213,520	
Discharge Valve	Dia. 500 mm	set	4	3,668,000	14,672,000	11,000	44,000	17,357,000	284,448	Motorized
Maintenance Valve	Dia. 500 mm	set	4	1,845,000	7,380,000	5,000	20,000	8,600,000	140,937	
Maintenance Valve	Dia. 1000 mm	set	2	5,900,000	11,800,000	17,000	34,000	13,875,000	227,384	Butterfly Valve
Pump Lifting Equipment	Suspension crane : 3.2ton	set	1	1,632,000	1,632,000	5,000	5,000	1,937,000	31,744	
Pipes		lot	1	35,913,000	35,913,000	104,000	104,000	42,259,000	692,543	
<b>sub-total</b>					<b>275,329,000</b>		<b>795,000</b>	<b>323,840,000</b>	<b>5,307,112</b>	
Total					423,054,000		1,223,092			
<b>Total (Rounded)</b>	<b>to L6-1</b>				<b>423,054,000</b>		<b>1,223,000</b>	<b>497,681,000</b>	<b>8,156,000</b>	<b>L6-1-3</b>
	FCP:LCP				85%		15%			

10.5-56

**L6-1-4 Electrical Facility for PK11 Pump Station**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>PK-11</b>										
<b>30kV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>32,640,000</b>		<b>94,396</b>	<b>38,400,000</b>	<b>629,302</b>	<b>a.</b>
30kV DS, LA Panel		set	1	4,250,000	4,250,000	12,291	12,291	5,000,000	81,940	DS: Disconnecting Switch LA: Lightning Arrester
30kV VT Panel		set	1	4,250,000	4,250,000	12,291	12,291	5,000,000	81,940	VT: Voltage Transformer
30kV VCB Panel		set	2	7,225,000	14,450,000	20,895	41,790	17,000,000	278,597	VCB: Vacuum Circuit Breaker
30kV/400V Transformer	oil type 2MVA	set	1	9,690,000	9,690,000	28,024	28,024	11,400,000	186,824	
<b>LV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>71,527,500</b>		<b>206,857</b>	<b>84,150,000</b>	<b>1,379,056</b>	<b>b.</b>
LV Main Switchgear	5 units	set	1	11,050,000	11,050,000	31,957	31,957	13,000,000	213,045	LV: Low Voltage
Transmission Pump for Bou Merra	400V VFD 132kW	set	3	3,060,000	9,180,000	8,850	26,550	10,800,000	176,991	VFD: Variable Frequency Drive
Transmission Pump for PK-10	400V VFD 355kW	set	4	7,820,000	31,280,000	22,616	90,464	36,800,000	603,081	
MCC for Transmission-1	6 units	set	1	17,467,500	17,467,500	50,516	50,516	20,550,000	336,775	MCC: Motor Control Centre
Local Panel		set	10	255,000	2,550,000	737	7,370	3,000,000	49,164	
<b>Instrumentation &amp; Monitoring</b>		<b>Ls</b>	<b>1</b>		<b>67,745,000</b>		<b>195,922</b>	<b>79,700,000</b>	<b>1,306,129</b>	<b>c.</b>
Transmission Flow	electro-magnetic 1400mm	set	1	7,820,000	7,820,000	22,616	22,616	9,200,000	150,770	
Transmission Flow	electro-magnetic 1000mm	set	1	5,270,000	5,270,000	15,241	15,241	6,200,000	101,606	
Transmission Flow	electro-magnetic 400mm	set	1	2,125,000	2,125,000	6,146	6,146	2,500,000	40,970	
Water Level	Ultrasonic	set	6	680,000	4,080,000	1,967	11,802	4,800,000	78,663	
Water Quality	Turbidity, pH, Res. Chlorine Electric Conductivity	set	9	1,275,000	11,475,000	3,687	33,183	13,500,000	221,239	Inflow: TDS x 5, Outflow:
Instrumentation Panel		set	1	2,550,000	2,550,000	7,375	7,375	3,000,000	49,164	
PLC Panel		lot	2	6,375,000	12,750,000	18,437	36,874	15,000,000	245,821	PLC: Programmable Logic Controller
Telemetry System	Plant-PK11, PK11-PK10, PK11-Bou Merra	lot	3	6,800,000	20,400,000	19,666	58,998	24,000,000	393,314	

10.5-57

**L6-1-4 Electrical Facility for PK11 Pump Station**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<i>UPS</i>	<i>10kVA</i>	<i>set</i>	<i>1</i>	<i>1,275,000</i>	<i>1,275,000</i>	<i>3,687</i>	<i>3,687</i>	<i>1,500,000</i>	<i>24,582</i>	UPS: Uninterruptive Power Supply
<b>Emergency Power Facilities</b>		<b>Ls</b>	<b>1</b>		<b>161,500,000</b>		<b>467,060</b>	<b>190,000,000</b>	<b>3,113,733</b>	<b>d.</b>
<i>Stand-by Generator</i>	<i>Diesel 2500kVA</i>	<i>set</i>	<i>1</i>	<i>161,500,000</i>	<i>161,500,000</i>	<i>467,060</i>	<i>467,060</i>	<i>190,000,000</i>	<i>3,113,733</i>	
<b>Other Miscellaneous Works</b>		<b>Ls</b>	<b>1</b>		<b>33,341,000</b>		<b>96,000</b>	<b>39,199,000</b>	<b>642,396</b>	Sum of (a~d) x 10%
<b>Total</b>					366,753,500		1,060,235			
<b>Total (Rounded)</b>	<b>to L6-1</b>				<b>366,754,000</b>		<b>1,060,000</b>	<b>431,435,000</b>	<b>7,070,000</b>	<b>L6-1-4</b>
	FCP:LCP				85%		15%			

10.5-58

**L6-2 Pumping Facilities (PK10)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pumping Station		Ls	1		0		1,580,000	96,411,600	1,580,000	L6-2-1
Sub-Station		Ls	1		0		706,000	43,080,120	706,000	L6-2-2
Mechanical Work (incl. Air Chamber)		Ls	1		228,523,000		663,000	268,979,000	4,408,047	L6-2-3
Electrical Work		Ls	1		240,810,000		1,594,000	338,075,880	5,540,411	L6-2-4
Total					469,333,000		4,543,000			
<b>Total Cost (Rounded)</b>	<b>to L6</b>				<b>469,333,000</b>		<b>4,543,000</b>	<b>746,547,000</b>	<b>12,234,000</b>	<b>L6-2</b>
	FCP:LCP				63%		37%			

**L6-2-1 Pump Station (PK10)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	2,874	0	0	16.500	47,421	2,893,629	47,421	
Backfilling/Filling		m <sup>3</sup>	1,477	0	0	11.000	16,247	991,392	16,247	
Waste Soil Removal		m <sup>3</sup>	1,398	0	0	23.100	32,294	1,970,580	32,294	
Gravel		m <sup>3</sup>	80	0	0	74.800	5,984	365,144	5,984	
Waterproofing		m <sup>2</sup>	462	0	0	42.900	19,820	1,209,416	19,820	
Formwork		m <sup>2</sup>	3,056	0	0	62.700	191,611	11,692,103	191,611	
Lean Concrete		m <sup>3</sup>	119	0	0	440.000	52,360	3,195,007	52,360	
Reinforced Concrete		m <sup>3</sup>	828	0	0	935.000	774,180	47,240,464	774,180	
Scaffolding		m <sup>2</sup>	2,115	0	0	107.800	227,997	13,912,377	227,997	
Other Miscellaneous Works	incl. Rebar	Ls	1		0		136,791	8,347,011	136,791	Sum of above items x 10%
Engineering Cost		Ls	1		0		75,235	4,590,856	75,235	Sum of other items x 5%
Total					0		1,579,941			
<b>Sub-Total (rounded)</b>	<b>to L6-2</b>				<b>0</b>		<b>1,580,000</b>	<b>96,412,000</b>	<b>1,580,000</b>	<b>L6-2-1</b>
	FCP:LCP				0%		100%			

10.5-60

**L6-2-2 Sub-station (PK10)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	248	0	0	16.500	4,092	249,694	4,092	
Backfilling/Filling		m <sup>3</sup>	57	0	0	11.000	627	38,260	627	
Waste Soil Removal		m <sup>3</sup>	191	0	0	23.100	4,412	269,220	4,412	
Gravel		m <sup>3</sup>	66	0	0	74.800	4,937	301,256	4,937	
Waterproofing		m <sup>2</sup>	366	0	0	42.900	15,701	958,075	15,701	
Formwork		m <sup>2</sup>	1,627	0	0	62.700	102,013	6,224,833	102,013	
Lean Concrete		m <sup>3</sup>	121	0	0	440.000	53,240	3,248,705	53,240	
Reinforced Concrete		m <sup>3</sup>	323	0	0	935.000	302,005	18,428,345	302,005	
Scaffolding		m <sup>2</sup>	1,156	0	0	107.800	124,617	7,604,129	124,617	
Other Miscellaneous Works	incl. Rebar	Ls	1		0		61,164	3,732,252	61,164	Sum of above items 10%
Engineering Cost		Ls	1		0		33,640	2,052,738	33,640	Sum of other items x 5%
Total					0		706,449			
<b>Total Cost (Rounded)</b>	<b>to L6-2</b>				<b>0</b>		<b>706,000</b>	<b>43,080,000</b>	<b>706,000</b>	<b>L6-2-2</b>
	FCP:LCP				0%		100%			

10.5-61



**L6-2-3 Mechanical Facility for PK10 Pump Station** Foreign Portion: 85%, Local Portion: 15% (Installation) Exchange Rate: 1.00US\$= 119.60JPY .000TND= 61.02JPY

Items	Specification	Unit	Qt'ly	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Intermediate transmission pump station</b>										
<b>PK10</b>	PK10 - PK14									
Transmission Pump	32.9m3/min x 53m	set	3	52,165,000	156,495,000	151,000	453,000	184,137,000	3,017,650	
Inlet Valve	Dia. 450mm	set	3	1,704,000	5,112,000	5,000	15,000	6,027,000	98,771	
Check Valve	Dia. 300mm	set	3	347,000	1,041,000	1,000	3,000	1,224,000	20,059	
Discharge Valve	Dia. 300mm	set	3	2,380,000	7,140,000	7,000	21,000	8,421,000	138,004	Motorized
Maintenance Valve	Dia. 300mm	set	3	612,000	1,836,000	2,000	6,000	2,202,000	36,087	
Maintenance Valve	Dia. 600 mm	set	2	2,367,000	4,734,000	7,000	14,000	5,588,000	91,577	Butterfly Valve
Maintenance Valve	Dia. 800 mm	set	1	3,551,000	3,551,000	10,000	10,000	4,161,000	68,191	Butterfly Valve
Pump Lifting Equipment	Suspension crane : 5.0ton	set	1	19,270,000	19,270,000	56,000	56,000	22,687,000	371,796	
Pipes		lot	1	29,344,000	29,344,000	85,000	85,000	34,531,000	565,896	
Total					228,523,000		663,000			
<b>Total (Rounded)</b>	<b>to L6-2</b>				<b>228,523,000</b>		<b>663,000</b>	<b>268,979,000</b>	<b>4,408,000</b>	<b>L6-2-3</b>
	FCP:LCP				85%		15%			

10.5-62

**L6-2-4 Electrical Facility for PK10 Pump Station**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>PK-10</b>										
<b>30kV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>32,640,000</b>		<b>94,396</b>	<b>38,400,000</b>	<b>629,302</b>	<b>a.</b>
30kV DS, LA Panel		set	1	4,250,000	4,250,000	12,291	12,291	5,000,000	81,940	DS: Disconnecting Switch LA: Lightning Arrester
30kV VT Panel		set	1	4,250,000	4,250,000	12,291	12,291	5,000,000	81,940	VT: Voltage Transformer
30kV VCB Panel		set	2	7,225,000	14,450,000	20,895	41,790	17,000,000	278,597	VCB: Vacuum Circuit Breaker
30kV/400V Transformer	oil type 2MVA	set	1	9,690,000	9,690,000	28,024	28,024	11,400,000	186,824	
<b>LV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>61,412,500</b>		<b>993,975</b>	<b>122,065,000</b>	<b>2,000,410</b>	<b>b.</b>
LV Main Switchgear	5 units	set	1	11,050,000	11,050,000	31,957	31,957	13,000,000	213,045	LV: Low Voltage
Transmission Pump for PK-14	400V VFD 450kW	set	3	10,455,000	31,365,000	302,360	907,080	86,715,000	1,421,091	VFD: Variable Frequency Drive
MCC for Transmission-1	6 units	set	1	17,467,500	17,467,500	50,516	50,516	20,550,000	336,775	MCC: Motor Control Centre
Local Panel		set	6	255,000	1,530,000	737	4,422	1,800,000	29,499	
<b>Instrumentation &amp; Monitoring</b>		<b>Ls</b>	<b>1</b>		<b>35,615,000</b>		<b>102,999</b>	<b>41,900,000</b>	<b>686,660</b>	<b>c.</b>
Transmission Flow	electro-magnetic 1000mm	set	1	5,270,000	5,270,000	15,241	15,241	6,200,000	101,606	
Transmission Flow	electro-magnetic 800mm	set	1	4,335,000	4,335,000	12,537	12,537	5,100,000	83,579	
Water Level	Ultrasonic	set	2	680,000	1,360,000	1,967	3,934	1,600,000	26,221	
Water Quality	Turbidity, pH, Res. Chlorine Electric Conductivity	set	6	1,275,000	7,650,000	3,687	22,122	9,000,000	147,493	Inflow: TDS x 2, Outflow: 4
Instrumentation Panel		set	1	2,550,000	2,550,000	7,375	7,375	3,000,000	49,164	
PLC Panel		lot	1	6,375,000	6,375,000	18,437	18,437	7,500,000	122,911	PLC: Programmable Logic
Telemetry System	PK10-PK14	lot	1	6,800,000	6,800,000	19,666	19,666	8,000,000	131,105	
UPS	10kVA	set	1	1,275,000	1,275,000	3,687	3,687	1,500,000	24,582	UPS: Uninterruptive Power Supply

**L6-2-4 Electrical Facility for PK10 Pump Station**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'ry	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Emergency Power Facilities</b>		<b>Ls</b>	<b>1</b>		<b>89,250,000</b>		<b>258,112</b>	<b>105,000,000</b>	<b>1,720,747</b>	
Stand-by Generator	Diesel 1250kVA	set	1	89,250,000	89,250,000	258,112	258,112	105,000,000	1,720,747	
<b>Other Miscellaneous Works</b>		<b>Ls</b>	<b>1</b>		<b>21,892,000</b>		<b>145,000</b>	<b>30,740,000</b>	<b>503,769</b>	Sum of (a~d) x 10%
<b>Total</b>					240,809,500		1,594,482			
<b>Total (Rounded)</b>	<b>to L6-2</b>				<b>240,810,000</b>		<b>1,594,000</b>	<b>338,076,000</b>	<b>5,540,000</b>	<b>L6-2-4</b>
	FCP:LCP				71%		29%			

**L6-3 Pumping Facilities (PK14)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Pumping Station		Ls	1		0		1,580,000	96,411,600	1,580,000	L6-3-1
Sub-Station		Ls	1		0		706,000	43,080,120	706,000	L6-3-2
Mechanical Work (incl. Air Chamber)		Ls	1		106,124,000		303,000	124,613,060	2,042,167	L6-3-3
Electrical Work		Ls	1		199,950,000		578,000	235,219,560	3,854,794	L6-3-4
<b>Total</b>					306,074,000		3,167,000			
<b>Total Cost (Rounded)</b>	<b>to L6</b>				<b>306,074,000</b>		<b>3,167,000</b>	<b>499,324,000</b>	<b>8,183,000</b>	<b>L6-3</b>
	FCP:LCP				61%		39%			

**L6-3-1 Pump Station (PK14)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	2,874	0	0	16.500	47,421	2,893,629	47,421	
Backfilling/Filling		m <sup>3</sup>	1,477	0	0	11.000	16,247	991,392	16,247	
Waste Soil Removal		m <sup>3</sup>	1,398	0	0	23.100	32,294	1,970,580	32,294	
Gravel		m <sup>3</sup>	80	0	0	74.800	5,984	365,144	5,984	
Waterproofing		m <sup>2</sup>	462	0	0	42.900	19,820	1,209,416	19,820	
Formwork		m <sup>2</sup>	3,056	0	0	62.700	191,611	11,692,103	191,611	
Lean Concrete		m <sup>3</sup>	119	0	0	440.000	52,360	3,195,007	52,360	
Reinforced Concrete		m <sup>3</sup>	828	0	0	935.000	774,180	47,240,464	774,180	
Scaffolding		m <sup>2</sup>	2,115	0	0	107.800	227,997	13,912,377	227,997	
Other Miscellaneous Works	incl. Rebar	Ls	1		0		136,791	8,347,011	136,791	Sum of above items x 10%
Engineering Cost		Ls	1		0		75,235	4,590,856	75,235	Sum of other items x 5%
<b>Total</b>					0		1,579,941			
<b>Sub-Total (rounded)</b>	<b>to L6-3</b>				<b>0</b>		<b>1,580,000</b>	<b>96,412,000</b>	<b>1,580,000</b>	<b>L6-3-1</b>
	FCP:LCP				0%		100%			

10.5-66

**L6-3-2 Sub-station (PK14)**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qty	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
Excavation		m <sup>3</sup>	248	0	0	16.500	4,092	249,694	4,092	
Backfilling/Filling		m <sup>3</sup>	57	0	0	11.000	627	38,260	627	
Waste Soil Removal		m <sup>3</sup>	191	0	0	23.100	4,412	269,220	4,412	
Gravel		m <sup>3</sup>	66	0	0	74.800	4,937	301,256	4,937	
Waterproofing		m <sup>2</sup>	366	0	0	42.900	15,701	958,075	15,701	
Formwork		m <sup>2</sup>	1,627	0	0	62.700	102,013	6,224,833	102,013	
Lean Concrete		m <sup>3</sup>	121	0	0	440.000	53,240	3,248,705	53,240	
Reinforced Concrete		m <sup>3</sup>	323	0	0	935.000	302,005	18,428,345	302,005	
Scaffolding		m <sup>2</sup>	1,156	0	0	107.800	124,617	7,604,129	124,617	
Other Miscellaneous Works	incl. Rebar	Ls	1		0		61,164	3,732,252	61,164	Sum of above items x 10%
Engineering Cost		Ls	1		0		33,640	2,052,738	33,640	Sum of other items x 5%
<b>Total</b>					0		706,449			
<b>Total Cost (Rounded)</b>	<b>to L6-3</b>				<b>0</b>		<b>706,000</b>	<b>43,080,000</b>	<b>706,000</b>	<b>L6-3-2</b>
	FCP:LCP				0%		100%			

10.5-67

**L6-3-3 Mechanical Facility for PK14 Pump Station**

Exchange Rate: 1.00US\$= 119.60JPY .000TND= 61.02JPY

Items	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
<b>Intermediate transmission pump station</b>										
<b>PK14</b>	PK14-S,Salah H									
Transmission Pump	22.8m3/min x 38m	set	3	16,529,000	49,587,000	48,000	144,000	58,374,000	956,637	
Inlet Valve	Dia. 450mm	set	3	1,420,000	4,260,000	4,000	12,000	4,992,000	81,809	
Check Valve	Dia. 300mm	set	3	1,188,000	3,564,000	3,000	9,000	4,113,000	67,404	
Discharge Valve	Dia. 300mm	set	3	2,881,000	8,643,000	8,000	24,000	10,107,000	165,634	Motorized
Maintenance Valve	Dia. 300mm	set	3	1,204,000	3,612,000	3,000	9,000	4,161,000	68,191	
Maintenance Valve	Dia. 500 mm	set	2	2,367,000	4,734,000	7,000	14,000	5,588,000	91,577	Butterfly Valve
Maintenance Valve	Dia. 700 mm	set	1	2,841,000	2,841,000	8,000	8,000	3,329,000	54,556	Butterfly Valve
Pump Lifting Equipment	Suspension crane : 3.2ton	lot	1	15,720,000	15,720,000	45,000	45,000	18,466,000	302,622	
Pipes		set	1	13,163,000	13,163,000	38,000	38,000	15,482,000	253,720	
Total					106,124,000		303,000			
<b>Total (Rounded)</b>	<b>to L6-3</b>				<b>106,124,000</b>		<b>303,000</b>	<b>124,613,000</b>	<b>2,042,000</b>	<b>L6-3-3</b>
	FCP:LCP				85%		15%			

10.5-68

**L6-3-4 Electrical Facility for PK14 Pump Station**

Exchange Rate: 1.00US\$= 119.60JPY

1.000TND= 61.02JPY

Items	Specification	Unit	Qt'y	FC Portion (JPY)		LC Portion (TND)		Total		Reference
				Unit Price	Amount	Unit Price	Amount	(JPY)	(equiv. TND)	
PK-14										
<b>30kV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>25,925,000</b>		<b>74,976</b>	<b>30,500,000</b>	<b>499,836</b>	<b>a.</b>
30kV DS, LA Panel		set	1	4,250,000	4,250,000	12,291	12,291	5,000,000	81,940	DS: Disconnecting Switch LA: Lightning Arrester
30kV VT Panel		set	1	4,250,000	4,250,000	12,291	12,291	5,000,000	81,940	VT: Voltage Transformer
30kV VCB Panel		set	2	7,225,000	14,450,000	20,895	41,790	17,000,000	278,597	VCB: Vacuum Circuit Breaker
30kV/400V Transformer	oil type 0.5MVA	set	1	2,975,000	2,975,000	8,604	8,604	3,500,000	57,358	
<b>LV Switchgear</b>		<b>Ls</b>	<b>1</b>		<b>44,837,500</b>		<b>129,668</b>	<b>52,750,000</b>	<b>864,471</b>	<b>b.</b>
LV Main Switchgear	3 units	set	1	8,500,000	8,500,000	24,582	24,582	10,000,000	163,881	LV: Low Voltage
Transmission Pump for Sidi Salah EH	400V VFD 250kW	set	3	5,780,000	17,340,000	16,716	50,148	20,400,000	334,317	VFD: Variable Frequency Drive
MCC for Transmission-1	6 units	set	1	17,467,500	17,467,500	50,516	50,516	20,550,000	336,775	MCC: Motor Control Centre
Local Panel		set	6	255,000	1,530,000	737	4,422	1,800,000	29,499	
<b>Instrumentation &amp; Monitoring</b>		<b>Ls</b>	<b>1</b>		<b>47,260,000</b>		<b>136,678</b>	<b>55,600,000</b>	<b>911,177</b>	<b>c.</b>
Transmission Flow	electro-magnetic 800mm	set	1	4,335,000	4,335,000	12,537	12,537	5,100,000	83,579	
Transmission Flow	electro-magnetic 800mm	set	1	4,335,000	4,335,000	12,537	12,537	5,100,000	83,579	
Water Level	Ultrasonic	set	3	680,000	2,040,000	1,967	5,901	2,400,000	39,331	
Water Quality	Turbidity, pH, Res. Chlorine	set	6	1,275,000	7,650,000	3,687	22,122	9,000,000	147,493	Inflow: TDS x 2, Outflow: 4
Instrumentation Panel		set	3	2,550,000	7,650,000	7,375	22,125	9,000,000	147,493	
PLC Panel		lot	1	6,375,000	6,375,000	18,437	18,437	7,500,000	122,911	PLC: Programmable Logic







## 10.12-1 FIRR キャッシュフロー

(1) FIRR with Present Water Rate at 0.382TND/m<sup>3</sup>

		1TND= 61.02		JPY		UNIT:JPY	
0.382	YEAR	Project Cost	Non-eligible Cost to be financed by SONEDE	Operation & Maintenance Cost	Revenue	Net Benefit With CAPEX	Net Benefit Without CAPEX
		a	b (included in a)	c	d	d-a-c	d-b-c
Construction	2015	0	0	0	0	0	0
	2016	0	0	0	0	0	0
	2017	701,738,436	111,086,679	0	0	-701,738,436	-111,086,679
	2018	346,429,763	76,845,491	0	0	-346,429,763	-76,845,491
	2019	5,752,699,567	540,549,751	0	0	-5,752,699,567	-540,549,751
	2020	9,892,306,518	1,065,375,471	0	0	-9,892,306,518	-1,065,375,471
	2021	9,403,934,920	983,924,237	0	0	-9,403,934,920	-983,924,237
	2022	8,516,748,025	901,726,138	0	136,736,013	-8,380,012,012	-764,990,125
Operation & Maintenance	2023	7,888,928,826	805,443,700	391,979,012	562,136,943	-7,718,770,895	-635,285,769
	2024	1,820,589,502	182,022,124	1,676,743,126	607,715,614	-2,889,617,013	-1,251,049,636
	2025	144,100,349	13,587,337	1,676,743,126	607,715,614	-1,213,127,861	-1,082,614,849
	2026	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2027	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2028	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2029	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2030	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2031	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2032	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2033	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2034	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2035	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2036	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2037	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2038	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2039	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2040	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2041	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2042	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2043	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2044	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2045	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2046	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
	2047	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512
2048	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512	
2049	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512	
2050	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512	
2051	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512	
2052	0	0	1,676,743,126	607,715,614	-1,069,027,512	-1,069,027,512	
TOTAL		44,467,475,906	4,680,560,928	49,017,529,664	18,322,625,771	-75,162,379,800	-35,375,464,822
FIRR						-	-

(2) FIRR with Water Rate at 1.154TND/m<sup>3</sup>

TND.1.0 = JPY61.02

1.154	YEAR	Project Cost	Non-eligible Cost to be financed by SONEDE	Operartion & Maintenance Cost	Revenue	Net Benefit With CAPEX	Net Benefit Without CAPEX
		a	b (included in a)	c	d	d-a-c	d-b-c
Construction	2015	0	0	0	0	0	0
	2016	0	0	0	0	0	0
	2017	701,738,436	111,086,679	0	0	-701,738,436	-111,086,679
	2018	346,429,763	76,845,491	0	0	-346,429,763	-76,845,491
	2019	5,752,699,567	540,549,751	0	0	-5,752,699,567	-540,549,751
	2020	9,892,306,518	1,065,375,471	0	0	-9,892,306,518	-1,065,375,471
	2021	9,403,934,920	983,924,237	0	0	-9,403,934,920	-983,924,237
	2022	8,516,748,025	901,726,138	0	192,003,135	-8,324,744,890	-709,723,003
Operartion & Maintenance	2023	7,888,928,826	805,443,700	391,979,012	1,016,555,498	-7,264,352,340	-180,867,214
	2024	1,820,589,502	182,022,124	1,676,743,126	1,344,610,569	-2,152,722,059	-514,154,682
	2025	144,100,349	13,587,337	1,676,743,126	1,590,242,220	-230,601,255	-100,088,243
	2026	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2027	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2028	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2029	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2030	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2031	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2032	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2033	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2034	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2035	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2036	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2037	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2038	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2039	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2040	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2041	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2042	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2043	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2044	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2045	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2046	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
	2047	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745
2048	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745	
2049	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745	
2050	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745	
2051	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745	
2052	0	0	1,676,743,126	1,835,873,871	159,130,745	159,130,745	
TOTAL		44,467,475,906	4,680,560,928	49,017,529,664	53,712,005,950	-39,772,999,620	13,915,358
FIRR						-10.54%	0.02%

(3) FIRR with Water Rate at 1.258TND/m<sup>3</sup>

TND.1.0 = JPY61.02

1.258	YEAR	Project Cost	Non-eligible Cost to be financed by SONED	Operartion & Maintenance Cost	Revenue	Net Benefit With CAPEX	Net Benefit Without CAPEX
		a	b (included in a)	c	d	d-a-c	d-b-c
Construction	2015	0	0	0	0	0	0
	2016	0	0	0	0	0	0
	2017	701,738,436	111,086,679	0	0	-701,738,436	-111,086,679
	2018	346,429,763	76,845,491	0	0	-346,429,763	-76,845,491
	2019	5,752,699,567	540,549,751	0	0	-5,752,699,567	-540,549,751
	2020	9,892,306,518	1,065,375,471	0	0	-9,892,306,518	-1,065,375,471
	2021	9,403,934,920	983,924,237	0	0	-9,403,934,920	-983,924,237
	2022	8,516,748,025	901,726,138	0	199,448,447	-8,317,299,578	-702,277,692
Operartion & Maintenance	2023	7,888,928,826	805,443,700	391,979,012	1,077,772,506	-7,203,135,332	-119,650,206
	2024	1,820,589,502	182,022,124	1,676,743,126	1,443,881,391	-2,053,451,236	-414,883,859
	2025	144,100,349	13,587,337	1,676,743,126	1,722,603,317	-98,240,158	32,272,854
	2026	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2027	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2028	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2029	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2030	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2031	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2032	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2033	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2034	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2035	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2036	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2037	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2038	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2039	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2040	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2041	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2042	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2043	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2044	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2045	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2046	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
	2047	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117
2048	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117	
2049	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117	
2050	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117	
2051	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117	
2052	0	0	1,676,743,126	2,001,325,243	324,582,117	324,582,117	
TOTAL		44,467,475,906	4,680,560,928	49,017,529,664	58,479,487,218	-35,005,518,352	4,781,396,625
FIRR						-7.67%	4.79%

(4) FIRR with Water Rate at 2.022TND/m<sup>3</sup>

TND.1.0 = JPY61.02

2.022	YEAR	Project Cost	Non-eligible Cost to be financed by SONEDE	Operartion & Maintenance Cost	Revenue	Net Benefit With CAPEX	Net Benefit Without CAPEX
		a	b (included in a)	c	d	d-a-c	d-b-c
Construction	2015	0	0	0	0	0	0
	2016	0	0	0	0	0	0
	2017	701,738,436	111,086,679	0	0	-701,738,436	-111,086,679
	2018	346,429,763	76,845,491	0	0	-346,429,763	-76,845,491
	2019	5,752,699,567	540,549,751	0	0	-5,752,699,567	-540,549,751
	2020	9,892,306,518	1,065,375,471	0	0	-9,892,306,518	-1,065,375,471
	2021	9,403,934,920	983,924,237	0	0	-9,403,934,920	-983,924,237
	2022	8,516,748,025	901,726,138	0	254,142,852	-8,262,605,173	-647,583,286
Operation & Maintenance	2023	7,888,928,826	805,443,700	391,979,012	1,527,482,060	-6,753,425,778	330,059,348
	2024	1,820,589,502	182,022,124	1,676,743,126	2,173,140,129	-1,324,192,499	314,374,878
	2025	144,100,349	13,587,337	1,676,743,126	2,694,948,300	874,104,825	1,004,617,837
	2026	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2027	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2028	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2029	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2030	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2031	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2032	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2033	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2034	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2035	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2036	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2037	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2038	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2039	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2040	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2041	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2042	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2043	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2044	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2045	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2046	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
	2047	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345
2048	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345	
2049	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345	
2050	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345	
2051	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345	
2052	0	0	1,676,743,126	3,216,756,471	1,540,013,345	1,540,013,345	
TOTAL		44,467,475,906	4,680,560,928	49,017,529,664	93,502,138,069	17,132,499	39,804,047,477
FIRR						0.00%	21.96%

(5) FIRR with Water Rate at 3.035TND/m<sup>3</sup>



TND.1.0 = JPY61.02

3.035	YEAR	Project Cost	Non-eligible Cost to be financed by SONEDE	Operartion & Maintenance Cost	Revenue	Net Benefit With CAPEX	Net Benefit Without CAPEX
		a	b (included in a)	c	d	d-a-c	d-b-c
Construction	2015	0	0	0	0	0	0
	2016	0	0	0	0	0	0
	2017	701,738,436	111,086,679	0	0	-701,738,436	-111,086,679
	2018	346,429,763	76,845,491	0	0	-346,429,763	-76,845,491
	2019	5,752,699,567	540,549,751	0	0	-5,752,699,567	-540,549,751
	2020	9,892,306,518	1,065,375,471	0	0	-9,892,306,518	-1,065,375,471
	2021	9,403,934,920	983,924,237	0	0	-9,403,934,920	-983,924,237
	2022	8,516,748,025	901,726,138	0	326,663,051	-8,190,084,973	-575,063,087
Operartion & Maintenance	2023	7,888,928,826	805,443,700	391,979,012	2,123,759,258	-6,157,148,580	926,336,546
	2024	1,820,589,502	182,022,124	1,676,743,126	3,140,076,124	-357,256,503	1,281,310,874
	2025	144,100,349	13,587,337	1,676,743,126	3,984,196,294	2,163,352,819	2,293,865,831
	2026	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2027	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2028	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2029	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2030	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2031	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2032	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2033	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2034	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2035	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2036	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2037	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2038	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2039	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2040	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2041	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2042	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2043	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2044	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2045	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2046	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
	2047	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338
2048	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338	
2049	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338	
2050	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338	
2051	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338	
2052	0	0	1,676,743,126	4,828,316,464	3,151,573,338	3,151,573,338	
TOTAL		44,467,475,906	4,680,560,928	49,017,529,664	139,939,239,263	46,454,233,693	86,241,148,671
FIRR						4.77%	35.16%

## 第 11 章 本事業の妥当性及びリスクの確認



11.3-1 40MW 電力供給についての SONEDE から STEG への問い合わせ (2013/5/28)

 **الشركة الوطنية للاستغلال وتوزيع المياه**  
**SOCIÉTÉ NATIONALE D'EXPLOITATION ET DE DISTRIBUTION DES EAUX** 

تونس في 20 ماي 2013

إلى  
السيد المدير العام للشركة التونسية للكهرباء والغاز 26170

الموضوع: مشروع إنجاز محطة لتحلية مياه البحر بصفاقس

تحية طيبة و بعد،


في إطار مشروع إنجاز محطة لتحلية مياه البحر بصفاقس و ربطها بشبكة التوزيع، قام وفد من الوكالة اليابانية للتعاون الدولي بزيارة إلى البلاد التونسية خلال الفترة الممتدة من 13 إلى 17 ماي 2013 قصد التحضير لإعداد دراسة أواية للمشروع الذي سيتم تمويله من طرف الجانب الياباني، وقد طالب الفريق الياباني بمدة بعض المعطيات المتعلقة بتزويد ولاية صفاقس بالطاقة الكهربائية التالية:

- إجمالي وتفاصيل حجم الطاقة الكهربائية بولاية صفاقس،
- الزيادة المتوقعة من إمدادات الطاقة الكهربائية في السنوات القليلة القادمة بولاية صفاقس.

نالرجاء مكننا بالمعطيات المطلوبة في أقرب الأجل لتيسر انطلاق دراسة لمشروع علما و أن الطاقة الضرورية لتشغيل المحطة المزعم إنجازها تقارب (40) ميغاوات.

تقبلا فائقا لمباركات التقدير و السلام.

الرئيس المدير العام  
الهادي بالحاج



شارع مطران بن سنان  
الحي II - تونس 2092  
M. Slimane Ben Slimane  
4, Avenue II - Tunis 2092

الهاتف : 71.887.009  
الفاكس : 71.871.009  
E-mail : sonede@sonede.com.tn

الرقم السجل التجاري هو 0111892608  
Matrioule Fiscal 1455 M/2004/030  
البريد 2071

# SONEDE

Tunis, May 28, 2013

To the kind attention of the General Manager of STEG, Tunisian Power Company

Subject: Construction project of the sea water desalination project in Sfax

Greetings,

In the framework of the sea water desalination plant construction project and its subsequent connection to the distribution network, a delegation representing the Japan International Cooperation Agency visited Tunisia on May 13-17, 2013 to set the framework for a preliminary study of a project that will be funded by the Japanese part, and the Japanese team requested some information concerning power supply to the Sfax Governorate as follows:

- Total and detailed power supply to the Governorate of Sfax;
- Possible increase of electrical power supply in the few next years in the Sfax Governorate;

Therefore, we would appreciate you providing us with these data in the best possible time to ensure smooth beginning of the project, knowing that power required for the operation of the planned station would be about 40 MW.

Please accept my best regards

General Manager

Hedi Belhaj

11.3-3 SONEDE の 2013/5/28 付の問い合わせに対する STEG の回答 (2013/8/22)

**Société Tunisienne de l'Electricité et du Gaz**  **الشركة التونسية للكهرباء والغاز**

1962-2012  
50 سنة STEG

الشركة التونسية للكهرباء والغاز  
الإدارة الحكومية للتوزيع بصفاقس  
طريق سيدو منصور كذا لا صفاقس 30412  
هاتف : 236 255 74 الفاكس : 236 043 74

السيد الرئيس المدير العام للشركة  
الوطنية لاستغلال و توزيع المياه  
شارع سليمان بن سليمان  
العنار II 2092 تونس

22 أوت 2013

00581

الموضوع : مراسلة ع-26170 حدد بتاريخ 2013/05/28  
الموضوع : مشروع إنجاز محطة لتحلية مياه البحر بصفاقس

سيدي الرئيس المدير العام ،

أما بعد فتبعاً للمراسلة المذكورة بالمرجع أعلاه و المتعلقة بمشروع إنجاز محطة لتحلية مياه البحر بصفاقس بقوة كهربائية قدرت ب 40 ميغاواط نعلمكم بأن تنوير هذا المشروع يتطلب تركيز محطة تحويل كهربائية جهد عالي/ جهد متوسط خاصة بهذه المحطة و يقع ربطها بشبكة الجهد العالي على حسابكم. و لدراسة هذا الأمر فإنا نرجو منكم مدنا بالمعطيات التالية :

- الموقع الجغرافي للمشروع و الإحداثيات الرقمية للموقع باستخدام نظام تحديد المواقع العالمي (GPS)
- تاريخ تشغيل المحطة و بيان قوة الطاقة الكهربائية المطلوبة في كل سنة
- طريقة ربط المحطة (simple alimentation ou double alimentation)

و نبقى على استعداد للمزيد من الارشادات في هذا الموضوع.  
تقبلوا سيدي المدير فائق إحترامنا و تقديرنا.

  
محمد قطاطة

R.C. : B 121461997

المقر الإقليمي : 38, Rue Kamel Atabek, BP. 190-1080 Tunis CEDEX - تونس 1000-190  
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# STEG

August 22, 2013

To the kind attention of the Director General of SONEDE

Reference: Letter n. 26170 dated May 28, 2013

Subject: Construction project of the sea water desalination project in Sfax

Mr. Director General:

Further to your letter referenced above concerning the sea water desalination construction project in Sfax with a total power of 40 MW, we inform you that this project will require the construction of a high voltage/middle voltage power transformation station that will be connected to the high voltage station at your expense. In order to further study this subject, we kindly ask you to provide us with the following information:

- Geographic location of the project and the digital coordinates based on GPS;
- Date of project operation and electrical power required per year;
- Connection pattern of the station: simple supply or double supply.

We remain prepared to provide you with additional information.

Please accept our best regards.

Sfax Regional Distribution Director


Mohamed Ketata

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11.3-5 電力供給設備工事費及び方法に関する STEG の回答 (2013/11/20)

21-NOV-2013 THU 10:11 SONEDE.DTTS FAX NO. 216 74 223303 P. 01/02

à l'attention de  
M<sup>x</sup> A. Boussoffara

Société Tunisienne de l'Electricité et du Gaz  الشركة التونسية للكهرباء والغاز

Le Chef Service  
Travaux Equipements  
M.F MAALEJ

**STEG**  
Direction Régionale  
Distribution de Sfax  
Rue de Mansour Km 3 - Sfax 302  
Tél. 14 213 152 Fax 1 436 843

**SONEDE**  
Division Equipement Sud  
Rue Ibn Badis 3029 Sfax

20 NOV 2013 N° 00844

**OBJET : Raccordement de la station de dessalement projetée à Sfax.**  
**Réf : Votre note du 04/11/2013**

Monsieur

Suite à votre note du 04/11/2013 relative au raccordement de la station de dessalement projetée à Sfax et en réponse à l'enquête avancée par l'équipe japonaise chargé de l'étude de la dite station nous vous transmettons ci-après les éléments de réponse relatifs à cette enquête.

- 1) Les coupures sur le réseau 150 kV sont minimales du fait que le réseau HTB est maillé. Cependant la puissance demandée par le projet est disponible actuellement en termes de production.
- 2) La puissance maximale du transformateur qui peut être raccordé sur le réseau 150 kV est de 40 MVA.
- 3) La distance et le coût actuel d'extension de la ligne électrique dépendent de l'emplacement du site. Le calcul du coût s'est fait sur la base d'un câble souterrain. Le tableau suivant résume ces différentes quantités.

Site N°	Distance	Coût d'extension (DT HTVA)
1	2x3.6 km	11 million
2	2x5.6 km	17 million
3.1	2x11.1 km	34 million
3.2	2x15.5 km	47 million
3.3	2x18.2 km	55 million
5	2x26 km	78 million
6	2x35.3 km	106 million

P 12/11/2013

- 4) L'alimentation sera en double ligne (entrée sortie) à partir du point le plus proche du réseau 150 kV. Il n'y aura pas de ligne spécialisé ni d'alimentation duplex à partir d'une autre station. Cependant il est possible que la ligne soit en partie en souterrain et en partie en aérien.



*Le Directeur Régional de la  
Distribution de Sfax*

*Mohammed KETATA*

11.3-6 11.3-5 の英訳

**From: STEG Regional Distribution Department, SFAX**

**To: SONEDE Equipment Division – SOUTH**

**20 November, 2013**

**Subject: Connection of the Sfax desalination station project**

**Reference: Your note dated November 4, 2013**

Dear Sir,

Further to your note dated November 4, 2013 related to connection of the Sfax Desalination Station and in response to the survey questions raised by the Japanese team in charge of the study of subject station, please find below answers related to questions raised:

- 1- Power cutoffs on the 150 kV network are scarce as the HTB (High Voltage) network is meshed. And capacity currently requested by the project is available.
- 2- The maximal power of the transformer that can be connected to the 150 kV network is 40 MVA.
- 3- The distance and the current extension cost of the electrical line depend on the project location. The cost calculation is made based on an underground cable. The following table summarizes the different quantities:

<u>Site n.</u>	<u>Distance</u>	<u>Extension Cost</u>
1	2 x 306 km	11 million
3.1	2 x 11.1 km	34 million
3.2	2 x 15.5 km	47 million
3.3	2 x 18.2 km	55 million
5	2 x 26 km	78 million
6	2 x 35.3 km	106 million

- 4- Supply will be in double line (incoming/outgoing) from the closest point of the 150 kV network. There will be neither specialized line nor dual supply from a different power plant. However, the line may be partly buried and partly airborne.

**Mohamed Ketata**  
**Regional Director**