添付資料 **1-4**

# Minutes of Meeting (3rd Steering Committee)

# &

# Discussion materials

# MOM
## OF
## PROJECT STREERING COMMITTEE
## ON
## FEASIBILITY STUDY
## FOR
## ENHANCED WATER SUPPLY SYSTEM PROJECT

DATE: June 7, 2010
PLACE: Praia, Cape Verde

1. The Government of the Republic of Cape Verde (GoCV), in cooperation with the Government of Japan, intends to develop a structuring and strategic water sector project on the island of Santiago, aiming both at improving the water supply conditions, through the interconnection of water transmission and distribution networks, and at strengthening the production capacities;
2. Given the specific and strategic significance of the project, a diligent and efficient technical follow-up will be needed for the same ;
3. In the scope of implementation of the above mentioned project, there will be a need to guarantee, to the GoCV, reliable technical counsel and assistance;
4. It is much advisable that the project be followed up and supported by all sectors and institutions which are, in one or other way, related to the water sector.
5. In this purpose, a Project Steering Committee has been officially established on 26th of January 2010 by the DISPATCH No. 007 / 2010 issued by MEGC (now MTIE).
6. The Project Steering Committee has met officially for the third time on the 7th of June 2010, in the office of Cape Verde Investment Agency, Praia, Cape Verde. The list of participants is given in ANNEX-2.
7. The main points discussed are based on the presentation by The JICA study team of all results and propositions related to the project at the time of the meeting. This presentation is given in ANNEX-1.
8. The Project Steering Committee members hereby confirmed full understanding of main points discussed as per hereto the Attachment of the Minutes of Meeting.

By Chairman of the Project Steering Committee

Mr. Abraao Andrade LOPES
Director General,
Ministry of Tourism, Industry and Energy
Cape Verde

MS

MINUTES OF MEETING
ON
DESIGN CONDITION DEFINITION
FOR
THE PREPARATORY SURVEY
ON
WATER SUPPLY SYSTEM DEVELOPMENT PROJECT
IN
THE REPUBLIC OF CAPE VERDE

Praia, June 7, 2010

Mr. Abraao Andrade LOPES
Director General,
Ministry of Tourism, Industry and Energy
The Government of the Republic of Cape Verde

Mr. Mitsutoshi SUZUKI
Lead Consultant of the Survey Team
Japan International Cooperation Agency

Attachment

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a mission (hereinafter referred to as "the JICA Mission") to the Republic of Cape Verde. Since its arrival on May 17th, 2010, the JICA Mission and officials of Government of the Republic of Cape Verde (hereinafter referred to as "the GoCV"), Ministry of Tourism, Industry and Energy, (hereinafter referred to as "MTIE") had detailed discussions on the Progress Report of the Preparatory Survey (hereinafter referred to as "the Survey") for Water Supply System Development Project (hereinafter referred to as "the Project").

In the course of discussions, both sides confirmed the main items described below. The JICA Mission will proceed as planned up to December 2010, when the Survey comes to the end.

1. Conditions of the Survey in general
   The JICA Survey Team stated that the results of discussions do not imply any decision or commitment by JICA for its prospective loan for the Project at this moment and the above results should be reported to the higher authority of JICA and the Government of Japan.

2. Major Points Discussed

(Activities of other donors and firms)

(1) As for the activities of other donors and firms the GoCV explained and confirmed the below.
   a. The Survey shall include financial cooperation of Spain (5,000$m^3$/day) and of World Bank (5,000$m^3$/day) to expand the existing desalination plant at Palmarejo in Praia.
   b. The concession contract between GoCV and CAIS is still under discussion. Therefore, the Survey does not need to include CAIS projects to construct desalination plants in Sao Miguel and Santa Cruz.
   c. The Survey shall take note of the construction plan of water transmission line from Calheta de Sao Miguel to Assomada, which was already planned by GoCV.

(Outcomes of the 3rd mission by JICA Survey Team and Design Framework)

(2) As for the Survey conducted by during the 3rd mission, JICA Survey Team explained and all the participants of Steering Committee accepted the below.
   a. JICA Survey Team has conducted the actual Survey based on the option proposed by the internal steering committee held on April 28th and the discussion and result of the 2nd Steering Committee held on May 21st, 2010.
   b. JICA Survey Team reached the conclusion of the most optimal solution through development of survey including cost analysis, which is to produce desalinated water by 2 major plants located within the premises of ELECTRA at Palmarejo and at the proposed site of Calheta de Sao Miguel, each of them having a production capacity of 20,000 $m^3$/day of desalinated water at Horizon 2020, and to transport produced desalinated water with inter-municipality transmission network.
   c. JICA survey team has presented the revised prospective evaluation of water demand in 2020 The JICA Survey Team has actualized the data through the meeting with concerned authorities and institutions of GoCV such as MTIE, INE, INGRH, ELECTRA, etc. for the basic plan and feasibility study.

d. All participants of the present Steering Committee explained their opinion concerning the revised prospective evaluation of water demand, whose subjects are mainly; 1) household connection ratio target in 2020, 2) leakage ratio target in 2020 of their municipalities in order to finalize the prospective evaluation by JICA Survey Team. Thus all participants of the present Steering Committee confirmed the result of calculation as described in the ANNEX-3 Design Framework, and agreed to start the system design by JICA Survey Team.
e. JICA Survey Team summarized the design philosophy. In order to follow the agreed initial schedule of feasibility study to be conducted by the JICA Survey Team, the design framework, comprising basic data for water demand volume and design philosophy, discussed by the members of 3rd Steering Committee should not be altered from this date.
f. GoCV side has shared necessary information, changes and results regarding water supply in the country with the JICA Survey Team. Therefore, it shall be considered that the design framework for the Feasibility Study, attached as ANNEX-3 Design Framework, is accepted by GoCV.

(CNAG Meeting – Ground water and Boron Issues)

(3) Although the conclusion needs to be determined officially by CNAG in the GoCV level for ground water mixture and boron issues, JICA Survey Team will start the system design in Japan based on the agreed design framework with basic data and design philosophy by the 3rd Steering Committee.
   a. JICA Survey Team met and explained and discussed on 3rd of June, 2010 with Ministers of GoCV during the 3rd Mission, Ms. Fátima FIALHO - Honorable Minister of Tourism, Industry and Energy, Ms. Cristina DUARTE - Honorable Minister of Finance, Mr. Jose Maria VEIGA Honorable - Minister of Environment Rural Development and Maritime Resources, though CNAG Meeting was not possible to be held before the present 3rd Steering Committee.
   b. Though GoCV's principal policy of Ground water utilization is orientated to solely agricultural purpose, it shall be utilized for potable water unless the sufficient volume of potable water is supplied to users of each Municipality in Santiago Island. JICA Survey Team will not take into consideration the actual quantity of ground water used for potable water.
   c. The Ministers recommended to follow EU standard concerning Boron content of drinking water as there is not CV standard. This subject is to be officially reported to JICA Headquarter and JICA Survey Team when GoCV decides this issue by the Ministry in charge.

(IEE Workshop)

(4) Inter-Municipal Meeting for Environmental Issues was conducted and invited MTIE, DGA, and Chambers of Municipality on 25th of May, 2010 in Praia. Output and Confirmed items are also shown in ANNEX-4.

(Municipality Mayors Workshop)

(5) Mayors Workshop was conducted and invited Mayors of all municipalities of Santiago island on 31st of May, 2010 for introduction of the JICA Study and its objectives using ANNEX-5. All participants understood the JICA Study.

(Fourth Steering Committee)

(6) JICA Survey Team proposed the 4th Steering Committee after the submission of Interim Report (IT/R) of Feasibility Study to be held around August 2010.

(End)

ANNEX-1 Third Steering Committee Presentation
ANNEX-2 Attendants List of the Second Steering Committee
ANNEX-3 Design Framework
ANNEX-4 IEE Workshop
ANNEX-5 Municipality Mayors Workshop

# 3rd Steering Committee
# on
# Water Supply System
# Development Project in Santiago, Cape Verde
# (JICA-II Project)

**June 7, 2010 at Praia**

Japan International Cooperation Agency

**Toyo Engineering Corporation**
**Ingérosec Corporation**
**UNICO International Corporation**



## Topics and Modification after 2nd Committee

1. **Critical Issues**
2. **Project Work Shop**
3. **IEE Work Shop**
4. **Modification after 2nd Steering Committee**
   - **4-1. Water Demand and Frame Work**
   - **4-2. System Development Approach**
   - **4-3. Water Supply System**
   - **4-4. Cost Comparison**
5. **Ground Water utilization and Boron content**
6. **Basic Data and Design Philosophy**
7. **Way Forward to Interim Report**

# Critical Issues

- **To solve the critical issues of the JICA project attending**
  **- Minister of Tourism, Industry and Energy**
  **- Minister of Finance**
  **- Minister of Environment Rural Development and Maritime Resources**
  **with JICA Study Team on 3rd June, 2010 in Praia.**

- **Solution of Critical issues:**

1. **Desalination will be installed at Calheta Sao Miguel and Palmarejo with inter-municipality network.**
2. **Other projects, which are considered regarding JICA Study,**
   **- Spanish cooperation project (5,000m$^3$/day desalination expansion), and**
   **- World Bank cooperation project (5,000m$^3$/day newly installed).**
3. **Ground water will not be utilized for potable after JICA project completion.**
4. **Boron content in potable water will follow to EU standard of less than 1.0mg/l.**



# Project Work Shop

**The work shop was conducted inviting MTIE, INGRH, and Camara Municipals on 31st May, 2010 in Praia.**

- **Topics:**

1. **JICA Study, its objective, time schedule, and methodology**
2. **Water demand estimation with population horizon in Santiago island**
3. **Water supply system with layout, production, reservoir, and transmission**
4. **Scope of JICA and GoCV**

- **Discussion Items:**

1. **System development approach was confirmed.**
2. **Ground water utilization and Boron removal were discussed.**
3. **Main reservoir capacity was discussed.**
4. **Holding company idea in Santiago island was discussed.**
5. **Production cost and tariff were discussed.**

# IEE Work Shop

- **Output:**

1. **Inter-Municipal Meeting for Environmental Issues was conducted inviting MTIE, DGA, and Camara Municipals on 25th May, 2010 in Praia.**

**2. Subjects discussed:**

**1) Definition of category of JBIC guideline**
**2) EIA mandate based on category.**
**3) General issues to be considered in each municipality for formulation of Project**
**4) Forthcoming EIA study**

- **Confirmed Items:**

**1. JICA will categorize the Project based on IEE.**
**2. Each Municipality Environment Plan shall be considered as the opinion of local stakeholders for F/S and IEE stage.**
**3. GoCV will prepare TORs for EIA based on recommendation of IEE.**



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1. Critical Issues
2. Project Work Shop
3. IEE Work Shop
4. Modification after 2nd Steering Committee
   - 4-1. Water Demand and Frame Work
   - 4-2. System Development Approach
   - 4-3. Water Supply System
   - 4-4. Cost Comparison
5. Ground Water utilization and Boron content
6. Basic Data and Design Philosophy
7. Way Forward to Interim Report

# Demand and Frame work at 2nd Committee

| | | | South | | | | North | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Praia | Ribeira Grande | Sao Domingos | Total South | Tarrafal | Sao Miguel | SS do Mundo | Santa Cruz | Sao Lourenco | Santa Catarina | Total North | Grand Total |
| (a) | | Target Year (2020) Population | 177,718 | 9,572 | 15,542 | 202,832 | 31,637 | 19,110 | 13,013 | 35,617 | 10,986 | 57,369 | 167,732 | 370,564 |
| | a-1 | Urban | 177,007 | 1,522 | 2,891 | 181,420 | 11,041 | 7,204 | 1,835 | 15,743 | 2,318 | 23,751 | 61,892 | 243,312 |
| | a-2 | Rural | 711 | 8,050 | 12,651 | 21,412 | 20,596 | 11,906 | 11,178 | 19,874 | 8,668 | 33,618 | 105,840 | 127,252 |
| (b) | | Service Coverage (%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| (c) | | Served Population | 177,718 | 9,572 | 15,542 | 202,832 | 31,637 | 19,110 | 13,013 | 35,617 | 10,986 | 57,369 | 167,732 | 370,564 |
| | c-1 | Urban | 177,007 | 1,522 | 2,891 | 181,420 | 11,041 | 7,204 | 1,835 | 15,743 | 2,318 | 23,751 | 61,892 | 243,312 |
| | c-2 | Rural | 711 | 8,050 | 12,651 | 21,412 | 20,596 | 11,906 | 11,178 | 19,874 | 8,668 | 33,618 | 105,840 | 127,252 |
| (d) | | Per-Capita Demand (LCD) | | | | | | | | | | | | |
| | d-1 | Urban | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | d-2 | Rural | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| (e) | | Domestic Demand ($m^3$/day) | 17,736 | 555 | 922 | 19,213 | 2,134 | 1,316 | 742 | 2,568 | 665 | 4,056 | 11,481 | 30,694 |
| | e-1 | Urban | 17,701 | 152 | 289 | 18,142 | 1,104 | 720 | 184 | 1,574 | 232 | 2,375 | 6,189 | 24,331 |
| | e-2 | Rural | 36 | 403 | 633 | 1,071 | 1,030 | 595 | 559 | 994 | 433 | 1,681 | 5,292 | 6,363 |
| (f) | | Non-Domestic Demand ($m^3$/day | 2,100 | 0 | 0 | 2,100 | 250 | 200 | 0 | 300 | 0 | 1,800 | 2,550 | 4,650 |
| | f-1 | Tourizm Demand | 600 | 0 | 0 | 600 | 50 | 100 | 0 | 100 | 0 | 300 | 550 | 1,150 |
| | f-1-1 | Number of Tourists (Daily) | 2400 | 0 | 0 | 2,400 | 200 | 400 | 0 | 400 | 0 | 1200 | 2,200 | 4,600 |
| | f-1-2 | Per-Capita Demand (LCD) | 250 | 0 | 0 | 250 | 250 | 250 | 0 | 250 | 0 | 250 | 1,000 | 1,250 |
| | f-2 | Others | 1500 | 0 | 0 | 1,500 | 200 | 100 | 0 | 200 | 0 | 1500 | 2,000 | 3,500 |
| (g) | | Net Water Demand ($m^3$/day) | 19,836 | 555 | 922 | 21,313 | 2,384 | 1,516 | 742 | 2,868 | 665 | 5,856 | 14,031 | 35,344 |
| (h) | | Leakage Ratio (%) | 24 | 20 | 10 | 23 | 24 | 16 | 20 | 28 | 10 | 28 | 25 | 24 |
| (i) | | Day Average Demand ($m^3$/day) | 26,100 | 693 | 1,020 | 27,813 | 3,137 | 1,804 | 928 | 3,983 | 736 | 8,133 | 18,722 | 46,535 |
| (j) | | Seasonal Peak Factor | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| (k) | | Day Maximum Demand ($m^3$/day) | 33,930 | 901 | 1,325 | 36,157 | 4,078 | 2,346 | 1,206 | 5,178 | 957 | 10,573 | 24,338 | 60,495 |
| | | | | | | 60% | | | | | | | 40% | 100% |

**Estimated daily maximum demand: 60,000m$^3$/day.**
**- Northern area is 24,000m$^3$/day (40% of island), and**
**- Southern area is 36,000m$^3$/day (60% of island).**



# Demand and Frame work modified

| items | | South | | | South total | North | | | | | North total | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Praia | Ribeira Grande | Sao Domingos | | Tarrafal | Sao Miguel | SS do Mundo | Santa Catarina | Santa Cruz | Sao Lourenco | | | |
| a. Target Year (2020) Population (person) | | 157,978 | 11,562 | 17,331 | 186,871 | 28,577 | 21,137 | 13,157 | 58,321 | 36,102 | 11,154 | 168,448 | 355,319 | Instituto Nacional de Estatistica (INE) |
| a1 | – Urban | 155,609 | 1,746 | 2,772 | 160,127 | 9,717 | 7,398 | 1,776 | 18,663 | 14,441 | 2,231 | 54,226 | 214,353 | INE |
| a2 | – Rural | 2,369 | 9,816 | 14,559 | 26,744 | 18,860 | 13,739 | 11,381 | 39,658 | 21,661 | 8,923 | 114,222 | 140,966 | INE |
| b. Overall Pipeline Service Coverage (%) | | 99.0% | 80.0% | 80.0% | | 90.0% | 75.0% | 60.0% | 80.0% | 85.0% | 70.0% | | | Study team |
| in 2007 | | 47.3% | 10.9% | 9.9% | | 54.1% | 53.7% | 15.4% | 48.8% | 76.9% | 43.9% | | | INE |
| c. Served Population | Connection ratio in Urban, data by INGRH 100 % | | | | | | | | | | | | | |
| c1 = a x b | Overall population served by pipe network | 156,398 | 9,250 | 13,865 | 179,513 | 25,719 | 15,853 | 7,894 | 46,657 | 30,687 | 7,808 | 134,618 | 314,130 | Connection ratio (Urban Total) |
| c2 = a1 x CONE % | – Urban, with pipe connection | 155,609 | 1,746 | 2,772 | 160,127 | 9,717 | 7,398 | 1,776 | 18,663 | 14,441 | 2,231 | 54,226 | 214,353 | 100% |
| c3 = c1-c2 | – Rural, with pipe connection | 789 | 7,504 | 11,093 | 19,386 | 16,002 | 8,455 | 6,118 | 27,994 | 16,246 | 5,577 | 80,392 | 99,777 | Connection ratio (Rural Total) |
| c4 = a-c1 | Overall population, NOT served by pipe | 1,580 | 2,312 | 3,466 | 7,358 | 2,858 | 5,284 | 5,263 | 11,664 | 5,415 | 3,346 | 33,830 | 41,189 | 71% |
| c5 = a1-c2 | – Urban, without pipe connection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | |
| c6 = a2-c3 | – Rural, without pipe connection | 1,580 | 2,312 | 3,466 | 7,358 | 2,858 | 5,284 | 5,263 | 11,664 | 5,415 | 3,346 | 33,830 | 41,189 | |
| d. Per-Capita Average Demand (liter/person/day) | | | | | | | | | | | | | | |
| d1 | – Urban, with pipe connection | 150 | 150 | 150 | | 150 | 150 | 150 | 150 | 150 | 150 | | | INGRH |
| d2 | – Rural, with pipe connection | 80 | 80 | 80 | | 80 | 80 | 80 | 80 | 80 | 80 | | | INGRH |
| d3 | – Urban, without pipe connection | 50 | 50 | 50 | | 50 | 50 | 50 | 50 | 50 | 50 | | | INGRH |
| d4 | – Rural, without pipe connection | 50 | 50 | 50 | | 50 | 50 | 50 | 50 | 50 | 50 | | | INGRH |
| e. Domestic demand (m3/day) | | | | | | | | | | | | | | |
| e1 = c2 x d1 | – Urban, with pipe connection | 23,341 | 262 | 416 | 24,019 | 1458 | 1110 | 266 | 2799 | 2166 | 335 | 8,134 | 32,153 | |
| e2 = c3 x d2 | – Rural, with pipe connection | 63 | 600 | 887 | 1,551 | 1280 | 676 | 489 | 2240 | 1300 | 446 | 6,431 | 7,982 | |
| e3 = c5 x d3 | – Urban, without pipe connection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| e4 = c6 x d4 | – Rural, without pipe connection | 79 | 116 | 173 | 368 | 143 | 106 | 263 | 583 | 271 | 167 | 1,692 | 2,059 | |
| A. = e1+e2+e3+e4 | Domestic Demand (m3/day) | 23,483 | 978 | 1,477 | 25,938 | 2,881 | 2,050 | 1,019 | 5,622 | 3,737 | 948 | 16,257 | 42,195 | |
| f. Tourizm Demand | | | | | | | | | | | | | | |
| f1 | Number of Beds (beds) | 2,400 | 100 | 100 | 2,600 | 200 | 100 | 0 | 500 | 200 | 0 | 1,000 | 3,600 | MTIE(Tourism dept) + Study team |
| f2 | Expected Average Occupancy | 70% | 70% | 70% | | 70% | 70% | 70% | 70% | 70% | 70% | | | Study team |
| f3 | Per-Capita Demand (liter/bed/day) | 300 | 300 | 300 | | 300 | 300 | 300 | 300 | 300 | 300 | | | MTIE(Tourism dept) + Study team |
| f = f1 x f2 x f3 | Tourism Sub total (m3/d) | 504 | 21 | 21 | 546 | 42 | 21 | 0 | 105 | 42 | 0 | 210 | 756 | |
| g. Industries, office, hospital, others (m3/day) | | 3,000 | 0 | 0 | 3,050 | 50 | 100 | 0 | 500 | 100 | 0 | 750 | 3,800 | MTIE(Industry dept) + Study team |
| B = f + g | Non-Domestic Demand (m3/day) | 3,504 | 21 | 71 | 3,596 | 92 | 121 | 0 | 605 | 142 | 0 | 960 | 4,556 | |
| C = A + B | Total Net Water Demand (m3/day) | 26,987 | 999 | 1,548 | 29,534 | 2,973 | 2,171 | 1,019 | 6,227 | 3,879 | 948 | 17,217 | 46,751 | |
| h. | Leakage Ratio (%) | 15 | 15 | 5 | | 15 | 10 | 15 | 15 | 15 | 5 | | 15 | Study team |
| NOW | | 24 | 20 | 10 | | 24 | 16 | 20 | 28 | 28 | 10 | | 24 | SAAS |
| D = C /(100% - h%) | Day Average Demand (m3/day) | 31,750 | 1,175 | 1,682 | 34,607 | 3,497 | 2,413 | 1,199 | 7,326 | 4,563 | 1,031 | 20,028 | 54,635 | |
| i. | Seasonal Peak Factor (Tourism) | 1.4 | 1.4 | 1.4 | | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | | | Study team |
| j. f x (i-1) / (100%-h%) | Seasonal Additional Demand (m3/d) | 237 | 10 | 9 | 256 | 20 | 9 | 0 | 49 | 20 | 0 | 98 | 354 | |
| E = D + j | Daily Maximum Demand (m3/day) | 31,987 | 1,185 | 1,691 | 34,863 | 3,517 | 2,422 | 1,199 | 7,375 | 4,583 | 1,031 | 20,126 | **54,990** | |
| | | 58% | 2% | 3% | 63% | 6% | 4% | 2% | 13% | 8% | 2% | 37% | 100% | |
| **2. Existing plant, including planned plant** | | | | | | | | | | | | | | |
| | **Existing Desalination Plant** | 5,000 | (Palmarejo) | | 5,000 | | | | | 500 | | 500 | 5,500 | |
| | **Planned plant** | | | | | | | | | (Achada Ponta) | | | | |
| | by Spanish fund | 5,000 | (Palmarejo) | | 5,000 | | | | | | | 0 | 5,000 | |
| | by World Bank fund | 5,000 | (Palmarejo) | | 5,000 | | | | | | | 0 | 5,000 | |
| | **Total** | | | | 15,000 | | | | | | | 500 | **18,500** | |
| **3. Necessary additional plant (1-2)** | | | | | | | | | | | | | | |
| | Detail figure (m3/d) | | | | 19,863 | | | | | | | 19,626 | 39,490 | |
| | Round figure (m3/d) | | | | **20,000** | | | | | | | **20,000** | **40,000** | |

**Estimated daily maximum demand: 55,000m$^3$/day.**
**- Northern area is 20,000m$^3$/day (36% of island), and**
**- Southern area is 35,000m$^3$/day (64% of island).**

# System Development Approach modification

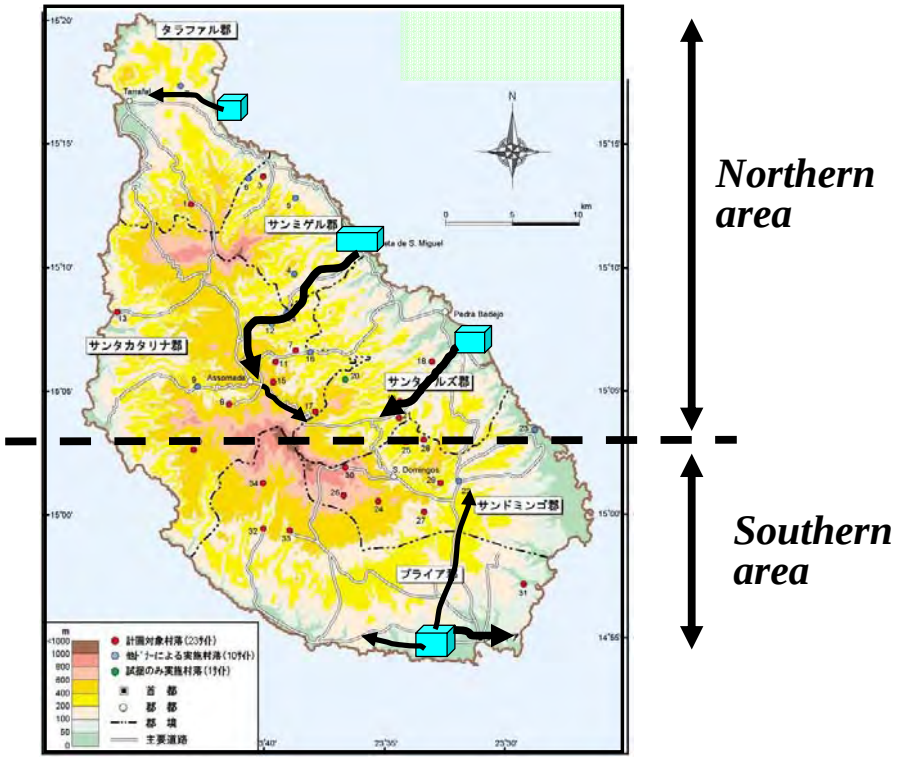
- **Served population and its distribution**
- **Natural condition and Power supply condition**
- **Construction cost and operation cost**
- **O & M system and organization**
- **Environment and social consideration**

- ***Other project impacts of Spanish, WB, and CAIS***
- ***Inter-municipality network***

***were added during this field survey in Cape Verde***



# Proposed System at 2nd Steering Committee



# Modified System


Altitude levels are indicative
Pumps location and reservoirs locations are indicative

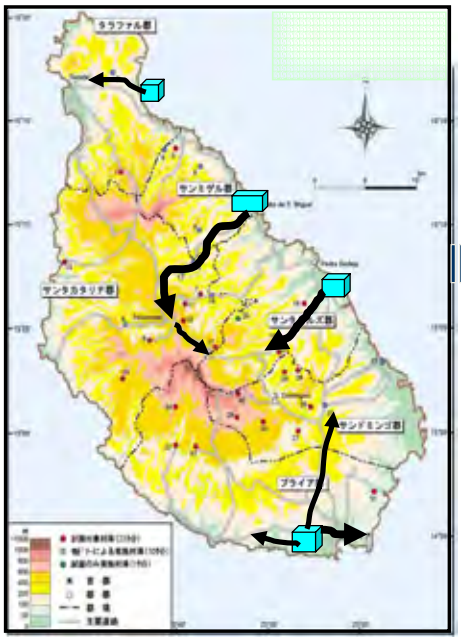
transmission mains
transmission mains
transmission mains
pumping station
existing and planned desalination plants
JICA dessalination plant
Existing reservoir
JICA reservoir
JICA reservoir

1. Two desalination system will be installed at Palmarejo and Calheta Sao Miguel.
2. Palmarejo Capacity:
   Total Production 35,000m³/day
   Existing and fixed plan 15,000m³/day
   JICA plan 20,000m³/day
3. Calheta Capacity: 20,000m³/day
4. Desalinated water will be supplied to all communities by transmission line to reservoirs.



# System Modification after 2nd Steering Committee

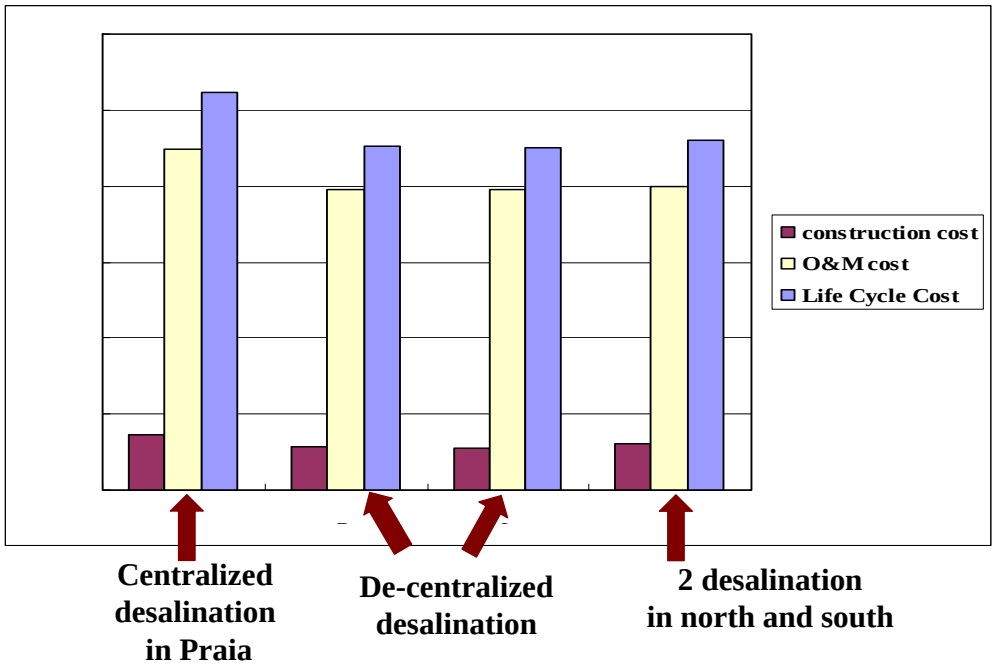
before



after


Altitude levels are indicative
Pumps location and reservoirs locations are indicative

# Cost comparison of 3 + 1 cases on PR/R basis



# Ground Water Utilization issues

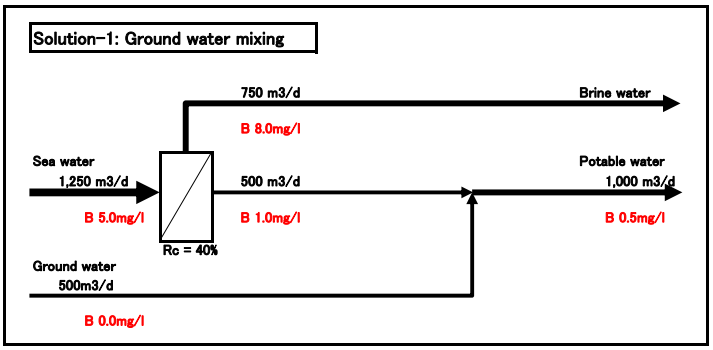
- **Major Advantage:**
- Desalination capacity reduction
- Water tariff reduction
- Boron content reduction

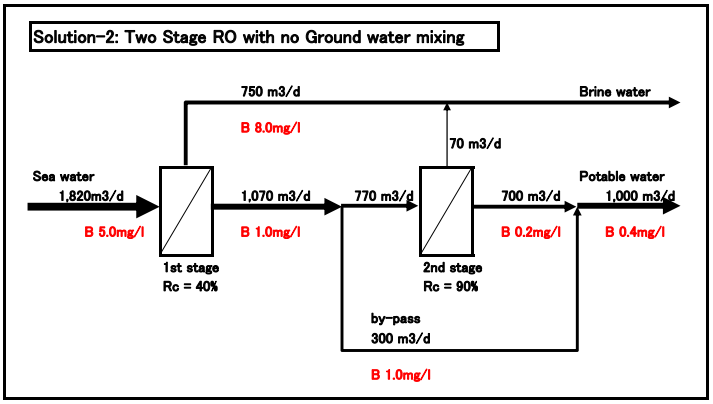
- **Major Disadvantage:**
- Unstable supply
- Unstable quality
- Lack of irrigation water

- **GoCV Policy**



# Boron Removal Solution for WHO guideline




**WHO: <0.5mg/l**
**EU: <1.0mg/l**
**Japan: <1.0mg/l**

**View points of**
**- GW availability**
**- GW utilization policy**
**- Boron content of EU/JPN**

**EU standard might follow.**

# Basic Data for Design

| | | |
|---|---|---|
| 1. | Unit of Measurement | SI (International System) |
| 2. | Code and Standard | ISO, EN and/or JIS |
| 3. | Sea water specification | To be identified (*) |
| 4. | Product water specification | EU standard |
| 5. | Effluent information | To be identified |
| 6. | Ground water specification | To be identified (*) |
| 7. | Soil information | To be identified (*) |
| 8. | Supplied power | Medium voltage, 20/15/10/6kV |

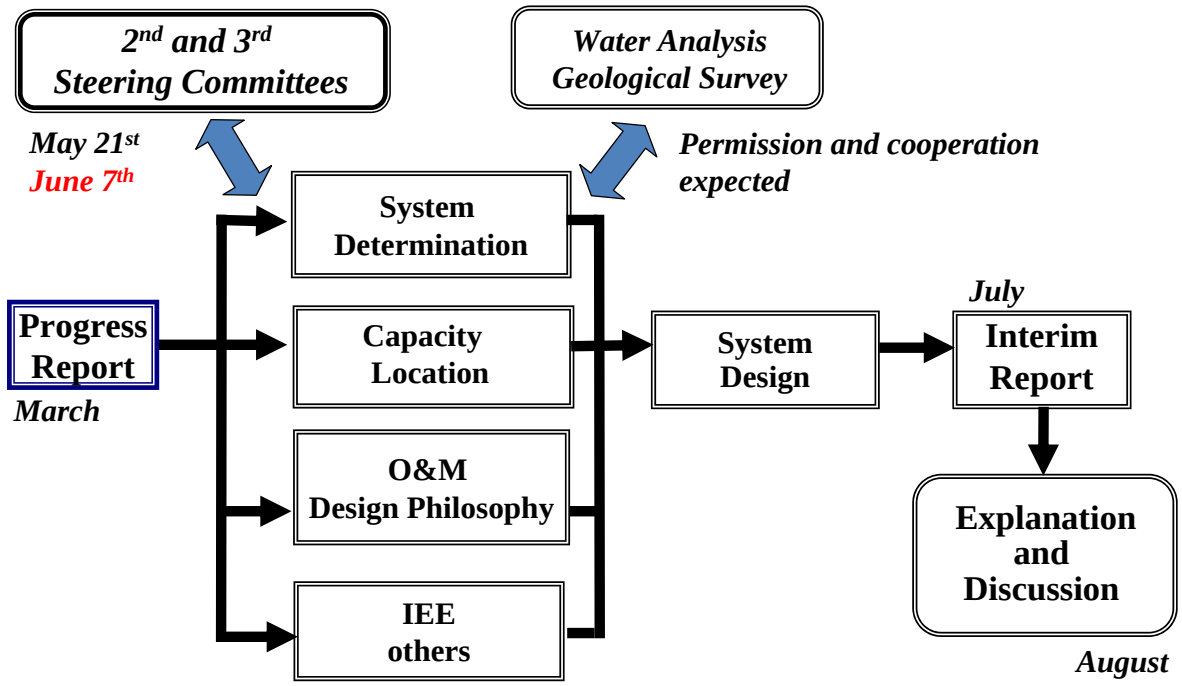
(*) : under analysis



# Design Philosophy

| | | |
|---|---|---|
| 1. | Desalination Technology | Reverse Osmosis |
| 2. | Power source | Electric power purchased |
| 3. | Major pumps | 50% spare |
| 4. | Reservoir capacity | 1/2 day for consumer<br>1/3 day for production |
| 5. | Instrumentation | Flow control for pumping<br>Level control for reservoir |
| 6. | Disinfection system | Chlorination |
| 7. | Major monitoring | pH, $Cl^-$, Conductivity |

# Way forward to Interim Report






# Interim Report contents

- Water supply system specification
- Each desalination plant specification
- Each reservoir specification
- Transmission network specification with pumping
- Preparation of project financial analysis
- IEE result
- EIA study preparation
- Sea Water and Ground Water Analysis
- Soil Analysis

**Thank you and Obrigado**

添付資料 **1-5**

# Minutes of Meeting (4th Steering Committee)

# &

# Discussion materials

# MOM
## OF
## PROJECT STREERING COMMITTEE
## ON
## FEASIBILITY STUDY
## FOR
## ENHANCED WATER SUPPLY SYSTEM PROJECT

DATE: August 27th, 2010
PLACE: Praia, Cape Verde

1. The Government of the Republic of Cape Verde (GoCV), in cooperation with the Government of Japan, intends to develop a structuring and strategic water sector project on the island of Santiago, aiming both at improving the water supply conditions, through the interconnection of water transmission and distribution networks, and at strengthening the production capacities;
2. Given the specific and strategic significance of the project, a diligent and efficient technical follow-up will be needed for the same;
3. In the scope of implementation of the above mentioned project, there will be a need to guarantee, to the GoCV, reliable technical counsel and assistance;
4. It is much advisable that the project be followed up and supported by all sectors and institutions which are, in one or other way, related to the water sector.
5. In this purpose, a Project Steering Committee has been officially established on 26th of January 2010 by the DISPATCH No. 007 / 2010 issued by MEGC (now MTIE).
6. The Project Steering Committee has met officially for the fourth time on the 23rd of August 2010, in the office of Cape Verde Stock Exchange (Bolsa-de Valores), Praia, Cape Verde. The list of participants is given in ANNEX-2.
7. During the Project Steering Committee, the JICA study team made a presentation regarding the Interim Report of the study as referred in ANNEX-1.
8. The Project Steering Committee members hereby confirmed full understanding of the Interim Report with main points discussed as per hereto the Attachment of the Minutes of Meeting.

By Chairman of the Project Steering Committee

Mr. Pedro Alcantara Silva
MTIE / General Directorate of Energy

MINUTES of MEETING
on
THE INTERIM REPORT
for
THE PREPARATORY SURVEY
on
WATER SUPPLY SYSTEM DEVELOPMENT PROJECT
in
THE REPUBLIC OF CAPE VERDE

Praia, 27th August, 2010

Mr. Pedro Alcantara Silva
Directorate General for Energy,
Ministry of Tourism, Industry and Energy
The Government of the Republic of Cape Verde

Mr. Mitsutoshi SUZUKI
Lead Consultant of the Survey Team
Japan International Cooperation Agency

Attachment

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a mission (hereinafter referred to as "the JICA Mission") to the Republic of Cape Verde. Since their arrival on August 19th, 2010, the JICA Mission and officials of Government of the Republic of Cape Verde (hereinafter referred to as "the GoCV"), Ministry of Tourism, Industry and Energy, (hereinafter referred to as "MTIE") had detailed discussions on the Interim Report of the Preparatory Survey (hereinafter referred to as "the Survey") for Water Supply System Development Project (hereinafter referred to as "the Project").

In the course of discussions, both sides confirmed the main items described below. The JICA Study Team will proceed as planned up to December 2010, when the Survey comes to the end.

1. Conditions of the Survey in general
   The JICA Mission stated that the results of discussions do not imply any decision or commitment by JICA for its prospective loan for the Project at this moment and the above results should be reported to the higher authority of JICA and the Government of Japan.

2. Reports submitted
   The JICA Mission handed the following reports to MTIE during their staying in Praia
   1) 7 hard copies of Interim Report
   2) 1 hard copy and electrical data of Water Analysis Report
   3) 1 electrical data of Geotechnical Survey Report

3. Major Points Discussed

(1) JICA Mission made a presentation regarding the Interim Report of the study using ANNEX-1 to all attendants listed in ANNEX-2.

(2) After the presentation, all attendants made discussion, question and comment as below:

a. RO core system

2 staged RO system is adopted in order to clear less than 0.5mg/liter of the Boron content in drinking water without ground water utilization as dilute.

CAPEX and OPEX of 2 staged RO system are about 5-10% higher than those of 1 staged RO system accordingly.

In future, when above Boron content become less than 2.4mg/liter, 2nd stage RO may be deleted.

b. Ground water utilization

No ground water will be utilized for drinking water after the system completion, due to the GoCV policy, the small CAPEX and OPEX reduction effect, and Boron removal technology using 2 staged RO system.

c. Transmission line material

Ductile Iron cement lining pipe (DICL) and High Density Polyethylene (HDPE) were proposed. Those materials are well known for water service, and are expected to be high corrosion resistance. The some existing transmission lines in Praia are producing red water due to corrosion during the long service period, and must be repaired or replaced.

d. Implementation Schedule

The proposed schedule is a JICA typical schedule.

Cape Verde side strongly expressed to shorten the schedule, since the water supply issue must be critical.

e. Water analysis

JICA Mission introduced the water analysis result conducted by Inpharma, Cape Verde.

JICA Mission commented that the fresh sea water around the candidate desalination facility construction site has no issue for the facility design.

JICA Mission also commented that some results of ground water analysis should be further investigated on Nitrate, Coliform and Total Hardness in particular. Those data were higher than allowable on the sampling date.

It was proposed that ground water of PT33 well in Santa Cruz should be analyzed, since the well is for potable water. JICA mission commented that purpose of this analysis is to determine the possibility of mixing ground water to RO product water, and ground water is already concluded not to be used, in this situation, further analysis is recommended to be discussed separately.

f. Power supply

JICA Mission commented that power supply might be a medium grade risk for the reliable operation of the water supply system.

The captive power for the system is likely installed for the OPEX reduction and the reliable operation, however the power supply system in Santiago island will be improved shortly.

As a result, the water supply system will have neither the captive power generation system nor the emergency power generation system.

g. Existing 500$m^3$/day SWRO in Santa Cruz

The OPEX including power, fuel and chemicals is very high for Santa Cruz municipality.

Chemicals are high cost and difficult for purchasing in particular.

h. Boron content in drinking water

Boron content in drinking water was newly declared to be less than 1.0mg/liter on July 2010 by the Ministry of Health, the GoCV.

The JICA Mission insisted that keeping Boron content less than 0.5mg/liter was the expected performance and was required proper operation and maintenance of the desalination facility.

JICA Mission will not modify the technical specification regarding Boron in the Interim Report.

i. Water production by sea water desalination or ground water

Each municipality has each financial and geotechnical properties.

Municipalities, who can draw ground water easily with low cost, would like to continue utilizing ground water as potable.

j. Japan's ODA Loan

JICA Mission explained to conduct the preliminary economics study based on the general loan condition such as 1.4% p.a. interest, because STEP is not yet concluded to be applied.

JICA Mission expressed that this project could be applied to STEP loan, in case the requirements for STEP loan application will be satisfied.

k. Economics Study

JICA Mission commented their preliminary economic study on

1) the total system (huge CAPEX required) on the Santiago island
2) the separated and phased systems of south and north regions on the island,

then the project for Praia area (S1 Project) shows the best economics.

For further detail discussion among related parties, JICA Mission agreed to prepare,

1) Desalinated water production facility cost, and product water transmission facility cost
2) Initial investment cost, and operation & maintenance cost,
3) Rough Profit & Loss calculation in each municipality referring to real tariff.

l. O&M Planning

JICA Mission proposed the phased operation and maintenance planning.

The operation and maintenance planning will be further discussed by JICA Mission and the GoCV.

m. IEE and EIA

JICA Study Team conducted IEE, and no critical issue was found.

The GoCV will conduct EIA based on the Interim Report.

(End)

ANNEX-1: Fourth Steering Committee Presentation
ANNEX-2: Attendants List of the Second Steering Committee

# 4th. Steering Committee
# on
# Water Supply System
# Development Project in Santiago, Cape Verde

**August 23, 2010 at Praia**

Japan International Cooperation Agency

**Toyo Engineering Corporation**
**UNICO International Corporation**
**Ingérosec Corporation**



1. Introduction
2. Water Analysis and Geotechnical Survey
3. Basic Plan Development
4. Project Feasibility Study
5. Operation and Maintenance
6. Initial Environmental Examination
7. Conclusion and Way Forward

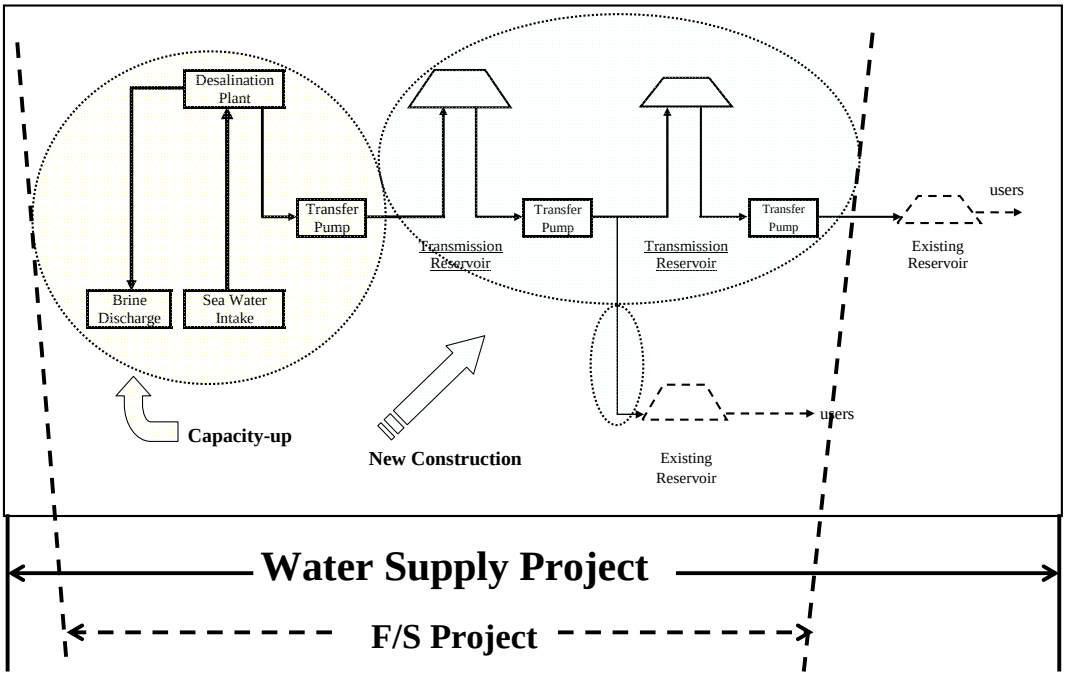
# 1-1 Implementation Schedule of JICA Study

| | | 2009 | | | 2010 | | | | | | | | | | 2011 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year / Month | | Phase 1 | | | | | | Phase 2 | | | | | | | | | | | | |
| | | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 |
| Field Work | | 1st | | | 2nd | | | | 3rd | | | 4th | | | 5th | | | | | | | |
| Submission of JICA Report | | IC/R | | | | | PR/R | | | | IT/R | | | DF/R | | F/R | | | | | | |
| Steering Committee | | | | | | ☆ | | | ☆ | ☆ | | ☆ | | | ☆ | | | | | | | |
| Local Consultant | | | Socio Economica Analysis | | | | | | water analysis geological survey | | | | | | | | | | | | | |
| Phase 1 | To analyze the project conditions | | | | | | | | | | | | | | | | | | | | | |
| | To set the project scope, sites and components | | | | | | | | | | | | | | | | | | | | | |
| Phase 2 | To define Water Supply System as FS subject | | | | | | | | | | | | | | | | | | | | | |
| | To conduct Conceptual Design with CAPEX/OPEX | | | | | | | | | | | | | | | | | | | | | |
| | To conduct IEE | | | | | | | | | | | | | | | | | | | | | |
| | To develop Financing Plan and conduct Economical Analysis | | | | | | | | | | | | | | | | | | | | | |

***We are here.***

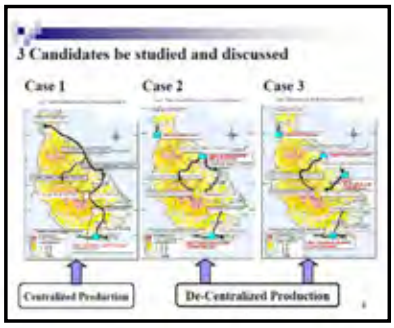


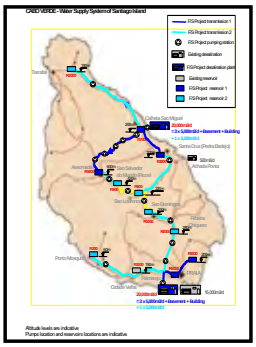
# 1-2 Outline of F/S Project



# 1-3 Each Report Topics

| 09/2009 | 03/2010 | 08/2010 | 10/2010 | 12/2010 |
|---|---|---|---|---|
| **IC/R** | **PR/R** | **IT/R** | **DF/R** | ***F/R*** |
| - KOM<br>- Methodology<br>- Approach<br>- Field Survey | - Horizon in 2020<br>- System Planning<br>- Socio Analysis<br>- donor projects<br>- 3 candidates | | - Cost Estimation for JICA scope and GoCV scope<br>- Economics<br>- Funding<br>- ODA loan | - *comments*<br>- *modification*<br>- *correction* |



- Water Analysis and Geotechnical Survey
- Basic Plan Development
- Project Feasibility Study including
  - Material Balance of SWRO System
  - Technical Specification Development
  - Project Risk and Pre Economics
- Operation and Maintenance proposal
- Initial Environmental Examination



# 2-1 Water Quality Analysis

Water quality analysis was conducted by the local laboratory, Inpharma.
Sampling water and its analysis results with some comments are as below:

a) Desalinated water from existing facilities in Praia and Santa Cruz
- Quality is generally within or close to the allowable level as drinking water
- $Cl^-$ and Boron contents in Praia are slightly higher than WHO guideline

b) Beach well water for the existing plants in Praia and Santa Cruz
- No serious issue is found

c) Ground water near the candidate sites of the planned water distribution
- Quality of the water is within allowable level as drinking water
- Nitrate, Total Coliform and Total Hardness should be further investigated

d) Sea water around the candidate sites for the planned desalination facilities
- No serious issue for RO desalination application is found
- Ordinary pre-treatment is required for RO desalination
- Analysis result was applied to the planned facility design

# 2-2 Sampling Location and Desalinated Water


## Current Desalinated Water Analysis

| Sample Location / Sampling No. | | Praia | St. Cruz | Dringking Water Regulation | | |
|---|---|---|---|---|---|---|
| | | SP 1-1<br>SP 1-2<br>1-1<br>1-2 | SS 1-1<br>SS 1-2 | | | |
| Analysis Item | | Range | Range | WHO | EU | Japan |
| Item | Unit | | | | | |
| Temperature | ℃ | 16.4 ~ 19.1 | 24.1 ~ 24.2 | | | |
| pH | - | 6.4 ~ 7.4 at 21 ℃ | 6.0 a 20 ℃ | - | 6.5 ~ 9.5 | 5.8 ~ 8.6 |
| Conductivity | μS (cm) | 940 ~ 1,100 at 25 ℃ | 220 ~ 230 at 25 ℃ | | 2,500 | |
| TDS | mg/l | 770 ~ 790 | 160 ~ 180 | 1,000 | | 200~500 |
| Tubidity | NTU | <0.3 (LQ) | - | 1 (Max 5) | - | <2 deg |
| Total Hardness | mg($CaCO_3$) | 71.1 | <9.6 (LQ) | - | - | <300 |
| Chloride | mg ($Cl^-$)/l | 320 ~ 800 | 64 | <250 | <250 | <200 |
| Boron | mg (B)/l | 0.65 ~ 0.69 | <0.05(LQ) ~ 0.51 | <0.5* | <1.0* | <1.0* |
| Total Coliform Bacteria Count | ufc/100ml | 0 | 0 | | | |



# 2-3 Ground Water Analysis

| Sample Location / Sampling No. | | 1)Sao Miguel | 2) St. Cruz | 3) Assomada and Picos | 4) Sao Lourenco dos Orgaos | 5) Tarrafal | 6) Sao Domingos | 7) Ribeira Grande de Santiago | 8) Praia | Dringking Water Regulation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FBE-145<br>FBE-205<br>FBE-188<br>FBE-112 | FBE-146<br>FT-09<br>FT-47<br>FT-59<br>FT-63 | FT-186<br>FBE-116<br>FBE-161<br>FBE-100<br>FBE-117 | FT-145<br>FT-21<br>FT-23<br>FT-80<br>FT-84 | FBE-129<br>SST-04<br>FBE-131<br>FBE-113<br>FST-24 | FBE-153<br>FBE-156<br>FT-81<br>PT-29<br>FT-208 | 58-09<br>58-01 | FBE-58<br>FT-202<br>FBE-1A<br>FT-171 | | | |
| Analysis Item | | Range | Range | Range | Range | Range | Range | Range | Range | WHO | EU | Japan |
| Item | Unit | | | | | | | | | | | |
| Temperature | ℃ | 26.1~26.8 | 24.3 ~ 28.8 | 26.0 ~ 28.7 | 26.2 ~ 28.1 | 26.0 ~ 28.4 | 25.5 ~ 28.2 | 27.5 ~ 27.8 | 26.8 ~ 30.6 | | | |
| pH | - | 7.5 ~ 8.5 at 22 ℃ | 7.2 ~ 7.8 at 20 ℃ | 7.2 ~ 8.1 at 20 ℃ | 7.4 ~ 7.7 at 22 ℃ | 7.9 ~ 8.2 at 25 ℃ | 7.0 ~ 8.0 at 23 ℃ | 8.0 ~ 8.2 at 22 ℃ | 8.2 ~ 8.4 at 24 ℃ | - | 6.5~9.5 | 5.8~8.6 |
| Tubidity | NTU | 0.3(LQ) ~ 1.55 | <0.3(LQ) ~ 0.62 | <0.3 (LQ) | <0.3(LQ) ~ 0.68 | <0.3(LQ) ~ 0.79 | <0.3(LQ) ~ 0.72 | <0.3 (LQ) | <0.3(LQ) ~ 0.41 | 1(Max 5) | - | <2 deg |
| Nitrate | mg($NO_3$)/Ll | 1.0(LQ) ~ 73.9 | 5.6 ~ 54.4 | 31.0 ~ 71.6 | <1.0 ~ 54.4 | 12.4 ~ 16.6 | <1(LQ) ~ 54 | 12.3 ~ 16.1 | 10.6 ~ 24.8 | <50 | <50 | <10 |
| Nitrite | mg($NO_2$)/l | <0.01(LQ) ~ 0.02 | <0.01 (LQ) | <0.01 (LQ) | <0.01(LQ) ~ 0.21 | <0.01 (LQ) | <0.01 (LQ) | <0.01 (LQ) | <0.01 (LQ) | <3 | <0.5 | <0.05 |
| Chloride | mg ($Cl^-$)/l | 78 ~ 220 | 59 ~ 300 | 37 ~ 85 | 96 ~ 200 | 43 ~ 92 | 120 ~ 230 | 42 ~ 85 | 42 ~ 130 | <250 | <250 | <200 |
| Boron | mg (B)/l | 0.05 ~ 0.14 | 0.06 ~ 0.13 | 0.05 | <0.05 ~ 0.09 | <0.05 ~ 0.06 | 0.07 ~ 0.12 | <0.05(LQ) | <0.05(LQ) ~ 0.07 | <0.5* | <1.0* | <1.0* |
| Fluorine | mg (F)/l | <0.5(LQ) ~ 2.2 | <0.5(LQ) ~ 0.6 | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <1.5 | <1.5 | <0.8 |
| Total Coliform Bacteria Count | ufc/100ml | 0 ~ 130 | 0 ~ 610 | 92 ~ 3,400 | 0 ~ 576 | 0 ~ 3,600 | 0 ~ 16 | 38 ~ 1,200 | 31 ~ 36 | | | |
| Standard Plate Count Bacteria | ufc/ml | 0 ~ >300 | 0 ~ >300 | 0 ~ 36 | 0 ~ 28 | 0 ~ >300 | 0 ~ 40 | 83 ~ 89 | 0 ~ 82 | | | |
| Fecal Coliform Bacteria Count | ufc/100ml | 0 | 0 ~ 119 | 0 ~ 5,800 | 0 ~ 19 | 0 ~ 140 | 0 ~ 35.2 | 11 ~ 83 | 0 ~ 40 | | | |
| Iron | μg (Fe)/l | <60 (LQ) | <60(LQ) ~ 130 | <60 (LQ) | <60(LQ) ~ <93(LQ) | <60(LQ) ~ 100 | 60(LQ) ~ 1,900 | <60 (LQ) | <60 (LQ) | <300 | <300 | <300 |
| Total Hardness | mg($CaCO_3$) | 11.7 ~ 497.7 | 189.7 ~ 575 | 98. ~ 148 | 149 ~ 418 | 96 ~ 138 | 200 ~ 770 | 111 ~ 136 | 84.1 ~ 217.1 | - | - | <300 |
| Arsenic | μg (As)/l | <1(LQ) ~ 12 | <1 (LQ) | <1 (LQ) | <1 (LQ) | <1 (LQ) | <1 (LQ) | <1 (LQ) | <1 (LQ) | <10 | <10 | <10 |
| Cadmium | μg (Cd)/l | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <0.5 (LQ) | <3 | <5 | <10 |
| Mercury | μg (Hg)/l | <0.1 (LQ) | <0.1 (LQ) | <0.1 (LQ) | <0.1 (LQ) | <0.1 (LQ) | <0.1 (LQ) | <0.1 (LQ) | <0.1 (LQ) | <1 | <1 | <0.5 |
| Cr+6 | μg (Cr)/l | <2 (LQ) | <2 (LQ) | <2(LQ) ~ 4 | <2 (LQ) | <2 (LQ) | <2(LQ) ~ 6 | 4 | 3 ~ 7 | <50 | <50 | <50 |
| Lead | μg (Pb)/l | <5 (LQ) | <5 (LQ) | <5 (LQ) | <5 (LQ) | <5 (LQ) | <5 (LQ) | <5 (LQ) | <5 (LQ) | <10 | <10 | <10 |
| Manganese | μg (Mn)/l | <4(LQ) ~ 48 | <4 (LQ) | <4 (LQ) | <4(LQ) ~ 80 | <4 (LQ) | <4 (LQ) | <4 (LQ) | <4 (LQ) | <400 | <50 | <50 |

# 2-4 Geotechnical Survey


- 3 bore holes for SWRO facility
- 20 trial pits for Transmission line
- 4 laboratory tests for construction

Survey Results are under review, But no critical issues are found at moment.

Actual survey was conducted by Tecnasol, Portugal.



# 3-1 Population & Water Demand in 2020

Horizon of population in 2020 of the project targeted year was assumed to be about 370,566 persons in Santiago island in PR/R, but the horizon was newly assumed to be 355,319 persons by the latest Institute Nacional de Estatistics (INE).

The ratio of urban area to rural area was also newly assumed to be "60 to 40" instead of "66 to 34" in the island.
Water consumption rate was also re-estimated, and summarized as below:

| | Urban | Rural |
|---|---|---|
| With public pipeline connection | 150 | 80 |
| Without public pipeline connection | 50 | 50 |
| For hotel user (tourist) | 300 | 300 |

(unit: liter/day/person)

# 3-2 Water Demand and Production in 2020

| items | | South | | | South total | North | | | | | | North total | Total | data source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Praia | Ribeira Grande | Sao Domingos | | Tarrafal | Sao Miguel | SS do Mundo | Santa Catarina | Santa Cruz | Sao Lourenco | | | |
| a. Target Year (2020) Population (person) | | 157,978 | 11,562 | 17,331 | 186,871 | 28,577 | 21,137 | 13,157 | 58,321 | 36,102 | 11,154 | 168,448 | 355,319 | Institute Nacional de Estatistica (INE) |
| a1 | - Urban | 155,609 | 1,746 | 2,772 | 160,127 | 9,717 | 7,398 | 1,776 | 18,663 | 14,441 | 2,231 | 54,226 | 214,353 | INE |
| a2 | - Rural | 2,369 | 9,816 | 14,559 | 26,744 | 18,860 | 13,739 | 11,381 | 39,658 | 21,661 | 8,923 | 114,222 | 140,966 | INE |
| b. Overall Pipeline Service Coverage (%) | | 99.0% | 90.0% | 90.0% | | 95.0% | 90.0% | 80.0% | 95.0% | 95.0% | 90.0% | | | Steering Committee (SAAS) |
| | in 2007 | 47.3% | 10.9% | 9.9% | | 64.1% | 53.7% | 15.4% | 48.8% | 76.9% | 43.9% | | | INE |
| c. Served Population | Connection ratio in Urban, data by INGRH 100 % | | | | | | | | | | | | | |
| c1 =a x b | Overall population served by pipe network | 156,398 | 10,406 | 15,598 | 182,402 | 27,148 | 19,023 | 10,526 | 55,405 | 34,297 | 10,039 | 156,438 | 338,839 | Connection ratio (Urban Total) |
| c2 = a1 x CONE % | - Urban, with pipe connection | 155,609 | 1,746 | 2,772 | 160,127 | 9,717 | 7,398 | 1,776 | 18,663 | 14,441 | 2,231 | 54,226 | 214,353 | 100% |
| c3 = c1-c2 | - Rural, with pipe connection | 789 | 8,660 | 12,826 | 22,275 | 17,431 | 11,625 | 8,750 | 36,742 | 19,856 | 7,808 | 102,212 | 124,486 | Connection ratio (Rural Total) |
| c4 = a-c1 | Overall population, NOT served by pipe | 1,580 | 1,156 | 1,733 | 4,469 | 1,429 | 2,114 | 2,631 | 2,916 | 1,805 | 1,115 | 12,011 | 16,480 | 88% |
| c5 = a1-c2 | - Urban, without pipe connection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| c6 = a2-c3 | - Rural, without pipe connection | 1,580 | 1,156 | 1,733 | 4,469 | 1,429 | 2,114 | 2,631 | 2,916 | 1,805 | 1,115 | 12,011 | 16,480 | |
| d. Per-Capita Average Demand (liter/person/day) | | | | | | | | | | | | | | |
| d1 | - Urban, with pipe connection | 150 | 150 | 150 | | 150 | 150 | 150 | 150 | 150 | 150 | | | INGRH |
| d2 | - Rural, with pipe connection | 80 | 80 | 80 | | 80 | 80 | 80 | 80 | 80 | 80 | | | INGRH |
| d3 | - Urban, without pipe connection | 50 | 50 | 50 | | 50 | 50 | 50 | 50 | 50 | 50 | | | INGRH |
| d4 | - Rural, without pipe connection | 50 | 50 | 50 | | 50 | 50 | 50 | 50 | 50 | 50 | | | INGRH |
| e. Domestic demand (m3/day) | | | | | | | | | | | | | | |
| e1 = c2 x d1 | - Urban, with pipe connection | 23,341 | 262 | 416 | 24,019 | 1458 | 1110 | 266 | 2799 | 2166 | 335 | 8,134 | 32,153 | |
| e2 = c3 x d2 | - Rural, with pipe connection | 63 | 693 | 1026 | 1,782 | 1394 | 930 | 700 | 2939 | 1588 | 625 | 8,177 | 9,959 | |
| e3 = c5 x d3 | - Urban, without pipe connection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| e4 = c6 x d4 | - Rural, without pipe connection | 79 | 58 | 87 | 223 | 71 | 106 | 132 | 146 | 90 | 56 | 601 | 824 | |
| A. = e1+e2+e3+e4 | Domestic Demand (m3/day) | 23,483 | 1,012 | 1,529 | 26,024 | 2,923 | 2,145 | 1,098 | 5,885 | 3,845 | 1,015 | 16,911 | 42,936 | |
| f. Tourizm Demand | | | | | | | | | | | | | | |
| f1 | Number of Beds (beds) | 2,400 | 100 | 100 | 2,600 | 200 | 100 | 0 | 500 | 200 | 0 | 1,000 | 3,600 | MTIE(Tourism dept) + Study team |
| f2 | Expected Average Occuppancy | 70% | 70% | 70% | | 70% | 70% | 70% | 70% | 70% | 70% | | | Study team |
| f3 | Per-Capita Demand (litter/bed/day) | 300 | 300 | 300 | | 300 | 300 | 300 | 300 | 300 | 300 | | | MTIE(Tourism dept) + Study team |
| f = f1 x f2 x f3 | Tourism Sub total (m3/d) | 504 | 21 | 21 | 546 | 42 | 21 | 0 | 105 | 42 | 0 | 210 | 756 | |
| g. Industries, office, hospital, others (m3/day) | | 3,000 | 0 | 50 | 3,050 | 50 | 100 | 0 | 500 | 100 | 0 | 750 | 3,800 | MTIE(Industry dept) + Study team |
| B = f + g | Non-Domestic Demand (m3/day) | 3,504 | 21 | 71 | 3,596 | 92 | 121 | 0 | 605 | 142 | 0 | 960 | 4,556 | |
| C = A + B | Total Net Water Demand (m3/day) | 26,987 | 1,033 | 1,600 | 29,620 | 3,015 | 2,266 | 1,098 | 6,490 | 3,987 | 1,015 | 17,871 | 47,492 | |
| h. | Leakage Ratio (%) | 15 | 15 | 15 | | 15 | 15 | 15 | 15 | 15 | 15 | | 15 | Steering Committee (SAAS) |
| | NOW | 24 | 20 | 10 | | 24 | 16 | 20 | 28 | 28 | 10 | | 24 | SAAS |
| D = C /(100% - h%) | Day Average Demand (m3/day) | 31,750 | 1,216 | 1,882 | 34,848 | 3,548 | 2,666 | 1,292 | 7,635 | 4,690 | 1,194 | 21,025 | 55,873 | |
| i. | Seasonal Peak Factor (Tourism) | 1.4 | 1.4 | 1.4 | | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | | | Study team |
| j. f x (i-1) / (100%-h%) | Seasonal Additional Demand (m3/day) | 237 | 10 | 10 | 257 | 20 | 10 | 0 | 49 | 20 | 0 | 98 | 356 | |
| E = D + j | Daily Maximum Demand (m3/day) | 31,987 | 1,226 | 1,892 | 35,105 | 3,567 | 2,676 | 1,292 | 7,684 | 4,710 | 1,194 | 21,124 | **56,229** | |
| | | 57% | 2% | 3% | 62% | 6% | 5% | 2% | 14% | 8% | 2% | 38% | 100% | |
| **2. Existing plant, including planned plant** | | | | | | | | | | | | | | |
| | **Existing Desalination Plant** | 5,000 | (Palmarejo) | | 5,000 | | | | | 0 | | 0 | 5,000 | |
| | **Planned plant** | | | | | | | | | (Achada Ponta) | | | | |
| | by Spanish fund | 5,000 | (Palmarejo) | | 5,000 | | | | | | | 0 | 5,000 | |
| | by World Bank fund | 5,000 | (Palmarejo) | | 5,000 | | | | | | | 0 | 5,000 | |
| | **Total** | | | | 15,000 | | | | | | | 0 | **15,000** | |
| **3. Necessary additional plant (1-2)** | | | | | | | | | | | | | | |
| | Detail figure (m3/d) | | | | 20,105 | | | | | | | 21,124 | 41,229 | |
| | Round figure (m3/d) | | | | **20,000** | | | | | | | **20,000** | **40,000** | |



# 3-3 F/S Project Production Capacity

For decision of the F/S Project capacity, followings are applied:

- Whole potable water demand in 2020: 56,229m$^3$/day (round 55,000m$^3$/day)
- Existing Desalination Capacity in 2010: 5,000m$^3$/day, in Praia
- Firmly Planned expansion plant: 5,000m$^3$/day by Spain in Praia
- Firmly Planned plant: 5,000m$^3$/day by WB in Praia
- Additional Capacity for whole demand: **40,000m$^3$/day in island**
  (= 55,000 - 5,000 x 3units)

It is noted that small desalination plants with capacity of 500 and 1,200m$^3$/day production are already put in service, and
some private based desalination projects are planned.
Those capacities were not counted due to uncertainty.

# 3-4 Drinking Water Quality and Boron

a. The drinking water quality supplied by the F/S Project basically follows WHO guidelines for Drinking Water, 3rd edition, 2008.

b. Expected Boron content produced by the new desalination facility is less than 0.5mg/liter.

c. Boron content was declared to be from less than 0.5 to less than 1.0mg/liter at 29-07-2010 by the Ministry of Health, Cape Verde by the Decree Law nº 8/2004 of 02/23/2004, B. O. nº 6.

d. Though Boron content was declared,
The current technical specification will not be changed.
0.5mg/liter is expected performance, the proper operation and maintenance will be required to keep the performance.



# 3-5 Ground Water Utilization

Ground water utilization was studied and discussed from the view points of
- the project investment cost reduction,
- Boron content reduction, and
- drinking water quality improvement.

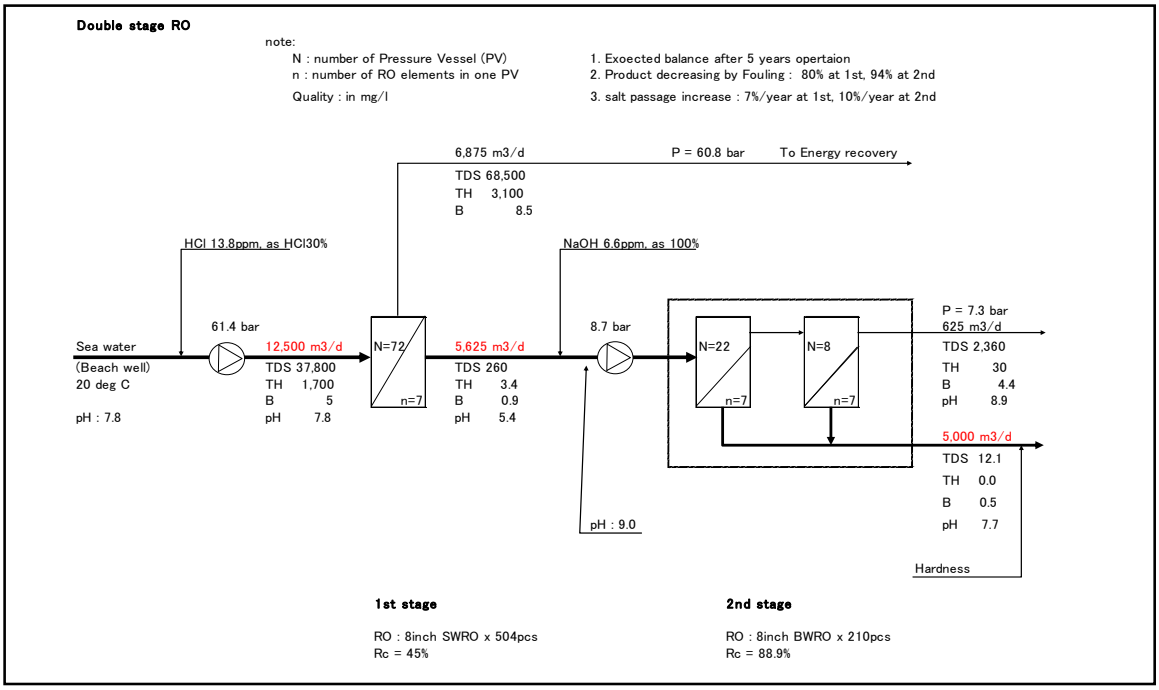
Due to the following reasons, no utilization of ground water for the study is concluded.

a. Investment cost impact might be very small if ground water will be utilized. Ground water production is about 4,000$m^3$/day, but demand is about 56,000$m^3$/day.

b. No ground water is required to reduce Boron content in desalinated water, if 2 stage RO system will be applied,

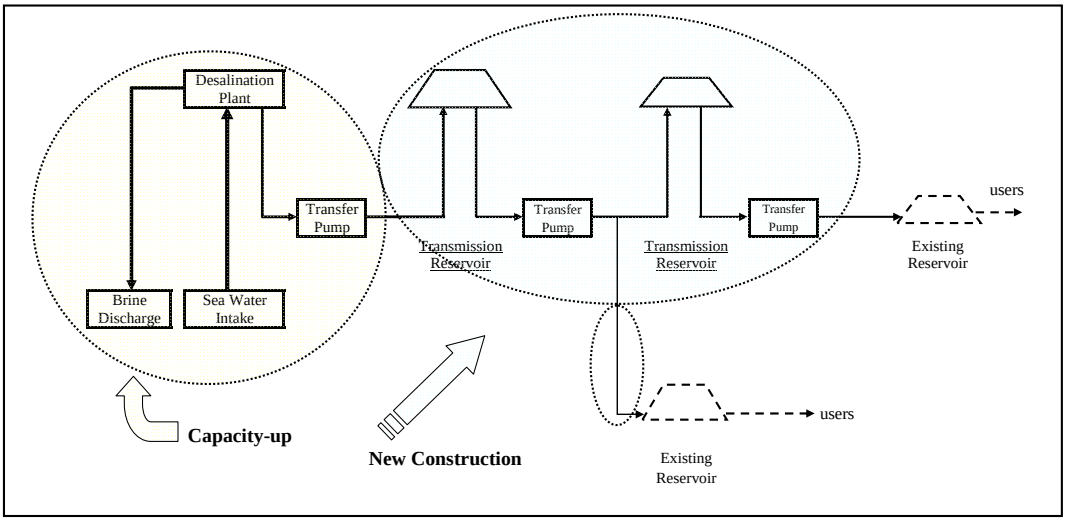
c. Cape Verde Government policy, ground water will be utilized for irrigation purpose after completion of enough network of desalinated water.

# 3-6 Material Balance and Boron Removal





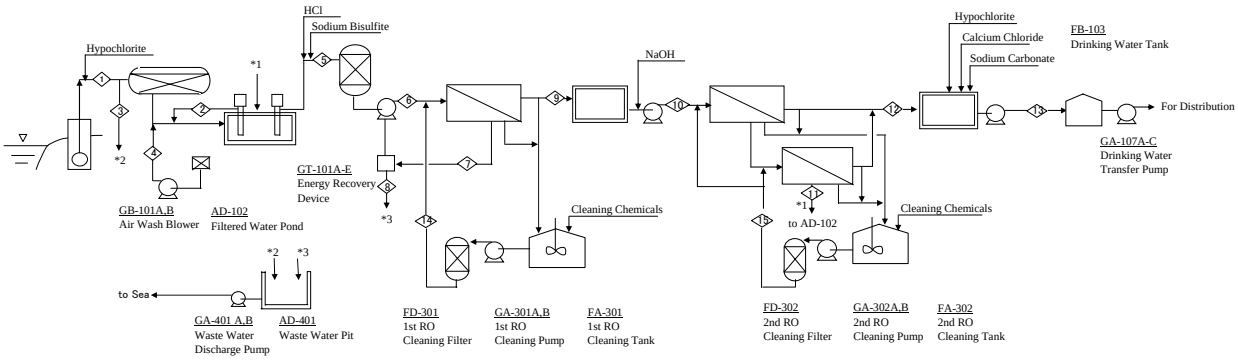

# 4-1 F/S Project Scope




1. Capacity up of Water Production
2. New Construction of Water Transmission

# 4-2 Sea Water Desalination Facility, *Flow Sheet*

AD-101A-I Intake Well
FD-101A-I Sand Filter
FD-102A-E Safety Filter
CJ-101A-D 1st Stage RO Unit
FB-101 Intermediate Tank
CJ-102A-D 2nd Stage RO Unit
FB-102 Product Water Tank
GA-101A-I Sea Water Intake Pump
GA-102A,B Sand Filter Backwash Pump
GA-103A-E Safety Filter Feed Pump
GA-104A-E 1st Stage RO Feed Pump
GA-105A-E 2nd Stage RO Feed Pump
GA-106A-C Product Water Pump




| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Feed Sea Water | Filter Backwash Water | Backwash Waste to Sea | Filter Backwash Air | Safety Filter Feed | 1st RO Feed Water | 1st RO Brine | Brine Discharge to Sea | 1st RO Permeate | 2nd RO Feed Water | 2nd RO Brine to Sea | 2nd RO Permeate | Product Water | 1st RO Cleaning Water | 2nd RO Cleaning Water |
| Flow m3/d | 50,000 | – | – | – | 50,000 | 50,000 | 27,500 | 27,500 | 22,500 | 22,500 | 2,500 | 20,000 | 20,000 | – | – |
| Flow m3/h | 2,083 | 580 | 580 | 1,160 | 2,083 | 2,083 | 1,146 | 1,146 | 937 | 937 | 104 | 833 | 833 | 430 | 180 |
| Operation time | 24 h/d | 10min x 8 times/d | 10min x 8 times/d | 3min x 8 times/d | 24 h/d | 24 h/d | 24 h/d | 24 h/d | 24 h/d | 24 h/d | 24 h/d | 24 h/d | 24 h/d | – | – |
| Temp ℃ | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Pressure kg/cm2G | 3.0 | 2.0 | 1.0 | 0.5 | 2.0 | 61.4 | 60.8 | 1.0 | 1.0 | 11.0 | 1.0 | 1.0 | 5.0 | 5.5 | 5.5 |
| TDS mg/l | 37,800 | 37,800 | 37,800 | – | 37,800 | 37,800 | 68,500 | 68,500 | 260 | 260 | 2,360 | 12 | 12 | 12 | 12 |
| Total Hardness mg/l as CaCO3 | 6,368 | 6,368 | 6,368 | – | 6,368 | 6,368 | 11,567 | 11,567 | 13 | 13 | 113 | 0 | 15 | 0 | 0 |
| pH | 7.8 | 7.8 | 7.8 | – | 7.8 | 7.8 | 7.5 | 7.5 | 5.4 | 8.7 | 8.9 | 7.7 | 7.7 | – | – |
| Boron mg/l | 5.0 | 5.0 | 5.0 | – | 5.0 | 5.0 | 8.5 | 8.5 | 0.9 | 0.9 | 4.0 | 0.5 | 0.5 | – | – |

PROCESS FLOW DIAGRAM
20,000m3day/day Desalination Facility in Palmarejo
DWG.NO.

*Palmarejo and Calheta are almost same*

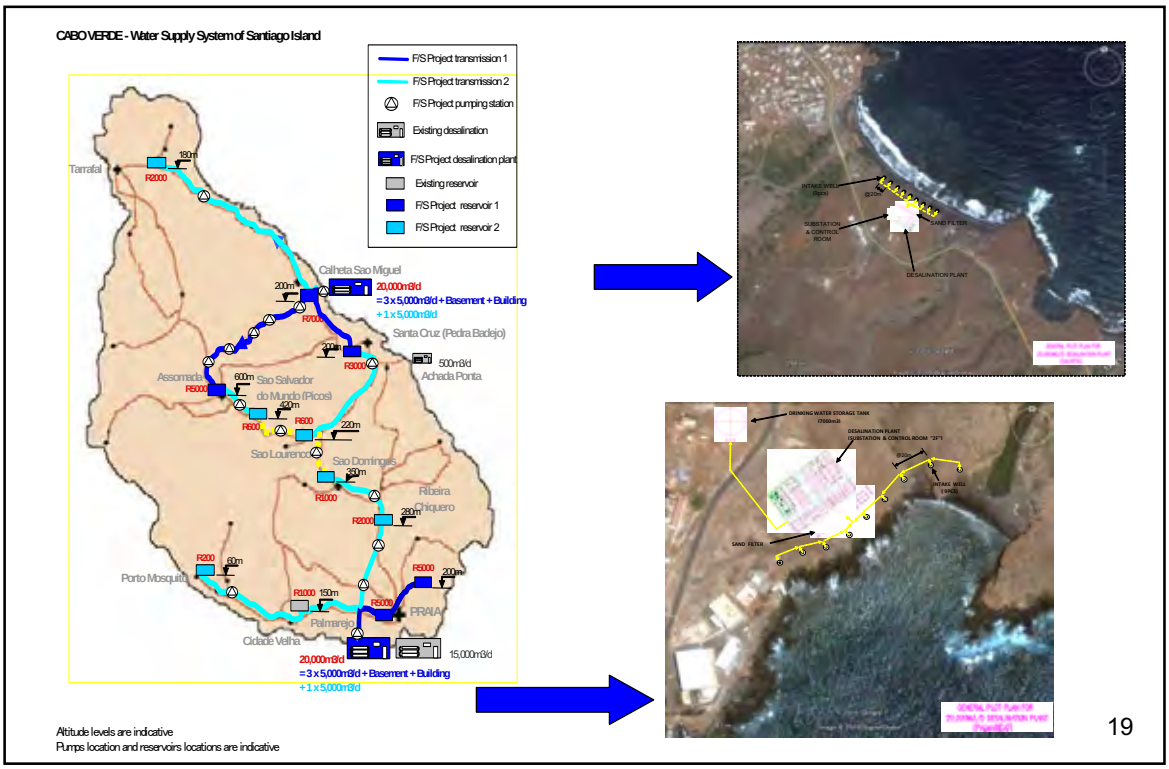


# 4-2 Sea Water Desalination Facility, *Equipment List*

| Item No. | Service | No. | Type | Short Specification | Motor kW | Material |
|---|---|---|---|---|---|---|
| AD-101A-I | Intake Well | 8+1 | | 14″ x 50000mmDepth | | |
| AD-102 | Filtered Water Pond | 1 | Semi-UG | 520m3, 10000mmW x 13000mmL x 4500mmH | | Concrete |
| AD-401 | Waste Water Pit | 1 | AG | 240m3, 8000mmW x 7500mmL x 4500mmH | | Concrete |
| CJ-101A-D | 1st Stage RO Unit | 4 blocks | | 72 Pressure Vessels, 7 elements/PV, 8″element 5000mmW x 6000mmH x 8000mmL | | |
| CJ-102A-D | 2nd Stage RO Unit | 4 blocks | | 30 Pressure Vessels, 7 elements/PV, 8″element 3000mmW x 6000mmH x 7500mmL | | |
| FA-201 | Hypochlorite Tank | 1 | Cone Roof | 10m3, 2400mmID x 2600mmH, by Drum | | FRP |
| FA-202 | HCl Tank | 1 | Cone Roof | 10m3, 2400mmID x 2600mmH, by Lorry | | FRP |
| FA-203A,B | SBS Tank | 2 | Cone Roof | 10m3, 2400mmID x 2600mmH, by Bag & Dissolving | | FRP |
| FA-204 | NaOH Tank | 1 | Cone Roof | 10m3, 2400mmID x 2600mmH, by Lorry | | FRP |
| FA-205A,B | Calcium Chloride Tank | 2 | Cone Roof | 10m3, 2400mmID x 2600mmH, by Bag & Dissolving | | FRP |
| FA-206A,B | Sodim Carboronate Tank | 2 | Cone Roof | 10m3, 2400mmID x 2600mmH, by Bag & Dissolving | | FRP |
| FA-301 | 1st RO Cleaning Tank | 1 | Cone Roof | 20m3, 2400mmID x 6000mmH | | FRP |
| FA-302 | 2nd RO Cleaning Tank | 1 | Cone Roof | 10m3, 2000mmID x 4000mmH | | FRP |
| FB-101 | Intermediate Tank | 1 | Semi-UG | 200m3, 4000mmW x 9000mmL x 6000mmH | | Concrete |
| FB-102 | Product Water Tank | 1 | Semi-UG | 200m3, 4000mmW x 9000mmL x 6000mmH | | Concrete |
| FB-103 | Drinking Water Storage Tank | 1 | Cone Roof | 7000m3 @Palmarejo, 29000mmID x 12000mmH | | CS/Epoxy |
| FD-101A-H | Sand Filter | 8+1 | Horizontal | 2400mmID x 8000mmL, Sand and Anthracite | | CS/Rubber |
| FD-102A-E | Safety Filter | 4+1 | Vertical | 1200mmID x 3000mmH, 5 micron Cartridge | | CS/Rubber |
| FD-301 | 1st RO Cleaning Filter | 1 | Vertical | 1200mmID x 3000mmH, Cartridge | | CS/Rubber |
| FD-302 | 2nd RO Cleaning Filter | 1 | Vertical | 800mmID x 3000mmH, Cartridge | | CS/Rubber |
| GA-101A-I | Sea Water Intake Pump | 8+1 | Submerged | 270m3/h x 50mH | 55kW | Duplex SS or 316SS |
| GA-102A,B | Sand Filter Backwash Pump | 1+1 | Centrifugal | 580m3/h x 20mH | 55kW | Duplex SS or 316SS |
| GA-103A-E | Safety Filter Feed Pump | 4+1 | Centrifugal | 530m3/h x 20mH | 45kW | Duplex SS or 316SS |
| GA-104A-E | 1st Stage RO Feed Pump | 4+1 | Centrifugal | 530m3/h x 700mH | 1400kW | Duplex SS or 316SS |
| GA-105A-E | 2nd Stage RO Feed Pump | 4+1 | Centrifugal | 240m3/h x 110mH | 110kW | 316SS |
| GA-106A-C | Product Water Pump | 2+1 | Centrifugal | 420m3/h x 50mH | 90kW | 304SS |
| GA-107A-C | Drinking Water Transfer Pump | 2+1 | Centrifugal | 420m3/h x 50mH @Parmarejo | 90kW | 304SS |
| GA-201A-D | Hypochlorite Injection Pump | 2+2 | Diaphragm | 40L/h x 20mH | 0.4 kW | SS/PTFE |
| GA-202A,B | HCl Injection Pump | 1+1 | Diaphragm | 40L/h x 20mH | 0.4 kW | SS/PTFE |
| GA-203A,B | SBS Injection Pump | 1+1 | Diaphragm | 60L/h x 20mH | 0.4 kW | SS/PTFE |
| GA-204A,B | NaOH Injection Pump | 1+1 | Diaphragm | 60L/h x 20mH | 0.4 kW | SS/PTFE |
| GA-205A,B | Calcium Chloride Injection Pump | 1+1 | Diaphragm | 250L/h x 20mH | 1.1 kW | SS/PTFE |
| GA-206A,B | Sodium Carbonate Injection Pump | 1+1 | Diaphragm | 500L/h x 20mH | 2.2 kW | SS/PTFE |
| GA-301A,B | 1st RO Cleaning Pump | 1+1 | Centrifugal | 430m3/h x 55mH | 110kW | 316SS |
| GA-302A,B | 2nd RO Cleaning Pump | 1+1 | Centrifugal | 180m3/h x 55mH | 45kW | 316SS |
| GA-401A,B | Waste Water Discharge Pump | 1+1 | Centrifugal | 1400m3/h x 20mH | 110kW | Duplex SS or 316SS |
| GB-101A,B | Air Wash Blower | 1+1 | Roots | 1160m3/h x 4.5mH | 30kW | CI |
| GD-203A,B | SBS Tank Mixer | 2 | Vertical | | 1.1 kW | CS/Rubber |
| GD-205A,B | Calcium Chloride Tank Mixer | 2 | Vertical | | 1.1 kW | CS/Rubber |
| GD-206A,B | Sodium Carbonate Tank Mixer | 2 | Vertical | | 1.1 kW | CS/Rubber |
| GD-301 | 1st RO Cleaning Tank Mixer | 1 | Vertical | | 1.1 kW | CS/Rubber |
| GD-302 | 2nd RO Cleaning Tank Mixer | 1 | Vertical | | 1.1 kW | CS/Rubber |
| GT-101A-E | Energy Recovery Device | 4+1 | | | | |
| CF-401 | Air Supply Package | 1 | | 300Nm3/h, with Air Compressor and Dryer | 30kW | |

*Palmarejo and Calheta are almost same*

# 4-2 Sea Water Desalination Facility, *General Layout*

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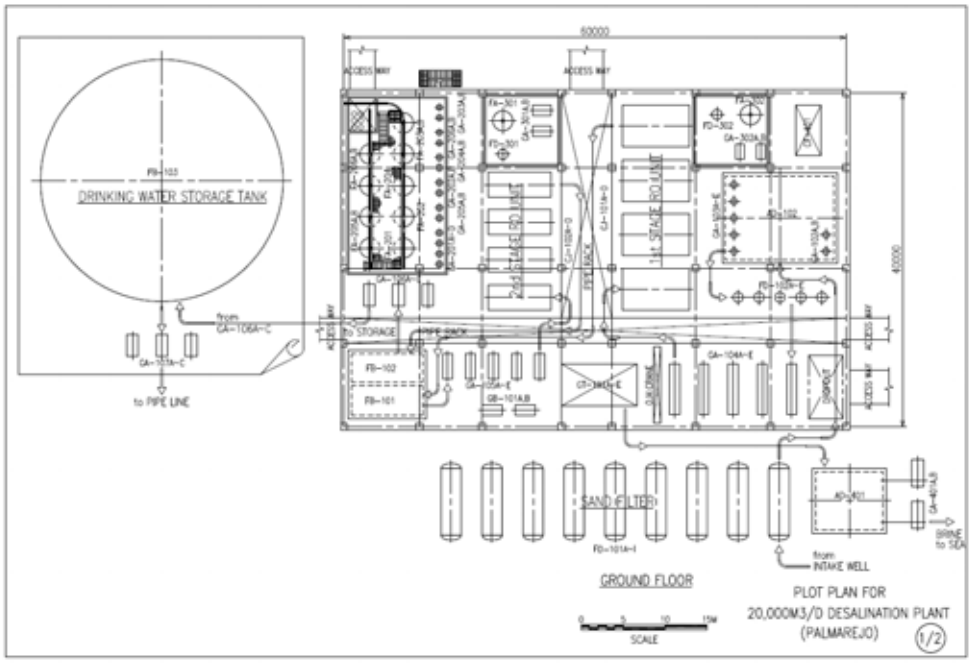
# 4-2 Sea Water Desalination Facility, *Plot Plan*




*Palmarejo and Calheta are almost same*

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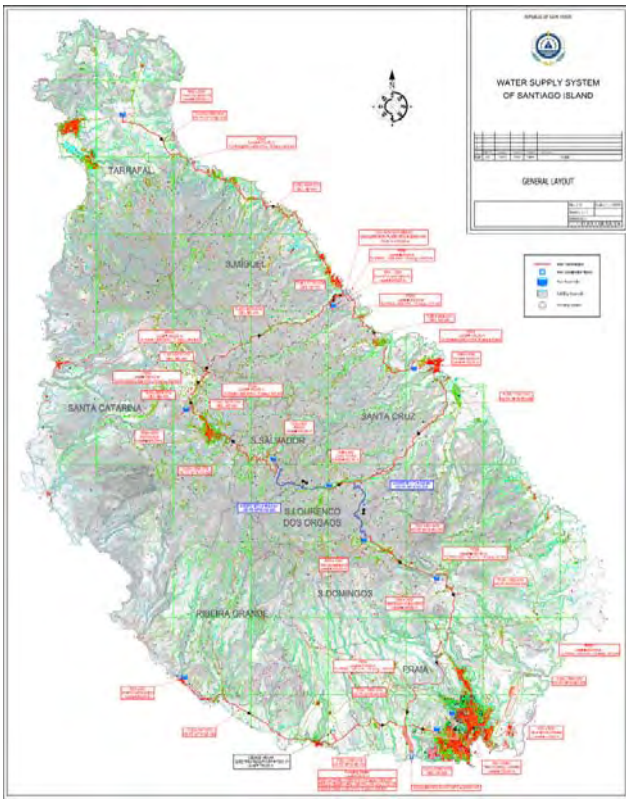
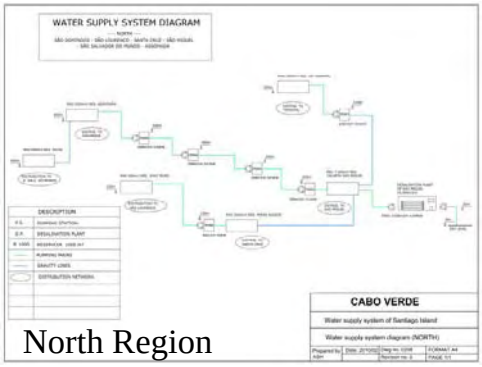
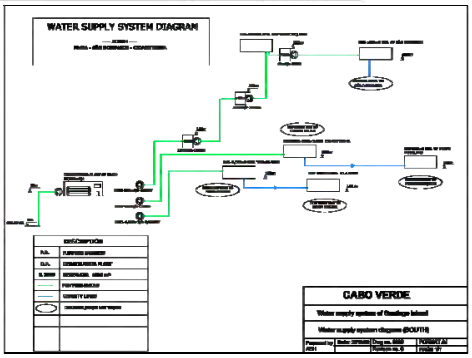
# 4-3 Water Transmission Facility, *General Layout*




North Region




South Region



# 4-3 Water Transmission Facility, *transmission lines*

South Area

| No. | Start | End | Type | Length (km) | Material |
|---|---|---|---|---|---|
| **SA1 : Network for Praia Center** | | | | | |
| TLS1 | PSS1 Praia WTP* | RS1-5000 / RS2-5000 | Pumped | 8.000 | 500 DICL |
| | | | | | |
| **SA2a : Network for Ribeira Grande** | | | | | |
| TLS2 | PSS2 Praia WTP* | Existing Cidade Verlha Tank | Pumped | 8.000 | 250 HDPE PN 16 |
| TLS3 | Existing Cidade Verlha Tank | RS3-200 | Gravity | 13.200 | 160 HDPE PN16 |
| | | | | | |
| **SA2b : Network for Sao Domingos** | | | | | |
| TLS4 | PSS3 Praia WTP* | PSS4 | Pumped | 5.000 | 225 HDPE PN 16 |
| TLS5 | PSS4 | PSS5 | Pumped | 6.500 | 225 HDPE PN 16 |
| TLS6 | PSS5 | RS4-2000 | Pumped | 4.700 | 225 HDPE PN 16 |
| TLS7 | PSS6 | RS5-1000 | Pumped | 5.700 | 200 HDPE PN 16 |

North Area

| No. | Start | End | Type | Length (km) | Material |
|---|---|---|---|---|---|
| **N0 : Network for all the North Area** | | | | | |
| TLN1 | PSN1 Calheta WTP | RN1-7000 Calheta tank | Pumped | 1.300 | 500 DICL |
| | | | | | |
| **NA1a: Network for Santa Catarina - Assomada** | | | | | |
| TLN2 | PSN2 | PSN3 | Pumped | 9.700 | 400 DICL |
| TLN3 | PSN3 | PSN4 | Pumped | 1.600 | 400 DICL |
| TLN4 | PSN4 | PSN5 | Pumped | 2.300 | 400 DICL |
| TLN5 | PSN5 | RN2-5000 Assomada | Pumped | 1.000 | 400 DICL |
| | | | | | |
| **NA1b : Network for Santa Cruz** | | | | | |
| TLN7 | RN1-7000 | RN5-3000 Pedra Badejo | Gravity | 11.200 | 300 DICL |
| | | | | | |
| **NA2a: Network for Tarrafal** | | | | | |
| TLN9 | RN1-7000 | PSN7 | Gravity | 20.000 | 400 DICL |
| TLN10 | PSN7 | RN4-2000 Tras Os Montes | Pumped | 6.000 | 315 HDPE PN 16 |
| | | | | | |
| **NA2b: Network for Sao Salvador Do Mundo** | | | | | |
| TLN6 | RN2-5000 | RN3-600 Picos | Gravity | 9.800 | 200 HDPE PN16 |
| | | | | | |
| **NA2c:Network for Sao Lorenco** | | | | | |
| TLN8 | PSN6 | RN3-600 Joao Teves | Pumped | 16.400 | 250 HDPE PN16 |

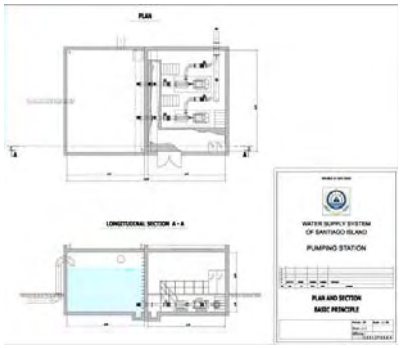
LOOP SECTIONS (optional sections)
Loop sections are proposed to complete and to secure the networks for total water supply system.

Loop sections are optional and are not included in the F/S Project.

# 4-3 Water Transmission Facility, *pump & reservoir*

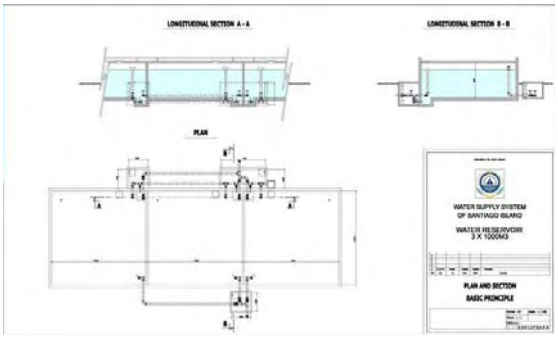
Pumping Station

| No. | Flow (m3/h) | Pressure (barg) | Total Installed power (kw) For CAPEX | Power consumption (KW) For OPEX |
|---|---|---|---|---|
| PSS1 | 1599 | 16.0 | 1,661 | 1,110 |
| PSS2 | 98 | 15.7 | 134 | 70 |
| PSS3 | 126 | 14.1 | 154 | 80 |
| PSS4 | 126 | 17.6 | 193 | 100 |
| PSS5 | 126 | 14.7 | 161 | 85 |
| PSS6 | 42 | 14.0 | 51 | 30 |
| PSN1 | 1056 | 18.2 | 1,249 | 840 |
| PSN2 | 598 | 13.3 | 689 | 350 |
| PSN3 | 598 | 10.4 | 539 | 275 |
| PSN4 | 598 | 10.6 | 552 | 280 |
| PSN5 | 598 | 10.2 | 528 | 270 |
| PSN6 | 80 | 13.7 | 95 | 50 |
| PSN7 | 238 | 14.6 | 301 | 160 |



Reservoir

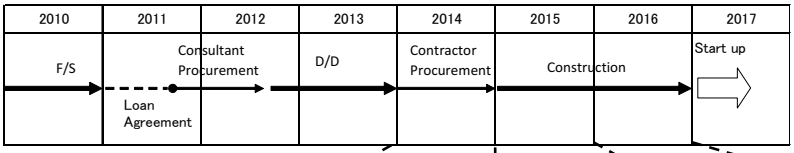
| Name | Description | Capacity (m3) | Elevation (m) |
|---|---|---|---|
| RS1-5000 | Praia – Tira Chapeu | 5 x 1000 = 5.000 | 120 |
| RS2-5000 | Praia- Vila Nova | 5 x 1000 = 5.000 | 110 |
| Existing | Existing reservoir Cidade Velha | 1 x 1000 = 1,000 | 150 |
| RS3-200 | Porto Mosquito | 1 x 200 = 200 | 60 |
| RS4-2000 | Ribeiro Chiquero | 2 x 1000 = 2,000 | 320 |
| RS5-1000 | Sao Domingos | 1 x 1000 = 1,000 | 450 |
| RN6-600 | Joao Teves | 1 x 600 = 600 | 220 |
| RN5-3000 | Pedra Badejo | 3 x 1000 = 3,000 | 120 |
| RN3-600 | Picos | 1 x 600 = 600 | 420 |
| RN1-7000 | Calheta Sao Miguel | 7 x 1000 = 7,000 | 200 |
| RN2-5000 | Assomada | 5 x 1000 = 5,000 | 600 |
| RN4-2000 | Tras Os Montes | 2 x 1000 = 2,000 | 220 |





# 4-4 Implementation Planning

- No critical issue of the construction of the system is found.
- Due to the long transmission line construction, plural construction teams would be organized for the effective and reasonable planning.




| DESCRIPTION | | YEAR | Year 1 | | | | | | | | | | | Year 2 | | | | | | | | | | | Year 3 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Calendar Mth | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | | Project Mth | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| GENERAL SCHEDULE | | Construction Team No. | Contractor Procurement | | | | | | | | | | | | Construction | | | | | | | | | | | | | | | | | | | | | | | |
| **North Area** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N1 | Desalination Facility Construction and Installation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Water Transition Facility Construction | 2 teams | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N2 | Desalination Facility Installation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Water Transition Facility Construction | 3 teams | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Commissioning | | | | | | | | | | | | | | | | | | | | | | | | | N1◆ | | | | | | | | | | | N2◆ |
| **South Area** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| S1 | Desalination Facility Construction and Installation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Water Transition Facility Construction | 1 team | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| S2 | Desalination Facility Installation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Water Transition Facility Construction | 1 team | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Commissioning | | | | | | | | | | | | | | | | | | | | | | | | | S1◆ | | | | | | | | | | | S2◆ |

# 4-5 Project Risk

| | | Risk Occurrence Possibility | | | Risk Description | Countermeasure |
|---|---|---|---|---|---|---|
| | | low | medium | high | | |
| Technical | | | | | | |
| | Capacity | ✓ | | | | |
| | Sea Water Specification | ✓ | | | | |
| | Potable Water Specification | ✓ | | | | |
| | Water Transmission | | ✓ | | unforseen obstacle or soil condition | route change will be discussed |
| | Power Supply | | ✓ | | emergency failure | emergency generator will be installed |
| | Beach Well Water | | ✓ | | water volume decreasing | another well will be newly digged |
| | Regulation | ✓ | | | | |
| Commercial | | | | | | |
| | Funding | ✓ | | | | |
| | Yen Loan | ✓ | | | | |
| | Market | ✓ | | | | |
| | Inflation | ✓ | | | | |
| | Concession | ✓ | | | | |
| Environment | | | | | | |
| | Regulation | ✓ | | | | |
| | Permission | ✓ | | | | |
| | Natural Conditions | ✓ | | | | |
| | Social Consideration | ✓ | | | | |
| others | | | | | | |
| | Policy | ✓ | | | | |
| | Human Resources | ✓ | | | | |
| | Construction Site | ✓ | | | | |
| | Operation | | ✓ | | operation material shortage | material will be purchased |
| | Maintenance | | ✓ | | maintenance material shortage | material will be purchased |
| | other projects impact | ✓ | | | | |

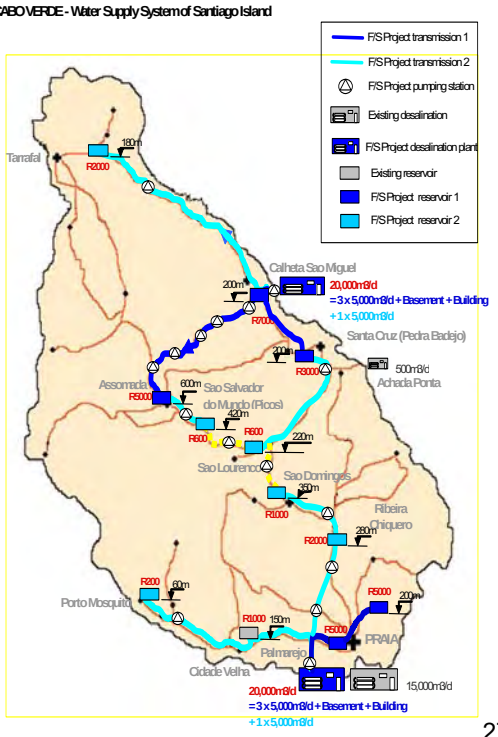


# 4-6 (1) Economics Analysis, - *presupposition* -

- Case “Total”, “S1”, “S2”, “N1” and “N2” are studied … ref 4-6(2)
- Production capacity, in “Total” case … ref 4-6(3)
  - Production: 40,000$m^3$/d, with 365days/year operation
  - Sales : around 85% (34,500$m^3$/d) of production
  - No safety margin is considered
- Project period
  - Construction : 2 years for EPC, including trial run … ref 4-4
  - Project life for Economics analysis : 20 years
- Financial condition
  - Equity:15%
  - Loan: 85% (25years Yen loan from Japanese Government, 1.4% p.a. interest)
  - Investment 60% at 1st year, 40% at 2nd year
- Project cost: as per slide 4-6(4)
- Tariff: 5.0US$/$m^3$ (395CVE/$m^3$) in 2020, in base case … ref 4-6(5)
- Depreciation
  - Manner of depreciation : Straight-line method, with Zero salvage value
  - Service life : 20 years, for Economics Analysis purpose
- Unit cost for study
  - Electricity: 21CVE/kWh (=0.265US$/kWh), based on ELECTRA tariff
  - 10,000 US$/year/person, including overhead
  - Maintenance, including membrane, chemical are considered accordingly

# 4-6 (2) Project Scoping, - *each project* -

| Project Name | SWRO | | | | | | Transmission and reservoirs for | |
|---|---|---|---|---|---|---|---|---|
| | Location | Train capacity (m3/d) | trains (unit) | Total quantity (m3/d) | Civil work | | Service Area | m3/d |
| | | | | | Civil work, including equipment base | Building | | |
| S1 | Palmarejo | 5,000 | 3 | 15,000 | for all (4 trains) | for all (4 trains) | Praia | 15,000 |
| S2 | Palmarejo | 5,000 | 1 | 5,000 | --- | --- | Ribiera Grande Sao Domingo | 5,000 |
| N1 | Calheta | 5,000 | 3 | 15,000 | for all (4 trains) | for all (4 trains) | Sao Miguel Santa Catarina Santa Cruz | 15,000 |
| N2 | Calheta | 5,000 | 1 | 5,000 | --- | --- | Tarrafal SS.Mundo Sao Laurence | 5,000 |
| Total | | | | 40,000 | | | | 40,000 |

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Altitude levels are indicative
Pumps location and reservoirs locations are indicative

# 4-6 (3) Production and Sales Plan (unit: $m^3$/day)

| Project name | | | Delivery (Sales) = Production − Leakage | Leakage = Production x 15% | Production | | | |
|---|---|---|---|---|---|---|---|---|
| Name | Service Area | Population, in 2020 (persons) | | | Delivery + Leakage | Round figure | F/S Project | Others (Spain, WB) |
| *by others* | Praia | 157,978 | *13,500* | *2,382* | *15,882* | *15,000* | --- | *15,000* |
| S1 | | | 13,500 | 2,382 | 15,882 | 15,000 | 15,000 | --- |
| S2 | Ribiera Grande Sao Domingo | 28,893 | 3,000 | 529 | 3,529 | 5,000 | 5,000 | 0 |
| N1 | Sao Miguel Santa Catarina Santa Cruz | 115,560 | 13,000 | 2,294 | 15,294 | 15,000 | 15,000 | 0 |
| N2 | Tarrafal SS.Mundo Sao Laurence | 52,888 | 5,000 | 882 | 5,882 | 5,000 | 5,000 | 0 |
| Total (S1+S2 +N1+N2) | | 355,319 | 34,500 | 6,088 | 40,588 | 40,000 | 40,000 | 0 |
| | | *Others* | *13,500* | | | | | *15,000* |
| | | Grand Total | 48,000 | | | | 55,000 | |

# 4-6 (4) F/S Project Cost, *- preliminary -*

| Project name | | Plant Cost | | | | | Project Cost |
|---|---|---|---|---|---|---|---|
| | | SWRO | | Transmission | | Total | (= Plant cost x 1.4) |
| Name | Service Area | *m3/d* | mio $ | *m3/d* | mio $ | mio $ | mio $ |
| S1 | Praia | *15,000* | 23.2 | *15,000* | 8.6 | 31.8 | 44 |
| S2 | Ribiera Grande<br>Sao Domingo | *5,000* | 5.8 | *5,000* | 13.7 | 19.5 | 27 |
| N1 | Sao Miguel<br>Santa Catarina<br>Santa Cruz | *15,000* | 23.2 | *15,000* | 24.8 | 48.0 | 67 |
| N2 | Tarrafal<br>SS.Mundo<br>Sao Laurence | *5,000* | 5.8 | *5,000* | 19.3 | 25.1 | 35 |
| Connection | | | | | | 0.0 | 0 |
| Total | | *40,000* | 58.0 | *40,000* | 66.4 | 124.4 | 174 |

Project cost is calculated by adding project implementation cost in future such as consultant fee, land acquisition fee, detail design fee etc. From in-house data, 1.4 times of Plant cost is applied.



# 4-6 (5) Current Sales Price, *tariff*

| Area | | South | | | | | North | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project name | | S1 | S2 | | | South total | N1 | | | | N2 | | | | North total | Total |
| Municipality | | Praia | Ribeira Grande | Sao Domingos | Average | | Sao Miguel | Santa Catarina | Santa Cruz | Average | Tarrafal | SS do Mundo | Sao Lourenco | Average | | |
| *Tariff in 2008, consumption range of 6m3/month* | *CVE.m3* | ***333*** | *354* | *280* | ***309*** | *331* | *280* | *120* | *280* | ***198*** | *134* | *310* | *150* | ***175*** | *192* | ***279*** |
| | *US$/m3* | ***4.2*** | *4.5* | *3.5* | *3.9* | *4.2* | *3.5* | *1.5* | *3.5* | *2.5* | *1.7* | *3.9* | *1.9* | *2.2* | *2.4* | *3.5* |
| Sales quantity in 2020 (m3/d) | Normal | 26,987 | 1,033 | 1,600 | | 29,620 | 2,266 | 6,490 | 3,987 | | 3,015 | 1,098 | 1,015 | | 17,871 | 47,491 |
| | Peak | 237 | 10 | 10 | | 257 | 10 | 49 | 20 | | 20 | 0 | 0 | | 99 | 356 |
| | Total | 27,224 | 1,043 | 1,610 | | 29,877 | 2,276 | 6,539 | 4,007 | | 3,035 | 1,098 | 1,015 | | 17,970 | 47,847 |
| | | | 2,653 | | | | 12,822 | | | | 5,148 | | | | | |
| | Round Figure | **13,500** | **3,000** | | | (30,000) | **13,000** | | | | **5,000** | | | | (18,000) | **34,500** |
| | by Others | 13,500 | | | | | | | | | | | | | | |

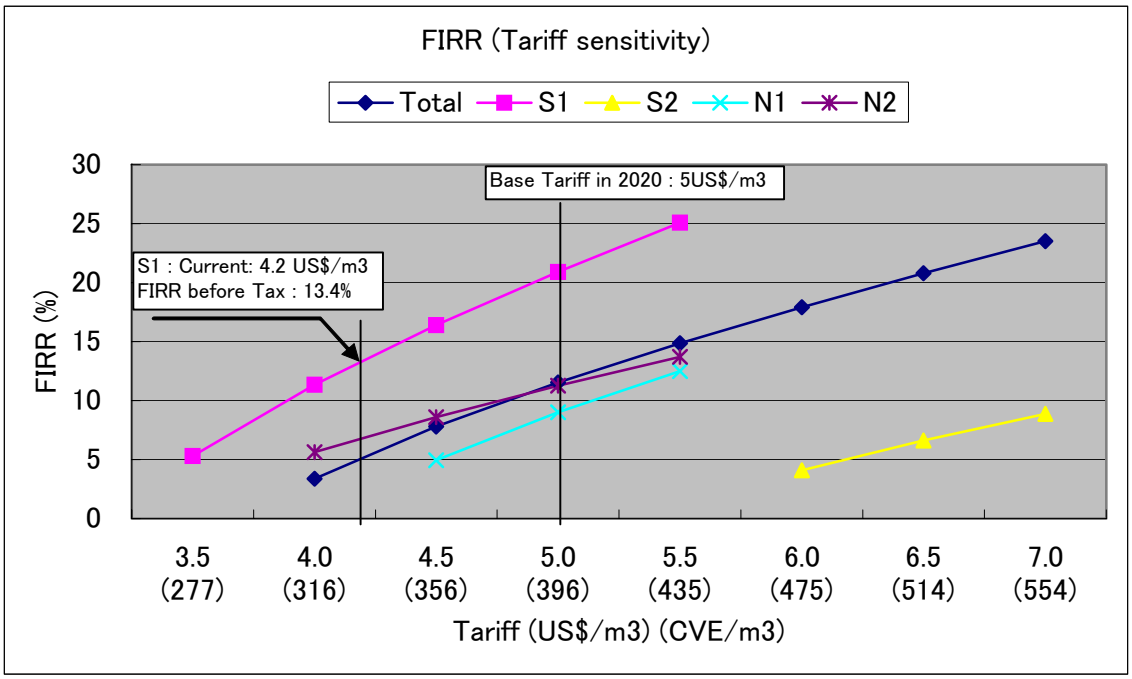
USD 1 = 79.1 CVE
Praia area 333 CVE/m3= 4.2 USD/m3
Other Praia 207 CVE/m3= 2.6 USD/m3

Data source: Electra for Praia, and SAAS for other municipality than Praia

Average tariff in other area than Praia is 207 CVE/m3. According to Social survey in 2009 by JICA study team, these area

may accept tariff increase up to 200-350 CVE/m3 (=1.7 times max). Therefore 1.4 times of average tariff of 279 CVE/m3 (=3.5 US$/m3) (= 5US$/m) is set as base case in 2020.

# 4-6 (6) F-IRR Calculation Results, - *preliminary* -




5US$/m3 is enough feasibility in all cases except “S2”.



# 4-6 (7) Economics Analysis, - *summary* -

**(a) Summary of profitability study**

S1 shows most stable financial result from view points of F-IRR and DSCR.

F-IRR: 20.9% @ 5.0US$/$m^3$ at base tariff

13.4% @ 4.2US$/$m^3$ at current tariff

DSCR: 3.67 and higher @ 1st Operation year and afterward

**(b) Tariff of potable water**

Sales price is set up only based on the current tariff of potable water.

This tariff shall be politically adjusted.

All cases except “S2” show healthy financial economics.

In case people cannot accept this tariff,

the subsidy application by the GoCV is recommended.

# 5. Operation and Maintenance Planning

There is no organization which comprehensively manages and supervises waterworks and O&M at whole island level.

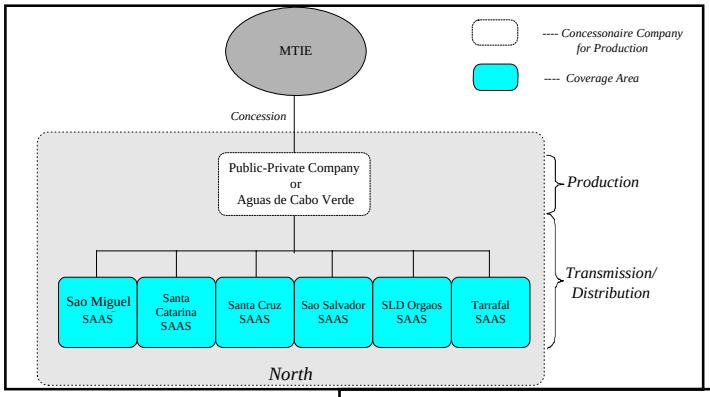
Considering the current waterworks situation and the project nature, the O&M systems in the transition period and in the future are recommended.

In the transition period, two water supply systems will be established in the south and the north in the island. The desalinated water produced by 2 desalination facilities in the southern and the northern regions will be transmitted and distributed to target municipalities.

As a future scenario, establishing an inter-municipal public holding company will manage and supervise the water supply system comprehensively in southern and northern regions.

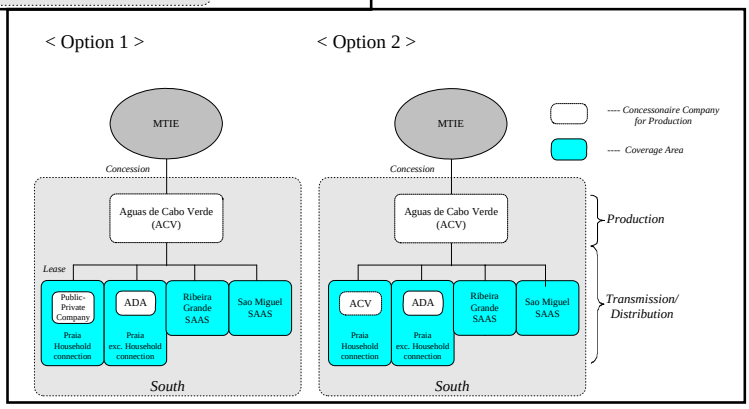


# 5-1 O&M Planning in Transition Period

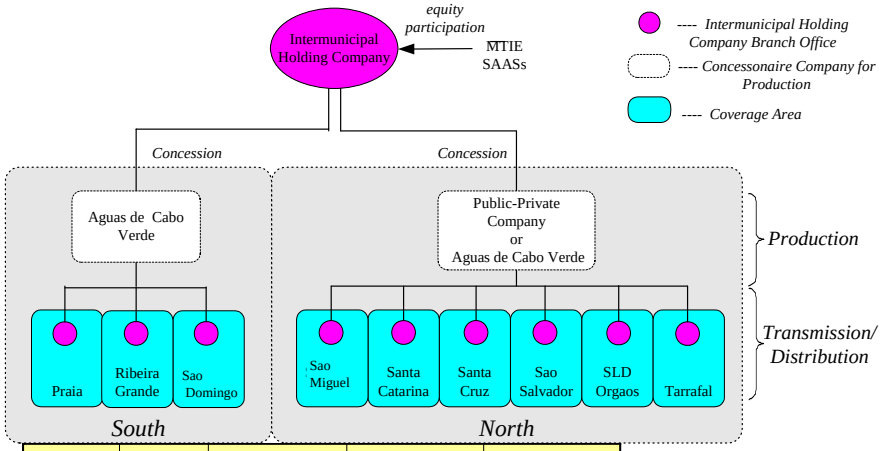



North Region

South Region



# 5-2 O&M Planning in Future




| Region | Ownership/ Role | Production | Transmission | Distribution |
|---|---|---|---|---|
| North | Property ownership | Public-Private Company (SPC) | State | Municipality |
| | O&M | Public-Private Company (SPC) | Inter-municipal Public Holding Company | Inter-municipal Public Holding Company |
| South | Property ownership | Aguas de Cabo Verde | State | Municipality |
| | O&M | Aguas de Cabo Verde | Inter-municipal Public Holding Company | Inter-municipal Public Holding Company |



# 6. Initial Environmental Examination, IEE

IEE of the F/S Project took place from October 2009 to July 2010.

IEE has been carried out in accordance with the JBIC Guidelines dated April 2002 and relevant laws of the GoCV.

In IEE stage, general environmental impacts were presumed according to the dialogue with local stake holders for environmental management through “Inter-municipal Meeting for Environmental issues” conducted by the Study team on May 2010 in Praia.

As conclusion, general measures for environmental management are summarized in each municipality’s Municipality Development plan (PDM) and Municipality Environmental plan and those measures should be considered at the stage of the F/S Project formation and IEE and EIA.

# 7-1 Conclusion

1. JICA Study Team developed the Technical Specification of Water Supply System on the Santiago island with MTIE of GoCV, and no specific issue was found.

2. JICA Study Team conducted the preliminary Economics Analysis on the total F/S Project and separated projects of S1, S2, N1, and N2 based on the developed system specification.
   All cases except “S2” show healthy financial economics.

3. JICA Study Team proposed the Operation and Maintenance systems in the transition period and in the future, but those systems should be further discussed.

4. JICA Study Team conducted the Initial Environmental Examination, and no specific issue was found.



# 7-2 Way Forward

1. JICA Study Team will conduct the CAPEX and OPEX estimation for their project scope with MTIE of GoCV.

2. MTIE of GoCV will conduct the CAPEX and OPEX estimation for their project scope with JICA Study Team.

3. Draft Final Report will be developed through home office work in Japan and field work in Cape Verde with careful discussion among MITE, JICA, and JICA Study Team based on the Interim Report.

4. Draft Final Report will be prepared by the end of October.
   1) Its discussion will be held on November in Praia.
   2) Final Report will be developed by the end of this year.

5. The major contents of the (Draft) Final Report are as follows:
   1) CAPEX and OPEX estimation
   2) Project Economics Study
   3) Financing and funding in consideration of Japan’ ODA loan