MINISTRY OF AGRICULTURE, WATER RESOURCES AND FISHERIES

SOCIETE NATIONALE D'EXPLOITATION ET DE DISTRIBUTION DES EAUX（SONEDE）

THE PREPARATORY SURVEY ON SFAX SEA WATER DESALINATION PLANT CONSTRUCTION PROJECT IN THE REPUBLIC OF TUNISIA

FINAL REPORT

VOL. 2 : APPENDICES

AUGUST 2015

JAPAN INTERNATIONAL COOPERATION AGENCY

NJS CONSULTANTS CO., LTD.
INGEROSEC CORPORATION
JAPAN TECHNO CO., LTD.

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CHAPTER 1

PURPOSE AND CONTENTS OF THE SURVEY

1.4-1 Condition of Existing Desalination Plants

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1.4-1 Condition of Existing Desalination Plants

SONEDE has many desalination plants and the desalination plants in Gabes, Djerba, Zarzis and Ben Guerdane in southern Tunisia are main plants. All those plants are desalination of brackish groundwater while this project is for the sea water desalination.

The salinity (TDS) of seawater is approx. 40000 mg/ℓ, while the raw water of the existing plants shows a significant difference: 3000 mg/ℓ in Gabes, 5500 mg/ℓ in Djerba, 6000 mg/ℓ in Zarzis, and 14400 mg/ℓ in Ben Guerdane.

The desalination processes of the existing plants are the reverse osmosis (RO) system the same system as this project. While the material of RO membrane and operating pressure will be different due to the difference of the osmosis pressure, there are many similarities such as components of the sand filter and RO unit, mechanical and electrical facilities, operation method, O&M system and so on.

The field survey has been made on the four existing plants as mentioned above. The outlines of each plant are listed below.

Table 1 Existing Desalination Plants

Location	Capacity (m^3/day)	Process	Raw water	Year of operation
Gabes	34,000	RO	Brackish water	1995
Djerba	20,000	RO	Brackish water	1999
Zarzis	15,000	RO	Brackish water	1999
Ben Guerdane	1,800	RO	Brackish water	2013

Source: JICA Survey Team

1. Gabes Desalination Plant

(1) Outline of the plant

This plant is located western suburb of Gabes City. The plant started its operation in 1995. The production is maximum of 34,000 m^3/day (8,500 m^3/day×4series), while the current production is 8,500 m^3/day by operating only a single series due to the lack of raw water intake. The raw water is consisting of two systems: one is the water from 7 wells in Chatt Fejij located 45 km away supplied via Aziza reservoir, another one is the water from 2 wells in Chanchou directly sent to this plant. The treated water is blended with the untreated water of the same amount in the reservoir for controlling TDS, and then the total quantity of 17,000 m^3/day is supplied to the service reservoirs of Mnara, Madine, Bouchama, Rema, Wedhref, in Gabes City.

In this final process before supply, the treated water with a TDS of 100 to 500 mg/ℓ is blended with the untreated one with a TDS of 3000 mg/ℓ for producing service water with a TDS less than 1500mg/ℓ, targeted by SONEDE against the allowable value of 2500 mg/ℓ in the Tunisia water standard. The similar process of TDS control is carried out in other 3 desalination plants in Djerba, Zarzis and Ben Guerdane.

The TDS of raw water is 3000 mg/ℓ and that of treated water is 100-500mg/ℓ. The recovery rate (treated water /raw water) of the RO unit in this plant is 75%.

(2) Mechanical facilities

The system consists of Aeration basin, Sand filter, 5μm Cartridge filter, 1μm Cartridge filter, RO Unit, and Treated water reservoir.

The sand filter is gravity system. There are 4 series from the cartridge filter to RO unit, but only one series is in use at present. Initially RO unit was installed as single stage, however, the currently used series has been modified into the two stages same as other three plants; the concentrated water from first RO stage is fed to the second RO stage in order to obtain higher recovery.

The chemicals used in this plant are anti-scalants to control the scale formation on RO membrane, and sodium hydroxide (NaOH) to increase pH of RO treated water. Other chemicals such as $FeCl_3$, NaClO and $NaHSO_3$ are stopped using, since it was confirmed no problem even without injection of those through the long year operation performance.

Regarding the replacement record of the major consumables, the cartridge filter is replaced two times a year. And the RO membrane is inconstantly replaced according to the operation status; some of membranes are never replaced more than 13 years.

Pumping facilities installed in this plant are the backwash pumps for washing the filter basin, the pumps for the cartridge filter, and the high pressure pumps for RO membrane. No major breakdown has been occurred for 18 years since started the operation. Some of the name plates of pumps however indicates year 2000 or 2005, so it seems to be done the periodical replacement of the pumps.

Photo 1 Cartridge filter

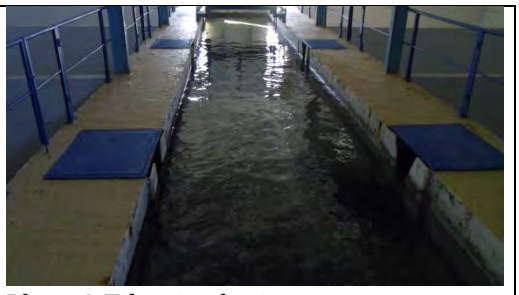


Photo 2 Filtration basin

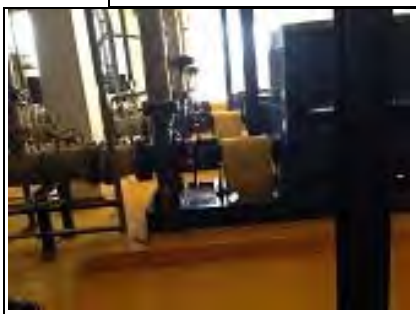


Photo 3 High pressure pumps for RO

Photo 4 Name plate of RO pump

Photo 5 Backwash pump

(3) Electrical facilities

The power receiving is 30 kV and two line connections (regular and standby). The nearest transmission tower of STEG distribution line stands outside the plant, and from the nearest tower

to the power receiving room in the plant the power cable is led through the underground route.

Photo 6 STEG transmission tower

Photo 7 STEG transmission tower

Photo 8 Control panels in the power receiving room

Photo 9 Monitoring operation panel

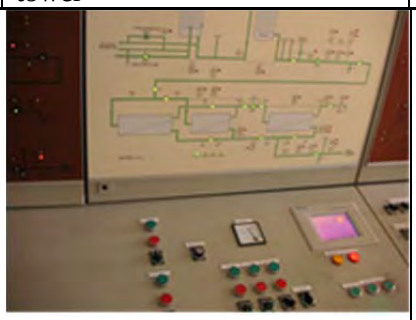


Photo 10 Monitoring operation panel

Photo 11 Monitoring display system

It is operated with 4 main transformers of 1,000 kVA, two are input/output of 30 kV/5.5 kV and other two are 30 kV/400V. There is no power generation facility. Up to the Power breaker panel in the power receiving room is under the operation and management of STEG.

In the control room, there are the monitoring operation panel (desk type) and monitoring display system. Through this room, the plant facilities are operated and monitored, and the process data are monitored and recorded.

(4) O&M system and operation status

The operation monitoring staffs are 11 persons and the maintenance inspection staffs are 4 persons. It was reported that the trouble of clogging with bio-organisms before. However, there are RO membranes never replaced for 13 years while the RO membrane life is generally 4-5 years, and the cartridge filter is replaced two times a year which is half of normal frequency. Therefore, under the existing conditions, a good operation and maintenance has been carried out.

2. Djerba Desalination Plant (Japanese yen loan)

(1) Outline of the plant

Located in the south of Djerba Island, this plant started its operation in 1999 with the production of 15,000 m^3/day. It was extended the capacity of 5,000 m^3/day in 2007, and the current production capacity is 20,000m^3/day. The raw water is taken from the wells located 16km away. Originally 12 wells were drilled as the water source, but 5 wells were contaminated hydrogen sulfide (H_2S) and abandoned to use, so the water is taken from the remaining 7 wells.

The TDS of raw water is 5.5 g/ℓ and that of treated water is 0.32 g/ℓ. The recovery rate of the RO unit in this plant is 75%.

(2) Mechanical facilities

The system is composed of Aeration basin, Sedimentation basin, Sand filter, 1μm Cartridge filter, RO Unit, and Treated water reservoir.

The sedimentation basin has 2 tanks and the sand filter of gravity system has 4 units. There are 3 series from the cartridge filter to the RO unit, and all series are in use. The RO unit is the two-stage system in which the concentrated water from the first RO stage is fed to the second RO stage.

The chemicals used in this plant are anti-scalants to control the scale formation on the RO membrane, and sodium hydroxide (NaOH) to increase pH of RO treated water. Other chemicals such as $FeCl_3$, NaClO, $NaHSO_3$ and H_2SO_4 are stopped using. $FeCl_3$ is no longer used due to the low turbidity of raw water. NaClO and NaHSO3 were used when bacteria was detected in raw water, however, it was deemed unnecessary injection based on many year's operation. Also, the injection of H_2SO_4 was stopped by increasing the dosage of anti-sclalants.

Regarding the replacement record of the major consumables, the cartridge filter is replaced two times a year, and the replacement rate of RO membrane is 10-20%/year.

Photo 12 RO unit

Photo 13 Sand filter

The treated water is sent to the reservoir in the plant. Pump is not used for this because there is enough pressure of RO treated water. Concerning the pump failure, daily maintenance and its records are properly carried out, and in case of serious problem, SONEDE maintenance shop in Sfax handles it.

(3) Electrical facilities

The power receiving is 30 kV and two line connections (regular and standby). The nearest transmission tower of STEG distribution line stands outside the plant, and the power cable is led-in through the underground from the nearest tower to the power receiving room in the plant.

		
Photo 14 STEG transmission tower	Photo 15 STEG transmission tower	Photo 16 Control panels in the power receiving room

Current power consumption of the plant is 18,790 kWh/day. It is operated with 3 main transformers of 800 kVA. There is no power generation facility. In the past there was almost no power outage except for the short-time power failure.

There are installed power control panels in the low-voltage electrical room which is equipped with air conditioning system for heat control of the panels. However, the cooling capacity is insufficient and thus the doors of panels need to be open during operation.

In the control room, there are the monitoring operation panel (wall-mounted type) and monitoring display system, for operation and monitoring of the plant facilities and monitoring record of the process data. There are also installed the monitoring camera for security.

		
Photo 17 Intake flow meter	Photo 18 Low-voltage electrical room	Photo 19 Monitoring operation panel
		
Photo 20 Monitoring operation panel	Photo 21 Monitoring display system	Photo 22 Security camera monitor

(4) O&M system and operation status

The operation monitoring staffs are 8 persons (2persons x 4teams x 3shifts/day) and the maintenance inspection staffs are 5 persons in this plant.

Even there are 5 wells out of twelve are out of use due to the hydrogen sulfide (H_2S), the amount of raw water is secured by the other wells. The current status of operation and maintenance is fairly good, because the replacement rate of RO membrane 10-20%/year w is longer than normal RO membrane life of 4-5 years, and replacement frequency two times a year of the cartridge filter is half of normal frequency.

3. Zarzis Desalination Plant (Japanese yen loan)

(1) Outline of the plant

Zarzis desalination plant is located in the northwest suburb of Zarzis City. It started the operation in 1999 and the production is 15,000 m^3/day. The raw water is taken from the 7 wells in Khaoula Ghdir water treatment plant located 5 km away. This desalination plant is nearly identical in design and facility layout as the above Djerba desalination plant.

The TDS of raw water is 6.0 g/ℓ and that of treated water is 0.32 g/ℓ. The recovery rate of RO unit in this plant is also 75%.

(2) Mechanical facilities

The mechanical facilities of this plant are almost same as the Djerba desalination plant.

The system is composed of Aeration basin + Sedimentation basin + Sand filter + 1μm Cartridge filter + RO Unit + Treated water reservoir.

The sedimentation basin has 2 tanks and the sand filter of gravity system has 4 units. From the cartridge filter to the RO unit, there are 3 series, and all series are in use. The RO unit is the two-stage system in which the concentrated water from the first RO stage is fed to the second RO stage.

The chemicals used in this plant are anti-scalants to prevent the scale formation on RO membrane, and sodium hydroxide (NaOH) to increase pH of RO treated water. Other chemicals such as $FeCl_3$, NaClO, $NaHSO_3$ and H_2SO_4 are stopped using. $FeCl_3$ is no longer used due to the low turbidity of raw water. NaClO and $NaHSO_3$ were used when bacteria was detected in raw water, however, it was deemed unnecessary injection based on many year's operation. Also, the injection of H_2SO_4 was stopped by increasing the dosage of anti-sclalants.

Regarding the replacement record of the major consumables, the cartridge filter is replaced two times a year, and the replacement rate of RO membrane is 10-20%/year.

The treated water is sent to the reservoir in the plant by using the pressure of RO treated water, and no pump is used for the treated water. Concerning the maintenance status, proper daily maintenance is carried out similar to other desalination plants. There was no major failure of facilities, only leakage from the FRP tank of NaOH, and the tank was replaced to a polyethylene tank.

Photo 23 Feed pumps

Photo 24 FRP tank

Photo 25 Polyethylene tank

(3) Electrical facilities

The power receiving is 30 kV and two line connections (regular and standby). The nearest transmission tower of the STEG distribution line is inside the plant plot, and from the tower to the power receiving room, the power cable is led-in through the underground way.

Photo 26 STEG transmission tower

Photo 27 Power receiving room

Photo 28 Control panels in the power receiving room

The service lines to the power receiving room were installed by STEG. Current power consumption of the plant is 16,257 kWh/day, and it is operated with 3 main transformers of 800 kVA. There is no power generation facility. Also there was almost no power outage in the past except for the short-time power failure.

There are installed power control panels in the low-voltage electrical room, which is equipped with air conditioning system for heat control of the panels. However, the cooling capacity is insufficient and the doors of panels need to be open during operation.

In the control room, there are the monitoring operation panel (wall-mounted type) and monitoring display system, for operation and monitoring of the plant facilities and monitoring record of the process data. And there are also installed the security camera monitor.

		
Photo 29 Power control panel	Photo 30 Power control panel	Photo 31 Monitoring operation panel

(4) O&M system and operation status

The operation monitoring staffs are 8 persons (2persons x 4teams x 3shifts/day) and the maintenance inspection staffs are 2 persons.

Since the replacement rate of RO membrane 10-20%/year is longer than normal RO membrane life of 4-5 years, and replacement frequency of the cartridge filter, two times a year, is half of normal frequency, the current status of operation and maintenance is a quite good.

4. Ben Guerdane Desalination Plant (Japanese Government's grant aid project)

(1) Outline of the plant

This plant is located in the north of Ben Guerdane City. The production is 1,800 m^3/day, and the raw water is pumped up from the deep well in the plant by the submersible motor pump. The plant started its operation in June 2013.

The TDS of raw water is 14.4 g/ℓ which is highest of the four plants surveyed during the study, and that of the treated water is 0.13 g/ℓ. The recovery rate of the RO unit is 70%.

As a special note, the raw water with the temperature of 45^{o}C is cooled down to around 32^{o}C at the cooling tower and then treated through the treatment processes.

(2) Mechanical facilities

The system consists of Submersible motor pump, Cooling tower, Sand filter, 10μm Cartridge filter, and RO Unit.

The deep well submersible motor pump is installed at the 160m deep in the water. The sand filter of pressure system has 2 units without standby, and from the cooling tower to the RO unit there are 3 series including standby.

There are two significant differences between this plant and the other three plants as listed below:

The first point is the method of iron oxidation. While the other three plants are equipped with the aeration facility, this plant has the chemical injection facility of sodium hypochlorite (NaClO).

The second point is the treatment method of the RO concentrated water. The other three plants are discharging of the concentrated water to the sea, but this plant has the treatment facility of the RO

concentrated water by the evaporation process, as the neighboring water of this plant is the protection area of the Ramsar Convention.

The chemicals used in this plant are same as the other plants, anti-scalants to prevent the scale formation on the RO membrane, and sodium hydroxide (NaOH) to increase the pH of the RO treated water. Also NaClO and $Na_2S_2O_5$ are used in this plant. NaClO is used as the oxidant of iron as mentioned above, and $Na_2S_2O_5$ is for reduction of HaClO to prevent the RO membrane from oxidative degradation.

Photo 32 Sun drying bed

Photo 33 Cooling tower

The treated water is supplied to the service reservoir located 6 km away by the supply pump. Since the plant stared operation recently, there has been no failure of the mechanical facilities, but some leakage from the pipe. SONEDE has additionally installed a bypass pipe of raw water for the pump maintenance, because the deep well is artesian.

Photo 34 Intake deep well

Photo 35 Filter pump, backwash pump

(3) Electrical facilities

The power receiving is 30 kV and single line connection. The nearest transmission tower of the STEG distribution line is inside the plant plot, and the power cable is led-in through the underground from the tower to the power receiving room.

Photo 36 STEG transmission tower

Photo 37 Power receiving room

Photo 38 RO units

This plant is equipped with 210 kW photovoltaic generating system and its power is equivalent to 50% of required power of the plant.

Current power consumption of the plant is 9,600 kWh/day without counting the power supply from the solar power generator. There are 2 main transformers of 400 kVA operated. There is no power generation facility. In the past, a power outage for eight hours was occurred once.

In the low-voltage electrical room the power control panels are installed, equipped with air conditioning system for heat control of the panels. The power control panel has a monitoring display.

Photo 39 Power control panel

Photo 40 Power control panel

Photo 41 Monitoring display system

In the control room, there installed the monitoring display system which operates and monitors the plant facilities and records the process data.

(4) O&M system and operation status

The operation monitoring staffs are currently only 3 but it is required to increase to 8 persons. Also the maintenance inspection staffs are now one but it will be increased to 2 persons.

On the commencement of the operation, a training guidance on operation was conducted for one month by the contractor. The current operation and maintenance such as operation of plant facilities and data collection is carried out following the guidance, thus with the increased number of the operators in the future it will continue the proper operation and maintenance.

Once the power outage for eight hours occurred, they could manage to resume operation in a short time after the power outage recovery even they have insufficient operation experience just after starting the operation though. Also power generation facility is not required.

No main consumables such as the cartridge filter and RO membrane has been replaced yet, since the plant started operation in June 2013.

5. Summary for Operation and Maintenance of Desalination Plants

The results of the survey of 4 desalination plants regarding the conditions of operation and maintenance are described as follows:

(1) Operation

The operation in 4 plants has satisfactorily been run, ensuring the quantity and quality of the treated water as initially designed.

(2) Maintenance

All the plants have been operated and maintained by experienced staff members with adequate expertise. Replacement of cartridge filters and RO membranes have been kept to a minimum level. The application of chemicals has been controlled or suspended in flexible way, based upon the experience so far.

The troubles with the facilities in the past were only clogging of membrane filters by bacteria once in Gabes and failures of deep well sources (5 wells) due to occurrence of hydrogen sulfide gas from them.in Djerba Island.

Summing up the survey results, all the plants were observed to have satisfactorily been operated and maintained.

Table 2 Summary of O&M Status

Plant location			Gabes	Djerba	Zarzis	Ben Guerdane
System	Aeration basin		1	1	1	None
	Sedimentation basin		None	2	2	None
	Filter basin		Gravity	Gravity, 4	Gravity, 4	Pressure, 2
	Cartridge filter		5 & 1μm	1μm	1μm	10μm
	RO unit		4series	3 series	3 series	3 series
Capacity		m^3/day	34,000 (Current 8,500)	15,000+5,000	15,000	1,800
Raw water	Salinity (TDS)	mg/l	3,000	5,500	6,000	14,400
	Turbidity	NTU	0.5	3	3	5
	Temperature	^oC	35	28-30	28-30	45→32
Treated water	Salinity (TDS)	mg/l	500	320	400	130
Chemical dosage	NaOH	mg/l	5	2	2	2
	Anti-scalants	mg/l	2.9	2.7	2.7	4.2
	NaClO	mg/l	0	0	0	4
	$NaHSO_3$	mg/l	0	0	0	1.7
RO unit recovery		%	75	75	75	70
Consumable replacement	Cartridge	times/year	2	2	2	0 (just started operation)
	RO membrane	%/year	inconstant	10-20	10-20	
RO concentration treatment			Discharge to the sea	Discharge to the sea	Discharge to the sea	Evaporation process
O&M system	Operation monitoring	person	11	8	8	3 (required 8)
	Maintenance inspection	person	4	5	2	1→2

6. Summary of Electrical Facilities

The result of survey on the electrical facilities of the existing plants of Gabes, Djerba, Zarzis, and Ben Guerdane is summarized in the table below.

Table -3 Summary of Existing Plants' Electrical Facilities

Location	Power received (kV)	Power demand (kW/h)	Power consumption (kWh/d)	Transformer capacity (kVA)	Number of power lines (lines)	Power receiving	Power generator	Power outage
Gabes	3Phase 30kV	430/unit (calculated)	10,320 /unit	1000×2 units (30/5.5kV) 1000× units (30kV/400V)	2 (regular-standby)	Under-ground	None	Not definite
Djerba	3Phase 30kV	783 (replied)	18,790	800×3units	2 (regular-standby)	Under-ground	None	Little or no
Zarzis	3Phase 30kV	677 (replied)	16,257	800×3units	2 (regular-standby)	Under-ground	None	Little or no
Ben Guerdane	3Phase 30kV	400 (calculated)	9,600	400×2units	1	Under-ground	None	8h ×1time

7. Other Desalination Plants

In addition to 4 groundwater desalination plants as explained herein, SONEDE has two other plants; one is in Kerkennah Island where the plant of a capacity of 3,300 m^3/day has been run since 1983, and the other in Djerba Island which was installed as additional equipment to increase the capacity by 5,000 since 2007. In Djerba a new project is now ongoing for installing a sea water desalination plant of 50,000 m^3/day.

8. SONEDE's Capability to Operate Desalination Plant

SONEDE has now 30 years of experience in running desalination plants since 1983 when it first installed the one in Kerkennah.

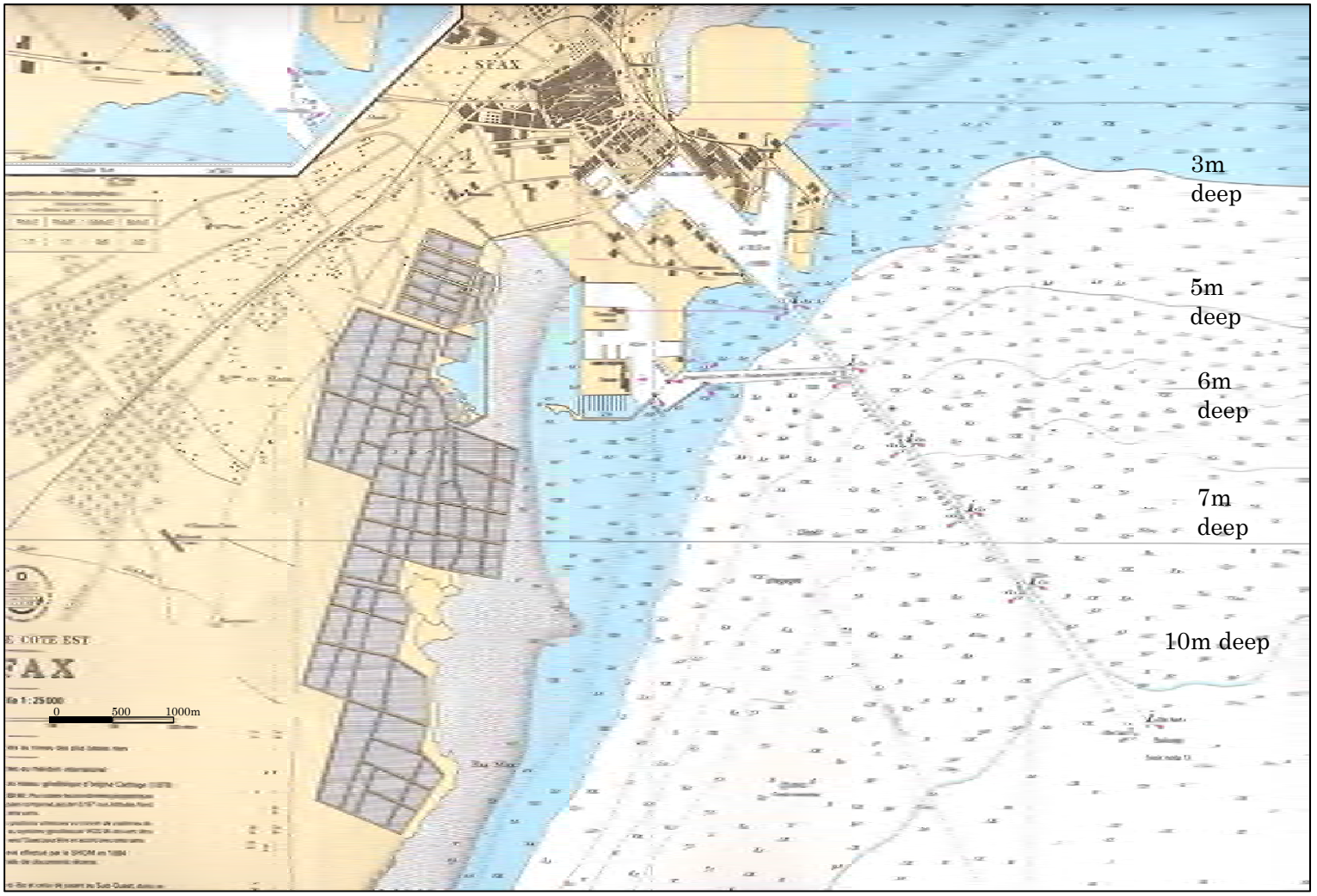
In 1999, SONEDE constructed the largest ones in Djerba and Zarzis. These facilities have satisfactorily been operated for nearly 14 years, keeping its capacity and quality as designed so far. The level of operation and maintenance is good, since the replacement of consumables such as cartridge filters and membranes have been kept to a minimum level.

SONEDE has accumulated an adequate experience and expertise in the operation and maintenance of desalination plants. Judging from its performance in this sector in the past, SONEDE can be expected to deal satisfactorily with a sea water desalination plant in this project as well.

CHAPTER 2

REVIEW OF EXISTING INFORMATION AND EXPLORATION

2.1-1 Sfax Port



CHAPTER 4

WATER SUPPLY PLAN FOR GREATER SFAX

4.1-1 Presentation Material for International Donors Conference in Marseille, France

REPUBLIQUE TUNISIENNE
MINISTERE DE L'AGRICUTURE
SOCIETE NATIONALE D'EXPLOITATION ET DE DISTRIBUTION DES EAUX

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

IV.3. Chronogramme de Réalisation du Projet :

COMPOSANTE	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
RENFORCEMENT SYSTÈME DE TRANSFERT DES EAUX DU NORD										
- Barrage réservoir Saida et infrastructures y afférentes										
- Système de transfert des eaux brutes										
RENFORCEMENT CAPACITE DE RESERVE ET DE TRAIT. EAUX DU NORD										
- Renforcement réseaux, pompage et réserves à Belli										
- Infrastructures séparation des deux conduites EN (Tr. et Brt.)										
- Retenue de Sahel et infrastructures y afférentes										
RENFORCEMENT CAPACITE DE PRODUCTION DU GRAND TUNIS										
- Création du pôle de traitement Bejoua										

LEGENDE

- Elaboration des études détaillés + DAO
- Procédure de passation des marchés
- Exécution des travaux

30

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^3),

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.

COUT ESTIMATIF : 121.3 MDT HT (54.0 million €)

Sous composante	Coût (MDT)
Retenue de régulation (45 Mm^3)	81.4
Adductions	22.1
Pompage	13.3
Réservoir	4.1
Electrification	0.5
TOTAL	121.3

36

Construction du barrage réservoir Saida (3/4)

ETAT D'AVANCEMENT DES ETUDES :

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

PLANNING DE REALISATION :
(2016-2018)

37

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.

39

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
TOTAL	90.2

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)

40

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

41

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 Mm³),

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 Mm³)	88.2
Adductions	21.1
Pompage	4.3
TOTAL	113.6

ETAT D'AVANCEMENT DES ETUDES :

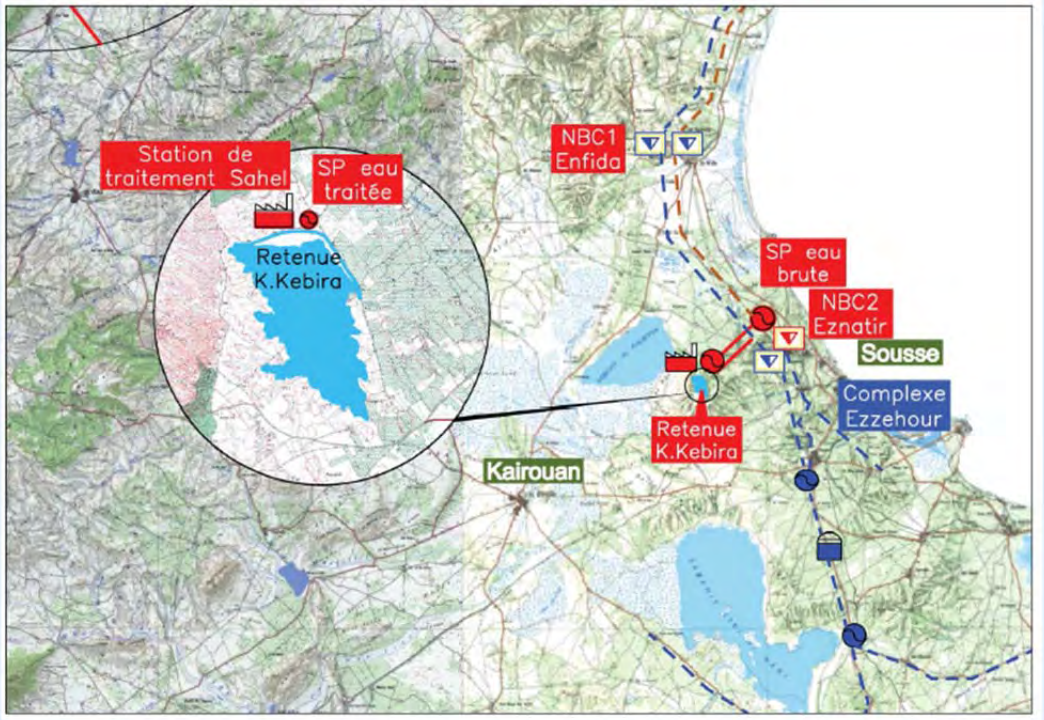
- Etude de faisabilité SOGREAH-STUDI –IDEACONSULT, 2005.
- Etude d'avant projet sommaire, groupement STUKY – CONCEPT, 2011
- Etude d'impact sur l'environnement, groupement STUKY – CONCEPT, transmis à l'ANPE depuis le 26 mars 2013.
- Etude d'avant projet détaillé en cours, groupement STUKY – CONCEPT.

PLANNING DE REALISATION :

(2016-2018)

43

Construction du barrage réservoir Sahel (3/3)



44

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)

COUT 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	
TOTAL			38.2

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)

46

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^3/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)

COUT ESTIMATIF : 69.2 MDT HT (31.0 million €)

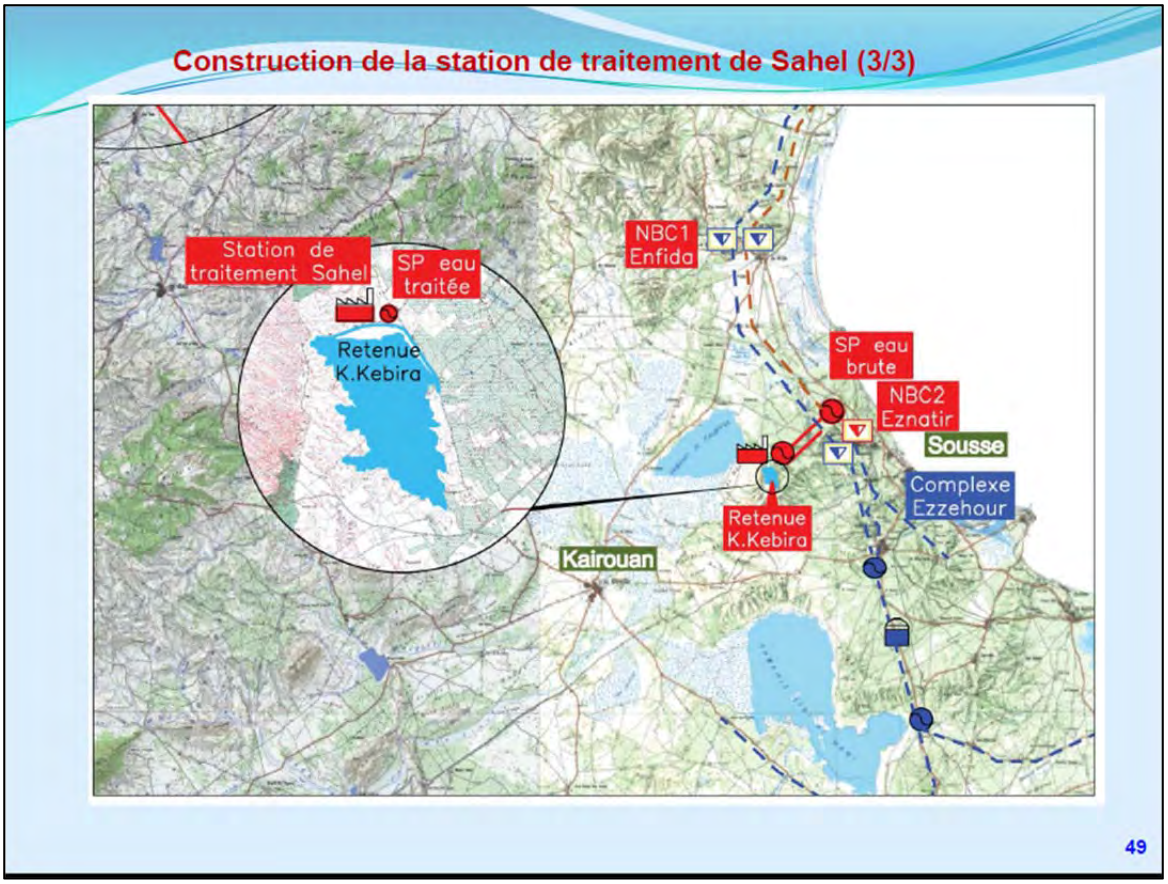
Désignation	Coût (MDT)
Station de traitement (4 m^3/s)	35.3
Adductions	21.1
Pompage	6.0
Foncier	6.8
TOTAL	69.2

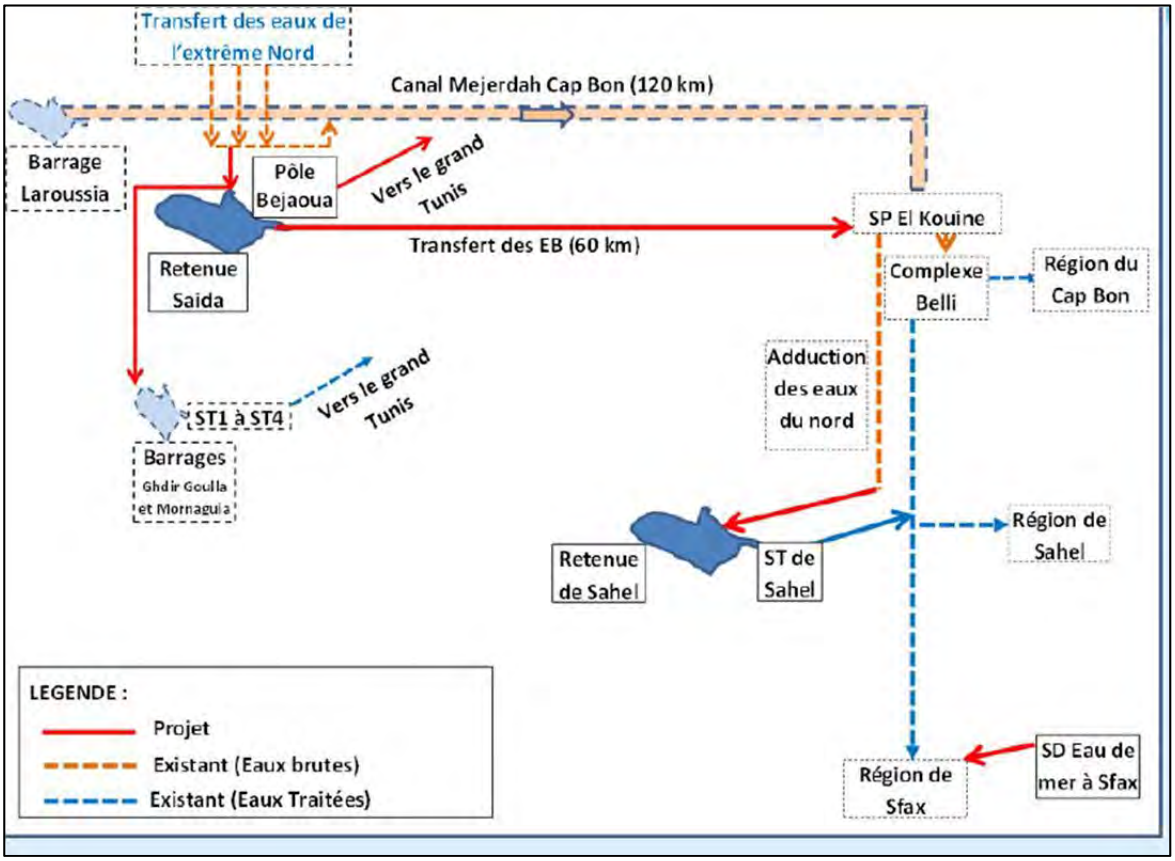
ETAT D'AVANCEMENT DES ETUDES :

- 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)
Station de traitement Sahel
SP eau traitée
Retenue K.Kebira
NBC1 Enfida
SP eau brute
NBC2 Eznatir
Sousse
Complexe Ezzehour
Retenue K.Kebira
Kairouan
49


Transfert des eaux de l'extrême Nord
Canal Mejerdah Cap Bon (120 km)
Barrage Laroussia
Pôle Bejaoua
Vers le grand Tunis
Retenue Saida
Transfert des EB (60 km)
SP El Kouine
Complexe Belli
Région du Cap Bon
Adduction des eaux du nord
ST1 à ST4
Vers le grand Tunis
Barrages Ghdir Goulla et Mornaguia
Retenue de Sahel
ST de Sahel
Région de Sahel
Région de Sfax
SD Eau de mer à Sfax
LEGENDE :
Projet
Existant (Eaux brutes)
Existant (Eaux Traitées)

4.3-1 Existing Water Supply Facilities in Greater Sfax

Table of Contents

4.3-1 Existing Water Supply Facilities in Greater Sfax

1. Outline

There are three water sources for water supply in Greater Sfax as follows:

- Treated water transferred by pumping trough the North Water Transfer System for about 200 km, from Belli water treatment plant with the water resource originated in Medjerda River.
- Groundwater transferred from Jelma and Sbeitla, and
- Groundwater pumped up in Sfax

The transferred water and groundwater are stored at distribution reservoirs located inland of Sfax and distributed to two water distribution districts, i.e. high and low distribution districts, from respective reservoirs by gravity. Water from each reservoir is distributed to high or low distribution districts. Further subdivision is not introduced.

2. Groundwater

(1) Groundwater Well

In recent years, water demand in upstream areas of the North Water Transfer System and the Jelma-Sbeitla Groundwater Transfer System has being increased, and consequently available water volume is decreased in Greater Sfax where no large water source exist, and then serious continuous water interruption happened. To cope with the situation in Sfax, SONEDE drilled wells at its reservoir sites as emergency measures though groundwater pumped up through those wells has high salinity. Groundwater pumped up in Sfax is distributed after mixing with the water transferred from the north water transfer system and Jelma-Sbeitla Groundwater transfer system. SONEDE evaluated its available water volume from those groundwater sources in Sfax at 491 ℓ/second or about 42,400m^3/day.

(2) Groundwater treatment facility

1) Purpose of the installation and capacity

Recently, on purpose to reinforce the supply capacity of water services, a well and groundwater treatment facility was installed in the plot of the PK10. The water yield is a fairly large quantity of 60ℓ/s (216 m^3/h), and the facility is operated 200-250 days a year. In Sfax region, there are totally 5 similar groundwater treatment facilities installed in the other service reservoirs and so on.

2) Outline of the facility

The treatment facility is for iron removal of groundwater composed of the aeration tower and sand filter. The aeration tower is for oxidation of iron in the water by the air-liquid contact technique; the raw groundwater falls down from the top and the air blows from the bottom in up- flow direction promoting the contact between

the air and water.

The aerated water is pumped through the sand filter and oxidized suspended iron is removed at the filter. The sand filter is pressure system in the horizontal tank. The accumulated iron at the filter layer is washed by periodical backwashing and discharged to the out of filter. The series of the operation such as filtration and backwash are all automatic.

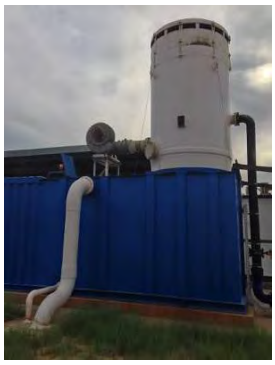


Photo 1 Aeration tower

Photo 2 Sand filter

3. Pumping Station

The Sfax service areas are divided into two zones: one is the lower zone lying along the coast at the lower elevations, and the other, the upper zone located inland at the higher elevations. Each service area receives water supply from a couple of service reservoirs by gravity. Accordingly the Greater Sfax has no pump stations for transmission and distribution.

4. Service Reservoir

SONEDE installed service reservoirs in various parts of the Greater Sfax area, among which those in service to the city zone are listed in Table 1 including those now under repair and in planning.

Table 1 Principal Reservoirs

Name of Reservoir	Volume (m^3)	Service Zone	HWL (m)	LWL (m)	Remarks
Bou Merra	500	Higher	84.0	79.0	Bou Merra_N +1,500m^3
PK11	22,000	Lower	59.0	53.0	5000m^3x4+1000x2
PK14	10,000	Higher	78.8	73.0	5000m^3x2
PK10	20,000	Lower	58.0	52.0	5000m^3x4
Sidi Salah_Haut	2,500	Higher	79.0	73.0	
Sidi Salah_Bas (plan)	-	Lower	59.0	53.0	Plan+5000m^3

Source: SONEDE

One of the major reservoirs, PK10, was examined under this study for its operation and maintenance, as follows:

(1) Water source and quality

The water sources of PK10 are the surface water in the north transmitted to and purified at Belli Treatment Plant, the groundwater from Jelma and Sbeitla in the west, and the groundwater pumped up from the well inside the plot as described later.

The water from those three water sources is blended and equalized in quality in the mixing basin, reserved in the four (4) distribution basins, and then distributed to each distribution areas in lower service zone.
The salinity (TDS) of the water sources are; the surface water 1.3-1.4 g/ℓ, groundwater 3.5-4 g/ℓ, and the blended water of the PK10, 2 to 2.1 g/ℓ which is under the drinking water standard of 2.5g/ℓ.

Photo 3 Mixing basin (right)

Photo 4 Inside of the mixing basin

(2) Specifications of the distribution basin

Each distribution basin is constructed above ground, shape of cylindrical and reinforced-concrete made.
For the prevention of temperature rise of the wall, upper slab and reserved water of the basin, the wall and upper slab are covered by soil protecting the concrete from the direct sunlight. Also grasses are planned on the protecting soil which presents a fine spectacle.
The above specifications of the distribution basin are the standard design of SONEDE.

Photo 5 Distribution Basins

CHAPTER 5

STUDY ON SEA WATER DESALINATION PLANT

CHAPTER 5 STUDY ON SEAWATER DESALINATION PLANT

Non-Disclosure Information

CHAPTER 6

PLAN OF WATER SUPPLY FACILITIES

CHAPTER 6 PLAN OF WATER SUPPLY FACILITIES

Non-Disclosure Information

CHAPTER 8

SOCIO-ENVIRONMENTAL CONSIDERATIONS

8.7-1 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) N (c) - (d) N	(a) The EIA including the one for power distribution line will be implemented by SONEDE from February to September 2015. (b) The EIA report shall be approved by ANPE(National Environment Agency) until December 2015. The TOR of the EIA are already approved by ANPE. (c) Not applicable. (d) The concession decree for the use of the maritime domain is scheduled for September 2016.また、The project will be implemented by SONEDE. Tunisian Electricity and Gas Supply Corporation (STEG), however, will construct the power distribution line. Since construction cost of it will be shouldered by SONEDE, necessary procedures have been started between SONEDE and STEG, and cost estimates offered by STEG is counted in the project cost.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) The first stakeholder meeting has been hold on the 22nd of May 2014. Considering the scope of the project, additional meetings will be scheduled during the EIA in 2015. STEG will prepare the plan of power distribution line. Based on it, SONEDE will make documents to explain the outline of the plan and collect opinions of residents from representatives of related areas, and then those opinions will be reflected in the plan of power distribution line. (b) The comments from the citizens have been reflected on the compensation policy.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) A comparison analysis, taking into account environmental items, considering different sites and processes, including the zero option, has been implemented.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) N (b) Y	(a) Liquid chlorine solutions are used so no air pollution is anticipated. (b) The plant will be built according to Tunisian specifications complying with applicable standards.
	(2) Water Quality -1	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards? (b) Does untreated water contain heavy metals?	(a) Y (b) N	(a) The brine discharge into the sea is complying with the Tunisian standard NT 106-002. (b) Almost all of heavy metals contained in brine discharged from the desalination plant originate in sea water, and is condensed to 100/45=2.22times. It, however, conforms to effluent quality standard. (for example: Zn++ in sea water = 38ug/l × 2.22 = 85ug/L; discharge <10,000ug/L; NT106-002).

8.7-1 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
2 Pollution Control	(2) Water Quality -2	(c) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If water quality degradation is anticipated, are adequate measures considered?	(c) N	(c) Plan of power distribution line is made by STEG. It is assumed that the line is led from 150kV national grid by aerial line, and tower interval is around 400m. Since it will be constructed on the flat olive field, large earth work and wood cutting are not necessary. Therefore, no impact on water quality and hydrology is anticipated.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) Y	(a) The membrane use is evaluated to 200m3/year, and these are considered as usual burnable wastes.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) Y	(a) The pumping facilities will be located within the existing reservoir facilities, so no noise nor vibrations are anticipated.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) Sea water will be the only feed water used, so there is no risk of subsidence.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The project area is not including any RAMSAR area.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms? (e) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife, and livestock? (f) Is there a possibility that improved access by the project will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? (g) In cases where the project site is located in undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	(a) Y (b) Y (c) Y (d) N (e) N (f) N (g) N	(a) The intake and discharge head are planned within a sea area including sea-grass meadows. The brine discharge will be done in an area with sea-grass meadows. (b) The sea-grass "posidonia oceanica" is considered a species to be protected under the Barcelona conference, (c) No significant impact on sea-grass meadows are anticipated, furthermore the discharge head allow for an efficient dilution of the brine, and offset mitigation measures are planned. (d) The intake head is planned within a depth of 8m, and is designed to take water at 2 to 3m height from the bottom, within a speed of max 0.2m/s, so that no fish nor organisms should be sucked up. (e) Plan of power distribution line is made by STEG. It is assumed that the line is led from 150kV national grid by aerial cable, tower interval is around 400m. No intercept of moving route of animals and livestock. (f) Since it will be constructed on the flat olive farming field, large earth work and wood cutting are not necessary. Therefore, no impact on ecosystem is anticipated. (g) Power distribution line will be constructed through developed environment, i.e. olive field.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a) N	(a) Sea water will be the only feed water used, so there will be no affection on surface water nor on groundwater flow.

8.7-1 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(4)Topography and Geology	(a) Is there a soft ground on the route of power transmission lines that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a,b,c) N	(a,b,c) The route of power distribution line is not decided yet by STEG as of December 2014. The area within a radius of 15.5km has gentle slope of 0.6% from 5m to 100m in elevation. No fear of landslide and no large scale earth work is needed for aerial power distribution line.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) Y (c) Y (d) Y (e) Y (f) - (g) - (h) Y (i) Y (j) Y	(a) The desalination plant is located with the public maritime domain, so no resettlement is anticipated. Also the pumping stations, reservoirs are planned within the existing reservoirs areas, so no resettlement is anticipated. Finally the distribution line route is planned along existing roads, so no resettlement is anticipated but some land acquisitions are required (ex: surge tanks). (b) No resettlement is anticipated but a stakeholder meeting has already been implemented with the purpose to explain about the project. Additional stakeholder meetings will be hold during the EIA. (c) No resettlement is anticipated but the compensation concept of the Tunisian law about expropriation is complying with the full replacement cost policy and a compensation procedure is established. (d) The payment of a compensation is a condition for expropriation according to Tunisian law. (e) The procedure for expropriation and land acquisition is described in the report of the preparatory survey for this project. (f) No resettlement is anticipated, so not applicable. (g) No resettlement is anticipated, so not applicable. (h) The land acquisition will be implemented by the land affairs department at SONEDE, the organisation is also including the participation of civil affairs court. In order to prepare an appropriate budget, the land acquisition scope has been estimated and is given in the report of the preparatory survey. (i) A monitoring plan (organization and monitoring form) including the state and progress of land acquisition has been established. (j) A complain management mechanism is established under the Tunisian law.

8.7-1 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses? (c) Is there a possibility that diseases, including communicable diseases, such as HIV will be introduced due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (d) Is there a possibility that installation of structures, such as power line towers will cause a radio interference? If significant radio interference is anticipated, are adequate measures considered? (e) Is compensation for construction of transmission line , such like compensation for underline executed in accordance with domestic law.	(a) Y (b) N (c) N (d) N (e) Y	(a) The construction of the intake and discharge pipe will affect the fishing activities. A compensation plan based on the activity time loss is established. (b) Sea water will be the only feed water used, so there will be no impact on current water uses. (c) Since Sfax is developed as the second largest population city in Tunisia, and rapid immigration of population is not anticipated. It will be developed in accordance with the population increase. Therefore, occurrence of disease caused by immigration will not be anticipated. (d) There are existing power lines in the project area. Therefore, new facilities will not affect on the present situation of radio. (e) The power distribution line is constructed by STEG, and land acquisition and underline compensation will be conducted in accordance with the law of Tunisia.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archaeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country' s laws?	(a) N	(a) The project area is not including the Thyna archaeological park. Registered archeologic ruins are not located in the project site.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) The project is not located within a touristic area and existing high tension power line exists. Therefore, impact on landscape by the facilities is small.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) - (b) -	(a) There is no ethnic minorities within the project area. (b) Not applicable.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d) Y	(a) The project will be implemented by SONEDE (public water supply company) and STEG (public power and gas supply company), so the Tunisian laws regarding working conditions will be enforced. (b) The project has been established considering present experience of SONEDE in the management of desalination facilities, and the project is not including any hazardous facility. (c) Upon completion of desalination plant, the plant maker will train the staff of SONEDE to the operation and maintenance of facilities. (d) The security guards will work from within the enclosed area of the facility and basically be at the guard post at the entrance of the plant. They will have to lay down their defence equipment into deposit at the guard post before leaving work.

8.7-1 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) Y (c) Y (d) N	(a) Measures to reduce turbidity during construction of intake and discharge pipes, are planned. (b) The living sea grass meadows will be destroyed by the construction of intake and discharge pipes. The development of artificial reefs is planned as a mitigation measure. (c) As the fishing activities will be affected by the construction of intake and discharge pipes, a compensation plan based on activity time loss, has been established. (d) The distribution line is planned along the existing roads, but the construction space will not include the pavement section, so no particular impact on traffic is anticipated.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) Y	(a) A monitoring plan of the water quality and sea grass meadows during construction and operation, will be implemented. (b) The items and methods of the monitoring program have been established according to Tunisian law on water quality and according to the expertise of the INSTM for the sea-grass, the frequencies have been set to monitor impacts during construction and operation. (c) The monitoring organization is established around SONEDE, including the ANPE, the INSTM, and the UTAP. (d) A monitoring form, easily usable by the PIU in SONEDE and defining format and frequency of reports, has been established.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a) N	(a) This checklist is made based on JICA's forms of checklists for water supply, and power transmission and distribution lines.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to trans-boundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as trans-boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) There is no trans-boundary or global issues related to the project.

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.

In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

CHAPTER 9

LAND ACQUISITION AND RESETTLEMENT

9.10-1 Documents delivered to Residents for Explanation about Power Transmission Line

الشركة الوطنية لاستغلال وتوزيع المياه
SOCIETE NATIONALE D'EXPLOITATION ET DE DISTRIBUTION DES EAUX

تونس في 12 ديسمبر 2014

29036

إلى السيد والي صفاقس

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

المصاحيب: - ملحق عدد1 حول المسار الأولي لخط الجهد العالي،
- ملحق عدد2 حول وثيقة استشارة (الملاحظات و التساؤلات حول المشروع)
- ملحق عدد3 حول العناصر الأساسية للمشروع،

تحية طيبة وبعد،

في إطار تدعيم تزويد صفاقس الكبرى بالماء الصالح للشرب، كما تعلمون برمجت الشركة الوطنية لاستغلال وتوزيع المياه انجاز محطة لتحلية مياه البحر بسعة 100 ألف متر مكعب في اليوم كمرحلة اولى. 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 انجاز 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 صحبة هذا ملخصا للعناصر الأساسية للمشروع (ملحق عدد3). كما نطلب من سيادتكم مدنا بملاحظاتكم و تساؤلاتكم بخصوص عناصر المشروع وذلك طبقا لوثيقة الاستشارة المصاحبة (ملحق عدد2).

وحتى نتمكن من إدراج ملاحظاتكم في الدراسة البيئية للمشروع، الرجاء موافاتنا بإجاباتكم في أقرب الآجال.

تقبلوا سيدي الوالي فائق عبارات التقدير و الاحترام.

المدير المركزي للدراسات
لخدان بوبكر

إدارة الدراسات

شارع سليمان بن سليمان
المنار II - تونس 2092
Av. Slimane Ben Slimane
El Manar II - Tunis 2092
E-mail : sonede@sonede.com.tn
السجل التجاري ص د ش B111892008
Matricule Fiscal 1455 J/A/M/000
المعرف الجبائي
البريد الالكتروني

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^3/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^3/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, fax: 74297335)
Or Mr. Charfeddine Sliti (email: 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: 200,000m3/day (phase I , 100,000m3/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.

Answer FAX of Sfax Governor to SONEDE
(Check at No question on the matter.)

04-02-2015 17:49 GOUVERNORAT DE SFAX 74 403 625 P.01/01
FAX NO. :216 71 494185 04 Feb. 2015 11:37 P 3

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

Destinataire: Direction régionale de Sfax ou Direction de dessalement et d'environnement (SONEDE) (email : [illegible]@sonede.com.tn, fax: 74297335)
Ou M. Charfeddine Sliti (email : c.sliti@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:.....@.....

الوالي
مهدي شلبي

وزارة الداخلية

TOTAL PAGE(S) 01

CHAPTER 10

IMPLEMENTATION PLAN

CHAPTER 10 IMPLEMENTATION PLAN

Non-Disclosure Information

CHAPTER 11

CONFIRMATION OF VIABILITY AND RISK ANALYSYS

11.3-1 Request Letter to STEG from SONEDE regarding Power Provision of 40MW (issued on May 28, 2013)

الشركة الوطنية لاستغلال وتوزيع المياه
SOCIETE NATIONALE D'EXPLOITATION ET DE DISTRIBUTION DES EAUX

تونس في: 28 ماي 2013

إلى

السيد المدير العام للشركة التونسية للكهرباء و الغاز 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 أولية للمشروع الذي سيتم تمويله من طرف الجانب الياباني، وقد طالب الفريق الياباني بمده ببعض المعطيات المتعلقة بتزويد ولاية صفاقس بالطاقة الكهربائية التالية:

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

نالرجاء منكم بالمعطيات المطلوبة في أقرب الآجال لتيسير انطلاق دراسة المشروع علما و أن الطاقة الضرورية لتشغيل المحطة المزمع إنجازها تقارب 40 ميغاوات.

تقبلوا فائق عبارات التقدير و السلام.

الرئيس المدير العام
الهادي بالحاج

ARRIVEE LE 28 MAI 2013

شارع سليمان بن سليمان
1002 تونس - البلفيدير
Bd. Slimane Ben Slimane
El Manar II - Tunis 2092

Tél. : 71.887.000 الهاتف
Fax : 71.871.000 الفاكس
E-mail sonede@sonede.com.tn البريد الإلكتروني

R.C. : C01115926/8 السجل التجاري عدد
Matricule Fiscal 1455 M/A/M/000 المعرف الجبائي

11.3-2 Translation of 11.3-1 in English

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;4

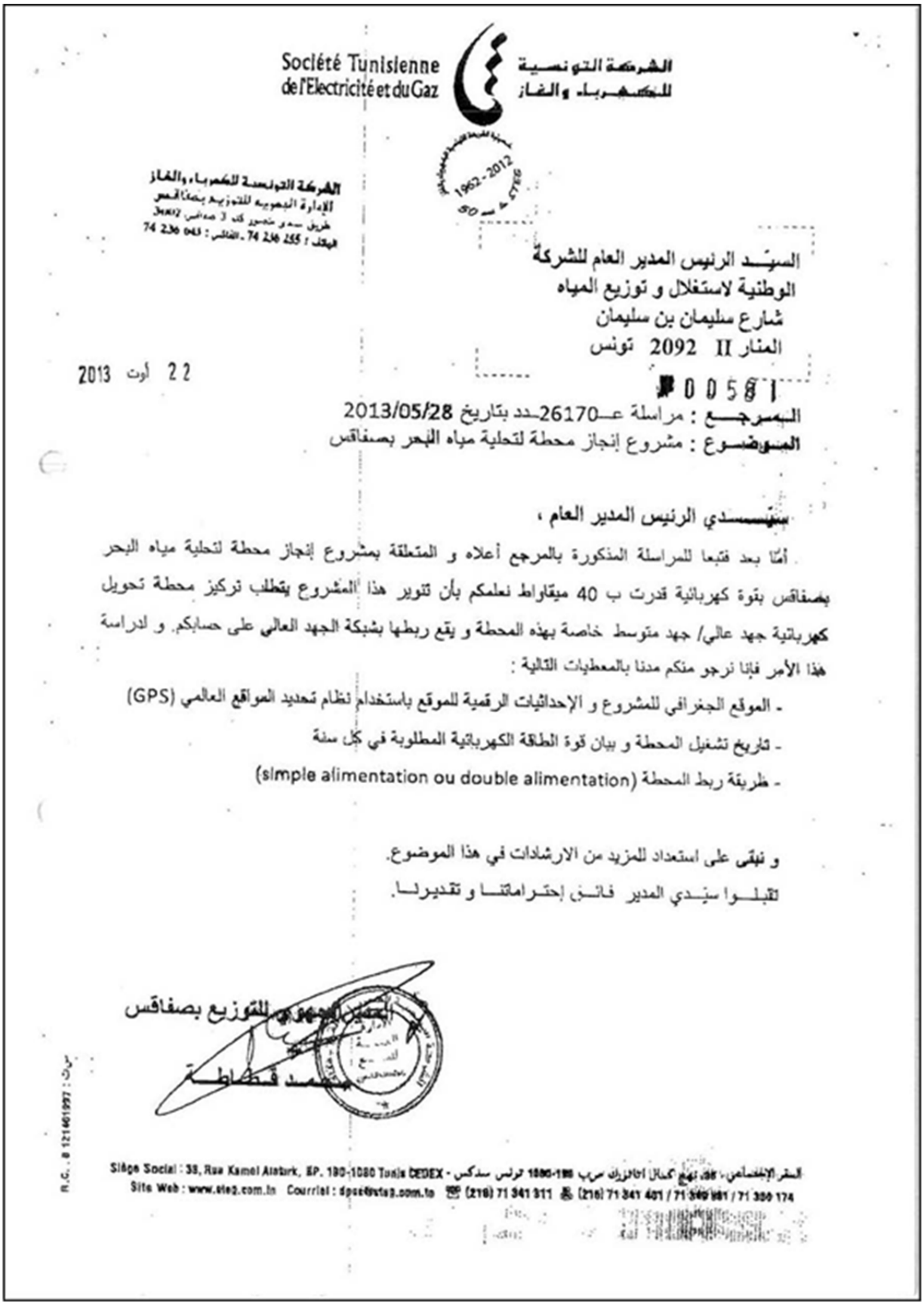
Therefore, we would appreciate you providing us with these data in the best possible time to ensure smooth beginning of the project, knowing that power required for the operation of the planned station would be about 40 MW.

Please accept my best regards

General Manager

Hedi Belhaj

11.3-3 Answer from STEG to SONEDE regarding Request Letter on May 28, 2013 (issued on August 22, 2013)



Société Tunisienne de l'Electricité et du Gaz

الشركة التونسية للكهرباء والغاز

1962 - 2012

الشركة التونسية للكهرباء والغاز
الإدارة الجهوية للتوزيع بصفاقس
طريق سيدي منصور كلم 3 صفاقس 3060
الهاتف : 74 236 255 - الفاكس : 74 236 043

السيّـد الرئيس المدير العام للشركة
الوطنية لاستغلال و توزيع المياه
شارع سليمان بن سليمان
المنار II 2092 تونس

2013 أوت 22

0058

المرجـع : مراسلة عـ26170ـدد بتاريخ 2013/05/28
الموضـوع : مشروع إنجاز محطة لتحلية مياه البحر بصفاقس

سيّـدي الرئيس المدير العام ،

أمّا بعد فتبعا للمراسلة المذكورة بالمرجع أعلاه و المتعلقة بمشروع إنجاز محطة لتحلية مياه البحر بصفاقس بقوة كهربائية قدرت ب 40 ميقاواط 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.

تقبلـوا سيّـدي المدير فائـق إحتـراماتنـا و تقديرنـا.

المدير الجهوي للتوزيع بصفاقس
محمد قطاطة

R.C. : B 1214611997

Siège Social : 38, Rue Kamel Ataturk, BP. 190-1080 Tunis CEDEX - المقر الاجتماعي : 38، نهج كمال أتاتورك ص.ب 190-1080 تونس سدكس
Site Web : www.steg.com.tn Courriel : dpse@steg.com.tn (216) 71 341 911 (216) 71 341 401 / 71 340 881 / 71 350 174

11.3-4 Translation of 11.3-3 in English

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

11.3-5 Answer of STEG about Power Supply Cost and Method（2013/11/20）

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

à l'attention de M^r 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
Route de Mahdia Km 3 - SFAX 3002
Tél. 74 225 450 Fax 74 636 843

SONEDE
Division Equipement Sud
Rue Ibn Badis 3029 Sfax

20 NOV 2013

N° 00845

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 minimes 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

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

Direction Régionale de Distribution de Sfax

Mohammed KETATA

11.3-6 Translation of 11.3-5 in English

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:

Site n.	Distance	Extension Cost
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