NO.

Palau International Coral Reef Center
Republic of Palau

FOLLOW-UP COOPERATION STUDY REPORT

ON

THE PROJECT FOR CONSTRUCTION

OF

PALAU INTERNATIONAL CORAL REEF CENTER

AUGUST 2016

SYSTEM SCIENCE CONSULTANTS INC.

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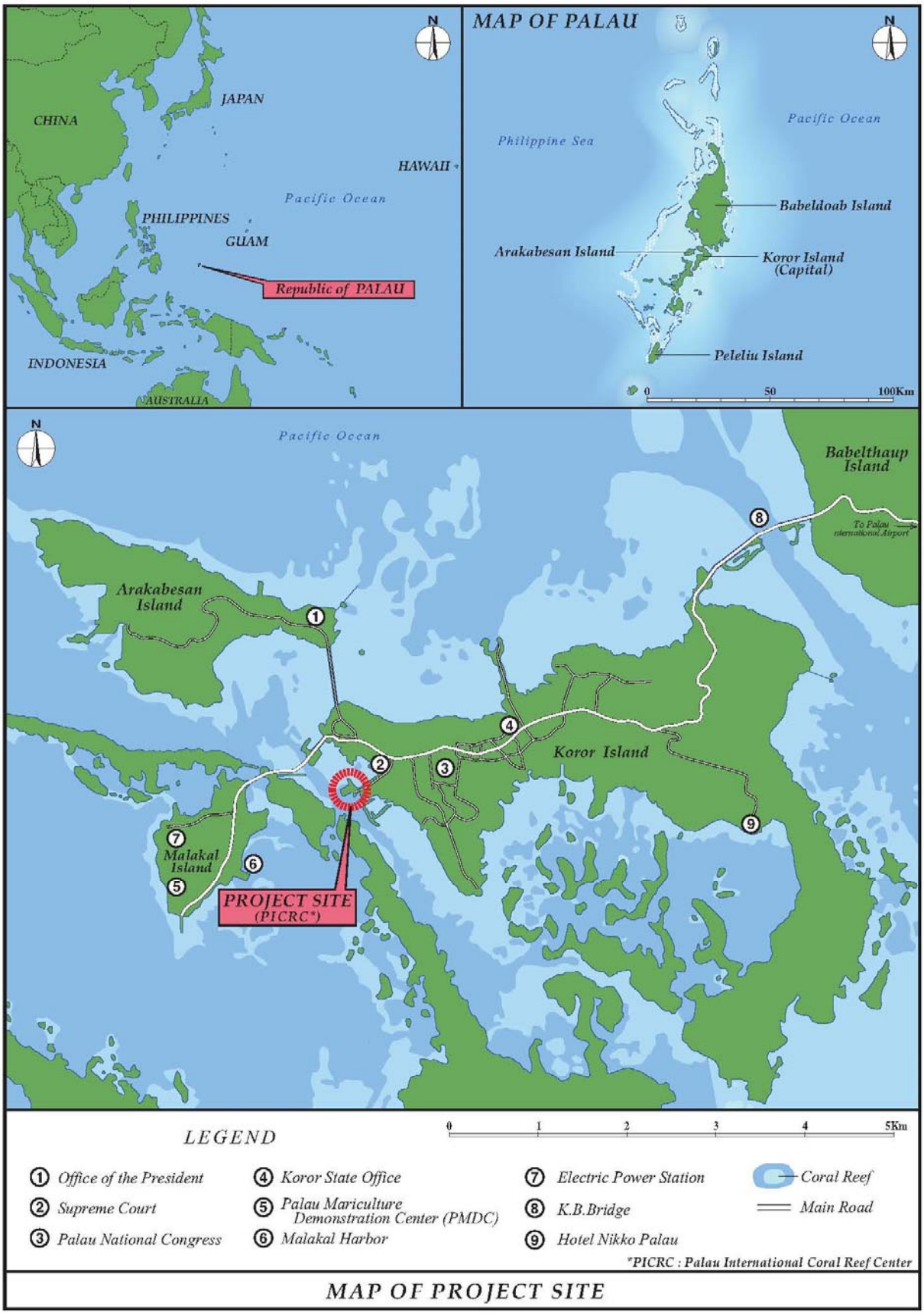
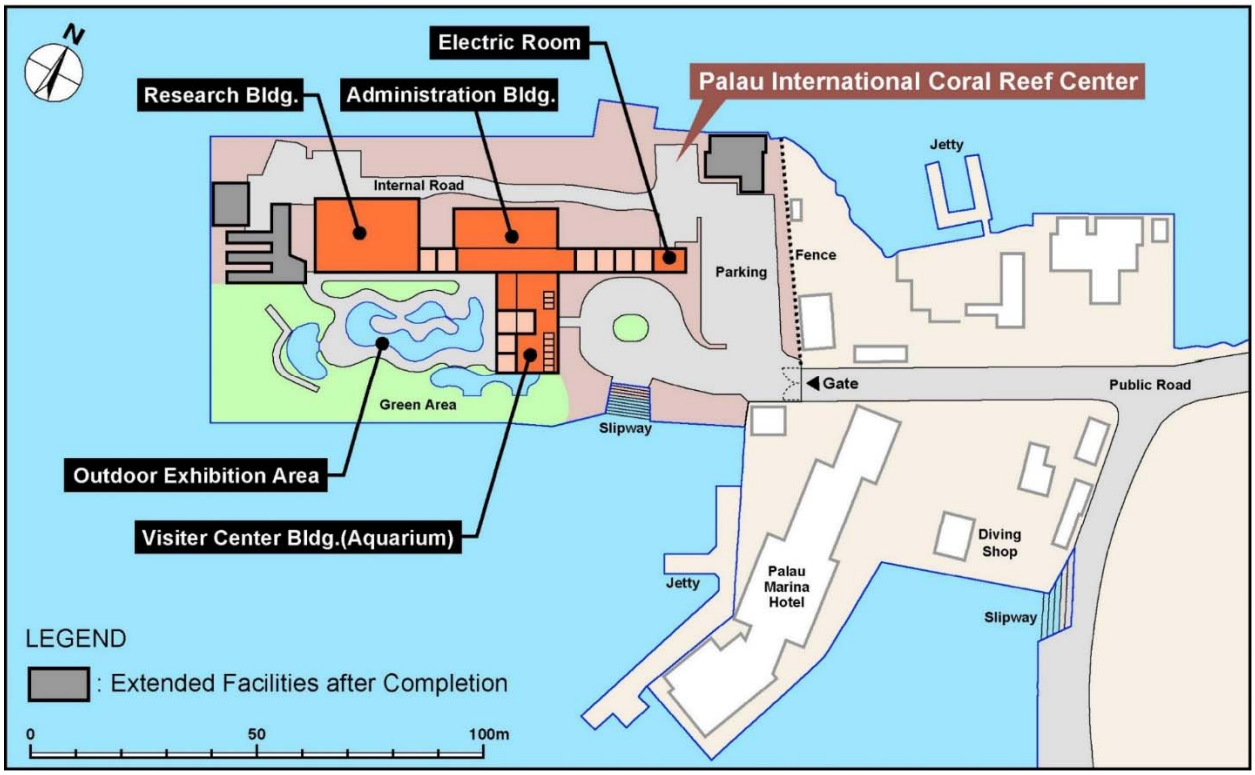
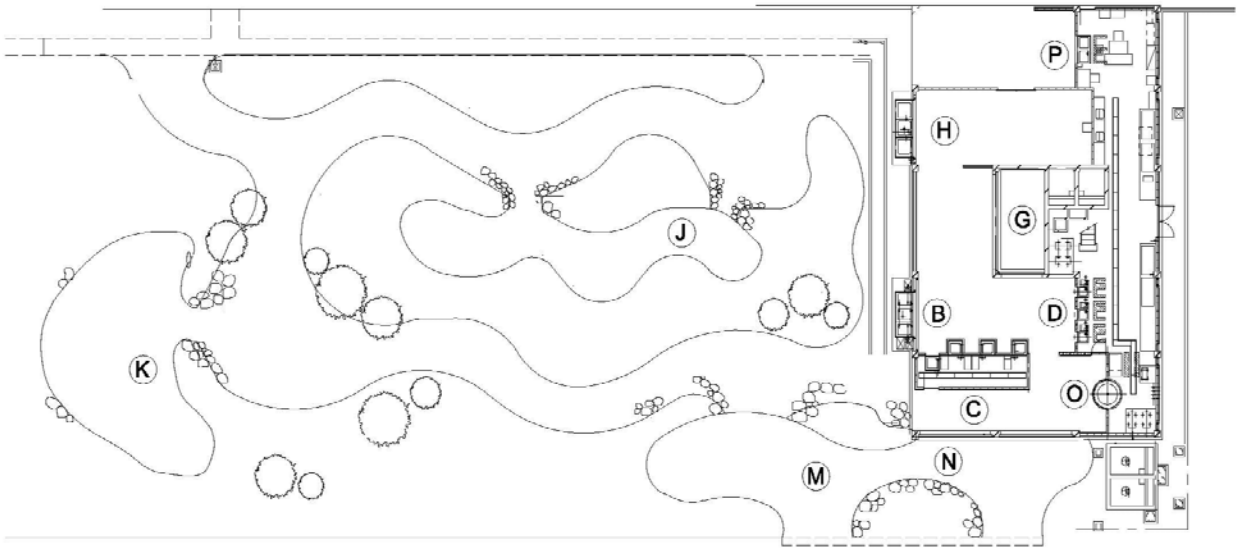
Attachment



Map of Project Site



Layout Plan of Facilities in PICRC



Layout Plan of Aquarium

1. Summary of Follow-up Cooperation

1.1 Back Ground

The waters with coral reefs of Palau have been used as a source of not only seafood but also raw materials of handicrafts, accessories and construction materials. Tourism development based on the coral reefs has supported the economy of Palau as a key industry for economic independence. However, the degradation of the biological resources including the coral reefs has become a serious problem. The Government of Palau (GOP) submitted a request for grant aid assistance to the Government of Japan (GOJ) for the construction of facilities and procurement of equipment to conduct studies on the conservation of coral reefs and the ecosystem to which they belong and their sustainable utilization as a tourism resource and to implement activities to make the residents and tourists aware of the importance of the conservation of the marine resources including coral reefs. In response to this request, the "Project for Construction of Palau International Coral Reef Center in the Republic of Palau" was implemented in FY1999 and FY2000. The construction of the center was completed in September 2000. The facilities constructed and the equipment provided in the project were as follows:

- ☐ Facilities: Research Building, Visitor Center Building (including water tanks), Administration Building (total floor area of approx. 1,390 m^2, two-storied), repair of the revetment of the dock, etc.
- ☐ Equipment: Equipment for survey and observation (including a boat for survey and observation), equipment for research and experiment, equipment for exhibition, equipment for maintenance, equipment for the museum shop, equipment for the administration and equipment for management

The Palau International Coral Reef Center (PICRC) has engaged in marine surveys and research for the development of measures to conserve and manage marine resources including coral reefs, and also awareness creation and environmental education for the residents and students of Palau and tourists on the conservation of marine resources. This work is following to the recommendation in "Palau National Master Development Plan" and "Palau International Coral Reef Center Act: 1998" since the center was handed over to GOP.

As the conditions of the facilities and equipment have deteriorated, their operation and maintenance cost has increased. The center is facing problems in its operation. For example, the coral in the exhibition tanks in the visitor center have died because the center can only use the seawater cooling system for limited time. Against this background, GOP submitted a request for this Follow-up Cooperation (F/C) to GOJ for the purpose of the restoration and improvement of the original functions of the facilities and equipment of the center and the development of a sustainable facility operation system.

1.2 Objectives of the Follow-up Cooperation Study

(1) The Study aims at, through the field survey and the meetings with PICRC, reviewing the current situation of the equipment, clarifying the request by the PICRC and collecting information necessary for JICA's decision-making on the Follow-up Cooperation.

(2) The viability of the implementation of the Follow-up Cooperation will be determined after further studies in Japan. PICRC understood that the final decision whether the Follow-up Cooperation would be implemented or not, and in case of getting approval for implementation, the final components of the Follow-up Cooperation would be decided after further studies, examination and analysis by JICA in Japan.

1.3 Objective of the Follow-up Cooperation

The objective of the Follow-up Cooperation is to restore the functions of PICRC's facility which were installed in the original functions.

2. Summary of PICRC Organization

2.1 Organization and Personnel

(1) Organization/personnel

PICRC is operating by 22 personnel. Organization chart of PICRC is shown as the following.

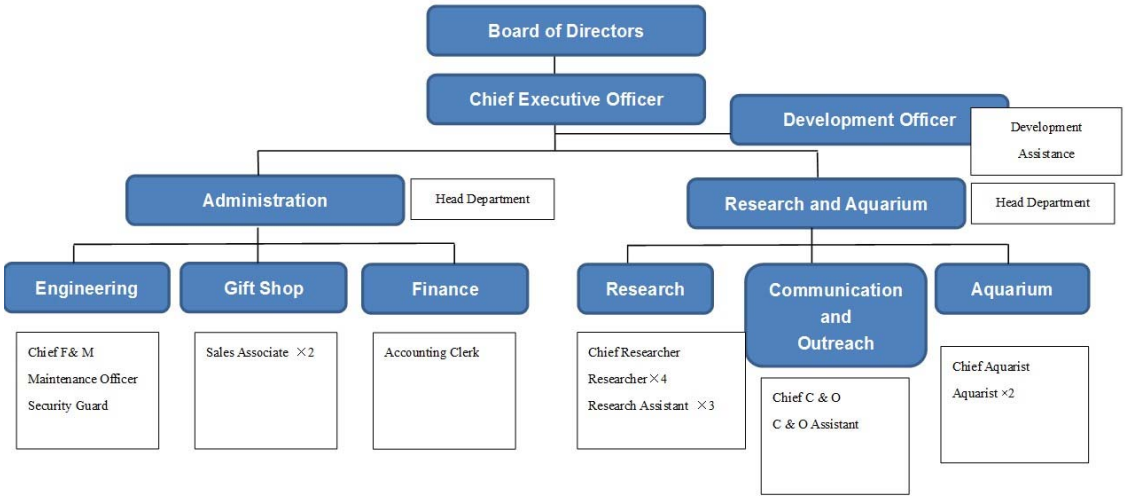


Fig. Organization Chart

(2) Function and Role of Each Department

The function and role of each department and section in PICRC are shown as the following.

- Board of director: provide guidelines, strategic vision, guidance, resources, and oversight to the Center.
- CEO: manage and ensure the efficient operation of the Center.

- Development officer: develop and implement fundraising program to raise funds for the Center.
- Administration: coordinate, and provide oversight of all business and administrative processes
- Engineering section: develop and implement plans of improvement and maintenance on the Facility and Equipment's of the Center including but not limited to the safeguard of the Center's assets.
- Gift Shop Section: provide front-line customer service in person and/or by telephone to refer customers to the aquarium or appropriate staff, and raising additional revenues to the Center through the Giant Clam merchandise and the Aquarium entrée.
- Finance Section : perform all standardized and applicable accounting and financial tasks required by the Center.
- Research section: develop and implement research activities as stated in the strategic plan.
- Aquarium section: develop, implement, and provide guidance in all aspects of aquarium's animal care and maintenance.
- Communication and outreach: planning and implementing the Center's education programs to promote the Center's mission and its programs to schools and community.

2.2 Implementation Plan

(1) Operation Plan of PICRC

The operation plan of PICRC is the "Five Year Strategic Plan (2013-2017)" which in 2013, the Board of Directors of PICRC authorized.

(2) Mid-term Strategy of the PICRC

The mission of PICRC would not be changed and the following core activity would be continued after the completion of "Five Year Strategic Plan (2013-2017)".

- Promoting the research that supports the conservation and management of marine resources in Palau and Micronesia.
- Promoting the education to raise awareness and concern for the conservation and management of marine resources and to showcase the rich diversity and underwater of Palau`s coral reef and associated ecosystem
- Operating above-mentioned activities while ensuring the financial sustainability

2.3 Main Activity and Achievement of PICRC

(1) Research field

PICRC has implemented the following research to support the conservation and management of marine resources in Palau and Micronesia. The result (scientific evidence) of research has been utilized to the government's policy/regulation of marine resource conservation and management as well as verified the effectiveness of implementation of regulations. The

current on-going activities in research field of PICRC are shown in the following.

- Monitoring the climate change impact to coral reef in Palau
- Monitoring the status and trend in the conditions of Palau's coral reef
- Research to identify the best land management practices to reduce sedimentation
- Targeted fisheries research to improve resource management

(2) Education field

Through the following activity, PICRC has been promoting the education to raise awareness and concern for the conservation and management of marine resources and to showcase the rich diversity and underwater of Palau`s coral reef and associated ecosystem by utilizing the result of research and Aquarium of PICRC.

- PICRC has provided the education program for free to all elementary, high schools and Palau Community Colleges (23 schools) in Palau since 2014
- PICRC or the government of the Republic of Palau have introduced the rich diversity and underwater of waters of Palau's coral reef and associated ecosystem to fringe special guests, visitors, researchers, senior citizens and women' group of Palau.

The actual result of the education activity and the number of visitors to Aquarium are shown in the following table.

Table: Number of visitors to Aquarium of PICRC

COUNTRY	2,011	2012	2013	2014	2015
JAPAN	2,164	2,844	2,602	2,900	2,513
KOREA	7,518	6,598	728	564	131
PRC CHINA	53	94	100	388	925
ROC TAIWAN	1,300	2,291	934	151	156
USA	501	593	850	796	879
PALAU	374	677	856	769	1,933
OTHERS	721	1,246	1,548	2,052	2,446
TOTAL	12,631	14,343	7,618	7,620	8,983

(3) Linkage between Research and Education

PICRC explains that the output of research has been utilized for the contents of education program as well as introduced in Aquarium.

2.4 Operation and maintenance cost of PICRC

The breakdown of operation and maintenance cost is shown in the following table.

Table: Operation Revenue and Expenditure（2011-2015） Unit: US$

	Financial Statement Items	FY2011	FY2012	FY2013	FY2014	FY2015
Operating Revenue						
1	Grant Revenue	375,720	270,040	577,677	324,470	503,268
2	ROP Appropriation	387,000	356,708	357,000	400,000	400,000
3	Contract service	20,899	103,179	69,700	142,233	85,200
4	Facility User	20,503	22,894	42,876	75,165	78,261
5	Donation	58,628	66,656	44,523	38,602	107,079
6	Merchandise sales	22,585	23,884	35,125	45,738	50,142
7	Admission	71,247	88,932	49,645	50,116	45,172
8	Fund raising	41,571	33,011	1,534	28907	92,653
9	Boat fee	13,169	27,097	28,712	35,967	28,399
10	Accommodation	5,641	8,822	1,665	1,942	0
11	Research facilities	5,609	12,705	62,185	73,568	100,362
12	Interest income	105	70	7,275	13,357	560
13	Education program fee	2,321	6,455	13,966	2,230	0
14	Other income	39,014	12,955	20,584	5,842	60,491
	Total operation revenues	1,064,012	1,033,408	1,312,467	1,238,137	1,551,587
Operating Expenses						
1	Salaries, wages and fringe benefits	453,082	405,233	439,335	462,009	487,924
2	Depreciation	157,263	167,337	164,956	216,798	253,498
3	Utilities	125,673	90,879	93,062	109,591	79,804
4	Supplies and printing	64,616	47,719	72,517	106,382	93,423
5	Professional services	55,363	60,135	82,339	67,053	74,815
6	Communications	21,960	7,578	9,102	8,865	14,110
7	Travel	17,006	20,488	36,873	31,071	4,368
8	Merchandise cost	14,744	12,536	25,019	29,261	28,129
9	Insurance	14,167	15,714	9,698	16,252	19,325
10	Fuel	11,545	25,759	29,750	39,094	41,200
11	Repair and maintenance	6,121	10,937	47,324	36,472	18,900
12	Anniversary	4,335	3,472	170	7,872	0
13	Education and training	2,550	8,509	7,549	8,957	23,862
14	Dues and subscription	2,335	898	308	467	2,247
15	Hospitality and entertainment	1,174	746	2,848	3,571	1,233
16	Postage and freight	262	142	919	1,274	2,979
17	Sales and marketing	30	15	0	0	708
18	Capital asset contribution	103,550	0	0	0	0
19	Donation to State Gov.			3,270	0	0
20	Others	44,413	43,619	47,126	27,611	2,424
21	Cost of contract					4,662
22	Interrest					4,647
23	Gran Contract Indirect cost					25,709
	Total operation expenses	1,100,189	921,716	1,072,165	1,172,600	1,183,967
	Net asset at end of year	-36,177	111,692	240,302	65,537	367,620

The features to be pointed out are as follow.

- The main resource of the revenue is the annual budget allocated by the government and the Grant from international organization and private foundation. However this revenue is not stable and fluctuates in each year.

- PICRC has tried to save 1 million US $ as the countermeasure against the unstable revenue (currently, about 400,000 US $ has been stocked).
- The overall goal of financial operation is to manage the revenue by their own income such as utilization fee of research facility, accommodation fee for the foreign researcher, sales of gift shop and admissions fee of aquarium. Currently, the PICRC has a total of $210,000 which $195,000 is invested in the money market. The goal is to build an endowment within the next 20 years where PICRC can use its interest to help fund the center's activities.
- PICRC has tried to decrease the expenditure of operation cost of the facility. Compared to 2011, the utilities (electric fee) cost in 2015 was decreased by about 40 %.

2.5 Plan for Introduction and Replacement of Research Equipment

There is a wide range of research equipment now at PICRC and it has been introduced over a period from 2004 to 2014, with about 96 items being registered as newly introduced equipment. As the result of surveys on electricity consumption made during this study, electricity consumed for research equipment was found significantly smaller than the originally established electricity circuit capacity (amperage). Therefore, if electricity consumption of experimental equipment that is planned to be introduced is added, the current capacity is still large enough. The following is research equipment for which PICRC requested for supply of electricity from the standby power source for the joint research.

- Freezer (-20 degrees C) 1 unit
- Freezer (-60 degrees C) 1 unit
- Heater (300w) 12 units
- Underwater pump (20w) 9 units
- Lighting fixture (250w) 4 units

2.6 Operation and Maintenance Organization

(1) Maintenance Section

Daily maintenance and Periodical maintenance of aquarium and other facility are implemented by three (3) technicians of aquarium section of research of aquarium department.

(2) Maintenance System (activity) of facility of PICRC

PICRC has tackled the following maintenance work after the completion of the Original Project with the limited budget and human resource. PICRC has tried to keep the best condition of each equipment to ensure the expected function of the facility as much as possible.

1) Daily maintenance

Daily maintenance method for tanks in aquarium is conducted in Japanese way which was transferred from Japanese expert of aquarium. For example, cleaning inside of tank, water control (temperature, water volume and PH) and feed control require skills and should be done in a reasonable way.

2) Periodical maintenance

Periodical maintenance of facilities is implemented by PICRC staff. The main items are shown in the following.

- Cleaning of seawater suction point in the sea and strainer for pump
- Seawater pumps operation and replacement of consumable parts.
- Maintenance of generator set (oil, fuel and battery)
- Modification of electric wiring distribution board

3) Installation of the new seawater intake pipe

New seawater intake pipe was installed by PICRC and local contractor in 2006. This pipe has been used constantly in good condition until now. This installation work is successful and durable.

4) Installation of the new cooling system for small tank

New cooling system for small tank have been modified and kept in good condition by PICRC staff. They have technical knowledge and skill on cooling system and other equipment.

3. Study on the Present State of the Facilities

3.1 Present state of facilities maintenance

It has already been 15 years since the existing PICRC facilities were constructed. Naturally, the facilities not only are aged but have also passed their service life, which indicates there should be plenty of machines and equipment that are out of order or malfunctioning. In the field study, however, it was found that regular maintenance had been made on intake pumps as well as machinery and equipment had been replaced and repaired independently by the facilities and no critical problem had occurred in relation to operation of the facilities. In addition, for reducing the consumption of electric power, which is expensive in the country, the facilities independently have replaced incandescent lamps with power-saving lighting fixtures or with inverter fluorescent lights in a phased manner. From which, we could confirm that the facilities had conducted operation and maintenance with limited human resources and budgets while making self-help efforts and devising possible related measures.

Furthermore, at the research division, which plays a central role in activities at PICRC, a joint research concerning the “Project for Sustainable Management of Coral Reef and Island

Ecosystems: Responding to the Threat of Climate Change" (2013 - 2018), a JICA technical cooperation project, has been continuously conducted and technological development has also been enhanced by implementing activities around research topics that are established independently by PICRC. In addition, the aquarium which is a center for education on the conservation of marine resources such as coral reef for the residents and tourists has been maintained relatively well thanks to instructions provided by Japanese experts and this fact proves that there is no problem in the aquarium's operational capability, while the number of tourist visitors has been decreasing in recent years and a near-term issue is to acquire a larger number of tourists through more attractive special exhibits.
Major repairs and improvements independently made by PICRC are listed below.

- Repair of aged intake pipes and addition of new pipes (2006)
- For the purpose of reducing electric bills, suspension of operation of circulation system for Tanks N and G (Currently, seawater is directly supplied into the tanks in an overflow system) (2006-2015)
- Phased replacement of air conditioners for major rooms (2006-2015)
- Painting of exteriors of the facilities (2015)
- Phased repainting of floor finishing material
- Gradual replacement of lighting fixtures
- Others

Currently, PICRC has been expanding its research facilities located on the east side of its premises, obtaining financial aid from Taiwan ($840,000).

3.2 Present state and issues of the aquarium

(1) Replacement of equipment of the aquarium's indoor small tanks

Since electric wiring used at the aquarium is a mixed combination of 100 V and 120 V for supplying power to cooling units and circulation pumps used for indoor small tanks, there may occur problems in relation to the aquarium's operation and safety. In addition, most of equipment and machinery is noticeably aged.

(2) Aging of seawater intake pipes

Originally the service life of seawater intake pipes was expected to be around five years and it has already been about 10 years since other seawater intake pipes (products made in the Philippines) were added to original ones in 2006. Although there is a range of problems, the aquarium has been operating its fundamental equipment and machinery independently. The original seawater intake pumps are still working but it is considered that replacement of them cannot be avoided in the very near future, when considering their service life. Continuously in the future, too, seawater intake machinery needs to be repaired and budgets need to be made

for maintenance.

(3) Reduction of maintenance cost

Prior to 2000, no coral breeding and growing methods had been established and, therefore, facilities that could adjust water temperature and filtration of the outdoor tanks were designed as far as possible at that time. In 2006, electricity charges increased dramatically in Palau ($0.3/Kwh) and as the result, in order to reduce the cost, the seawater cooling units and circulators for the large tanks N and G stopped operation and now raw seawater is directly supplied to the tank by keeping a certain level of water quality using an overflow system. Therefore, there is a negative impact on the water quality for exhibits and turbid seawater in the tank cannot be filtrated appropriately.

Under the Follow-up Cooperation, whilst no reduction in electricity charges can be expected to be achieved, it is effective to introduce solar power generation to reduce electricity costs. It is necessary, however, for donors to make a large initial investment for that purpose.

Since tanks N and G are both main tanks, filtration equipment to clear the turbidity in water should be considered in order to increase the quality of appreciation of exhibits at the aquarium.

(4) Need of maintenance expertise and record keeping

There is a shortage of human resources who have maintenance expertise for aquariums. Few records on repair and maintenance have been made for about 15 years. In addition, drawings after any repair or improvement is made have not been found and operation records of equipment and machinery are missing.

(5) Efforts for more attractive exhibits

Although those who visited the aquarium do not leave bad reviews about it, these may be more diplomatic reviews and considerations should be made on whether exhibits and exhibition methods are suitable to meet visitors' interests. Retail stores and restaurants in the city have attractive displays of coral using tanks and are making efforts to devise how to display. On video, jellyfish and coral in Palau are shown in an attractive manner, too. PICRC has also started giving consideration actively to updating of exhibits.

3.3 Present state of the other facilities

The state of malfunctions and deterioration of facilities confirmed in the field study (frameworks, roofs, finish works, exterior works, etc.) along with causes and countermeasures are shown in the following table.

Table: State of Malfunctions and Deterioration of Facilities

Site	Assumed cause of deterioration
Interior floor finish work of facilities	Interior floors of the facilities are made of plastic tiles or finished with paint. After 15 years from the completion, flooring on grand floor has peeled off and deteriorated as bubbles form. A main reason for this could be salty humid air that comes up through the concrete framework to make flooring material deteriorated.
Malfunction of door movement	Aged deterioration has caused interior wooden door fittings to warp and hinges and knobs to malfunction.
Water seepage through the roof of Electricity building	In the field study, it was visually confirmed that there was a trace that calcium contained in concrete formed icicles due to seepage. It is necessary to continue to follow up and monitor as PICRC has already conducted waterproofing works. The cause could be a loss in conformability of waterproofing material due to aged deterioration. It was found that waterproofing of flat roof of the main structure itself requires improvement as aged deterioration has progressed significantly, although no seepage has been identified there.
Progressive peeling-off of concrete walls and rusting on reinforcing bars in the reinforced concrete walls of aquarium's backyard areas	Concrete walls have peeled off because they swell as reinforced bars rust when seawater seeps into the wall through cracks. It is necessary to improve the situation by cleaning the rusted reinforced bars and filling in with polymer cement.
Peeling-off of toilet wall tiles	Wall tiles have peeled off due to aged deterioration accelerated by humid air. Peeled-off tiles should be removed and replaced with tiles.
Sedimentation of sand in final traps	Sand contained in seawater used in the aquarium has accumulated over the years and it is necessary to remove it.

4. Confirmation of the State of Existing Power Supply and Calculation of Current Value for each Distribution Board Circuit

4.1 Existing power supply wiring

(1) Improvement made after the completion of construction

During the past for about 15 years after the completion of construction, electrical facilities have been used safely without having had any major accident. It is found, however, that some parts of the electrical facilities have been altered as their usability changed but unfortunately, there is no record on what kind of measures were actually taken in the past. Therefore, the details of the present state of electric circuits were confirmed by making surveys to local personnel in charge concerning where and what kind of altered works was made.

1) Major distribution boards in the electric room

(i) General circuit

- The secondary circuit for an L-2 circuit having the circuit of F-04 (outlet circuit for lighting in the aquarium) has been removed and it is used as a standby circuit.
- Power is supplied to the Annex via a branch of the main circuit from the service line. A switchboard (225A) for the Annex has been installed on the right-side wall of the

entrance to the electric room.

(ii) Backup circuit for power generator

An L-2 circuit (outlet circuit for lighting in the aquarium) has been connected to a standby switch unit, MCCB, and it is used as a backup circuit. No alteration has been made to other circuits from what is shown in the completion drawing.

2) Electrical facilities for mains

A new wiring, 600V CVQ38mm3, has been installed for the Annex which was added building after the completion of the facilities.

4.2 Measurement of Electricity Consumption

(1) Measurement method

In order to understand how much electricity is consumed per distribution board at each facility, electricity consumption was measured for 7 days, installing an electrical measuring instrument that can continuously measure electric current for 24 hours along the main of each distribution board located in the electric room.

(2) Result of electric current measurement

The Maximum electric power value (A) and the average electric power value (A) for each power circuit measured from February 2 to February 9, 2016 are shown in the table below.

Table: Maximum Electric Power Values (A) and the Average Electric Power Values (A) for Each Electric Power Circuit

D.B. No.	Building Name	Voltage	Back up by Generator	MCCB (A)	2-3, Feb.		3-4, Feb.		4-5, Feb.		5-6, Feb.		6-7, Feb.		7-8, Feb.		8-9, Feb.	
					Max.(A)* Load(%)	Ave.* (A)	Max.(A) Load(%)	Ave. (A)	Max.(A) Load(%)	Ave. (A)	Max.(A) Load(%)	Ave. (A)	Max.(A) Load(%)	Ave. (A)	Max.(A) Load(%)	Ave. (A)	Max.(A) Load(%)	Ave. (A)
CP-A	Research Building	200V	O	100	**28.1**	21.1	24.4	20.6	22	20.7	21.6	20.4	25.5	20.7	25.5	20.7	25.9	21.1
					29.00%		25.00%		22.00%		22.00%		26.00%		26.00%		26.00%	
CP-B	Aquarium	200V	O	100	16.9	4.9	17.2	5.2	**19.9**	5	17	4.4	15.1	3.6	15.1	3.6	16.9	5.1
					17.00%		18.00%		**20.00%**		17.00%		16.00%		16.00%		17.00%	
L-1	Research Building	120V	O	50	19.9	10.5	19.9	10.5	**20.5**	9.9	16.6	9.7	13.5	8.3	13.5	8.3	12.9	8.9
					40.00%		40.00%		**41.00%**		34.00%		27.00%		27.00%		26.00%	
L-2	Aquarium	100/120V		50	13.7	6.4	13.9	5.6	12.2	6.1	13.4	5.3	**14.1**	6	14.1	6	13.9	5.9
					28.00%		28.00%		25.00%		27.00%		**29.00%**		29.00%		28.00%	
P-1	Research Building	200V		225	65.7	19.5	**74.8**	21.4	69	19.4	67.8	21	57.8	21	58.1	14.3	62.4	14.7
					30.00%		**34.00%**		31.00%		31.00%		26.00%		26.00%		28.00%	
P-2	Aquarium	200V		500									35	5.9	**49**	10.5	35	5.9
													7.00%		**10.00%**		7.00%	
Annex	Annex	120V		226	24.4	8.6	**33.3**	10.1	30	8.6	23.9	6.9						
					11.00%		**15.00%**		14.00%		11.00%							

* D.B. : Distribution Board * Max.(A) : Maximum Load (Apia) Load(%) : Max. (A)/MCCB(A) * Ave. (A) : Average load

Explanatory remark: Figures shown in red are the maximum values (A) observed for each electric circuit during the measurement period and the ratio of capacity (%) for the switch unit, MCCB.

According to data obtained continuously from February 2 to February 9, the peak electric power value was significantly lower than the size of switch unit for each circuit, which indicates electricity consumption is significantly controlled for each circuit.

(3) Confirmation of capacity of the existing emergency power generator

When making a calculation using the highest instantaneous current measured for each circuit and equipment that is requested by the joint research team (P-CoRIE) to add (electric light) and the power load (of each of freezer and motor), the needed capacity of the power generator is found to be 59.4KVA.

Since the power generator already installed on the site has a capacity of 65KVA, it is judged that the current capacity can have a surplus of about 5KVA over the needed capacity obtained through the above calculation.

The needed electric capacity has just been obtained in a calculation and if the electric load of on-site equipment changes or the power generator does not function as expected due to aging and deterioration, etc., it will be necessary to make some arrangement in operation of the equipment so that needed level of electricity can be secured.

5. Power Saving of PICRC Facilities

(1) Plan to introduce a new power generator

Through hearing surveys concerning the reason why electricity consumption is controlled, it was found that measures to improve the following situation have been taken independently since around 2006 following a dramatic rise in electric charges at that time:

- The way to use facilities and equipment at the aquarium was reviewed and the use of circulation system (filters and chillers) of outdoor seawater tanks was suspended.
- When renewing air conditioners, multiple-type air conditioners were removed and independent air conditioners were installed.
- Some of incandescent lamps and general fluorescent lamps were changed to energy-saving lighting fixtures.

It was found that the facilities managed to reduce electricity consumption by taking measures mentioned above.

(2) Methods for energy-saving

In order to understand how electricity is being used, measuring instruments were brought in to the site and current values were measured continuously for 24 hours for a total of 10 days, and it was found that electricity consumed was even less than expected.

Based on the result, it is found that self-help efforts were already made for saving electricity consumption on the site and it is considered difficult to ask them to achieve additional energy-savings by proposing them to introduce more of energy-saving equipment and facilities. If greater energy-saving is to be achieved, it is considered necessary to introduce a solar power generation system.

6. Contents of the Follow-up Cooperation

6.1 Confirmation of contents of requests

Items PICRC requested JICA to offer in the Follow-up Cooperation in 2013 are shown in the following table.

Table: Items Requested for Follow-up Cooperation

Original items in 2013	
1. Small Cooler Unit	: 10 sets
2. Main Pump (Motor, Circulation Pump, Sapir parts)	: 2 sets
3. Circulation Pump (N tank: Motor, Sapir parts)	: 1 set
4. Repairing of Seawater intake pump	: 1 set
5. Improvement observation bridge above Seaweed tank (Tank K) and Coral reef tank (Tank G)	: 1 set
6. Rehabilitation of facilities	: 1 set
7. Replacement of outboard boat engine of Maranda 3rd	: 1 set

Through discussions made with PICRC, contents of PICRC's requests were confirmed and requested rehabilitation items that could be deemed as necessary were prioritized.

6.2 Review of Contents of the Project

In the indoor small tanks, Japanese-manufactured cooler units, circulation pumps and filtration tanks were originally installed. Due to aged deterioration, however, the equipment composition was changed and rehabilitation and maintenance have been implemented in cooler units and circulation pumps (a mix of those manufactured in the U.S. and Japan) as shown in the following table.

Table: Present Equipment Composition for Indoor Tanks

Tank name	The number of tanks	The numbers of cooler units and circulation pumps		Remark
		U.S.-manufactured:120V	Japanese-manufactured: 100V	
Tank B	3	—	—	Machinery and equipment have already been removed.
Tank C	4	3	1*	*Operation is suspended for one unit.
Tank D	3	1	2*	*Operation is suspended for one unit.
Tank H	1	1		Replaced with a smaller tank due to breakage.
Tank O	1		1*	*Under operation
Tank P	1	—	—	Changed to exhibit of models and equipment is removed.

(1) Replace of Small Cooler unit and circulation pump (100V) for Small tanks (D: 3 sets, C: 4 sets, B: 3 sets, O: 1 set)

The power supply process is complicated since cooler units and circulation pumps used for each tank are a mix of those manufactured in the U.S. and Japan, which can cause a safety problem. In this project, cooler units and circulation pumps should be replaced and all new equipment should be manufactured in Japan.

(2) Replacement of tank H, cooler unit and circulation pump (100V) and sunshade for tank H and B

It is assumed that tank H was broken as its acrylic glass expanded and shrank under the influence of direct sunlight. The tank itself and its cooler unit and circulation pump should be replaced. Sunshade for tank H and tank B shall be constructed by PICRC.

(3) Circulation system of Tank N and G are not functioning (Chiller, Heat exchanger, Pump) to reduce electricity bill

Since 2006, operation of chillers for Tanks N and G has been suspended to reduce electricity consumption. This equipment is aged and cannot function any more. Replacement of the equipment should not be included in the cooperation project.

In order to reduce the turbidity of seawater in both of these tanks, however, one sand filter each should be installed additionally.

(4) Main pumps (Seawater intake)

1) Provide Consumable spare pump and spare parts for existing pumps:

Although the seawater intake pumps have passed their service life, they have been working for a total of 15 years thanks to appropriate maintenance. It is highly necessary to replace the pumps as intake of seawater is an important process. Only equipment should be provided and installation of the equipment should be conducted by the Palauan side.

2) Provide seawater intake pipe (Tee socket, Joint, Pipe and etc.: JP made) and installation

One intake pipe channel was added by the Palauan side independently in 2006 and it has been in service, which is a target equipment item under this project. It is necessary to replace all, as parts of pipes, joints, bulbs and supports are made of steel and severely deteriorated. Pipe components should only be provided under the cooperation project and the Palauan side should install them.

3) Clean up seawater drainage channel and modification of drainage root

Although it is planned to use the existing intake pipe pit and seawater drainage, it does not have enough capacity to drain all seawater, as each tank discharges plenty of water, and therefore, the exiting intake pipe pit should be used as a drainage channel. The drainage pit

should be partly modified to be used as a sedimentation water channel so that water can be discharged into the sea. The plan should be made by the Japanese side and works should be conducted by the Palauan side.

(5) Improvement of Facilities

Although it was originally requested to improve the spectators' walking route around the tanks, the Palauan side conducted the improvement works independently. Based on the study team's survey and observation, the following items should be conducted.

1) Cat walk (Stainless steel or GI) is necessary for inspection of tank G

There is no inspection stage above the tank G, which is dangerous. An improvement plan should be made under the cooperation project but the Palauan side should implement the construction.

2) Replacement of LED lighting fixture on tanks

The aged light fixtures in the aquarium should be replaced with LED lighting fixtures under the cooperation project.

(6) Rehabilitation

Based on the study team's survey and observation, a recommendation was made that the following items should be conducted by the Palauan side as part of maintenance process of the facilities. However, concerning one item, 7) Electrical re-wiring of distribution board, it was decided that designing and wiring of electrical facilities for a standby power source for the research room should be conducted under the cooperation project.

1) Peeling off wall tile of Toilet
2) Peeling of floor tile on Grand Floor (GF) in Research bldg.
3) Water leaking of ceiling of GF of Research bldg.
4) Cracking of concrete side wall beside Tank O
5) Broken hinges of door in Research bldg.
6) Cleaning fill up sand in existing sedimentation pit by sand pump
7) Electrical re-wiring of distribution board

Designing and wiring works should be conducted for re-wiring within the main distribution board in the electric room and to add wiring to outlets from the distribution for the research room. In addition, works to replace control panels of the existing standby power source should be conducted.

8) Other items by the Palau side

- Repair of broken areas of the roof of Research building and antirust painting
- Antirust painting of steel grating of intake pipe pits and cast-iron cover of catch basin.
- Installation of waterway walls for sediment along the seawater drainage
- Others

(7) Outboat engine is replaced in 2014

Replacement of the outboard boat engine was included in the original request and in 2014 it was already conducted by PICRC.

(8) Water leaking of tank G (Sealing)

Water is seeping from around acrylic glass material of tank G. To stop the seepage, waterproofing works should be conducted.

The waterproofing work shall be conducted under the cooperation project. Removal and return work of exhibition coral reef and fish shall be carried out by the Palau side.

(9) Solar power system is suitable for power saving 20KW

In order to reduce electricity consumption, during the field study, a request was made to conduct a study concerning the introduction of a solar power generation system. Although the local natural conditions are well-suited and effective for solar power generation, studies were being made as there is a limitation and constraint to the installation for solar panels and budgets. Therefore, the solar power system is not included in the Follow-up Cooperation.

The contents and priorities of requests and work categories as mentioned above are listed in the following table.

Table: Contents and Priorities of Requests and Work Categories

Target items by observation by Consultant on 2016		Priority	Japan	Palau
1. Replace of Small Cooler unit and circulation pump (100V) for Small tanks(D: 3 sets: 4 sets ,B: 3sets, O: 1 set)	: 11 sets	A	O	
2. Replacement of main pump is not identified. The following items are necessary				
2.1 Replacement of tank H, cooler unit and circulation pump (100V) and sunshade for tank H and B	: 1 set	A	O	O
2.2 Tank P was modified to show case of canoe model	: Acceptable			
3.Circulation system of Tank N and G are not functioning (Chiller, Heat exchanger, Pump) to reduce electricity bill	: Acceptable			
New installation of Sand filter and piping for tank N, G for clear water (200V)	: 2 set	A	O	
4. Main pumps (Seawater intake) is functioning well because of good maintenance. Maintenance metrical is necessary				
4.1 Provide Consumable spare pump and spare parts for existing pumps:	: 1 set	A	O	O
4.2Provide seawater intake pipe (Tee socket, Joint, Pipe and etc.: JP made) and installation	: 1set	A	O	O
4.3 Clean up seawater drainage channel and modification of drainage rout	: 1 set	A		O
5. Improvement of Facilities				
1) Cat walk (Stainless or GI) is necessary for inspection of tank G	: 1 set	C		O
2) Replacement of LED lighting fixture on Tanks	: 1 set	B	O	
6. Rehabilitation There are many rehabilitation items of facilities as the following				
1) Peeling off wall tile of Toilet	: 1 set	C		O
2) Peeling of floor tile on Grand Floor(GF) in Research bldg.	: Many places	C		O
3) Water leaking of ceiling of GF of Research bldg.	: Many places	C		O
4) Cracking of concrete side wall beside Tank O	: 1 set	C		O
5) Broken hinges of door in Research bldg.	: 1 set	C		O
6) Cleaning fill up sand in existing sedimentation pit by sand pump	: 1 set	C		O
7) Electrical re-wiring of main distribution board	: 1 set	B	O	
8) Other items by the Palau side	: 1 set	C		O
7. Out boat engine is replaced on 2014	NA			
8. Water leaking of Tank G (Water proofing and Sealing)	: 1 set	B	O	O
9. Solar power system is suitable for power saving 20KW: Under examination		:::::		O

Legend: Priority A: High B: second C: to be done by PICRC

Detail of List of Equipment Items is shown in Attachment 6.

6.3 Plan for Procurement of Equipment and Employment of Construction Companies

(1) Equipment procurement bidding

Most of existing equipment items already installed are products of Japan and the main component of this Follow-up Cooperation is the replacement of such equipment. It is reasonable, therefore, to procure Japanese-manufactured products for targeted equipment. Those Japanese-manufactured products should be procured in a process of bidding in which bidders should be Japanese trading companies or manufacturers.

(2) Procurement plan of equipment

1) Export permit

Equipment procured from Japan which is expected to need export permit should include liquid FRP to be used in the water-proofing work for tank interior and such equipment should be handled carefully as inflammable dangerous substance.

2) Packing for transportation

Equipment procured from Japan should be in packed in a manner appropriate for both marine and land transportation and then, in principle, put in a container for export to prevent damage, robbery and deterioration, etc. caused by weather conditions.

3) Method of transportation

Export of procured equipment is usually carried out by sea. Procured equipment is expected to be transported by land from the manufacturer's site and shipped from Yokohama Port, etc.

4) Route and duration of marine transportation

Procured equipment departing Japan generally is unloaded at Koror Port of Palau, between which a cargo liner operates from Yokohama Port, etc. of Japan. The cargo liner operates approximately four times monthly. The details of sailing schedule from Yokohama Port to Koror Port, including the type of the ship, duration necessary to arrive the port of Palau and the company operating the ship, is listed in the following table.

Table: Sailing Schedule between Japan and Koror Port of Palau

Port of departure	Port of unloading	Type of ship		Duration	Major shipping company
Yokohama	Koror Port	Container ship	Cargo liner	About 10 to 30 days	Kyowa Shipping Co., Ltd.

5) Inland transportation

Procured equipment unloaded at Koror Port should clear customs and be transported inland to PICRC by truck.

6) Delivery of procured equipment

Procured equipment should be temporarily stored at PICRC site until the unpacking, assembly, calibration and test-run begin and such temporary storage is the responsibility of the entity which procured the equipment.

(3) Employment of construction companies

1) Employment of local construction companies

The work to add seawater intake pipes in 2006 was carried out by a local construction company and the company has experience in difficult underwater works to install pipes at the seawater intake points. Through hearing surveys, it was confirmed that the planned work will be possibly completed in around two weeks at the shortest. It should be planned, therefore, that the work to replace intake pipes will be carried out by the Palauan side. For other works related to facilities and construction necessary for installation of equipment, local construction companies should be employed.

2) Dispatch of Japanese technicians

Because works to install equipment necessary for replacement of cooling units and circulation pumps for small tanks are special works to handle seawater, it is judged local technicians and skilled workers will not have sufficient skills and, as the result, it should be planned to assign Japanese skilled workers to the works.

(4) Major work to be carried out by manufacturers of equipment

1) Inspection and acceptance

Pre-shipment inspection on procured equipment and acceptance of the same delivered at the point of destination, which is PICRC in Palau, should be carried out.

2) Calibration and test run of equipment

Unpacking, assembly, installation, post-installation calibration and test run of procured equipment should be carried out. Calibration and test run should be carried out as a standard process of the manufacturer and the number of technicians to work on these processes and days of their dispatch should be determined depending on the number of units and details of calibration and test run.

3) Training during initial operation

After calibration and test run are carried out on the procured equipment, training should be offered to personnel of PICRC during the initial operation. The training should be carried out as a standard process of the manufacturer.

4) Construction completion and delivery inspection

After the work to install equipment is completed, construction completion and delivery inspection should be carried out together with PICRC and a completion certificate should be issued to the employed company to indicate that the work is completed. No defect inspection should be carried out.

6.4 Plan for Procurement and Construction Supervision

(1) Procurement and construction supervision work

The outline of procurement and construction supervision work to be carried out by the

Consultant is shown below:

1) Confirmation of itemized statement

Equipment to be procured under this Follow-up Cooperation should be composed of products of manufacturers from whom existing equipment was procured and, therefore, the specifications shown in the itemized statement for bidding should be confirmed but no attendance inspection should be carried out at the factory.

2) Attendance to equipment acceptance at the point of delivery

3) Attendance to inspection of equipment and facilities during construction work

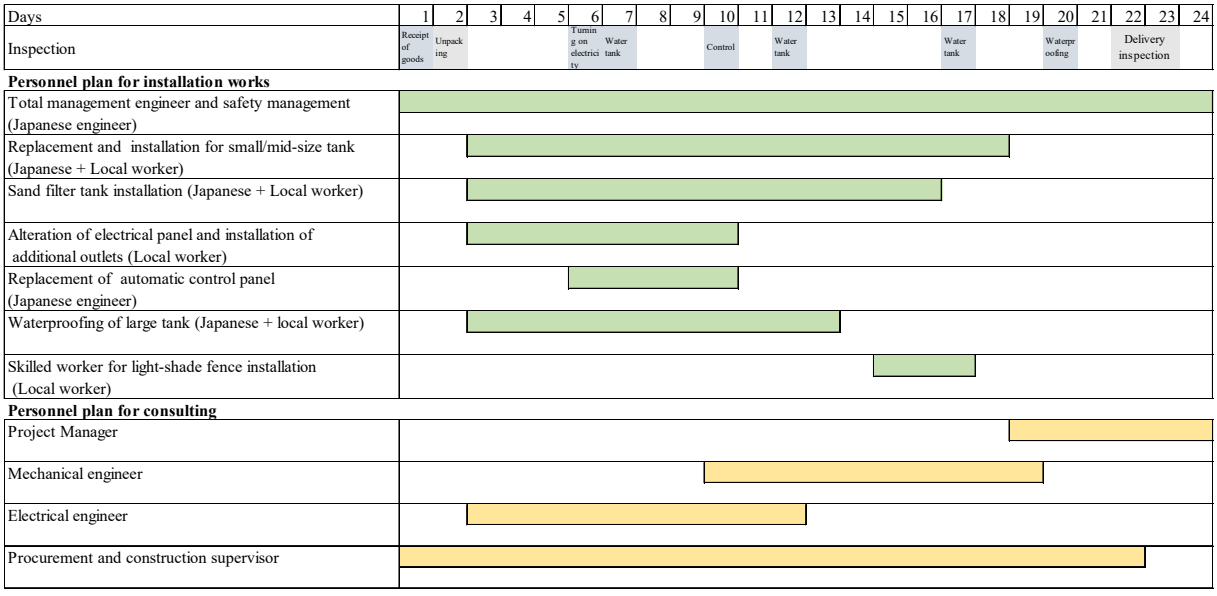
Construction supervision should be carried out on processes from installation, calibration, test run, training on operation to delivery of equipment that should be carried out by the contractor. Technicians in charge of procurement and construction supervision should be 4 persons who are planned to be dispatched from Japan to station in Palau during the installation work.

4) Attendance to construction completion and delivery inspection

(2) Personnel assignment during construction

A plan to assign personnel of the manufacturers of equipment as mentioned above (including local manufacturers) and personnel dispatched by the Consultant is shown in the following table.

Table: Personnel Assignment during Equipment Installation and Construction Supervision



6.5 Undertakings of PICRC

Details of works to be carried out by the Palauan side in relation with the installation of equipment and related construction are as follows:

(1) Procedures during the preparation of construction work

- Procedures for tax exemption

- Attendance to acceptance inspection when the equipment, etc. arrives at the site
- Application on intake pipe replacement construction work to be submitted to obtain approval of the Environmental Quality and Protection Board (EQPB)
- Application on a change in electric facilities to be submitted to obtain approval of the Palau Public Utilities Corporation (PPUC), If necessary.

(2) During installation work

- Temporary supply of electricity, water, etc. for construction work
- Cooperation in safety measures for persons coming to the site
- Selection of the facilities' off days for construction work
- Cooperation from employees during the construction work
- Attendance to delivery inspection and training on operation

(3) Construction work to be carried out by the Palauan side

(Construction preparation until mid-November 2016 prior to installation work)

- Removal of existing equipment and foundations instructed in the drawing (Machinery room: the main part and pipes of the air blower, cooling unit of the small tanks, circulation pumps, etc.)
- Removal of showpieces prior to repair work of Tank G and replacement of small tanks and returning of them

  *Cleaning and drying of tank interiors are necessary prior to the start of waterproofing works to be carried out by the Japanese side.
- Relocation and disposal of existing Tank H (excluding the platform pedestal which is to be reused)
- Cooperation for preparation of construction works to be carried out by the Japanese side

(Installation work within one year after the provision of materials until mid-December 2017)

Work Item: Provide seawater intake pipe (Tee socket, Joint, Pipe and etc.: JP made) by JICA and installation by PICRIC

- Removal of seawater intake pipes
- Laying of seawater intake pipes
- Fitting and installation of support metals of seawater intake pipes and water inlets

Work Item: Provide Consumable spare pump and spare parts for existing pumps:

- Renewal of seawater intake pumps (replacement)

Work Item: Clean up seawater drainage channel and modification of drainage rout

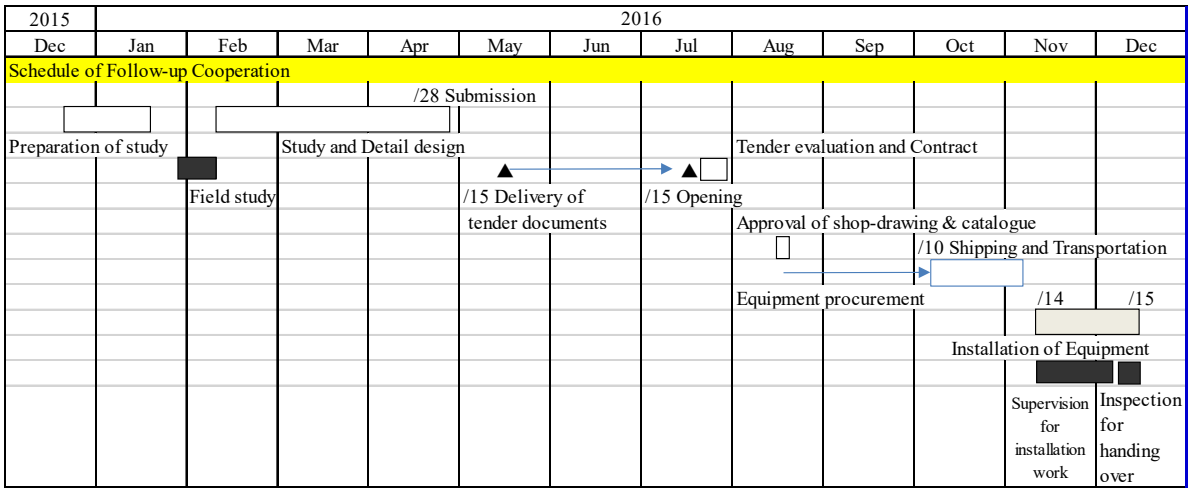
- It is implemented by the Palau side

General Major Undertakings to be taken by JICA and PICRC are shown in Annex-1 of Minutes of Discussion dated on 11 February 2016.

6.6 Time Schedule

The most recent time schedule of the Follow-up Cooperation as a whole is shown below. This time schedule has been established to make it as short as possible.

Table: Tentative Time Schedule of Follow-up Cooperation



6.7 Maintenance Plan

(1) Organization for maintenance process

The organization for maintenance of equipment and facilities of PICRC is shown below.

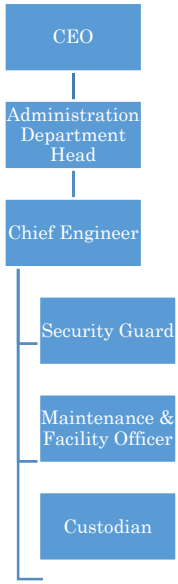


Fig.: Organizational chart of facility maintenance system

(2) Facility maintenance work

Daily maintenance of the Aquarium and related facilities has been carried out by the Aquarium Section (with three skilled workers) of the Research and Aquarium Department. Installation works, electric works and air conditioning works that are large in scale and unable to be completed within PICRC have been contracted to independent private companies.

7. Outcome Expected by the Follow-up Cooperation

7.1 Overall Goal and Project goal by the Follow-up cooperation

The overall goal, the project goal and their expected outcomes to be achieved when PICRC restores its function through rehabilitation of its facilities under this Follow-up Cooperation are shown below.

(1) Overall goal

To promote conservation of coral reef in Palau and living things in and around the reef and to enable sustainable use of such.

(2) Project goal

To ensure that the Palau International Coral Reef Center is effectively used.

(3) Expected outcome

To ensure that the Palau International Coral Reef Center restores its function.

7.2 Verification of the Validity of Follow-up Cooperation

Expected effect of this Follow-up Cooperation is shown in the table below.

Table: Effect of Follow-up Cooperation

	Current situation and issues	Measures to be taken in the cooperation project	Planned effect and degree of improvement
1	Failure of the seawater circulation system of small tanks Circulation pumps and cooling units to control the quality of water in tanks were replaced by PICRC but as the electric wiring is constructed with a mix of voltages, 100V and 120V, there still are management and safety issues.	Replacement of circulation pumps and cooling units for small tanks Aged cooling units and circulation pumps should be replaced with new products manufactured in Japan, so that all equipment procured will be that from Japan.	Control of water quality of small tanks will be carried out integrally from the circuit on the panel board, which enables safe operation and management.

2	Cracks in Tank H due to heat Tank H was broken as its acrylic material swelled and shrank because of exposure to direct sunlight.	Replacement of Tank H The tank and affiliated cooling unit and circulation pump should be replaced.	By restoring the function of Tank H, which is a mid-sized tank, the effect of exhibits will be enhanced largely and the scope of research will expand.
3	Turbid seawater in Tanks N and G Since 2006, cooling units for Tanks N and G have not been operated for the purpose of reducing electricity consumption. The equipment is aged and has not been functioning.	Installation of a new sand filter Sand filters should be installed for Tanks N and G to improve seawater turbidity.	The turbidity of seawater will be improved, which also will improve the quality of exhibits.
4	The seawater intake pump has passed its service life. The seawater intake pump has passed its service life but it has been in operation for 15 years since it has been well maintained. Seawater intake is a fundamental function for the facilities and it is highly necessary to replace it.	Provision of equipment only The seawater intake pump has passed its service life but it has been in operation for 15 years since it has been well maintained. Seawater intake is a fundamental function for the facilities and it is highly necessary to replace it. The equipment only should be provided so that the Palauan side will install it.	Japanese-manufactured pumps are highly appreciated as the operation record at PICRC shows. It is judged that on-site maintenance skill has also been appropriate and, therefore, by replacing the seawater intake pump, stable operation for a long time can be expected.
5	Aged intake pipes and steel parts Intake pipes to which the Palauan side added a separate channel have been in use. Some of pipes, joints, valves and supports are made of steel and their deterioration is very severe. It is necessary to replace them.	Provision of seawater intake pipes and suction points To intake pipes which are a target of this Follow-up Cooperation, PICRC has added a channel on their own, which is now in use. Some of pipes, joints, valves and supports made of steel and severely deteriorated should be replaced.	Intake pipes should be replaced about every 10 years considering their durability. By replacing seawater intake pipes in this Follow-up Cooperation, stable operation for a long time can be expected.

6	Malfunction in the starter of power generator Originally the power generator had a system to start when blackout occurs but presently, it is started manually as the automatic starter board does not function. When blackout occurs during nighttime, the standby power system does not function.	Installation of automatic starter panel Through studies and hearing surveys, it was found that an automatic starter board which is an authentic product of the power generator manufacturer was delivered about four years ago, but was not unpacked and was left untouched in the electric room. The broken automatic starter board should be replaced with a new one in this Follow-up Cooperation.	The power generator will start automatically when blackout occurs, which enables the power generator to restart power supply promptly and can reduce the risk of power failure at the aquarium and research facilities.
7	Addition of standby power circuit from power generator PICRC requested us to include a power source for experimental equipment, freezer and refrigerator within the circuit of standby power source available from the power generator.	Change in the circuit of receiving power panel A change should be made in the lighting panel for the research building (L-2) and the receiving power panel which currently is not functioning as a backup circuit, so that a circuit for standby power source can be secured. Power should be supplied through a single circuit from the lighting panel for the research building (L-2) to experiment equipment, freezer and refrigerator.	By making the L-2 panel function as a backup circuit, power will be supplied to research equipment continuously even during blackout, as requested.
8	Mix of power voltages in small tanks	Replacement with Japanese-manufactured equipment	
9	Aged lighting fixtures It was found that, at PICRC, lighting fixtures of the research building have been replaced with energy-saving fixtures from time to time but most of lighting fixtures for the aquarium, particularly for tanks, that were installed at the time of the opening are still in use.	Replacement of lighting fixtures Replacement with LED fixtures should be carried out. Some of new LED fixtures should be those that can repeatedly control and change the color of light responding to orders programmed on SD cards.	By replacing with LED fixtures, not only energy-saving will be promoted but also simple but more dramatic effects will become possible in tanks if a new light control and color change function is added, which hence will enable more attractive exhibits.

As listed above, rehabilitation and replacement of equipment and facilities will allow PICRC to continue to carry out research and educational activities for a long time in the future.

7.3 Effect and Effect Indicators by the Follow-up Cooperation

(1) Effect indicators

The table below shows anticipated changes in effect indicators between the current status in 2016 and the time when the planned construction works are completed in 2017.

1) Stabilization of small tank water quality

Effect indicator	Currently in 2016	In 2017 and later
Continued control and management of water quality	N/A (due to malfunction)	It is expected that water quality will be controlled for about 10 years.

2) Expansion of themes of exhibits through replacement of Tank H

Effect indicator	Currently in 2016	In 2017 and later
Size of Tank H for exhibits	Temporary small tank	Larger tanks and diversified exhibits

3) Safety of seawater intake

Effect indicator	Currently in 2016	In 2017 and later
Service life of pump	N/A	Extended for 10 years (over the actual service years)
Service life of piping work	N/A	Extended for 10 years (over the actual service years)

4) Reduction of turbidity in large tanks

Effect indicator	Currently in 2016	In 2017 and later
Reduction of turbidity, improvement of transparency	Low transparency	Higher transparency

5) Safety of electrical facilities

Effect indicator	Currently in 2016	In 2017 and later
Hours during which experiments can be carried out continuously and safely	8 hours (business hours)	24 hours
Number of instances of manual operation of power generator	8 times (actual record in 2015)	Zero annually

7.4 Recommendations for improvement of facilities operation and maintenance

(1) System for continued facility operation and maintenance

Although maintenance of the facilities as a whole is possible even under the current system, there is another issue, which is development of human resources who can maintain the facilities on a continued basis in the future. Measures for technology transfer should be taken, with renewal of the human deployment system in mind.

(2) Records of replacement of fundamental facilities and equipment and storage of operation records

During the study, it was confirmed that usual water quality management processes were recorded, while drawings of replacement and rehabilitation of facilities, equipment and tools and management records were not stored properly. The completion plans of the planned rehabilitation and replacement under this Follow-up Cooperation should be stored so that they will contribute to the future maintenance.

(3) Replacement of exhibits

At the aquarium, a video film shows underwater life (jellyfish, fish, coral, etc.) in an attractive manner. However, although exhibits of the aquarium are well received by visitors when viewing their evaluation, the current exhibits have not changed from the original in terms of the content and how they are shown, which do not align with visitors' interest. At shops in the

city, there are attractive exhibits of coral in special tanks.
As PICRC desires to increase the number of tourists who visit their facilities, it is necessary to have more attractive exhibits, and therefore, it is recommended that PICRC should contract the planning and designing of aquarium exhibits to local private companies.
Under this Follow-up Cooperation, lighting fixtures that can change the light colors will be partly replaced.

(4) Introduction of solar power generation

Based on the study result, reviews were made on a solar power generator that can be easily installed on the existing facilities and it was confirmed that about $5,000 could be saved annually. The summary of solar power generation system reviewed this time is as follows.

Summary of the system

-Location of Module: Open beam structure with no roof at the aquarium: Roof floor; Areas formerly outdoor air-conditioner units were located: First floor; and Upper part of hallway from the research building to the aquarium: First floor

-Installation total area: 89 modules in total (the solar power generation module size: 1,341mm x 990mm)

-Power to be generated: 17.8KW

-Rough estimate of construction cost: About US$200,000 - 300,000

ATTACHMENT

Attachment

1. Members List of Field Study

Name	Title	Organization
Kentaro Nishiyama	Chief of Mission	Deputy Director, Grant Aid Project Management Division 3, Financial Cooperation Implementation Department, JICA
Yukitaka Date	Project Manager/ Operation and Facilities Planning for Marine Facilities	System Science Consultants Inc.
Yoshihiko Gibo	Power Saving/Procurement Planning and Cost Estimation-1	-Do-
Hisayuki Noto	Power Saving /Procurement Planning and Cost Estimation-2	-Do-
Yoshiya Nakanishi	Supervision for Equipment Installation and Facilities Work	-Do-

2. Itinerary of Field Study

	Day and Week		Chief of Mission	Project Manager/ Operation and Facilities Planning for Marine Facilities	Power Saving /Procurement Planning and Cost Estimation-1	Power Saving /Procurement Planning and Cost Estimation-2	Supervision for Equipment Installation and Facilities Work
			Kentarou NISHIYAMA	Yukitaka DATE	Yosihiko GIBO	Hisayuki NOTO	Yoshiya NAKANISHI
1	30 Jan.	Sat		20:10 Nrt-01:00 Koror(+2) DL287	←	←	←
2	31 Jan.	Sun		Preparation	←	←	←
				13:30Employment of Assistant 16:00Meeting with JICA Palau office,	←	←	←
3	1 Feb.	Mon		08:00Meeting with PICRC (Explanation of I/R), Meeting with Japanese expert	08:00Meeting with PICRC Preparation of Electricity measurement	←	←
					13:00Preparation of Electricity measurement Observation of Existing electrical wiring	13:00Observation of Tank J,K,M Tank N,G	Deterioration survey of building ←
4	2 Feb.	Tue		Meeting with engineering staff (Confirmation of requested items of Follow-up:)	Setting of electricity measurement	Observation of Tank J,K,M,N, G	Deterioration survey of building ←
				14:00 Observation of Seawater Intake Financial analysis,	Clarification of electricity use	Observation of Tank J,K,M,N, G 14:00 Diving observation of Seawater Intake	Preparation of interview
5	3 Feb.	Wed			Electricity measurement-1day	Observation of Tank J,K,M,N, G	Preparation of interview
				Financial statement、Development Plan	Observation of Existing electrical wiring	Observation of research equipment	

6	4 Feb.	Thu		Preparation for Discussion	Electricity measurement-2day	←	Deterioration survey of building
				15:00 Meeting with PICRC (Discussion of Priority of requested components)	←	←	←
7	5 Feb.	Fri		Interview of local contractor and supplier	Electricity measurement-3 day Analysis of Electricity measurement	Interview of local contractor and supplier	←
				Priority of requested components Necessary measures to be taken by Palau	Modification plan of emargency electricity	←	Interview of local contractor and supplier
8	6 Feb.	Sat		Preparation of documents	Electricity measurement-4	Preparation of documents	←
			20:10 Nrt-01:00 Koror(+1) DL287	Off	←	←	←
9	7 Feb.	Sun		Renovation planning	←	←	←
			13:00Meeting with JICA and Japanese team	←	←	←	←
10	8 Feb.	Mon	PICRC Site Visiting	←	Electricity measurement-5, 6day	Interview of local contractor and supplier	←
			14:00 Meeting with PICRC (Explanation of MM)	←	Analysis of Electricity measurement	Detail survey with Contractor	←
11	9 Feb.	Tue	Interview to PICRC	Inspection with EPA	Electricity measurement-7	←	←
			Prepaaration of MM	Preparation for Operation Planning	Interview of local contractor and PUC	←	←
12	10 Feb.	Wed	Discussion of MM	Preparation of Field Report Summary	Inteview to PPEU	←	Interview of local contractor and supplier
			14:00 Reporting to EJ	←	Inteview to Aquaculture farm	←	←
13	11 Feb.	Thu	Discussion of MM	Submission of Field Report Summary	←	←	Interview of local contractor and supplier
			16:00 Signing of MM, Report to JICA Palau office	←	←	←	←
14	12 Feb.	Fri	05:00Koror-09:25Nrt	←	←	←	←

Attachment

3. List of Parties Concerned in Palau

Organization / Position	Name
PALOU INTERNATIONAL CORAL REEF CENTER (PICRC)	
Chief Executive Officer	Dr.Yimnang Golbuu
Project Coordinator	Dr. Seiji Nkaya
Research & Aquarium Department Head	Geraldine Rengiil
Administration Department Head	Mingrang Kloulechad
Chief Aquarist	Asap Bukurrou
Marketing Officer	Haruo Ueda
PALAU PUBLIC UTILITIES CORPPRATION(PPUC)	
Renewable Energy Manager	Ken Sugiyama
Manager	Hainta Nagata
ENVIROMENTAL QUALITY AND PROTECTION BOAD(EQPB)	
Officer	Carlos Wasisag
GAVIN's TECH. :Electrical & Mechanical Services	
Manager	Antonio Raquinio
SURANGIL & SONS : Construction Company	
Construction Manager	Johnson Iechad
Engineer	William Malano
BELAU ART GALLERY	
Artist/Gallery owner	Michael Glinski
EMBASSY OF JAPAN	
Counsellor	Koji Tomita
Economic Researcher	Takao Mochida
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) PALAU OFFICE	
JICA Representative	Nobuaki Matsui
JICA Sinner Volunteer	Haruo Ueda

Attachment

4. Minutes of Discussion

MINUTES OF DISCUSSIONS
ON
THE FOLLOW-UP COOPERATION STUDY
ON
THE PROJECT FOR CONSTRUCTION OF
PALAU INTERNATIONAL CORAL REEF CENTER

In response to a request from the Palau International Coral Reef Center (hereinafter referred to as "PICRC"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") decided to conduct a Follow-up Cooperation Study (hereinafter referred to as "the Study") on the "Project for Construction of Palau International Coral Reef Center (hereinafter referred to as the "Original Project")."

JICA dispatched the Follow-up Cooperation Study Team (hereinafter referred to as "the Team") headed by Mr. Kentaro Nishiyama, Deputy Director, Grant Aid Project Management Division 3, Financial Cooperation Implementation Department, JICA and the Team was scheduled to conduct the Study from January 31st to February 11th 2016.

The Team held a series of discussions with the officials concerned and conducted a field survey.

In the course of discussions and field survey, both sides confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Follow-up Study Report.

Koror, February 11th, 2016

西山 健太郎

Kentaro Nishiyama
Team Leader
Follow-up Cooperation Study Team
Japan International Cooperation Agency

Dr. Yimnang Golbuu
Chief Executive Officer
Palau International Coral Reef Center,
Republic of Palau

ATTACHMENT

1. Objectives of the Follow-up Cooperation Study

1.1. The Study aims at, through the field survey and the meetings with PICRC, reviewing the current situation of the equipment, clarifying the request by the PICRC and collecting information necessary for JICA's decision-making on the Follow-up Cooperation.

1.2. The viability of the implementation of the Follow-up Cooperation will be determined after further studies in Japan. PICRC understood that the final decision whether the Follow-up Cooperation would be implemented or not, and in case of getting approval for implementation, the final components of the Follow-up Cooperation would be decided after further studies, examination and analysis by JICA in Japan.

2. JICA's Follow-up Cooperation Scheme

The PICRC understood the JICA's Follow-up Cooperation Scheme explained by the Team as follows.

2.1. In case of getting approval of implementation of the Follow-up Cooperation, another Follow-up Cooperation will never be applied to the Original Project again.

2.2. The PICRC shall take the necessary measures, as described in Annex-1, for the smooth implementation of the Follow-up Cooperation.

3. The findings in the study

3.1. Mission of PICRC

To guide efforts supporting coral reef stewardship through research and its applications for the people of Palau, Micronesia and the World

3.2. Activity and Achievement of PICRC

1) Research field

PICRC has implemented the following research to support the conservation and management of marine resources in Palau and Micronesia. The result (scientific evidence) of research has been utilized to the government's policy/regulation of marine resource conservation and management as well as verified the effectiveness of implementation of regulations. The current on-going activities in research field of PICRC are shown in the Annex-2

- Monitoring the climate change impact to coral reef in Palau
- Monitoring the status and trend in the conditions of Palau's coral reef
- Research to identify the best land management practices to reduce sedimentation
- Targeted fisheries research to improve resource management

2) Education field

Through the following activity, PICRC has been promoting the education to raise

awareness and concern for the conservation and management of marine resources and to showcase the rich diversity and underwater of Palau's coral reef and associated ecosystem by utilizing the result of research and Aquarium of PICRC.

- PICRC has provided the education program for free to all elementary, high school and Palau Community College (~~XX~~ 23 schools) in Palau since 2014
- PICRC or the government of the republic of Palau have introduced the rich diversity and underwater of waters of Palau's coral reef and associated ecosystem to fringe special guest/ visitors/ researcher/senior citizen/women' group of Palau.

The actual result of the education activity and the number of visitors to Aquarium are shown in the Annex-3.

3) Linkage between Research and Education

PICRC explain that the output of research has been utilized for the contents of education program as well as introduced in Aquarium.

3.3. Operation System of PICRC

Organization chart of PICRC and the function of each section is shown in the Annex-4. .

3.4. Maintenance System (activity) of facility of PICRC

PICRC has tackled the following maintenance work after the completion of the Original Project with the limited budget and human resource. PICRC has tried to keep the best condition of the each equipment to ensure the expected function of the facility as much as possible.

1) Daily maintenance

Daily maintenance method for tanks in aquarium is following to Japanese way transferred from Japanese expert of aquarium. For example, cleaning inside of tank, water control (Temperature, water volume and PH) and feed control are skillful and reasonable way.

2) Periodical maintenance

Periodical maintenance of facilities is implemented by PICRC staffs. The main items are shown in the followings.

- Cleaning of seawater suction point in the sea and strainer for pump
- Seawater pumps operation and replacement of consumable parts.
- Maintenance of generator set (oil, fuel and buttery)
- Modification of electric wiring distribution board

3) Installation of the new seawater intake pipe

New seawater intake pipe was installed by PICRC and local contractor in 2006. This pipe has been used constantly in good condition until now. This installation work is

successful and durable.

4) Installation of the new cooling system for small tank

New cooling system for small tank have been modified and kept good condition by PICRC staff. They have technical knowledge and skill for cooling system and other equipment.

3.5. Operation and maintenance cost of PICRC

The breakdown of operation and maintenance cost is shown in the Annex-5

The features to be pointed out are as follow.

- The main resource of the revenue is the annual budget allocated by the government and the Grant from international organization and private foundation. However this revenue is not stable and fluctuates in each year.
- PICRC has tried to save the 1 million US $ as the countermeasure against the unstable revenue. (currently, about 400,000 US $ has been stocked)
- The overall goal of financial operation is to manage the revenue by their own income such as utilization fee of research facility, accommodation fee for the foreign researcher, sales of gift shop and admissions fee of aquarium. Currently, the PICRC has a total of $210,000 which $195,000 is invested in the money market. The goal is to build an endowment within the next 20 years where PICRC can use its interest to help fund the center's activities.
- PICRC has tried to decrease the expenditure of operation cost of the facility. Compared to the 2011, the utilities (electric fee) cost in 2015 was decreased by about 40 %.

3.6. Mid- term strategy of the PICRC

PICRC provided the "Five Year Strategic Plan (2013-2017) of PICRC" to the Team.

PICRC explained that the mission of PICRC would not be changed and the following core activity would be continued after the completion of Five Year Strategic Plan (2013-2017).

- Promoting the research that supports the conservation and management of marine resources in Palau and Micronesia.
- Promoting the education to raise awareness and concern for the conservation and management of marine resources and to showcase the rich diversity and underwater of Palau`s coral reef and associated ecosystem
- Operating above-mentioned activities while ensuring the financial sustainability

3.7. Problem to be solved by the Follow-up Cooperation

The listed equipment shown in the Annex-6 needs to be restored because of the deterioration and exhaustion.

The listed equipment related to the operation of water circulation play an important

function to ensure the overall function of research and aquarium facility. If the function of the listed equipment would not work well, the function of PICRC's facility would be totally stopped and PICRC face the huge trouble for their activities and operation. To control the water flow and condition (temperature) is the key elements to ensure the overall function of PICRC's facilities.

3.8. Relevance of Follow-Up Cooperation

- As mentioned in 3.4, PICRC has tried to maintain the provided facility as much as possible. On the other hand, as mentioned in 3.5, it is difficult for PICRC to manage the cost of the repairmen at this moment.
- The repairmen of listed equipment are technically specific and need the technical experience. Since the PICRC was launched through the Original project, it is first experience for PICRC to manage this kind of specific repairmen and maintenance task. Technical knowledge and experience to identify and design the contents of repairmen and supervise the repairmen work is required.
- PICRC has been establishing the position as the international research institute in the field of coral reef and climate change. The number of research collaborators is now 18 institutes and the number of forging visiting researcher has been increasing year by year. PICRC plans to expand the accommodation facility to accept the increasing forging visiting researcher.

4. Outline of the Follow-up Cooperation

4.1. Objective of the Follow-up Cooperation

The objective of the Follow-up Cooperation is to restore the functions of PICRC's facility which was installed in the original functions.

4.2. Responsible and Implementing Agency

Palau International Coral Reef Center, the Republic of Palau

4.3. Components of the Follow-up Cooperation

Both sides agreed that the equipment to be restored in the Follow-up Cooperation is tentative as listed in Annex-6.

5. Major Undertakings to be taken by JICA and PICRC

PICRC and the Teams confirmed that, for the smooth implementation of the Follow-up Cooperation, PICRC and JICA should particularly implement major undertakings described in Annex 1 as scheduled with the necessary budget and the arrangement.

6. Tentative work schedule

Based on the Minutes of Discussions and technical examination of the study in Japan, JICA will inform PICRC of the final components of the Follow-up Cooperation through JICA Palau Office by the mid of May, 2016. The final components will be confirmed by

the signing of Scope of Work between JICA and PICRC. Tentative work schedule of the Follow-up Cooperation is shown in Annex-7.

7. Draft Scope of Work

JICA explained the structure of article of the Scope of Work as shown in Annex-8 to PICRC

Annex-1 Major Undertakings to be taken by JICA and PICRC
Annex-2 On-going activities in research field of PICRC
Annex-3 Outline of the Education activity
Annex-4 Organization Chart
Annex-5 Operation and Maintenance Cost
Annex-6 List of equipment to be repaired in the Follow-up Cooperation (tentative)
Annex-7 Tentative schedule of Follow-up Cooperation
Annex-8 Scope of Work (Draft)

Annex-1

Major Undertakings to be taken by JICA and PICRC

1. JICA

1.1. To procure the equipment listed on the signed Scope of Work and transport it to Palau from Japan/ other foreign country under the contract with appropriate supplier/contractor /consulting firm. (If JICA procures the equipment in Palau, the equipment would be transported to PICRC directly. Except the above mentioned case, internal transportation fee of the equipment in Palau need to be covered by PICRC.)

1.2. To implement the restoring/installing work of the procured equipment under the contract with appropriate supplier/contractor/consulting firm.

1.3. To dispatch the engineer of supplier/contractor for a short-term to implement the restoring/installing work of the procured equipment under the contract with appropriate supplier/contractor in accordance with the necessity of the implementation of Follow-up Cooperation.

1.4. To dispatch the consultants for a short-term under the contract with appropriate consulting firm to supervise the the restoring/installing work of the procured equipment.

2. PICRC

2.1. To secure the budget for prompt unloading and customs clearance of the products and to assist internal transportation under secured conditions in recipient country.

2.2. To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in Palau with respect to the Follow-Up Cooperation be exempted.

2.3. To accord the entry and stay permit to Japanese nationals whose services may be required in connection with the supply of the products and the services under the contract, and arrange such facilities for their entry into the recipient country and stay therein for the performance of their work, when necessary.

2.4. To coordinate with relevant agencies in order to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies to all extent possible which may be imposed in Palau with respect to the supply of the products and services under the contract, when necessary.

2.5. To assign counterpart personnel during the period of the Study and the Follow-Up Cooperation.

2.6. To take necessary actions for completion of the Follow-Up Cooperation, upon the request of JICA and the consultant under the contract.

2.7. To bear all the expenses, other than those to be borne by the Follow-up Cooperation, necessary for the transportation and installation of the facility, when necessary.

2.8. To provide JICA with necessary information on the Follow-Up Cooperation upon the request of JICA.

2.9. To utilize/maintain the repaired Equipment properly and effectively under the Follow-Up Cooperation, including purchasing all necessary consumables for continuous utilization of the Equipment.

2.10. To apply and get the Environmental Quality Protection Board's and other permit necessary for the implementation of Follow-Up Cooperation.

Annex-2

On-going activities in research field of PICRC

1. Outline of Research Field

➢ Long-Term Monitoring Project

Understanding the changes in coral reef health that stressors impose as well as the health status of the marine environment overall is critical to selecting the most appropriate management activities. As a result, PICRC has long dedicated time and effort to monitoring and reporting on the status of and trends in coral reef health and condition across Palau. Working with management agencies in Palau, PICRC has established a series of 23 permanent monitoring sites around Palau on major reef types. Every two years between October and December, the Center monitors key parameters on the coral reefs and associated ecosystems of these sites to allow for a time series analysis of changes in the condition and health of the coral reefs of these areas. This includes monitoring of live coral cover, abundance and biomass of key fish and invertebrate species, and temperature monitoring.

➢ Marine Protected Area (MPA) Research

The marine component of the Protected Area Network (PAN) has been designed as an ecologically resilient network based on the best available science in order to promote the desired conservation and fisheries outcomes. New marine science is providing improved guidelines for MPA Network design that will enhance the long-term resilience and productivity of marine ecosystems by integrating biodiversity and fisheries management with adaptation to climate change impacts. While Palau already has a successful MPA system including 33 MPAs, this system can be greatly strengthened through application of the latest science guidance in ecological MPA network design. Using this guidance, the PICRC work closely with partners to carry out a revised design of the Palau MPA Network to create an ecologically resilient network including improving the linkages between marine and terrestrial protected areas. The results of this effort is used to guide the designation of additional MPAs in Palau as well as contribute to MPA knowledge regionally and internationally.

➢ Seagrass MPA Surveys

Seagrass MPA surveys is an ongoing research program to support effective marine conservation which has been conducted since 2011 with the purpose: 1) to gauge the effectiveness of MPAs, 2) to better understand the state of seagrass meadows around the islands of Palau, and 3) to assess changes over times in seagrass MPAs and their reference sites. Currently this research is being conducted within four Marine Protected Areas in Airai, Ngchesar, Koror and Peleliu. Surveys include estimate seagrass cover, fish density and biomass, and invertebrates' density. This research is ongoing and is conducted June and December of each year. The overall focus of this research project is to monitor the health of the seagrass MPAs over time. Results of this research are shared upon completion of the project so it can help guide management decisions in the four States.

- SATREPS Project: Project for the sustainable management of coral reef and island ecosystems: responding to the threat of climate change.

  Building on the very successful cooperative program with the Government of Japan during the Center's last Strategic Plan, PICRC and the Government of Japan Science and Technology Research Partnership for Sustainable Development (SATREPS), have entered into another cooperative project entitled, "Project for the sustainable management of coral reef and island ecosystems: responding to the threat of climate change."

- Fisheries Research

  Ongoing coastal fisheries research is tailored to meet current and anticipated management needs and regularly results in management recommendations. Current research topics at PICRC include determining spatial and temporal characteristics of grouper aggregation sites, stock assessment of bumphead parrotfish and Napolean Wrasse and the impact of harvesting on important fisheries species. Since the priority research topics change over time based on prevailing trends in fisheries use and management, PICRC hold at least one consultation annually to identify key research needs.

- Research to Support Palau State and National Government Conservation Management

  The PICRC is dedicated to supporting the management research needs of Palau's States and National Government. Providing research support to address key management questions is an important aspect of the PICRC's mission. The PICRC meet with States and National Agencies at least once a year to consult if there are any management research needs that the PICRC can help to support. Research questions that are applicable to more than one agency will be given priority as will those that are critical to pending resource management policy decisions. The PICRC also work with the agencies to identify the necessary resources to pursue prioritized research as possible.

- Micronesia Challenge

  Every two years, the effectiveness of prioritized sites in MC jurisdictions is assessed and understood to help support effective management through the Micronesia Challenge.
  PICRC is a key member of the Micronesia Challenge (MC) Measures Working Group, which is working to measure the overall progress toward achieving the goals of the MC across Micronesia. To measure progress it is essential to monitor management effectiveness, biological factors, and socio-economic impacts and benefits that result from MC implementation. PICRC has been working with other members of the Measures Working Group over the past four years to help establish and implement a standardized monitoring protocol and has been the main organization conducting marine biological monitoring.

2. List of research collaborators

- Australia Institute of Marine Science (AIMS), Australia

- Florida Institute of Technology, USA
- James Cook University, Australia
- Japan Wildlife Research Center, Japan
- Pennsylvania State University, USA
- Pacific Marine Resource Institute, CNMI
- Stanford University, USA
- The Nature Conservancy, USA
- Tokyo Institute of Technology, Japan
- University of Delaware, USA
- University of Georgia, USA
- University of Hawaii, USA
- University of Maine, USA
- University of Pennsylvania, USA
- University of Queensland, Australia
- University of the Ryukyus, Japan
- University of Tokyo, Japan
- Woods Hole Oceanographic Institute, USA

3. Number of visiting researcher

	Number of visiting researcher	**Total staying days**
2013	**38**	**Approximately 1-3 weeks per researcher per visit**
2014	**26**	**Approximately 1-3 weeks per researcher per visit**
2015	**33**	**Approximately 1-3 weeks per researcher per visit**

Annex-3

Outline of the Education activity

1. Education program to the people of Palau

The number of people who received the education program provided by PICRC is as follows.

Content	Number							
	2010	2011	2012	2013	2014	2015	2016 (up to Jan)	Total
Outreach Activities with Schools	2,124	990	1,010	1,640	1,580	1,000	419	8,763
Community Outreach	51	0	0-	0	0	599	76	726
Activities at PICRC	1,260	459	1,089	1,077	300	2,009	685	6,879
Total	3,435	1,449	2,099	2,717	1,880	3,608	1,180	16,368

The title of main education program in each year is as follows.

		Title of Program
2010	O	Presentation on Importance of Seagrass, Display on Importance of Seagrass & Life in the Seagrass
	C	Presentation about PICRC CEPCRM Project
	P	Presentation on Life in the Seagrass & Aquarium Tour, Summer Camps
2011	O	Presentation on Roles of Sharks in the Ocean & Food Web, Display on invertebrates, brochures, posters & edu. Games
	C	NA
	P	Guided Aquarium Tour, Summer Camp
2012	O	Display on Aquarium Species, Display of Brochures & Posters
	C	NA
	P	Guided Tour at Aquarium & Hands-on Touch tank, Summer Camp
2013	O	Presentation on Palau Eel, The Living Fossil, Display on Aquarium Species, Display of Brochures & Posters
	C	NA
	P	Guided Tour at Aquarium & Hands-on Touch tank
2014	O	Presentation on Sustainable Fishing Practices, Presentation on saving energy & Eco Friendly, Lecture on sustainable fishing practices & Eco Friendly, Show case of Research posters, brochures & info, Display on Aquarium Species, brochures & posters
	C	NA
	P	Presentation on Sustainable fishing & Aquarium Tour, Presentation on Coral Biology & Aquarium Tour, Guided Aquarium Tour, , Summer Camp

2015	O	Presentation on Protected Fish, Food chain & Groupers Spawning Areas, Presentation on Sustainable Fishing Practices, Presentation on PICRC Research projects, Display on Freshwater gobies & educational games
	C	Fishermen Forum, Job Fair Day
	P	Presentation on Sustainable Fishing Practices with Pre & Post Tests, Presentation on Sustainable Fishing Practices (Adult Groups-Not Students), Presentation & Video by National Geography with PICRC, After Dark Lecture Series at Palau Aquarium, Guided Aquarium Tour, , Summer Movie Night
2016	O	Presentation on Important Roles of Herbivores on Coral Reefs
	C	Presentation on Important Roles of Herbivores on Coral Reefs, Kayangel Community Outreach
	P	Presentation on Herbivores & Aquarium Tours, Intro to Ecological Monitoring on Coral Reefs, Lab on Water Quality Testing

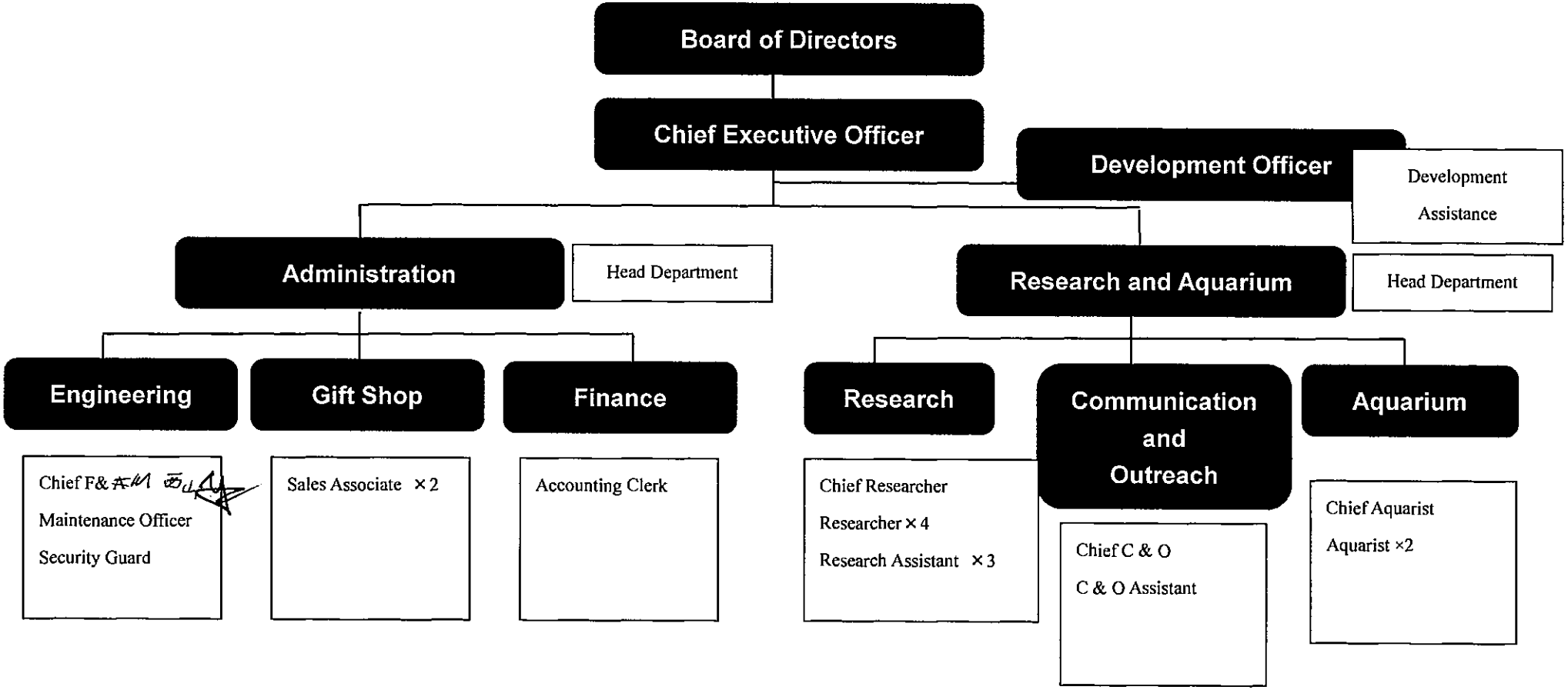
Notice; O: Outreach Activities with Schools, C: Community Outreach, P: Activities at PICRC

2. Number of visitors to Aquarium of PICRC

COUNTRY	2,011	2012	2013	2014	2015
JAPAN	2,164	2,844	2,602	2,900	2,513
KOREA	7,518	6,598	728	564	131
PRC CHINA	53	94	100	388	925
ROC TAIWAN	1,300	2,291	934	151	156
USA	501	593	850	796	879
PALAU	374	677	856	769	1,933
OTHERS	721	1,246	1,548	2,052	2,446
TOTAL	12,631	14,343	7,618	7,620	8,983

Annex-4

Organization Chart



The function of each sections

- Board of director: provide guidelines, strategic vision, guidance, resources, and oversight to the Center.
- CEO: manage and ensure the efficient operation of the Center.
- Development officer: develop and implement fundraising program to raise funds for the Center.
- Administration: coordinate, and provide oversight of all business and administrative processes
- Engineering section: Develop and Implement plans of improvement and maintenance on the Facility and Equipment's of the Center including but not limited to the safeguard of the Center's assets.
- Gift Shop Section: provide front-line customer service in person and/or by telephone to refer customers to the aquarium or appropriate staff, and raising additional revenues to the Center through the Giant Clam merchandise and the Aquarium entrée.
- Finance Section : perform all standardized and applicable accounting and financial tasks required by the Center.
- Research section: Develop and implement research activities as stated in the strategic plan.
- Aquarium section: develop, implement, and provide guidance in all aspects of aquarium's animal care and maintenance.
- Communication and outreach: planning and implementing the Center's education programs to promote the Center's mission and its programs to schools and community.

Operation and Maintenance Cost

(US $)

	Financial Statement Items	FY2011	FY2012	FY2013	FY2014	FY2015
Operating Revenue						
1	Grant Revenue	375,720	270,040	577,677	324,470	503,268
2	ROP Appropriation	387,000	356,708	357,000	400,000	400,000
	Contract service	20,899	103,179	69,700	142,233	85,200
3	Facility User	20,503	22,894	42,876	75,165	78,261
4	Donation	58,628	66,656	44,523	38,602	107,079
5	Merchandise sales	22,585	23,884	35,125	45,738	50,142
	Admission	71,247	88,932	49,645	50,116	45,172
6	Fund raising	41,571	33,011	1,534	28907	92,653
7	Boat fee	13,169	27,097	28,712	35,967	28,399
8	Accommodation	5,641	8,822	1,665	1,942	0
9	Research facilities	5,609	12,705	62,185	73,568	100,362
10	Interest income	105	70	7,275	13,357	560
11	Education program fee	2,321	6,455	13,966	2,230	0
12	Other income	39,014	12,955	20,584	5,842	60,491
	Total operation revenues	1,064,012	1,033,408	1,312,467	1,238,137	1,551,587
Operating Expenses						
1	Salaries, wages and fringe benefits	453,082	405,233	439,335	462,009	487,924
2	Depreciation	157,263	167,337	164,956	216,798	253,498
3	Utilities	125,673	90,879	93,062	109,591	79,804
4	Supplies and printing	64,616	47,719	72,517	106,382	93,423
5	Professional services	55,363	60,135	82,339	67,053	74,815
6	Communications	21,960	7,578	9,102	8,865	14,110
7	Travel	17,006	20,488	36,873	31,071	4,368
8	Merchandise cost	14,744	12,536	25,019	29,261	28,129
9	Insurance	14,167	15,714	9,698	16,252	19,325
10	Fuel	11,545	25,759	29,750	39,094	41,200
11	Repair and maintenance	6,121	10,937	47,324	36,472	18,900
12	Anniversary	4,335	3,472	170	7,872	0
13	Education and training	2,550	8,509	7,549	8,957	23,862
14	Dues and subscription	2,335	898	308	467	2,247
15	Hospitality and entertainment	1,174	746	2,848	3,571	1,233
16	Postage and freight	262	142	919	1,274	2,979
17	Sales and marketing	30	15	0	0	708
18	Capital asset contribution	103,550	0	0	0	0
	Donation to State Gov.			3,270	0	0
19	Others	44,413	43,619	47,126	27,611	2,424
	Cost of contract					4,662
	Interrest					4,647
	Gran Contract Indirect cost					25,709
	Total operation expenses	1,100,189	921,716	1,072,165	1,172,600	1,183,967
	Net asset at end of year	-36,177	111,692	240,302	65,537	367,620

List of equipment to be repaired in the Follow-up Cooperation (tentative)

Original items on 2013					
1. Small Cooler Unit		: 10 sets			
2. Main Pump (Motor, Circulation Pump, Sapir parts)		: 2 sets			
3. Circulation Pump (N tank: Motor, Sapir parts)		: 1 set			
4. Repairing of Seawater intake pump		: 1 set			
5. Improvement observation bridge above Seaweed tank (Tank K)and Coral reef tank(Tank G)		: 1 set			
6. Rehabilitation of facilities		: 1 set			
7. Replacement of out boat engine of Maranda 3rd		: 1 set			
Target items by observation by consultant on 2016			**Priority**	**Japan**	**Palau**
1. Replace of Small Cooler unit and circulation pump (100V) for Small tanks(D:3 sets: 4sets ,B:3sets, O: 1set)		: 11 sets	A	O	
2. Replacement of main pump is not identified. The following items are necessary					
2.1 Replacement of tank H, cooler unit and circulation pump (100V) and sunshade for tank H and B		: 1 set	A	O	
2.2 Tank P was modified to show case of canoe model	:Acceptable				
3.Circulation system of Tank N and G are not functioning (Chiller, Heat exchanger, Pump) to reduce electricity bill	:Acceptable				
New installation of Sand filter and piping for tank N, G for clear water (200V)		: 2 set	A	O	
4. Main pumps (Seawater intake) is functioning well because of good maintenance. Maintenance metrical is necessary					
4.1 Provide Consumable spare pump and spare parts for existing pumps: 2 sets		: 2 sets	A	O	
4.2Provide seawater intake pipe (Tee socket, Joint, Pipe and etc.: JP made) and installation		: 2 sets	A	O	O
4.3 Clean up seawater drainage channel and modification of drainage rout		: 1 set	A		O
5. Improvement of Facilities					
1) Cat walk (Stainless or GI) is necessary for inspection of tank G		: 1 set	C		O
2) Replacement of LED lighting fixture on Tanks		: 1 set	B	O	
6. Rehabilitation					
There are many rehabilitation items of facilities as the followings					
1) Peeling of wall Tile of Toilet		: 1 set	C		O
2) Peeling of floor tile on Grand floor(GF) in Research bldg.		: Many place	C		O
3) Water leaking of Ceiling of GF of Research bldg.		: Many place	C		O
4) Cracking of Concrete side wall beside Tank O		: 1 set	C		O
5) Broken Hinges of Door in Research bldg.		: 1 set	C		O
6) Cleaning fill up sand in Sedimentation pit by sand pump		: 1 set	C		O
7) Electrical re-wiring of distribution board		: 1 set	B	O	
8) Others		: 1 set	C		O
7. Out boat engine is replaced on 2014	NA				
8. Water leaking of tank G (Sealing)	:Under checking	: 1 set	B	O	O
9. Solar power system is suitable for power saving 20KW	:Under examination	:::::	:::::		

Legend : A: High B: second C: Done by PICRC

Tentative schedule of Follow-up Cooperation

Items/ Month	2016											2017		
	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Study														
Signing of Scope of Work														
Detail Design														
Procurement Procedure														
Procurement of Equipment														
Shiping/Transportation														
Implementation of Restoreing														

Attachment

5. Scope of Work

SCOPE OF WORK
FOR
THE FOLLOW-UP COOPERATION
ON
THE PROJECT FOR CONSTRUCTION OF
PALAU INTERNATIONAL CORAL REEF CENTER
AGREED
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
PALAU INTERNATIONAL CORAL REEF CENTER

In response to a request from the Palau International Coral Reef Center, (hereinafter referred to as "PICRC"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") decided to implement the Follow-up Cooperation for the Project for Construction of Palau International Coral Reef Center.

Based on discussion between PICRC and JICA, this document sets forth the Scope of Work for the Follow-up Cooperation and the undertakings to be taken by the authorities concerned.

Koror, July 27th 2016

Nobuaki Miyata	Ph. D. Yimnang Golbuu
Resident Representative	Chief Executive Officer
Palau Office	Palau International Coral Reef Center,
Japan International Cooperation Agency	Republic of Palau

1. Introduction

Based on the results of the study conducted by JICA in February 2016, JICA decided to implement the Follow-up Cooperation for the Project for Construction of Palau International Coral Reef Center (hereinafter referred to as "the Follow-up Cooperation").

Accordingly, JICA will undertake necessary work for the Follow-up Cooperation (hereinafter referred to as "the Work") in cooperation with the PICRC. This document sets forth scope of work for the Work and undertakings to be taken by JICA and PICRC.

2. Scope of Work

The objective of the Follow-up Cooperation is to restore the function of PICRC's facility as shown in Annex-1 which was installed in the "Project for Construction of Palau International Coral Reef Center".

The Work shall be to implement the procurement and restoring/replacing works of the equipment indicated in Annex 2.

3. Tentative Work Schedule

The Follow-up Cooperation will be carried out in accordance with the tentative schedule indicated in Annex-3.

4. Major Undertakings that shall be taken by JICA and PICRC

For the smooth implementation of the Follow-up Cooperation, PICRC and JICA should particularly implement major undertakings described in Annex-4 as scheduled and secure the necessary budget.

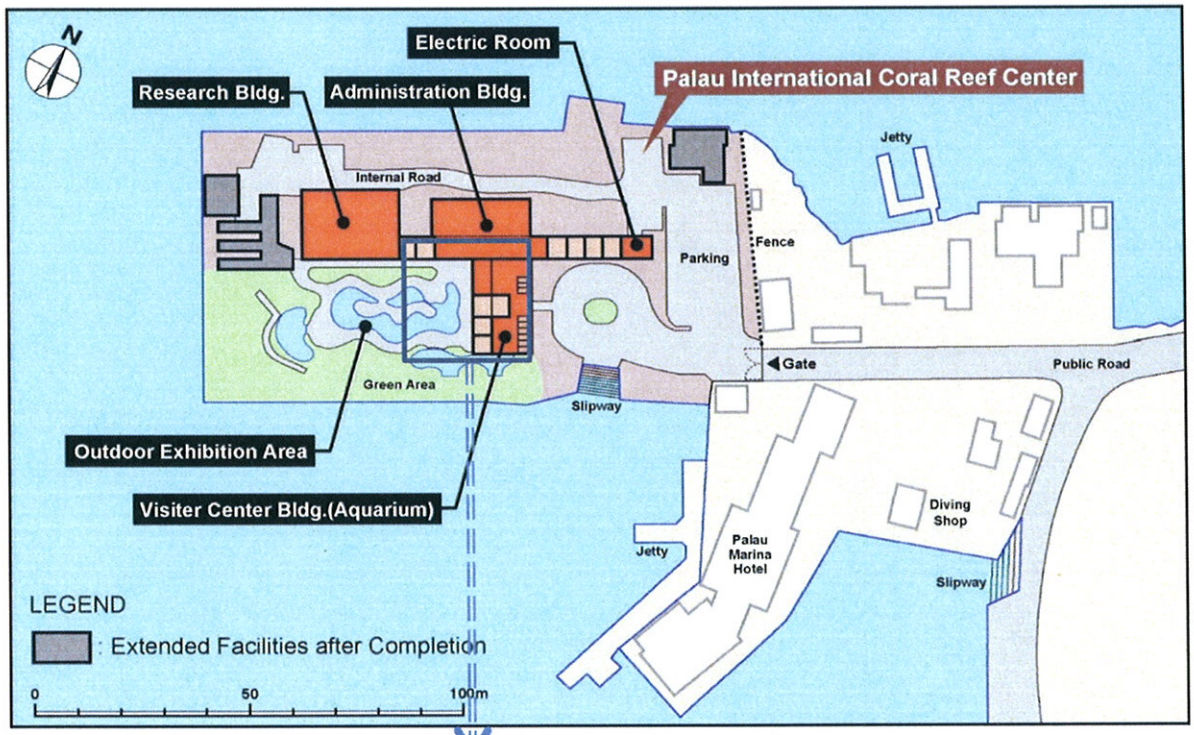
5. Mutual Consultation

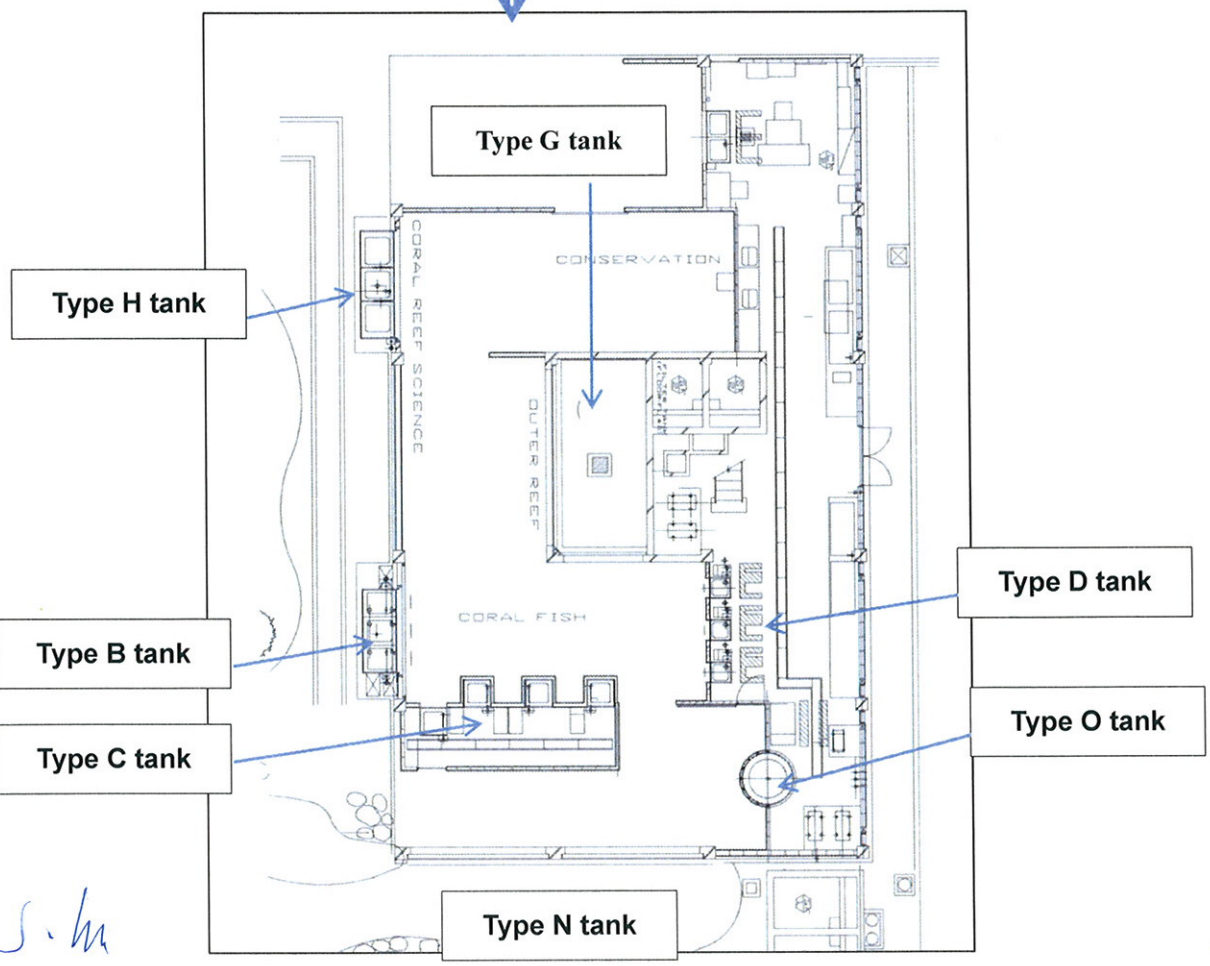
PICRC and JICA shall consult with each other on any matters that may arise from or be connected with the Follow-up Cooperation prior to actual responses.

Annex-1: Layout drawing of each facility
Annex-2: List of equipment to be restored/replaced by the Follow-up Cooperation
Annex-3: Tentative work schedule of the Follow-up Cooperation
Annex-4: Major undertakings to be taken by JICA and PICRC

Layout drawing of each facility

1) Outline





Annex-2

List of equipment to be restored/replaced by the Follow-up Cooperation

Name of equipment	Quantity
I. Restoring the controlling function of water condition for small tank	
1) Replacement of the coolers for Type B, C, D, O tank (Type B: 3 , Type C: 4, Type D: 3, Type O: 1)	**11 sets**
2) Replacement of the circulation pumps for Type B, C, D, O tank (Type B: 3 , Type C: 4, Type D: 3, Type O: 1)	**11 sets**
3) Replacement of the filter tanks for for Type B, C, D tank (Type B: 1 , Type C: 2, Type D: 3)	**6 sets**
II. Restoring the function of water circulation system for Type G tank	
1) Installation of the Sand Filter System	**1 set**
2) Restoring the water leak from Type G tank	**1 set**
III. Restoring the function of Type H tank	
1) Replacement of the tank (acrylic)	**1 set**
2) Replacement of the cooler	**1 set**
3) Replacement of the circulation pump	**1 set**
IV. Restoring the function of water filtering system for Type N tank	
1) Installation of the Sand Filter System	**1 set**
V. Restoring the sea water intake and distribution function	
1) Replacement of the main sea water intake pumps	**1 set**
2) Replacement of the sea water intake pipe	**60 m**
3) Electromagnetic flow meter	**1 set**
VI. Restoring the function of lighting for exhibition aquarium	
Installation of the LED lighting fixture for exhibition	**10 sets**
VII. Restoring the function of emergency power generator	
Replacement of the automatic control panel and re-wiring of the distribution board at Electric room and extension wiring and outlets replacing for freezers, etc. at Laboratory.	**1 set**

Annex-3

Tentative work schedule of the Follow-up Cooperation

Items/ Month	2016											2017		
	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Study														
Signing of Scope of Work														
Detail Design														
Procurement Procedure														
Procurement of Equipment														
Shipping/Transportation														
Implementation of Restoring														

Annex-4

Major Undertakings to be taken by JICA and PICRC

1. JICA

1.1. To procure the equipment listed on the signed Scope of Work and transport it to Palau from Japan/other foreign country under the contract with appropriate supplier/contractor/consulting firm. (If JICA procures the equipment in Palau, the equipment would be transported to PICRC directly. Except the above mentioned case, inland transportation fee in Palau of the equipment needs to be covered by PICRC.)

1.2. To implement the restoring/replacing work of the procured equipment under the contract with appropriate supplier/contractor/consulting firm.

1.3. To dispatch the engineers of supplier/contractor for a short-term to implement the restoring/replacing work of the procured equipment under the contract with appropriate supplier/contractor in accordance with the necessity of the implementation of the Follow-up Cooperation.

1.4. To dispatch the consultants for a short-term under the contract with appropriate consulting firm to supervise the restoring/replacing work of the procured equipment.

2. PICRC

2.1. To secure the budget for prompt unloading and customs clearance of the products and to assist inland transportation under secured conditions in recipient country.

2.2. To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in Palau with respect to the Follow-Up Cooperation be exempted.

2.3. To accord the entry and stay permit to Japanese nationals whose services may be required in connection with the supply of the products and the services under the contract, and arrange such facilities for their entry into the Republic of Palau and stay therein for the performance of their work, when necessary.

2.4. To coordinate with relevant agencies in order to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies to all extent possible which may be imposed in Palau with respect to the supply of the products and services under the contract, when necessary.

2.5. To assign counterpart personnel during the period of the restoring/ replacing work for the Follow-Up Cooperation.

2.6. To take necessary actions for completion of the Follow-Up Cooperation, upon the request of JICA and the consultant under the contract.

2.7. To bear all the expenses, other than those to be borne by the Follow-up Cooperation, necessary for the transportation and installation of the facility, when necessary.

2.8. To provide JICA with necessary information on the Follow-Up Cooperation upon the request of JICA.

2.9. To utilize/maintain the equipment properly and effectively repaired under the Follow-Up Cooperation, including by purchase of all necessary consumables for continuous utilization of the equipment.

2.10. To apply and get the Environmental Quality Protection Board's permit and others necessary for the implementation of Follow-Up Cooperation.

2.11. To conduct the following countermeasures during the Work.

- To supply the temporary electricity, water, storage, etc. for restoring/replacing work
- To cooperate to take safety measures for people(visitors) coming to the site
- To manage the facilities' off days for restoring/replacing work (if necessary)
- To remove the existing the main part and pipes of the air blower in Machinery room, and cooling unit and circulation pumps of the small tanks, circulation pumps(the Type B, C, D and O tanks),
- To remove the showpieces prior to repair work of Tank G, move them to the temporary tanks (it also needs to be prepared by PICRC) and return to the repaired Tank G

  *Cleaning and drying of tank interiors are necessary prior to the start of waterproofing works to be carried out by the Japanese side.

  **If necessary, the similar measures have to be taken for the Type B, C, D, O and N tanks.
- To install the shielding wall for Type B tank and Type H tank after the restoring/ replacing work

2.12. To install the following spare parts and the shielding wall by the end of December 2017

- Seawater intake pipes
- Seawater intake pump

2.13. To conduct the following incidental work by the end of December 2017.

- Cleaning up seawater drainage channel
- Re-replacing the seawater drainage rout/channel to ensure the space for the installation of intake pipes.

End

Attachment

6. List of Equipment Items

No.	Equipment Name	Specification	Manufacturer	Quantity
	M-1 Replacement of circulation pump, cooling unit for small tanks			
M-1 (1)	Equipment for Tank B	＜Seawater use type＞	Aqua Project	3 Sets
	Cooler unit	Air-cooled, 400W 1250kcal/H AC100V		
	Circulation pump	Magnetic pump 45W 684L/H AC100V		
	Support hardware	Resin made/ SUS made, Fixing BNW and related material		
	Control switch box	Thermostat & switch for pump		
	Plumbing material	PVC pipe, Vinyl hose pipe and related material		
M-1 (2)	Equipment for Tank C	＜Seawater use type＞	Aqua Project	4 Sets
	Cooler unit	Air-cooled, 400W 1250kcal/H AC100V		
	Circulation pump	Magnetic pump 45W 540L/H AC100V		
	Pedestal / Support hardware	Resin made/ SUS made, Fixing BNW and related material		
	Control switch box	Thermostat & switch for pump		
	Plumbing material	PVC pipe, Vinyl hose pipe and related material		
M-1 (3)	Equipment for Tank D	＜Seawater use type＞	Aqua Project	3 Sets
	Cooler unit	Air-cooled, 110W, 360kcal/H AC100V		
	Circulation pump	Magnetic pump 45W 181L/H AC100V		
	Support hardware	Resin made/ SUS made, Fixing BNW and related material		
	Control switch box	Thermostat switch for pump		
	Plumbing material	PVC pipe, Vinyl hose pipe and related material		
M-1 (4)	Equipment for Tank O	＜Seawater use type＞	Aqua Project	1 Set
	Cooler unit	Air-cooled, 400W 1250kcal/H AC100V		
	Circulation pump	Magnetic pump 90W 1584L/H AC100V		
	Support hardware	Resin made/ SUS made, Fixing BNW and related material		
	Control switch box	Thermostat & switch for pump		
	Plumbing material	PVC pipe, Vinyl hose pipe and related material		
M-1 (5)	Sand filter for tank B	PVC made box 130L	Aqua Project	1 Set
M-1 (6)	Sand filter for tank C	PVC made box 150L	Aqua Project	2 Sets
M-1 (7)	Sand filter for tank D	PVC made box 75L	Aqua Project	3 Sets
M-1 (8)	Hand lifter cart	Loading capacity 500kg, Hydraulic type		2 Sets

No.	Equipment Name	Specification	Manufacturer	Quantity
	M-2 Replacement of tank H			
M-2 （1）	Equipment for tank H	＜Seawater use type＞	Aqua Project	1 Set
	Acrylic Tank	Size:W3.0mxH1.0mxD1.0m　Back side sheet：Blue		
	Cooler unit	Air-cooled, 600W 1950kcal/H AC100V		
	Circulation pump	Magnetic pump 180W 2690L/H AC100V		
	Support hardware	Resin made/ SUS made, Fixing BNW and related material		
	Control switch box	Thermostat switch for pump		
	Plumbing material	PVC pipe, Vinyl hose pipe and related material		
M-2 （2）	Hand lifter cart	Loading capacity 500kg, Hydraulic type		2 Sets
M-2 （3）	Steel frame upper cover			
	Waterproof plywood	More than 18mm thickness, painted		1 Set
	Related material	Screw, Nail and etc.		1 Set

No.	Equipment Name	Specification	Manufacturer	Quantity
	M-3 New installation of Sand Filters			
M-3 (1)	Sand filtering Unit for tank N	＜Seawater use type＞	SHOEI	1 Set
	Sand filter	FRP600Φ, Filter media：Silica sand 0.6mm, Manual 5-way valve, Pressure gauge		
	Circulation pump	Self-priming plastic pump, 50A x 160Ｌ/Min x 15m x1.5kw, Pressure gauge		
	Piping inside unit	PVC pipe, valve (Reffer to drawing)		
	Pedestal / support	SUS made, Anchor bolt M12		
	Plumbing material	PVC50A pipe, valve		
M-3 (2)	Sand filtering Unit for tank G	＜Seawater use type＞	SHOEI	1 Set
	Sand filter	FRP600Φ, Filter media：Silica sand 0.6mm, Manual 5-way valve, Pressure gauge		
	Circulation pump	Self-priming plastic pump, 50A x 160Ｌ/Min x 15m x1.5kw, Pressure gauge		
	Piping inside unit	PVC pipe, valve (Refer todrawing)		
	Pedestal / support	SUS made, Anchor bolt M12		
	Plumbing material	PVC50A pipe, valve		
M-3 (3)	Piping material		SHOEI	
	PVC pipe	VP L=4m (Refer to drawing)		1 Set
	PVC fittings	VP made (Refer to drawing)		1 Set
	PVC50A ball valve	TS type		6 Nos.
	Strainer 50A	PVC made, resin net		4 Nos.
	Pipe support , etc.	Support hardware, Anchor, related material		1 Set
M-3 (4)	Piping material			
	VP50A	VP 4m		19 Nos.
	VP20A	VP 4m		1 Nos.
	PVC50A 90 ° elbow	VP		41 Nos.
	PVC50A 45° elbow	VP		4 Nos.
	PVC50A tee	VP		4 Nos.
	PVC50A socket	VP		6 Nos.
	PVC50Ax20A socket	VP		4 Nos.
	PVC50A cap	VP		3 Nos.
	PVC50A Union	VP		4 Nos.
	PVC50A TS Flange	JIS10K SUS304 BNW2 M20x85L Packing		8 Nos.
	PVC50A Ball valve	TS type		4 Nos.
	50A Strainer	PVC Resin net		4 Nos.
	Piping material	Support material, anchor, consumables, other		1 Set

No.	Equipment Name	Specification	Manufacturer	Quantity
	M-4 Replacement of seawater intake piping ＊Equipment and martial supply only			
M-4 (1)	Seawater intake pump			
	Pump＜seawater use type＞	Resin made, 125A x 100A x 1470 L/Min x 18mx11kw, Pressure gauge	EBARA	1 No.
	Spar parts	Mechanical seal, Bearing, Packing	EBARA	1 Set
M-4 (2)	Seawater intake pipes			
	Seawater intake Suction opening and pedestal made of steel	L75x75x6.5, C150x75x6.5 Epoxy paint finish and U-typing BNW		1 Set
	Resin net	#17mmx17mm W= 1m, 15m/roll		1 Roll
	VP200A	VP L=4m		15 Nos.
	PVC200A tee	VP		3 Nos.
	PVC200A90°elbow	VP		3 Nos.
	PVC200A45°elbow	VP		4 Nos.
	PVC200A TS flange for Outdoor	JIS10K SUS304 BNW2 M20x85L with Packing		8 Sets
	PVC200A TS flange for Sea water use	JIS10K SUS316L BNW2 M20x85L with Packing		7 Sets
	PVC200A Blind flange	JIS10K		3 Nos.
	PVC200A Socket	VP		8 Nos.
	Flexible joints	JIS10KF Twin flex Rustproof type by seawater		5 Sets
	Pipe support , etc.	Support hardware, Anchor, related material		1 Set
M-4 (3)	Strainer accessory			
	Strainer packing	NBR 450A, 5mm thick, 20 holes		2 Nos.
	Fixing bolt, Nut and Washer	SUS304 BN2W M24x130mm L		20 Sets
	100A packing for observation gla	NBR JIS10K 100A 3mmt, 8 holes		1 Nos.
	Fixing bolt, Nut and Washer for100A observation glass	SUS304 BN2W M16x75mmL		8 Sets
	20A nozzle packing	NBR JIS10K 20A 3mmt 4 holes		2 Nos.
	Fixing bolt, Nut and Washer	SUS304 BN2W M12x55mmL		8 Nos.
	M-5 Flow meter			
M-5(1)	Portable electromagnetic flow meter			
	Detection indicator	FSC320A2-00E English indicator	Fuji Denki	1 No
	Detector	FSSC1BC-YY stretch lace type 50A ~ 600A	Fuji Denki	1 No

No.	Equipment Name	Specification	Manufacturer	Quantity
	E-1 Replacement of LED lighting fixture on tanks			
E-1(1)	LED dimming and polarization lighting equipment	Color Lump ：High brightness LED(Color/ Red , Green, Blue)	COLORKINETICS JAPAN	10 Sets
		Input：AC100-240V、50-60HZ		
	COLORBLAST POWERCORE GEN4	Power consumption：50W		
		Light distribution：Standard10°+Optional lenses×40°		
		Control：Dedicated controller		
		Material：Body/Die-cast aluminum powder coated finish		
		Lens / Tempered glass		
		Size ：H185mm×W338mm×D171mm		
		weight：3.9K g		
		Connection: the lamp body attached cable		
E-1(2)	Data transmitter	Full-color LED lighting	COLORKINETICS JAPAN	3 Sets
	Data Enabler Pro	Input / Output：AC100-277V,50-60HZ		
		Material：Body/Die-cast aluminum		
		Size：H267mm×W138mm×D87mm		
		Connection: data input and output: 4-core terminal block		
		Power / data input: 4-wire terminal block		
		Power input: 3-wire terminal block		
E-1 (3)	Controller	Full-color LED lighting	COLORKINETICS JAPAN	3 Sets
	i-Color Player	Input / Output：AC100-277V,50-60HZ		
		Material：Body/Die-cast aluminum		
		Size：H74mm×W79mm×D29mm		
		Connection: data input and output: 4-core terminal block		
E-1(4)	LED Compact Light	Light source: high brightness LED (light source color / 6500K) Ra70		6 Sets
		Input：AC100-240V、50-60HZ		
		Power consumption：40W		
		Light distribution: wide angle		
		Material: body / aluminum die-casting		
		Arm / stainless		
		Front part / acrylic		
		Size：H202mm×W237mm×D92mm		
		Weight：2.6K g		
		Connection: the lamp body attached cable		
E-1 (5)	Cables / pipes	Control for vinyl insulating sheath cable CVV2.0mm-3C 18m		1 Set
		600V VVF vinyl insulating sheath cable flat VVF2.0mm-3C 25m		
		Synthetic resin Allowed Tou tube (PF22) 53m		

	E-2 Rewirring of Main electrical panel			
E-2(1)	Cables / terminal processing	600V cross-linked polyethylene insulated vinyl sheath cable CV38mmsq-1C 6m		1 Set
		Crimp terminal, copper plate drilling bolt nut		
E-2(2)	Switcher	Power switching switch	Kyoritsu keiki	1 Set
		Rated current 200A N4 pole. Double-throw type, surface installation type		
	E-4 Power supply of the filter, etc.			
E-4	Cables / terminal processing	600V cross-linked polyethylene insulated vinyl sheath cable CV5.5mmsq-4C 42m		1 Set
		Synthetic resin Allowed Tou tube (PF22) 42m		
	E-5 Electrical outlet and wiring of laboratory			
E-5	Cables / pipes / wiring instrumentation	600V cross-linked polyethylene insulated vinyl sheath cable CV5.5mmsq-4C 42m		1 Set
		Synthetic resin Allowed Tou tube (PF22) 53m		
		Outlet retaining-wall mounted type		
		Earth leakage breaker ELB 50AF / 20AT 2Nos		

No.	Equipment Name	Specification	Manufacturer	Quantity
A-2 Waterproofing work of Tank H				
A-2(1)	Seal material		Dia Works	
	Seal material	Sealant 4 litter(Sealant 70), Liquid Hardne 150g		12 Sets
	Seal additive color toner	Color toner 230g (Color toner)		12 Bags
	primer for FRP	n-Hexane 250g (Primer A-10)		3 Cans
	Primer for acrylic	Ethyl acetate, toluene 250g (Primer B-20)		3 Cans
	Solvent sealing material for cleaning	Thinner 16kg	(Local procurement)	1 Can
	Auxiliary materials	Curing materials, masking tape, back-up material, others		1 Set
	Tool consumables	Thunder blade, seal peel blade, others		1 Set
A-2(2)	Waterproof material		Dia Works	
	Waterproof foundation modifiers	Cement-based cationic acrylic resin mortar 20kg （Cation tight FS）		4 Cans
	Primer	1 liquid moisture effect type urethane primer 16kg cans (Tafusheel quick-dry primer)		1 Cans
	FRP base resin (intermediate)	Vinyl ester resin/ styrene 18kg(Tafubarrier＃200)		8 Cans
	FRP base resin (overcoat)	Vinyl ester resin/ styrene 18kg (Tafubarrier＃200)		1 Can
	FRP liquid Hardner	Methhy Ethyl Keyone Peroxide 1kg（PermeckNRK-04）	(Local procurement)	3 No
	Putty for aggregate	Talc 25kg		1 Bag
	Glass mat＃450	MC Chopped strand mat 1mx 64m 30kg		2 Roll
	FRP cleaning solvent	Acetone 16kg	(Local procurement)	1 Can
	Auxiliary materials	Curing material, Roller bucket, vinyl duct, others		1 Set
	Tool consumables	Thunder blade-protective equipment other		1 Set

Attachment

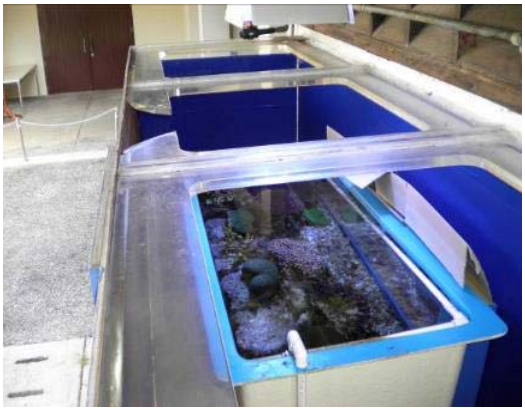
7. Photo of Field Study in PICRC

Small Tank and Circulation system

 Tank D: Good condition	 Tank D : Circulation system was aging
 Tank C : Good condition	 Tank C : Circulation system was aging
 Tank B : Good condition	 Tank B : Circulation system was aging
 Tank O : Good condition	 Tank O : Circulation system was aging

Small Tank and Circulation System

Tank H：Alteration to small tank



Tank H ： Small tank in Tank H

Tank H：Corruption of tank back board

Tank H：Circulation system was aging

Tank P：Change to model display

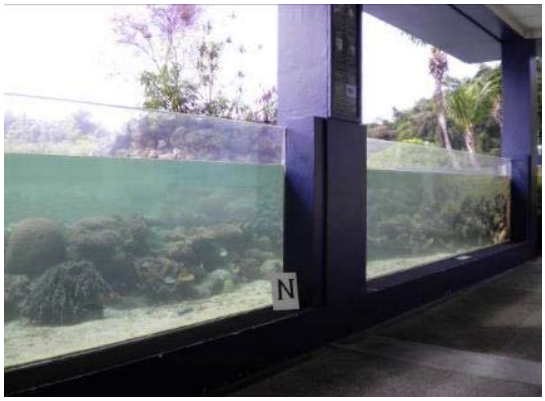
Tank P：Circulation system was token out

Outdoor Tank/ Large Size Tank

Outdoor tank J : Good condition

Outdoor tank K : Good condition

Outdoor tank N : Good condition



Outdoor tank N : No filtered seawater

Tank G : No filtered seawater

Filter tank for tank N and G : No function

Water chiller for tank N and G :No function

Tank G: Cleaning inside tank

Seawater Intake System

Old intake pipe: Not functioning

Existing intake pipe : Rust corrosion of steel

Existing and old intake pipe in pipe pit

Strainer for intake pump: Good condition

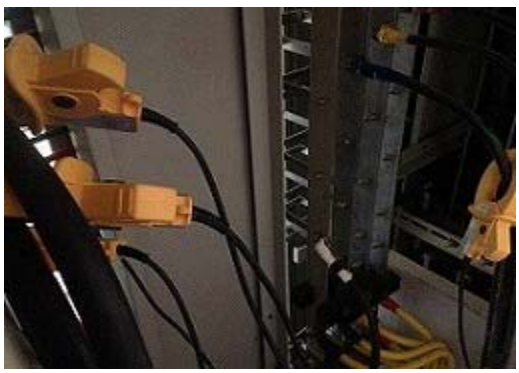
Seawater intake pumps : Good maintenance

Control panel of seawater intake :Good

Header for branch pipes

Cleaning maintenance of strainer

Electrical Facilities/ Main Distribution Board

 Exterior of Aquarium	 Exterior of Electric room
 Main distribution board	 Main distribution board
 Electrical measuring instrument	 Electrical measuring instrument
 Electrical measuring instrument	 Electrical measuring instrument

Distribution Board

 CP-A Distribution board in Research bldg.	 CP-A Distribution board in Research bldg.
 L-1 Distribution board in Research bldg.	 P-1 Distribution board in Research bldg.
 CP-B Distribution board in Aquarium	 P-2 Distribution board in Aquarium
 L-2 Distribution board in Aquarium	 Switch gear for Annex bldg.

Generator Set

Generator set 1

Generator set 2

Nameplate of generator set

Existing automatic control panel

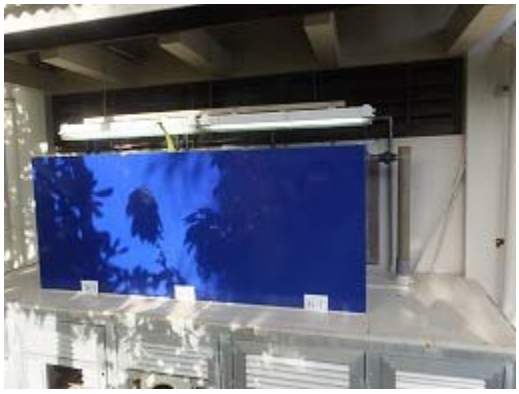
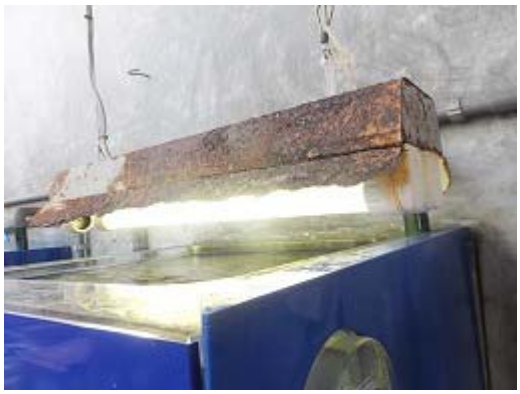
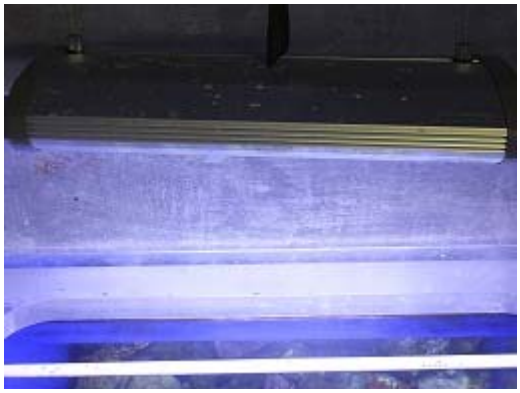
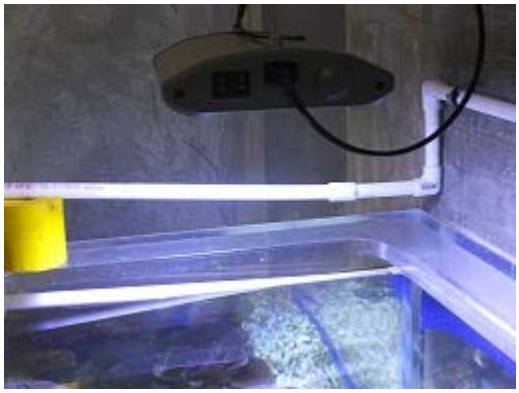
Automatic magnet switch

Name plate of magnet switch

Automatic control panel

Nameplate of automatic control panel

Lighting Fixture in Aquarium

 Lighting fixture for tank G	 Lighting fixture for tank G
 Lighting fixture for tank O	 Lighting fixture for tank B
 Lighting fixture for tank D	 Lighting fixture for tank H
 Lighting fixture for tank C	 Lighting fixture for tank C

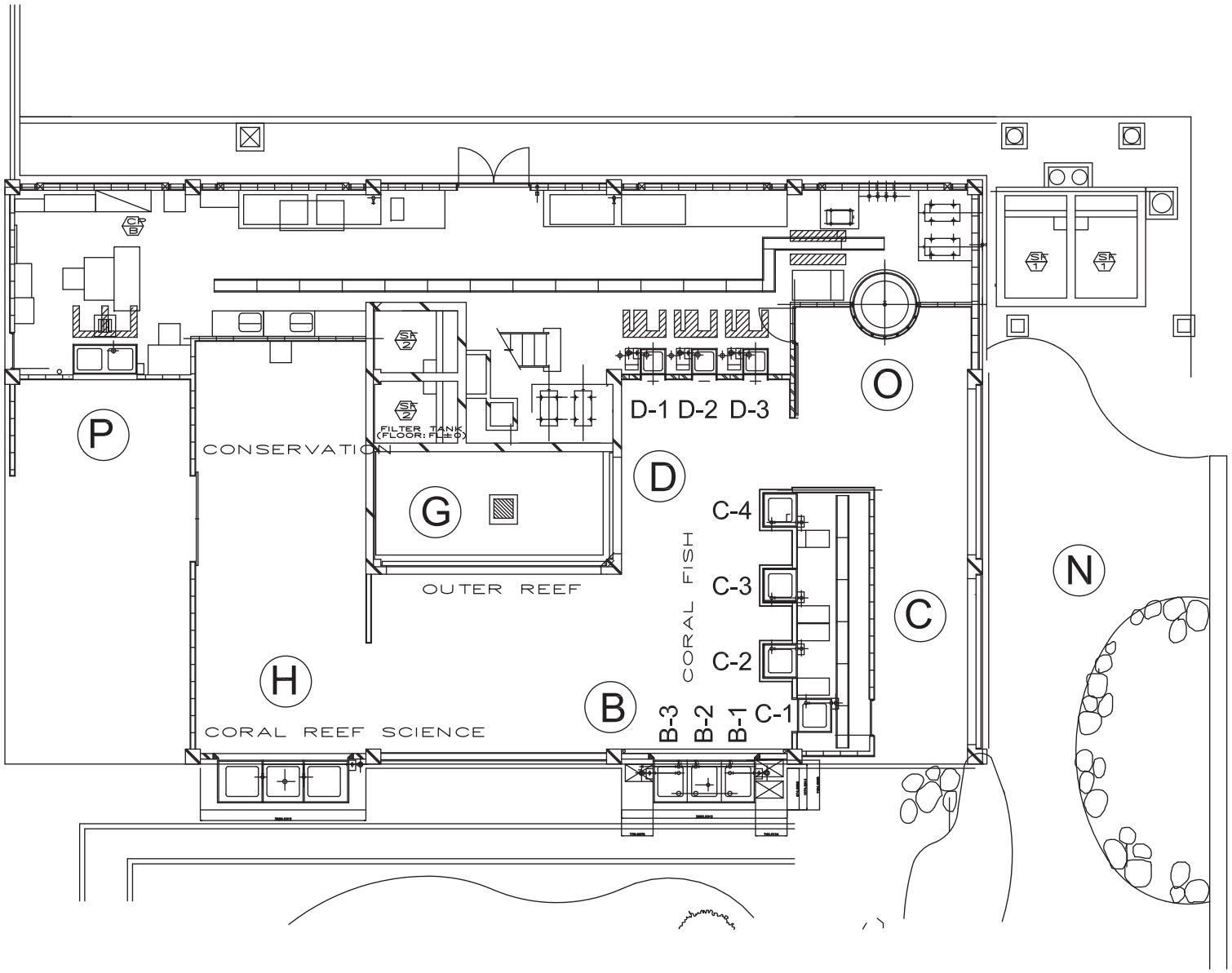
Drawings

Drawing List

Machinery Drawings			
DWG No.	Drawing Title		Scale
M-1-1	Small Cooler Unit	Location Plan	1/100
M-1-2	Small Cooler Unit	B Tank	1/20
M-1-3	Small Cooler Unit	C Tank	1/20
M-1-4	Small Cooler Unit	D Tank	1/20
M-1-5	Small Cooler Unit	O Tank	1/20
M-2-1	Replacement of H Tank	Machinery Detail	1/20
M-2-2	Hand lifter	Reference	
M-3-1	Installation of New Sand Filter	N Tank Location Plan	1/30
M-3-2	Installation of New Sand Filter	G Tank Location Plan	1/30
M-3-3	Installation of New Sand Filter	Machinery Detail	1/20
M-4-1	Rehabilitation of Sea Water Intake System	Existing Location Plan	1/200
M-4-2	Rehabilitation of Sea Water Intake System	Location Plan	1/200
M-4-3	Rehabilitation of Sea Water Intake System	Piping Detail	1/20
		Detail of Existing Strainer	1/20
M-4-4	Rehabilitation of Sea Water Intake System	Detail of Header	1/20

Electrical Drawing			
DWG No.	Drawing Title		Scale
E-1	Rehabilitation of Lighting Fixture above Exis	Layout Plan	1/100
E-2	Rehabilitation of Main Distribution Board	Diagram	1/100
E-3	Replacement of Automatic control panel of gene	Diagram	
E-4	Power Supply for Sand Filter	G,N Tank Wiring Plan	1/100
E-5	Outlet Wiring Plan for Lab	Lab Wiring Plan	1/100

Architectural Drawings			
DWG No.	Drawing Title		Scale
A-1-1	SUN SHADE-PLAN for H Tank/ B Tank	(For Reference)	1/30
A-1-2	SUN SHADE-ELEVATION AND SECTIONH for H Tank/ B Tank	(For Reference)	1/30
A-2-1	Rehabilitation of G Tank (Water Proofing Work) -1		1/50
A-2-2	Rehabilitation of G Tank (Water Proofing Work) -1		1/5



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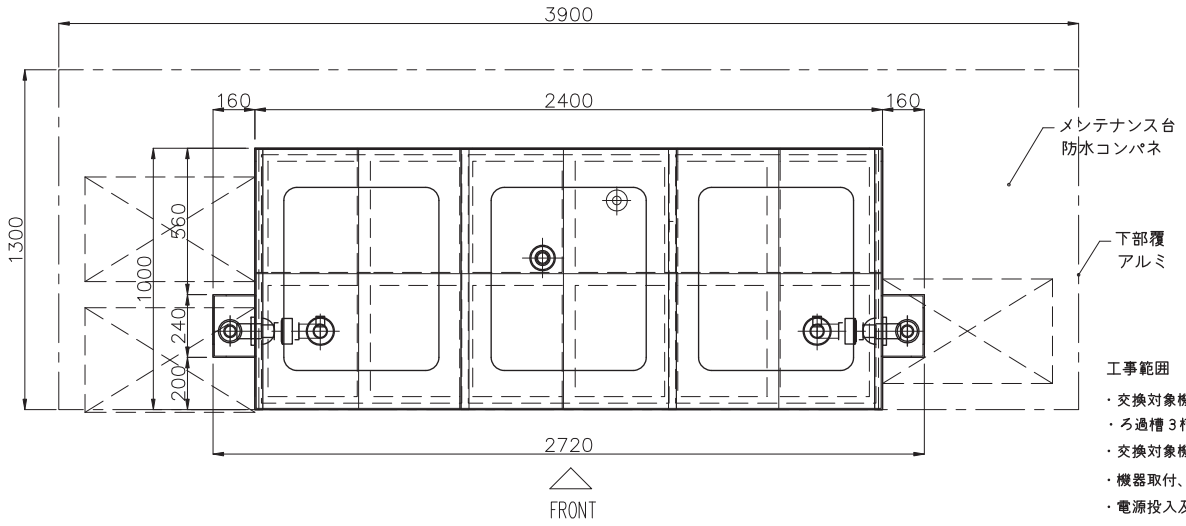
SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU, TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : 小型水槽用循環ポンプ、冷却器の更新 配置図	SCALE : 1:100	DRAWING No: M-1-1

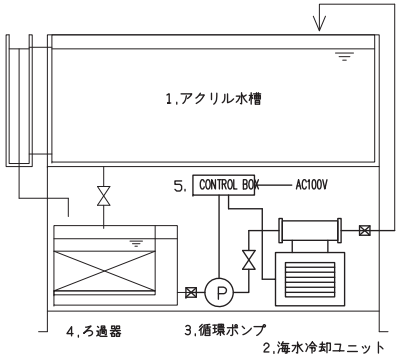
展示水槽 B　3sets

番号	名　称	仕　様	電　源	備　考
1	アクリル水槽	181L		既存利用
2	海水冷却ユニット	空冷式 400W	AC100V	交　換
3	循環ポンプ	ﾏｸﾞﾈｯﾄ式684L/Hx45W	AC100V	交　換
4	ろ過器	重力式 PVC 130L		既存利用
5	コントロールボックス	ｻｰﾓｽﾀｯﾄ　ﾎﾞﾝﾌﾞｽｲｯﾁ	AC100V	交　換
6	架　台	SUS304		既存利用



工事範囲　（赤表示部）

・交換対象機器の撤去及び更新：冷却器、循環ポンプ、コントロールボックス
・ろ過槽３槽の内１槽につき、破損状況確認の上、交換が必要であれば撤去及び更新
・交換対象機器に付属する配管（塩ビ、ビニールホース）、配線の撤去及び更新
・機器取付、固定材料（金具、ビス、バンド類）、その他雑材
・電源投入及び運転確認：検査員の承認を得ること
・下部覆（アルミ）上の防水コンパネ（１８ｍｍ厚以上）の張替及び塗装



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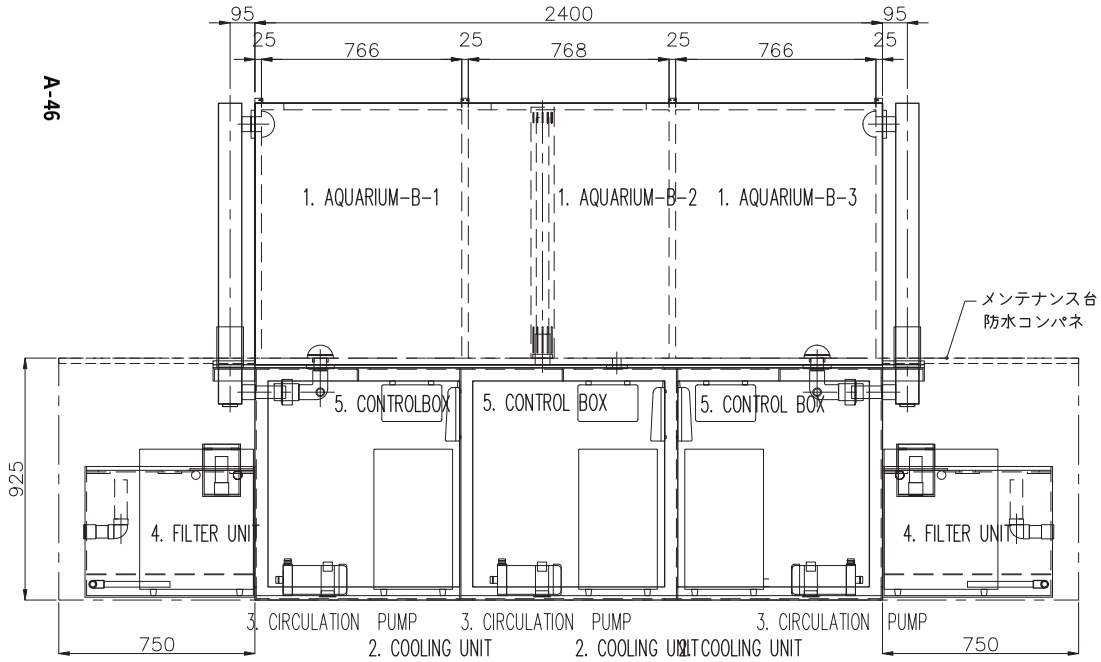
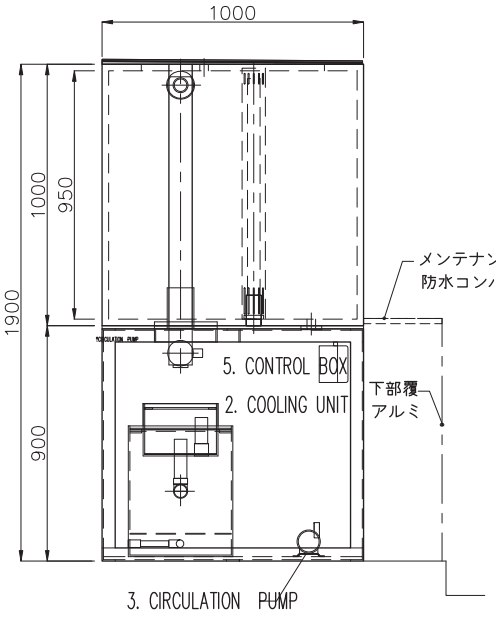
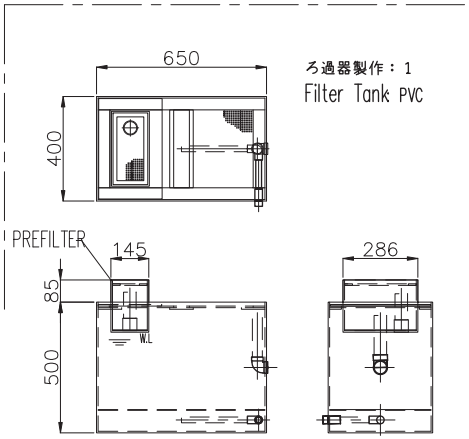
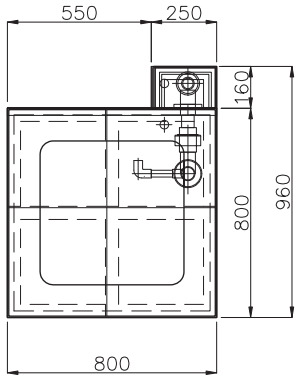






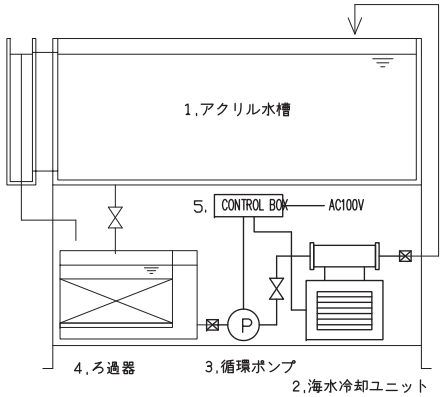
ろ過器製作：1
Filter Tank PVC

SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : 小型水槽用循環ポンプ、冷却器の更新 B水槽	SCALE : 1:20	DRAWING No: M-1-2



展示水槽 C　4sets

番号	名　称	仕　様	電　源	備　考
1	アクリル水槽	540L		既存利用
2	海水冷却ユニット	空冷式 400W	AC100V	交　換
3	循環ポンプ	ﾏｸﾞﾈｯﾄ式540L/Hx45W	AC100V	交　換
4	ろ過器	重力式 PVC 150L		既存利用
5	コントロールボックス	ｻｰﾓｽﾀｯﾄ　ﾎﾞﾝﾌﾞｽｲｯﾁ	AC100V	交　換
6	架　台	SUS304		既存利用



工事範囲　（赤表示部）

・交換対象機器の撤去及び更新：冷却器、循環ポンプ、コントロールボックス
　ろ過槽４槽の内２槽につき、破損状況確認の上、交換が必要であれば撤去及び更新
・交換対象機器に付属する配管（塩ビ、ビニールホース）、配線の撤去及び更新
・機器取付、固定材料（金具、ビス、バンド類）、その他雑材
・電源投入及び運転確認：検査員の承認を得ること

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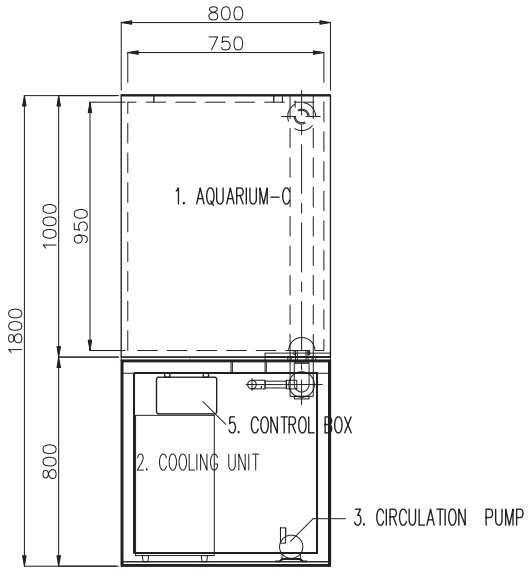
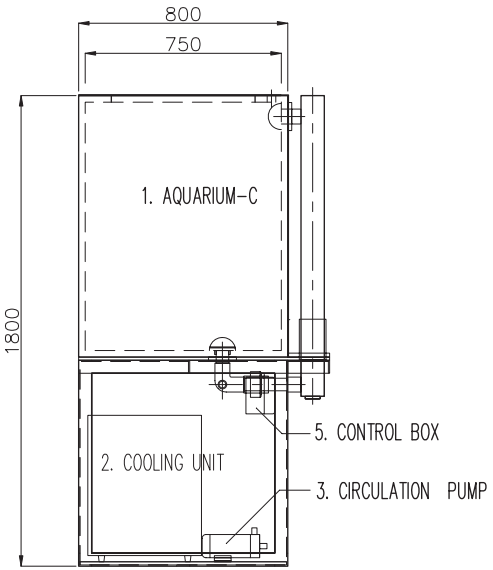
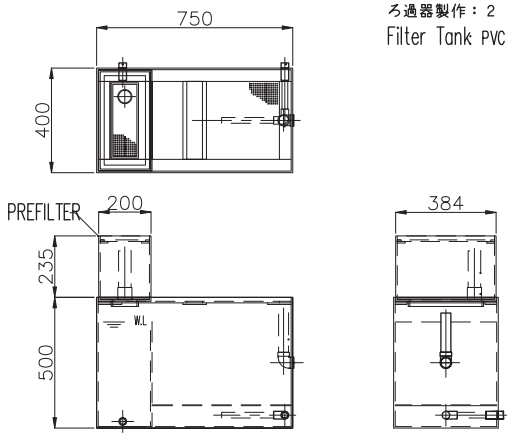




ろ過器製作：２
Filter Tank PVC



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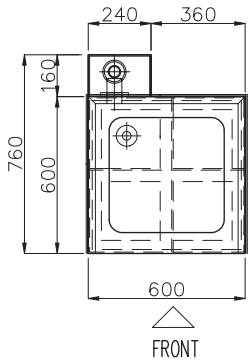
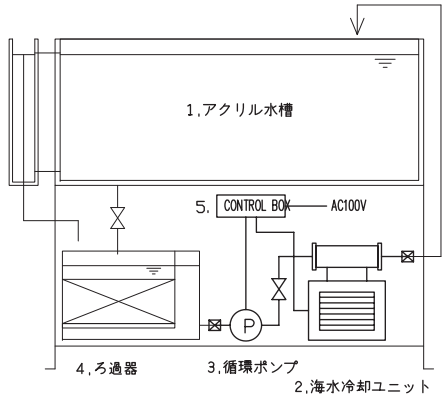


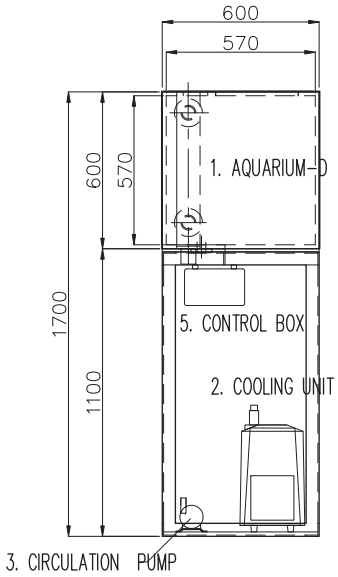
展示水槽 D　3sets

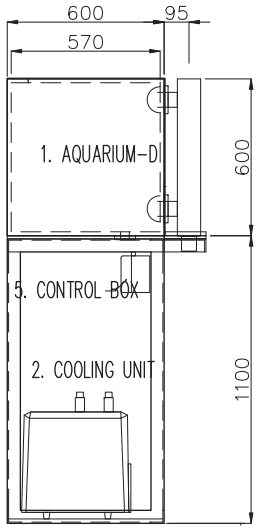
番号	名　称	仕　様	電　源	備　考
1	アクリル水槽	181L		既存利用
2	海水冷却ユニット	空冷式 400W	AC100V	交　換
3	循環ポンプ	ﾏｸﾞﾈｯﾄ式181L/Hx45W	AC100V	交　換
4	ろ過器	重力式 PVC 75L		既存利用
5	コントロールボックス	ｻｰﾓｽﾀｯﾄ　ﾎﾞﾝﾌﾞｽｲｯﾁ	AC100V	交　換
6	架　台	SUS304		既存利用

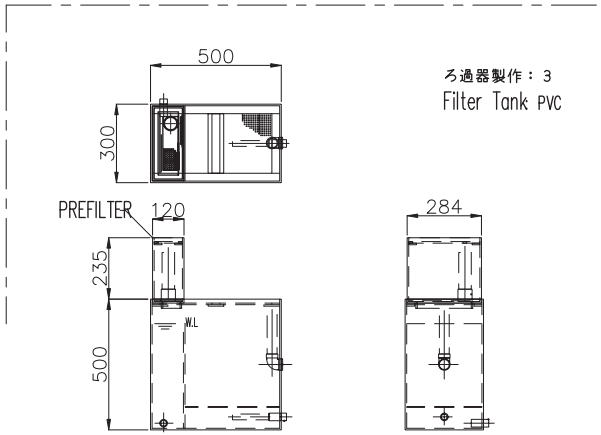


工事範囲　（赤表示部）

・交換対象機器の撤去及び更新：冷却器、循環ポンプ、コントロールボックス
　ろ過槽３槽につき、破損状況確認の上、交換が必要であれば撤去及び更新
・交換対象機器に付属する配管（塩ビ、ビニールホース）、配線の撤去及び更新
・機器取付、固定材料（金具、ビス、バンド類）、その他雑材
・電源投入及び運転確認：検査員の承認を得ること







ろ過器製作：３
Filter Tank PVC

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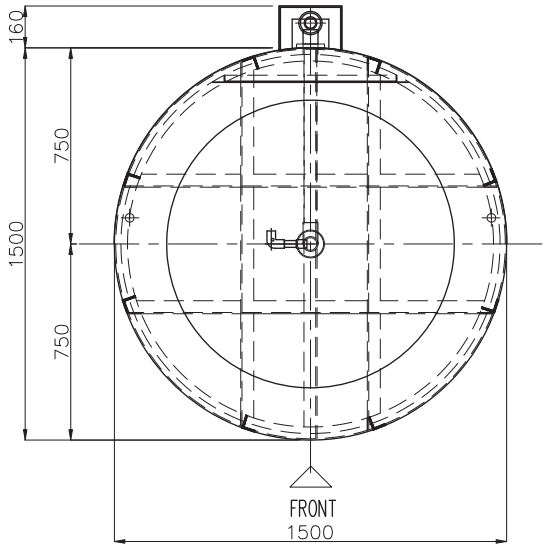
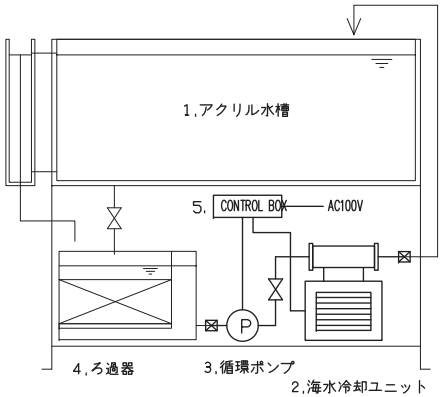
SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : 小型水槽用循環ポンプ、冷却器の更新 D水槽	SCALE : 1:20	DRAWING No: M-1-4



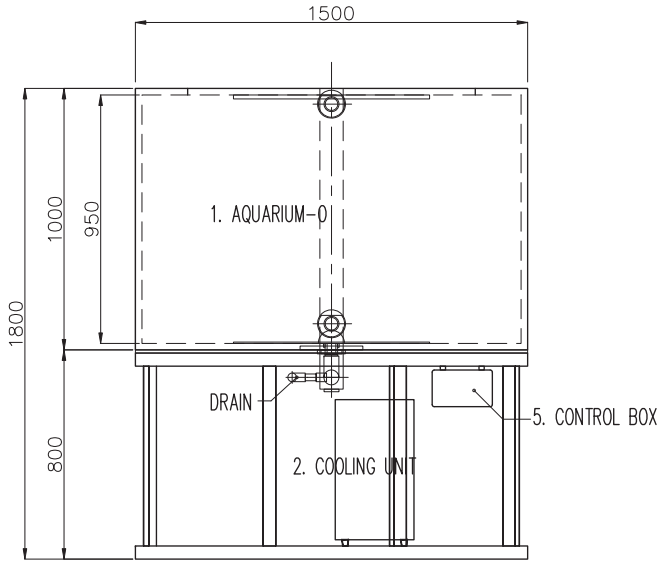
展示水槽 O　1set

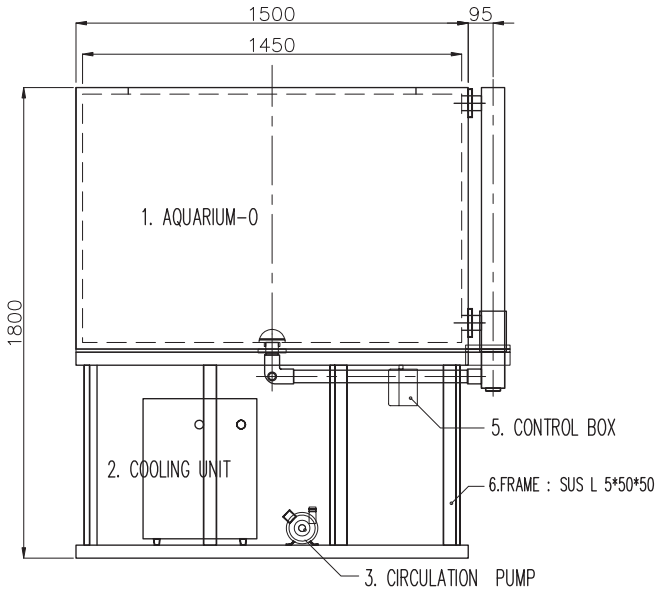
番号	名　称	仕　様	電　源	備　考
1	アクリル水槽	1500L		既存利用
2	海水冷却ユニット	空冷式 400W	AC100V	交　換
3	循環ポンプ	ﾏｸﾞﾈｯﾄ式1500L/Hx90W	AC100V	交　換
4	ろ過器	重力式 PVC 420L		既存利用
5	コントロールボックス	ｻｰﾓｽﾀｯﾄ ﾎﾞﾝﾌﾞｽｲｯﾁ	AC100V	交　換
6	架　台	SUS304		既存利用



工事範囲　（赤表示部）

・交換対象機器の撤去及び更新：冷却器、循環ポンプ、コントロールボックス
・交換対象機器に付属する配管（塩ビ、ビニールホース）、配線の撤去及び更新
・機器取付、固定材料（金具、ビス、バンド類）、その他雑材
・電源投入及び運転確認：検査員の承認を得ること





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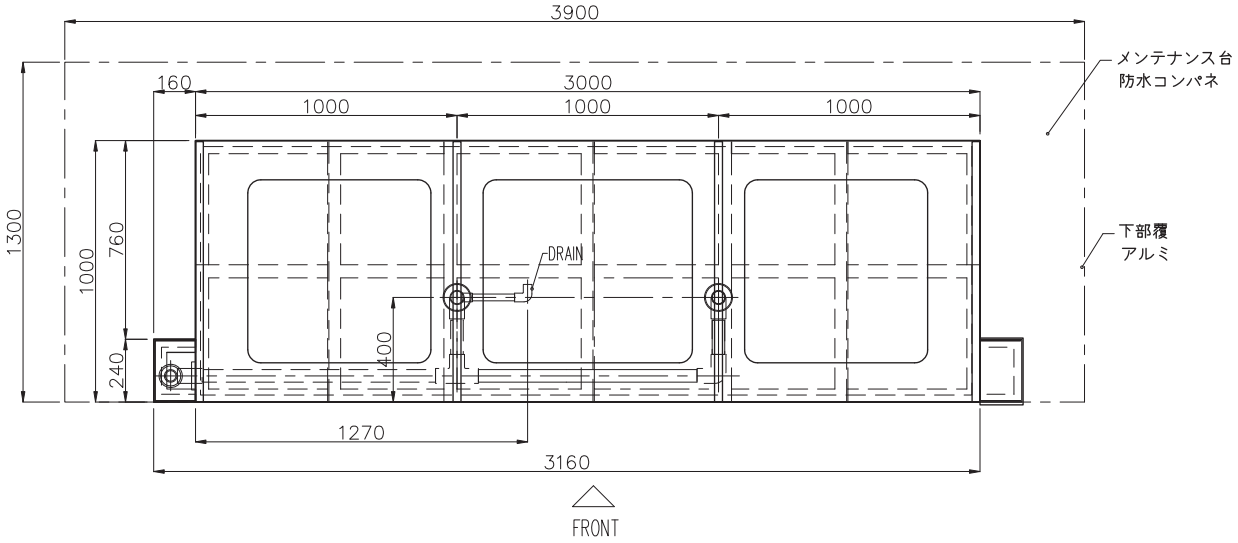


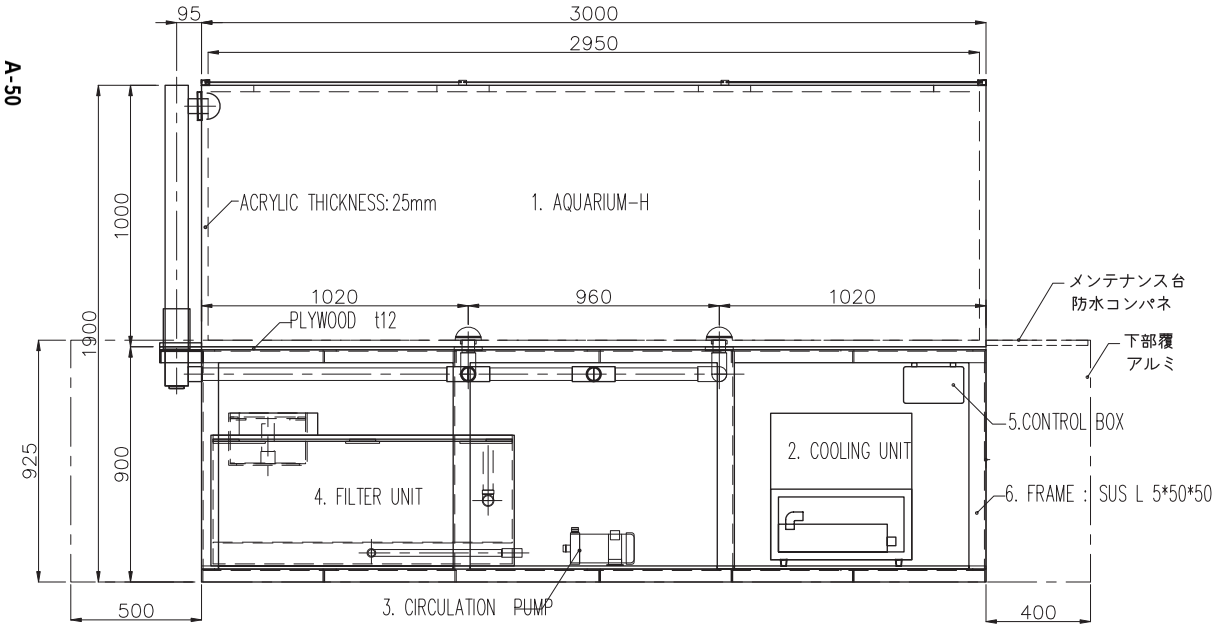
展示水槽 H　1set

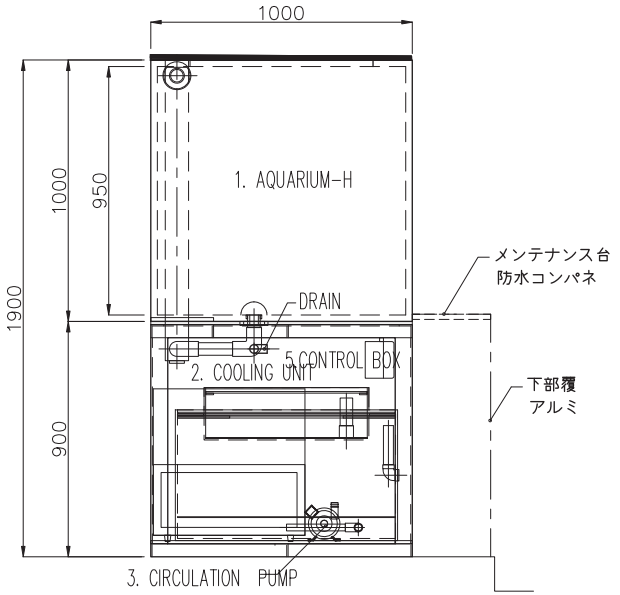
番号	名　称	仕　様	電　源	備　考
1	アクリル水槽	2600L		交　換
2	海水冷却ユニット	空冷式 600W	AC100V	交　換
3	循環ポンプ	ﾏｸﾞﾈｯﾄ式1500L/Hx1.8m	AC100V	交　換
4	ろ過器	重力式 PVC 1020L		既存利用
5	コントロールボックス	ｻｰﾓｽﾀｯﾄ　ﾎﾞﾝﾌﾞｽｲｯﾁ	AC100V	交　換
6	架　台	SUS304		既存利用

工事範囲　（赤表示部）

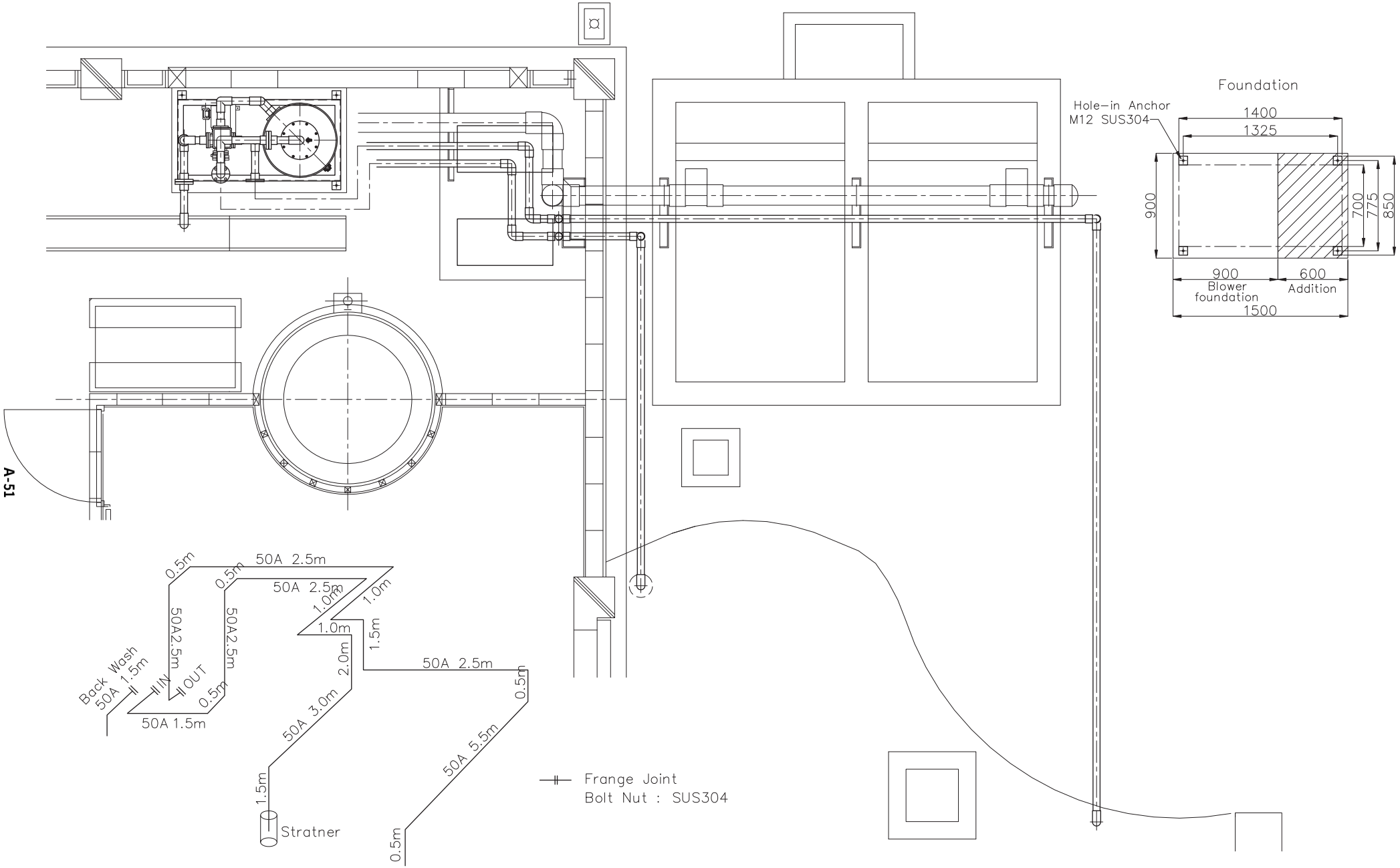
・交換対象機器の撤去及び更新：アクリル水槽、冷却器、循環ポンプ、コントロールボックス
・交換対象機器に付属する配管（塩ビ、ビニールホース）、配線の撤去及び更新
・機器取付、固定材料（金具、ビス、バンド類）、その他雑材
・電源投入及び運転確認：検査員の承認を得ること
・下部覆（アルミ）上の防水コンパネ（１８ｍｍ厚以上）の張替及び塗装

A-50

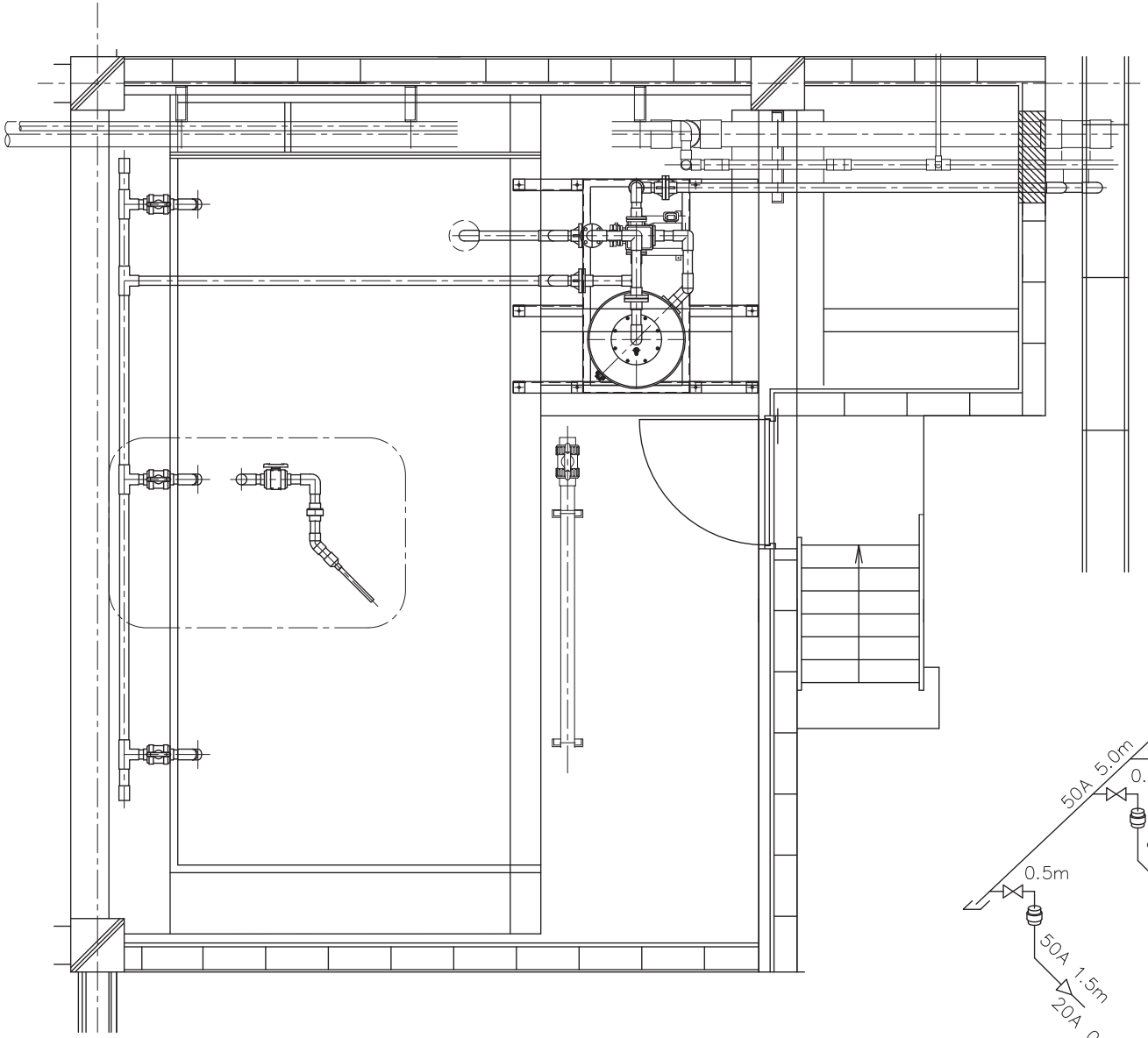


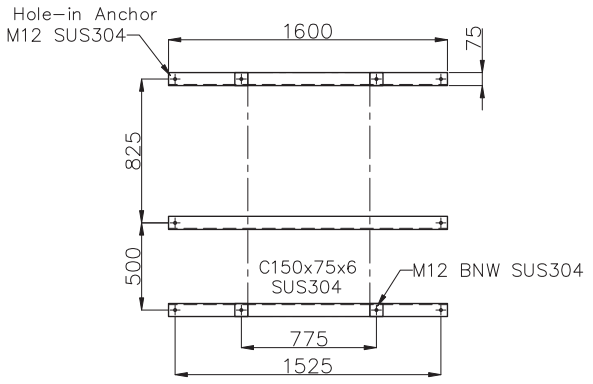


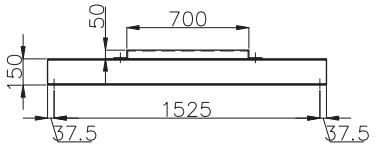
SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : H水槽更新 機器詳細	SCALE : 1:20	DRAWING No: M-2-1

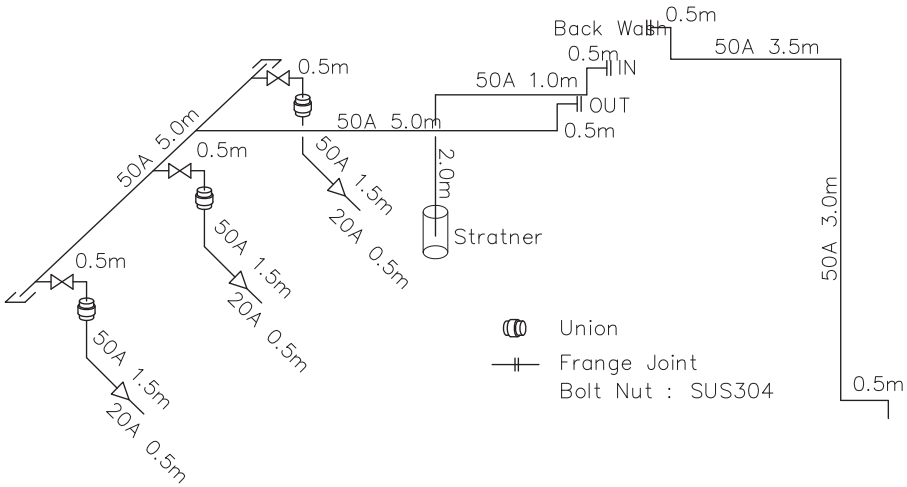


SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : 新規砂ろ過器の据付 N水槽 配置図	SCALE : 1:30	DRAWING No: M-3-1









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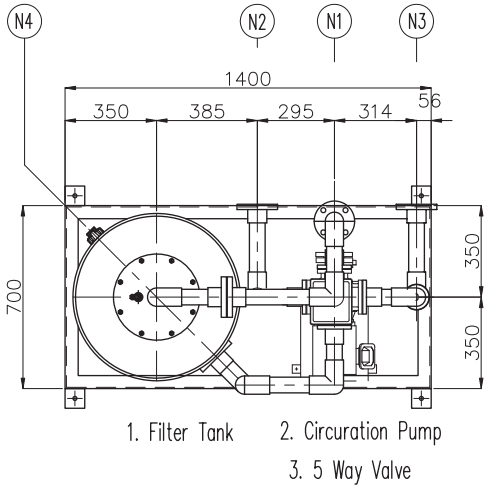
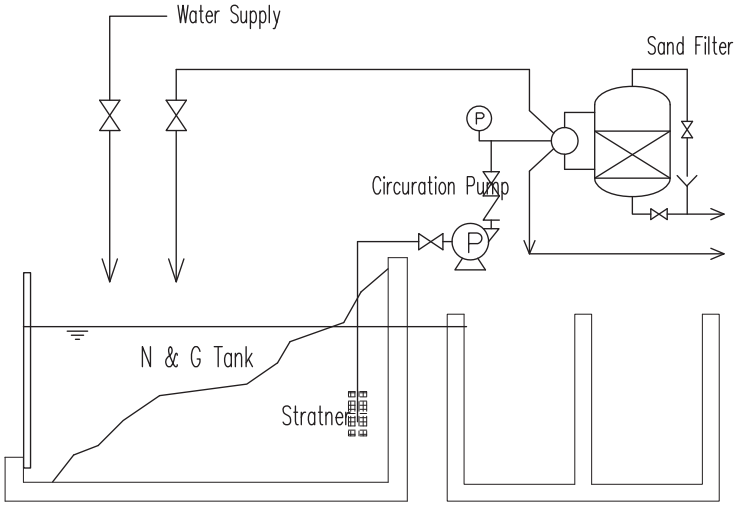
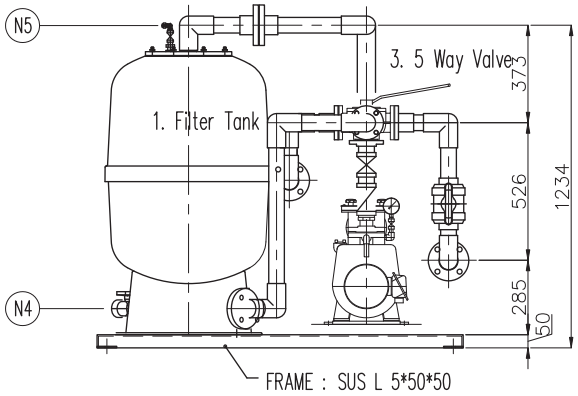
SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : 新規砂ろ過器の据付 G水槽 配置図	SCALE : 1:30	DRAWING No: M-3-2

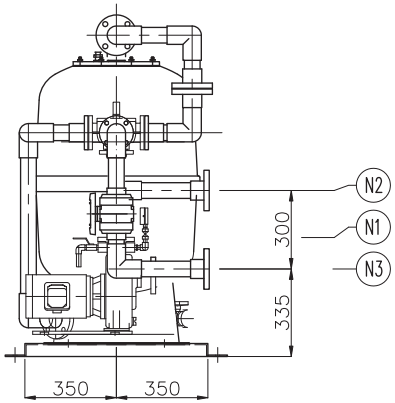


Pressure Sand Filter : 2sets

No	Equipment	Specification
1	Sand Filter Filter Area Filter Media Sand	FRP 600mm dia. 0.28 sq.m/unit 0.6mm 120l
2	Circuration Pump Circuration Rate Power Source Preessure Gauge Stratner	Self Priming 160 liter/h AC200V,60Hz 1.5kw PVC
3	5 Way Valve Size	Manual 50A
	Nozzle N-1 : IN 50A N-2 : OUT 50A N-3 : BACK WASH DRAIN 50A N-4 : DRAIN 25A N-5 : AIR DRAIN 13A	

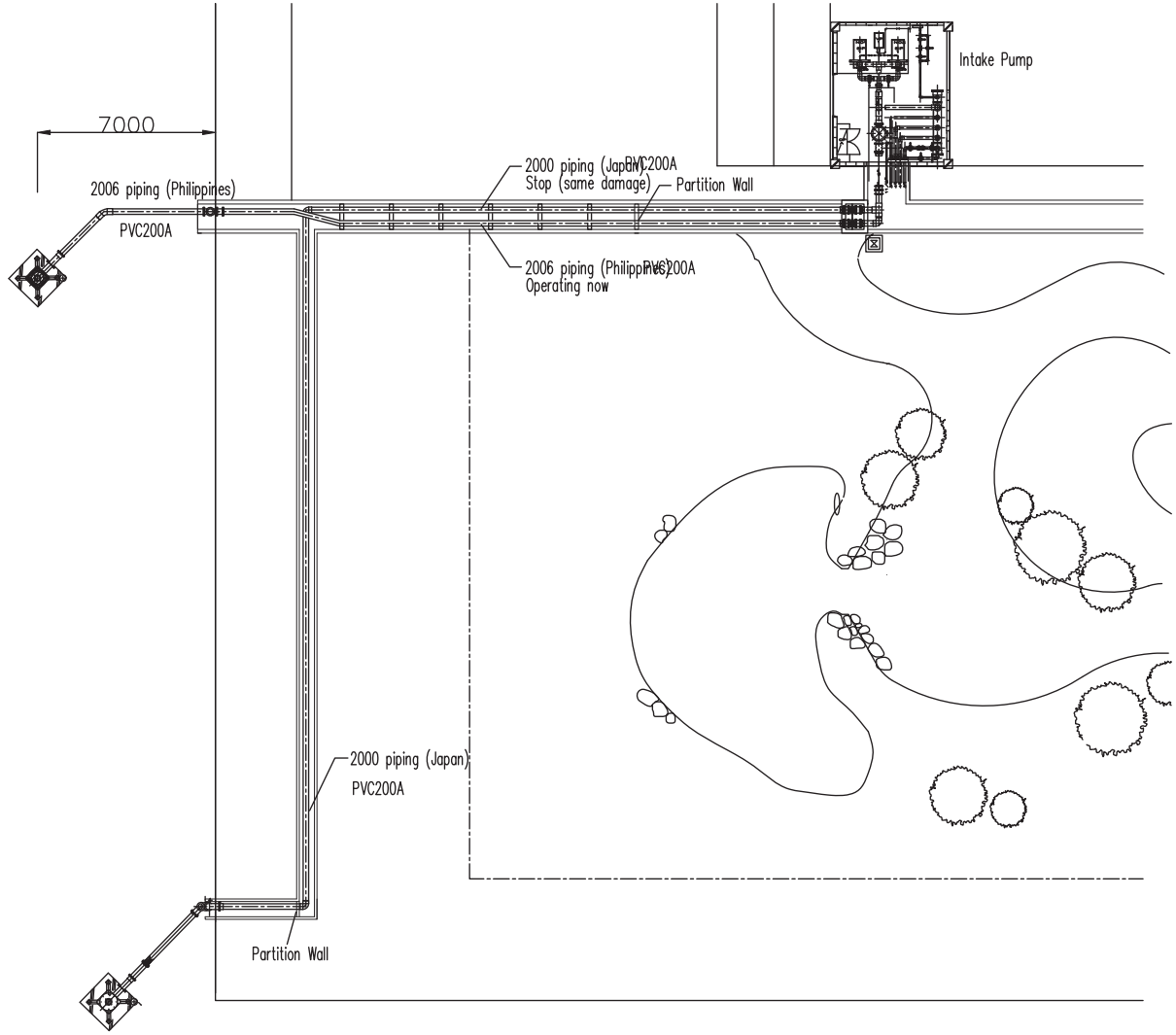






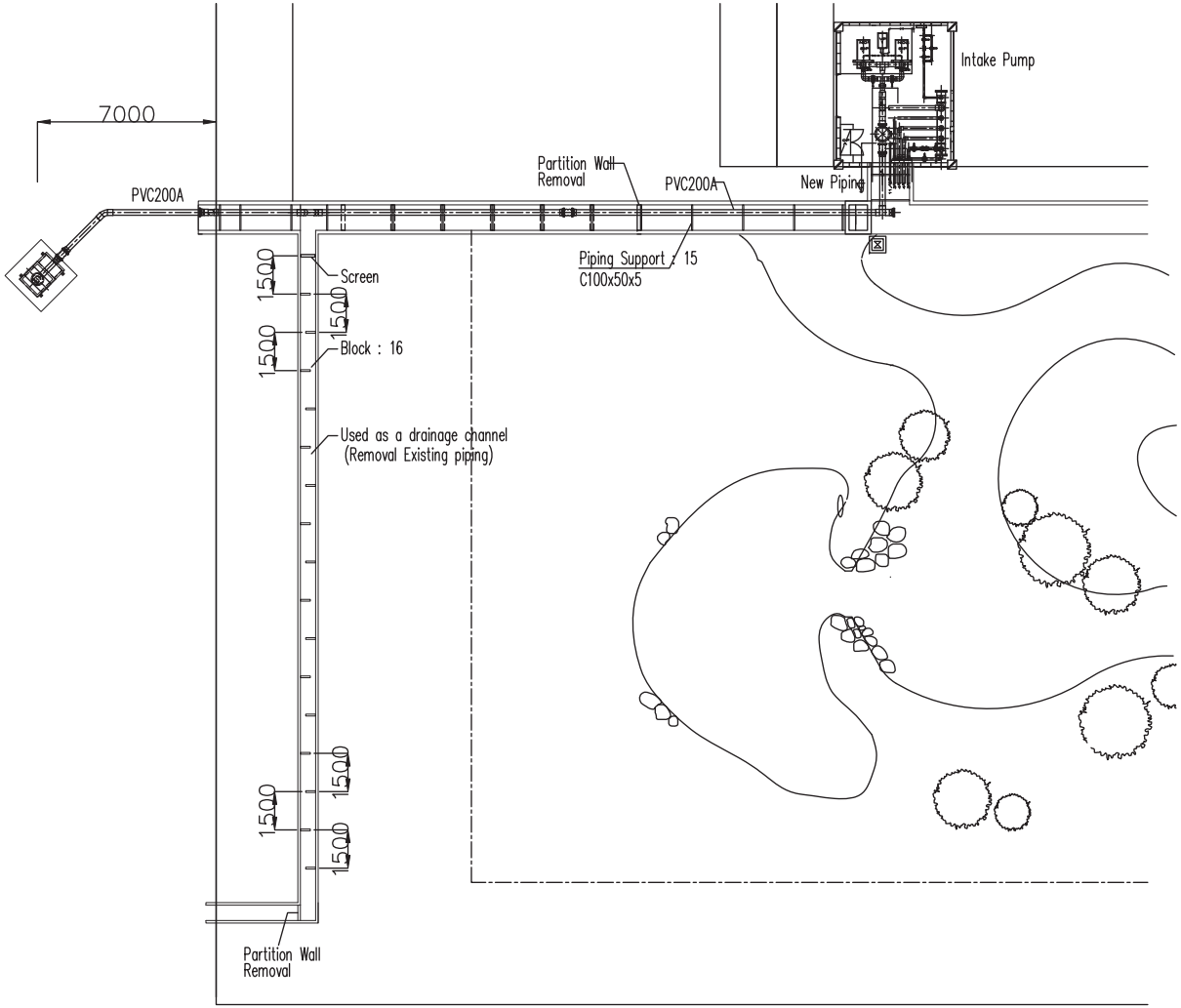
A-53

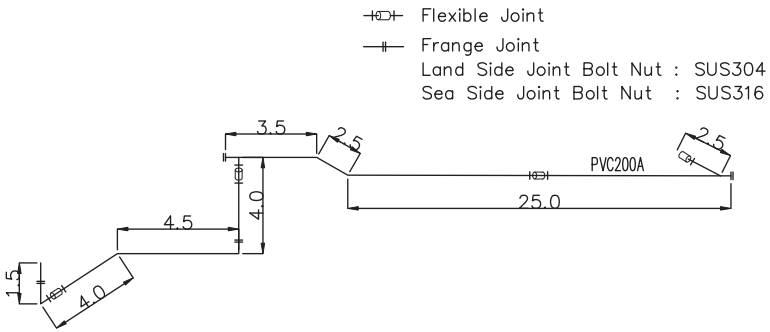
SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : 新規砂ろ過器の据付 機器群細	SCALE : 1:20	DRAWING No: M-3-3



A-54

SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : 海水取水設備更新 既設配置図	SCALE : 1:200	DRAWING No: M-4-1





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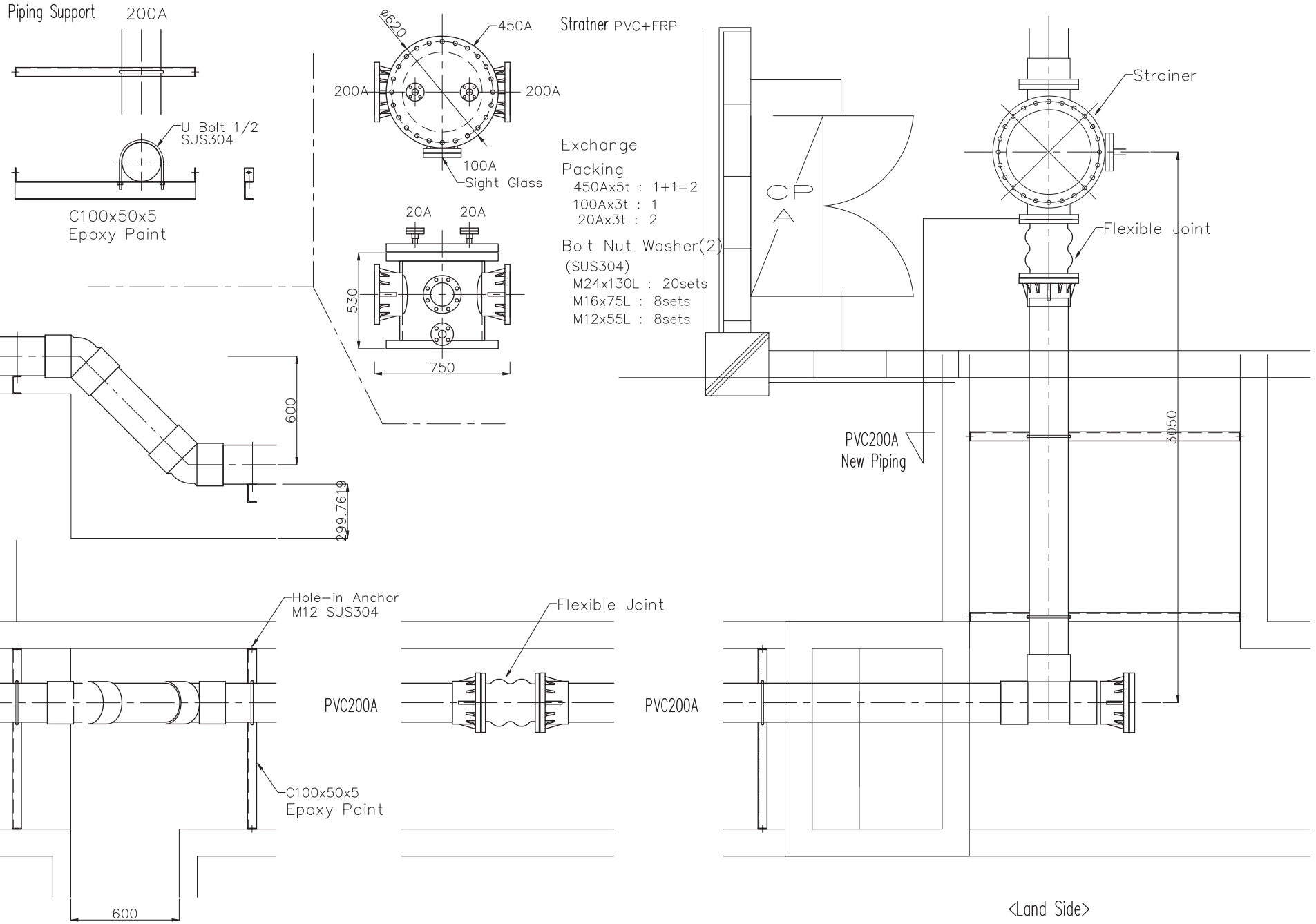
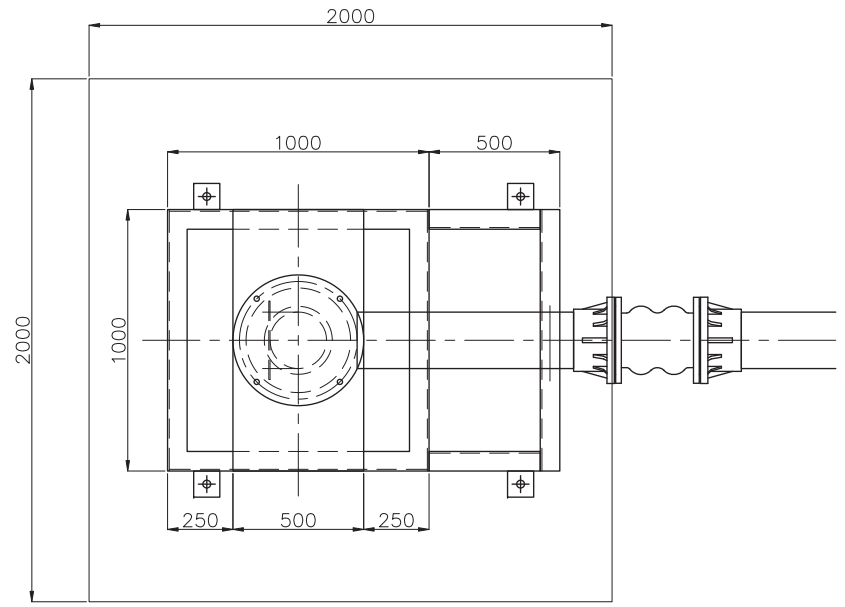
URL:http://www.ssc-tokyo.co.jp

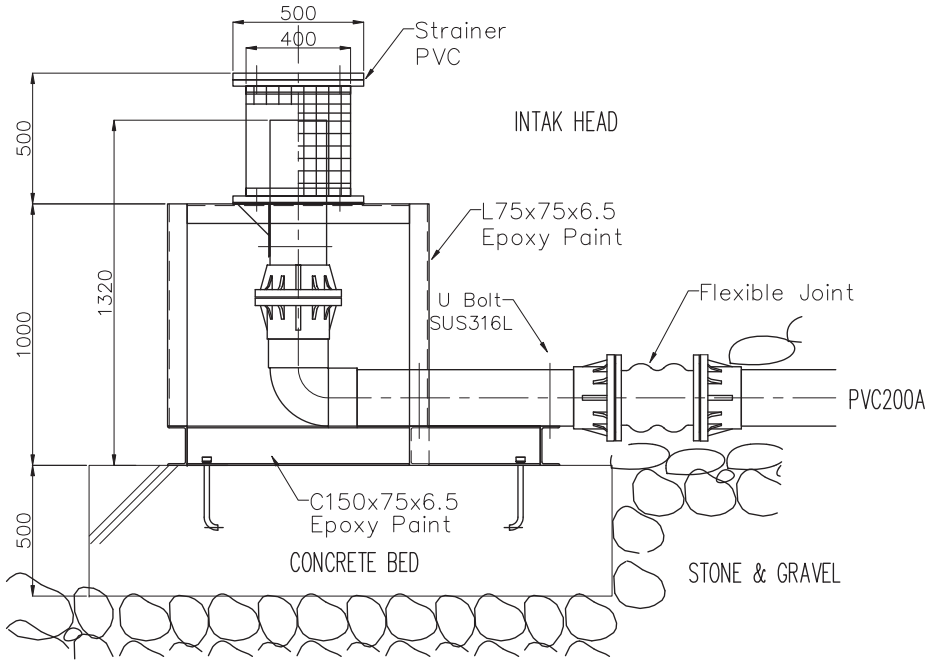
Drawn by :	PROJECT NAME:	SHEET TITLE :	SCALE :	DRAWING No:
Date :	パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	海水取水設備更新 計画配置図	1:200	M-4-2
Checked by :				

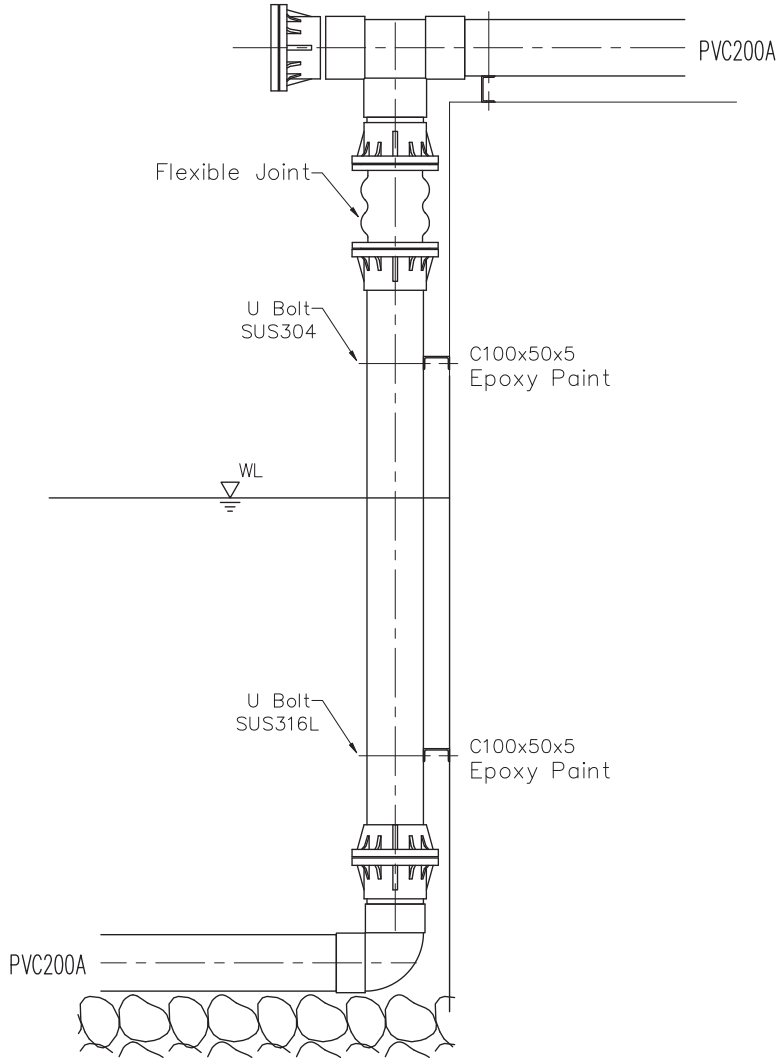


A-56

SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : 海水取水設備更新 配管詳細図	SCALE : 1:20	DRAWING No: M-4-3







<Sea Side>

A-57

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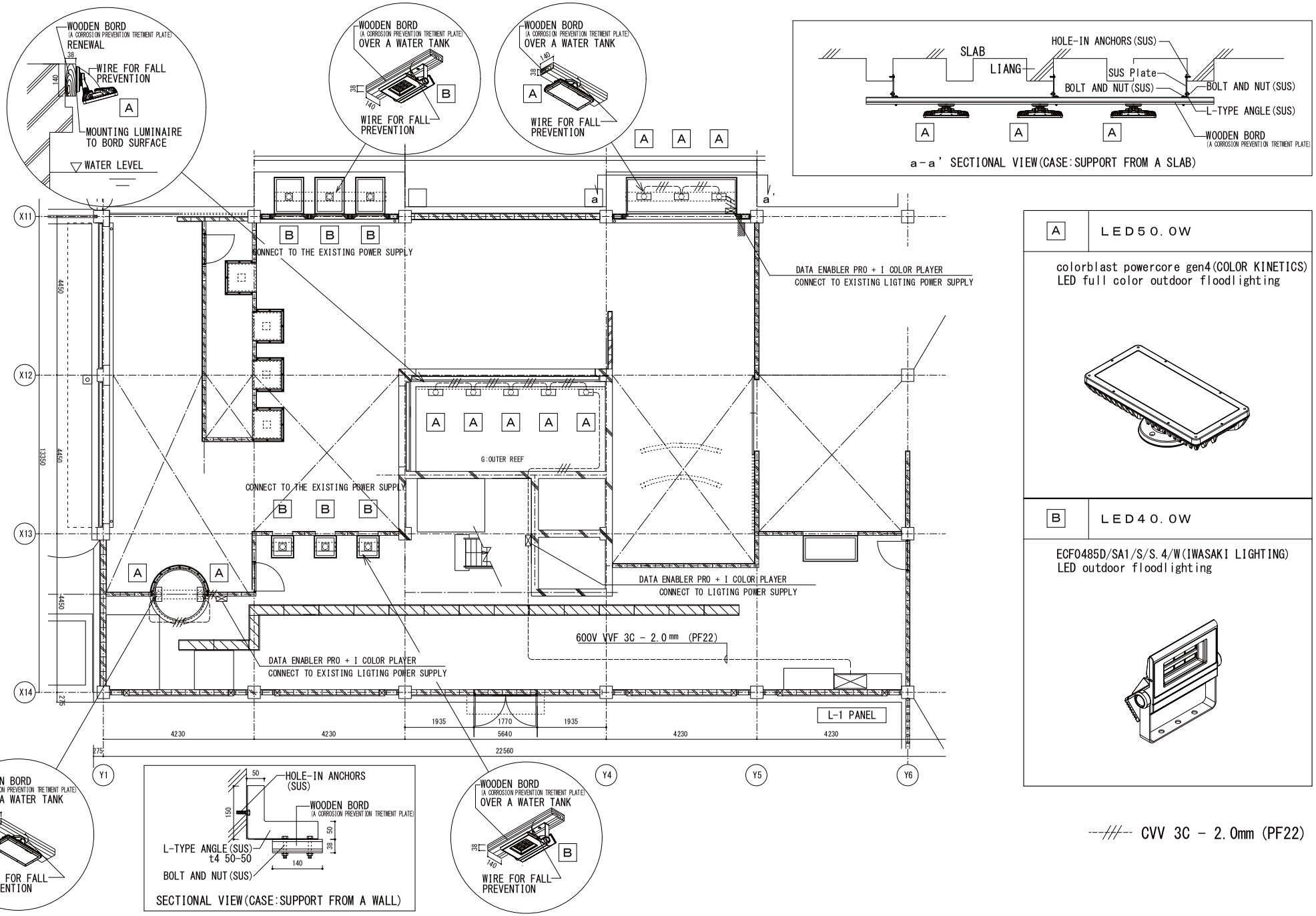

A-58

A	LED50.0W

colorblast powercore gen4(COLOR KINETICS)
LED full color outdoor floodlighting

B	LED40.0W

ECF0485D/SA1/S/S.4/W(IWASAKI LIGHTING)
LED outdoor floodlighting

---//--- CVV 3C - 2.0mm (PF22)

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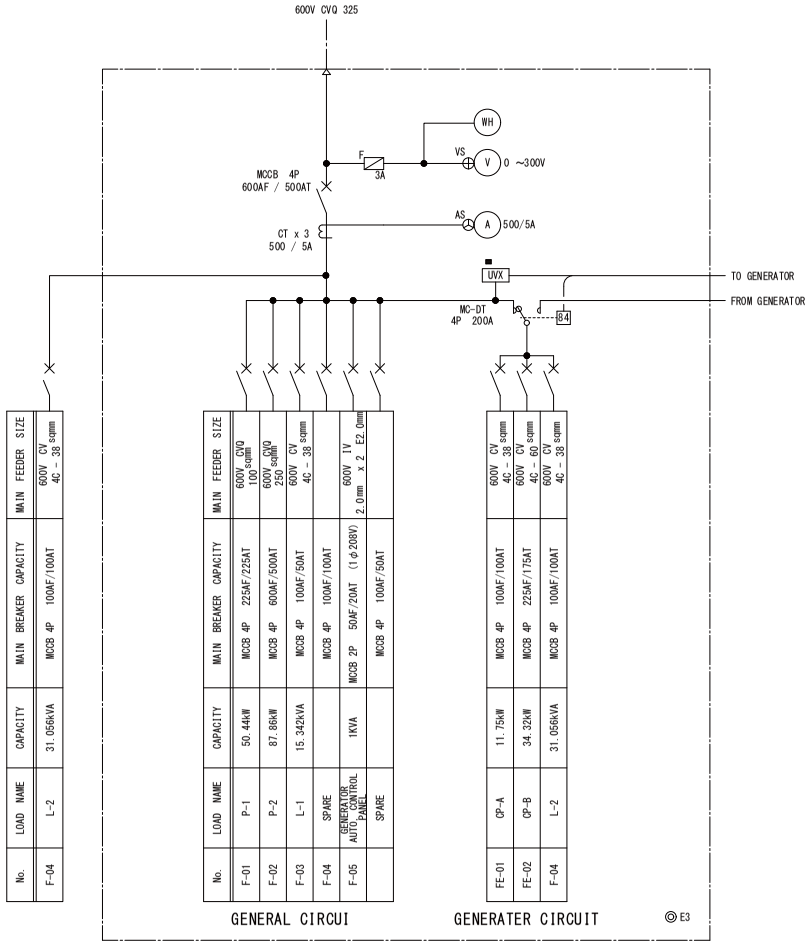
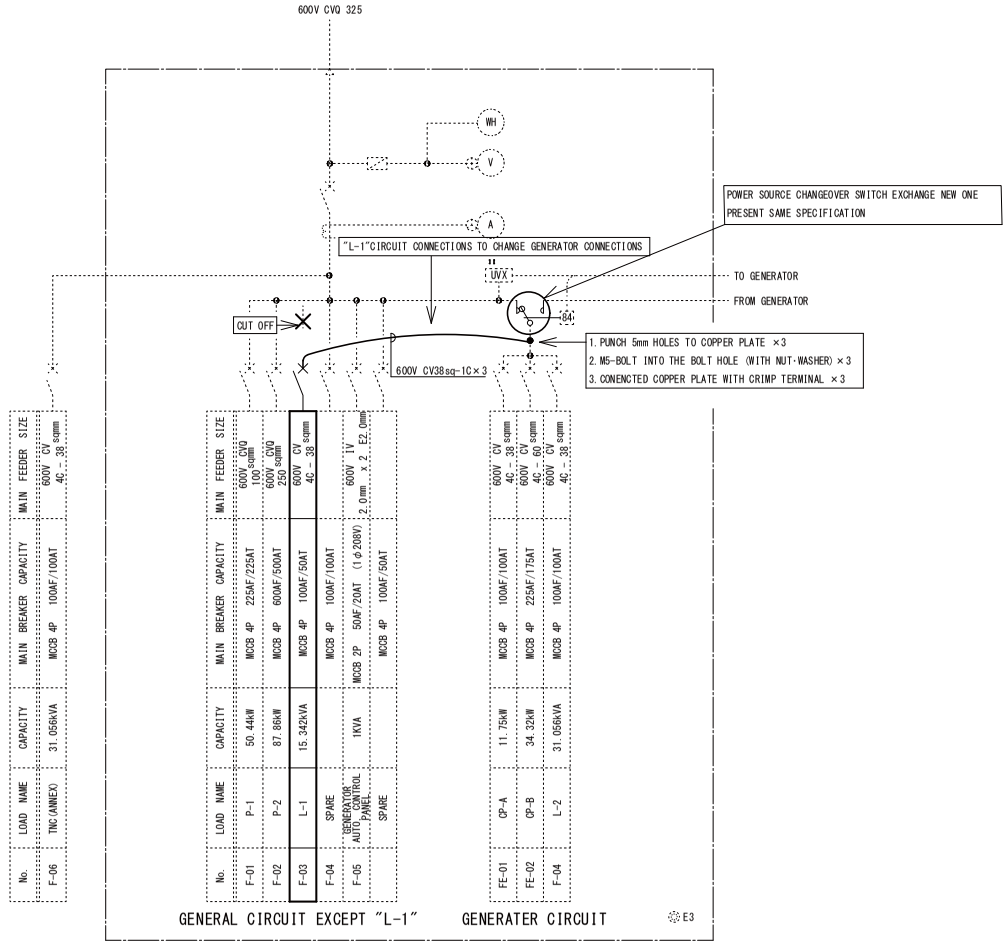
POWER RECEIVING SYSTEM SINGLE LINE DIAGRAM



BEFORE REMODELING



AFTER REMODELING

NOTES:THE DOTTED LINE MEANS KEEP EXISTING

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URL:http//www.ssc-tokyo.co.jp

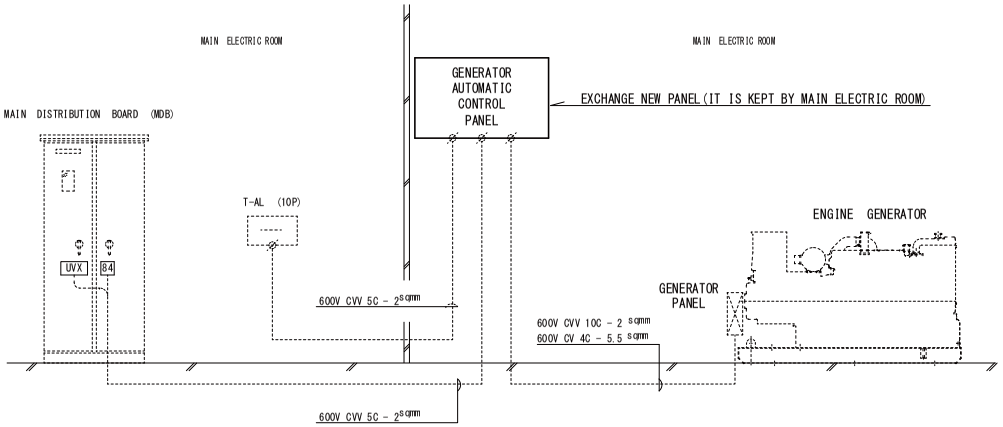
Drawn by :
Date :
Checked by :

PROJECT NAME:
パラオ国
国際珊瑚礁センター建設計画
フォローアップ協力

SHEET TITLE :
電気設備
主配電盤内配線の改造
系統図

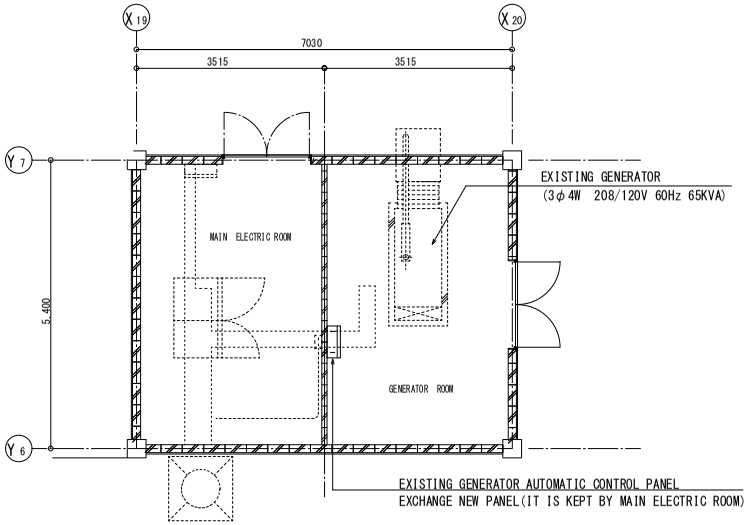
SCALE : N.S.

DRAWING No: E－2



GENERATOR CONTROL SYSTEM SINGLE LINE DIAGRAM

NOTES:THE DOTTED LINE MEANS KEEP EXISTING



ELECTRIC ROOM GENERATOR ROOM SITE PLAN (S=1/100)

NOTES:THE DOTTED LINE MEANS KEEP EXISTING

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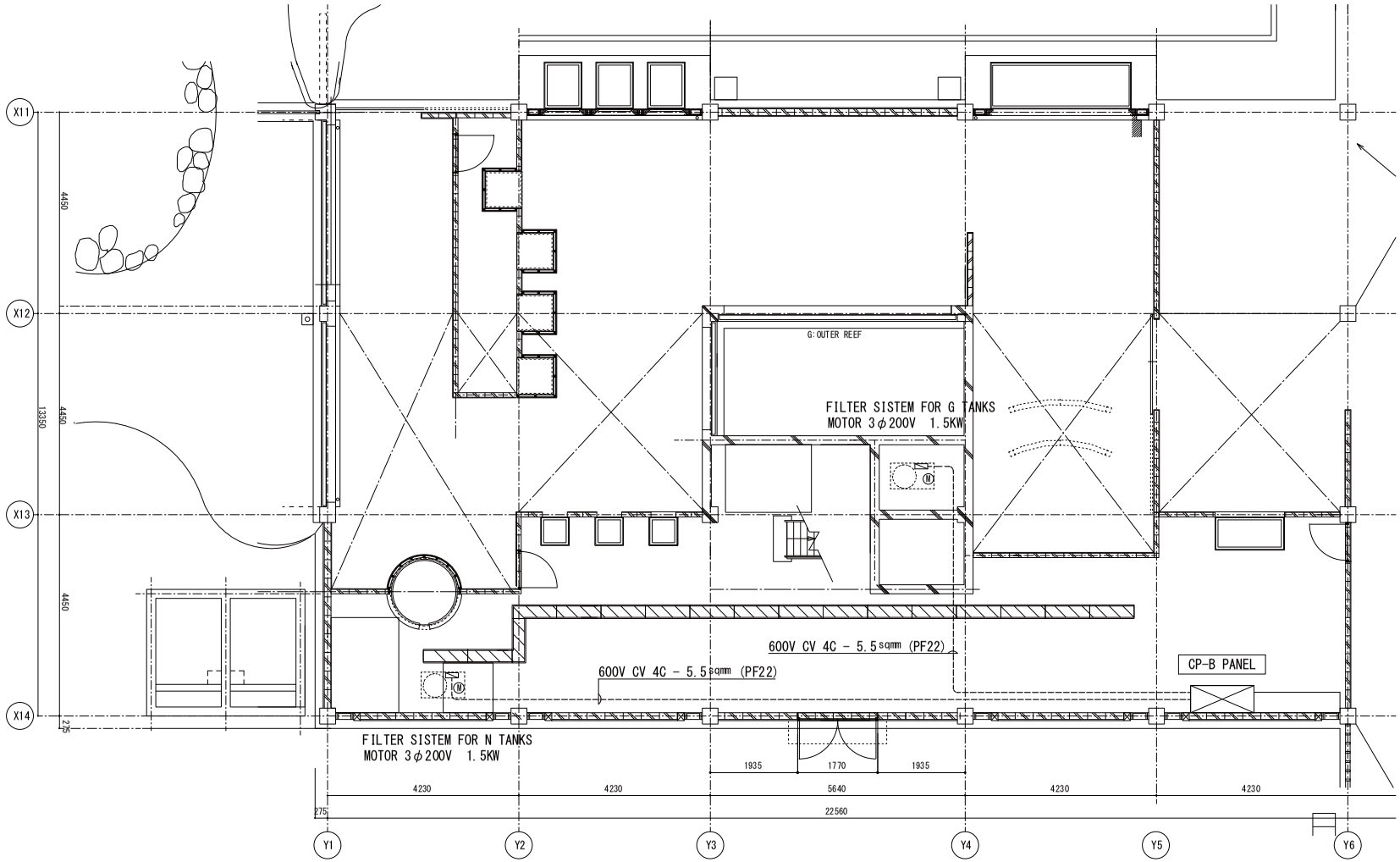

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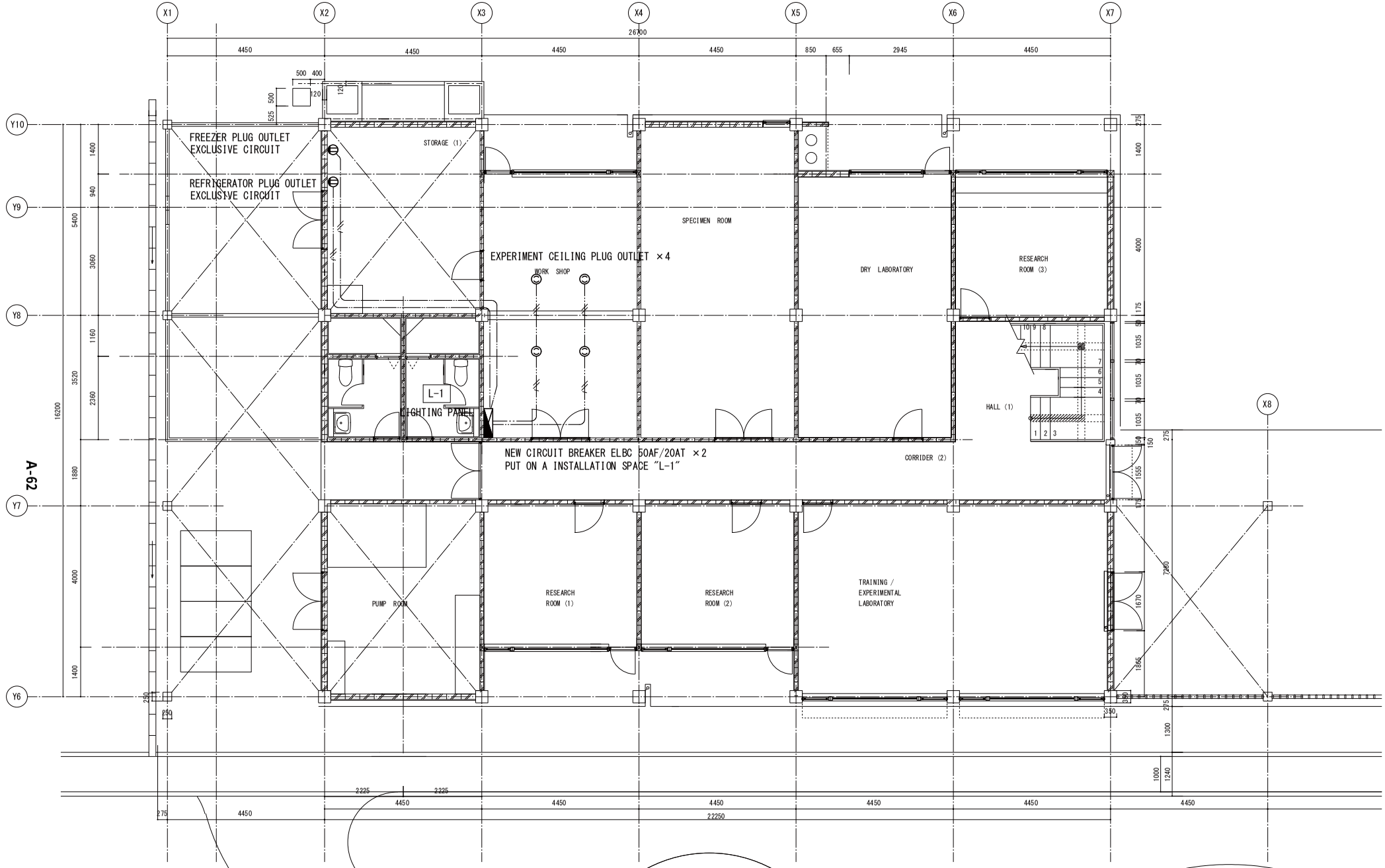
FAX +81-3-3265-8316
URL:http//www.ssc-tokyo.co.jp

Drawn by :	PROJECT NAME:	SHEET TITLE :	SCALE :	DRAWING No:
Date :	パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	電気設備 砂ろ過槽の電源供給 G．N水槽配線図	1/100	E－4
Checked by :				



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URL:http//www.ssc-tokyo.co.jp

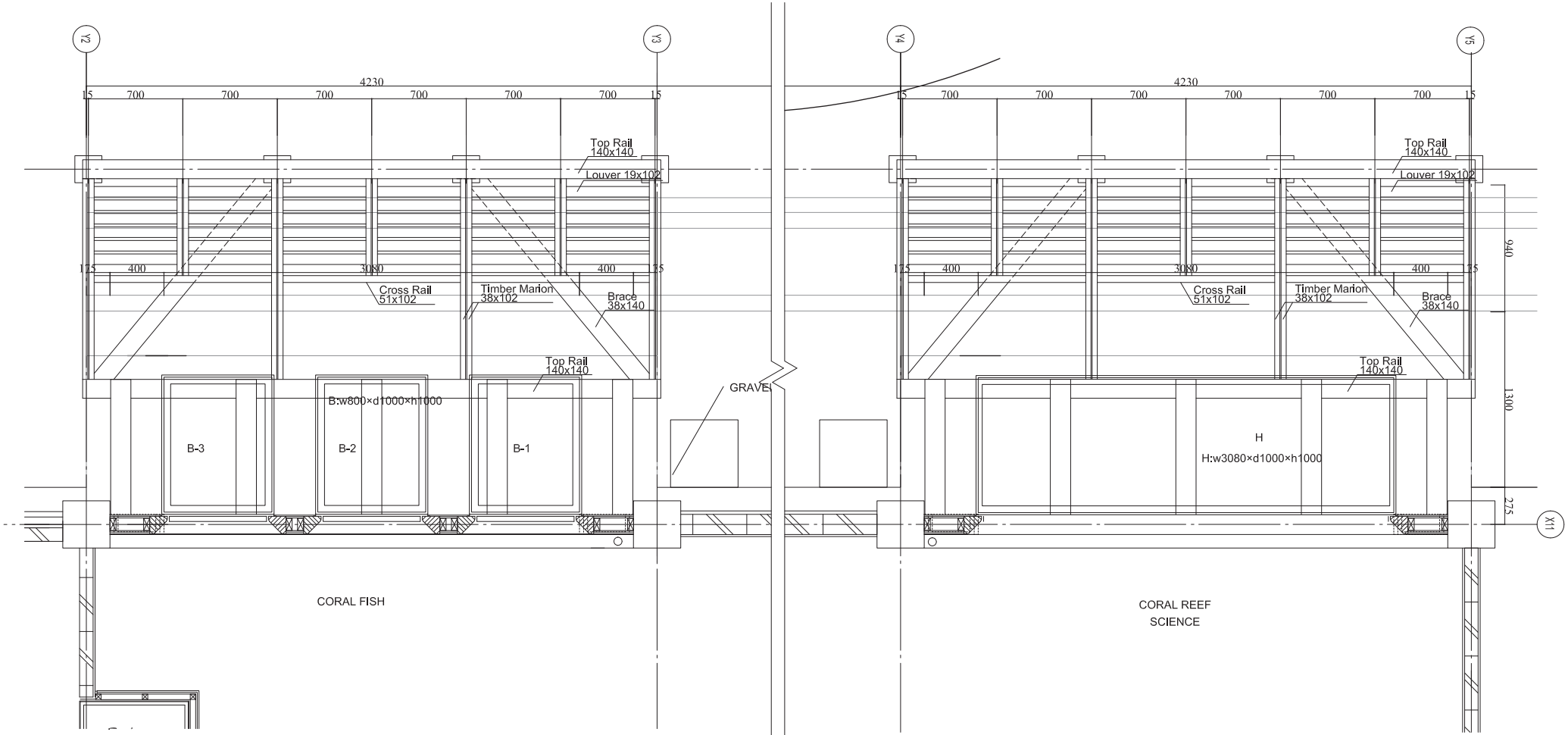
Drawn by :
Date :
Checked by :

PROJECT NAME:
パラオ国
国際珊瑚礁センター建設計画
フォローアップ協力

SHEET TITLE :
電気設備
既存水槽用照明器具の更新
研究室配線図

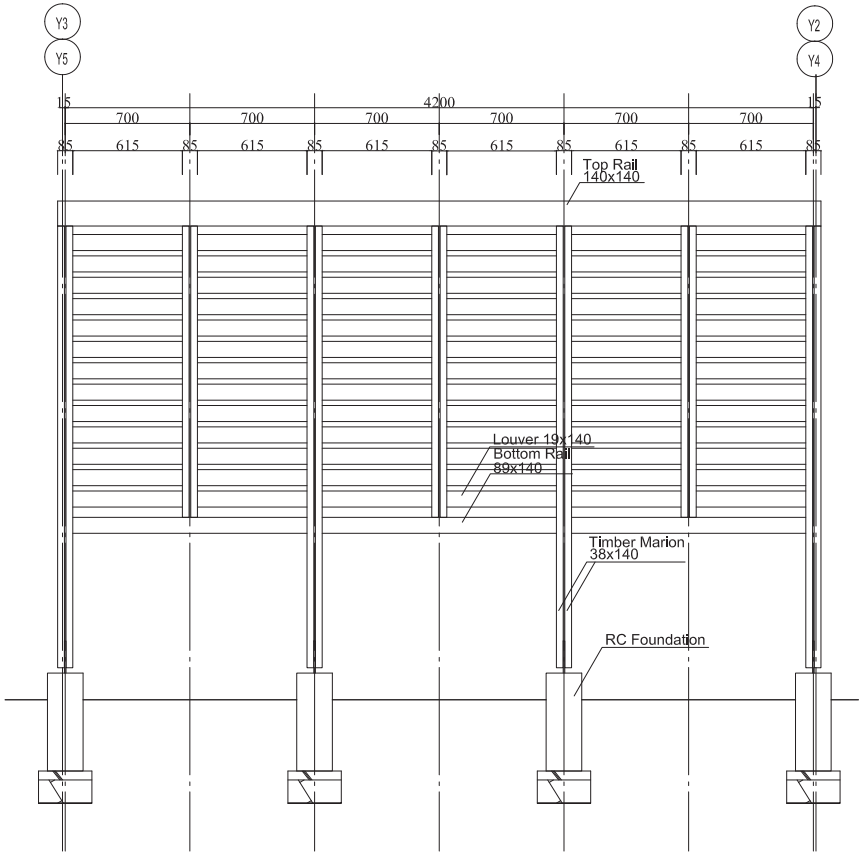
SCALE : 1/100

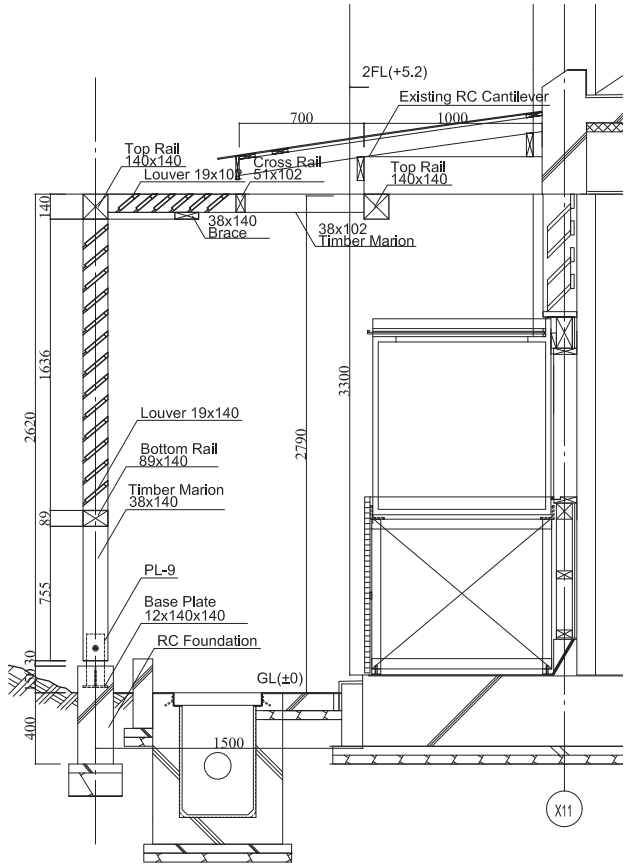
DRAWING No: E－5



*All Steel Member shall be hot dip galvanized
*All Timber Member shall be Anti- Termite Treated by Penetration Method

	SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU, TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: The Project for Construction of Palau International Coral Reef Center Follow up-Cooperation	SHEET TITLE : SUNSHADE -PLAN	SCALE : 1/30	DRAWING No: A-1-1





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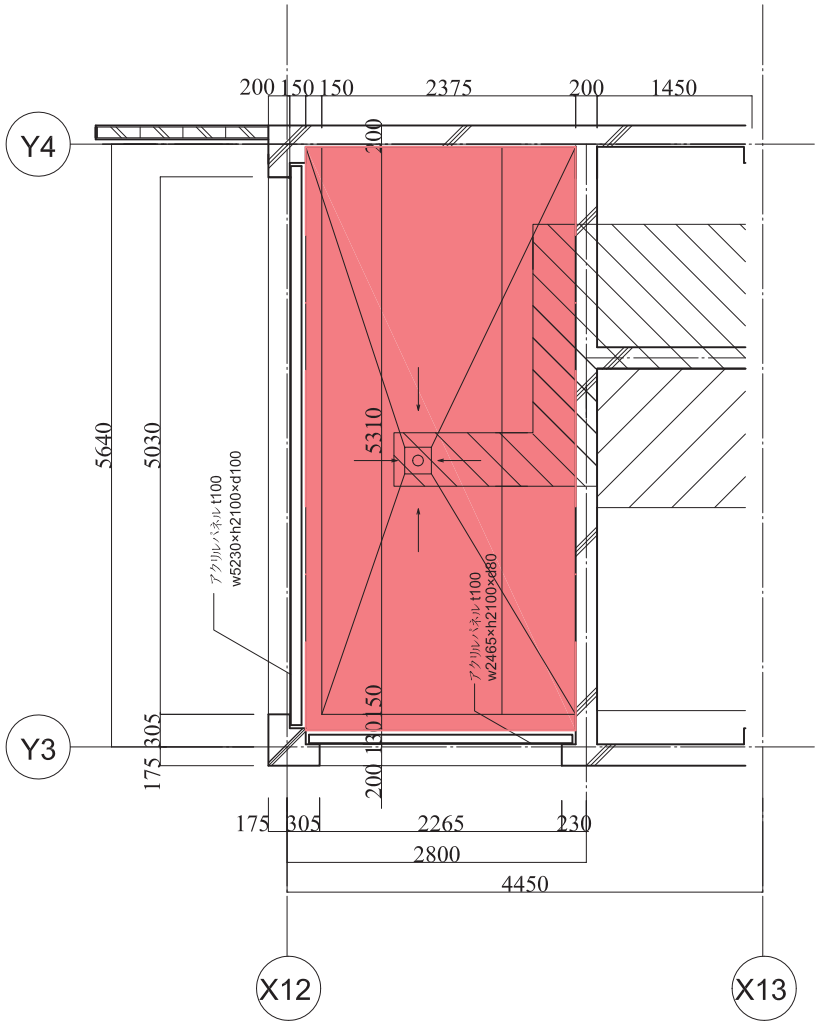
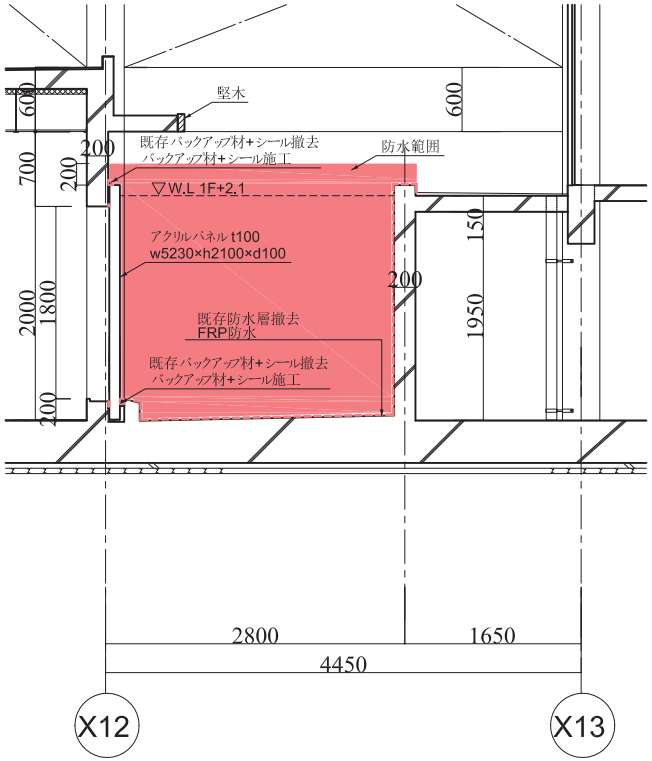
*All Steel Member shall be hot dip galvanized
*All Timber Member shall be Anti- Termite Treated by Penetration Method

	SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU, TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL:http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: The Project for Construction of Palau International Coral Reef Center Follow up-Cooperation	SHEET TITLE : SUNSHADE -ELEVATION AND SECTION	SCALE : 1/30	DRAWING No: A-1-2





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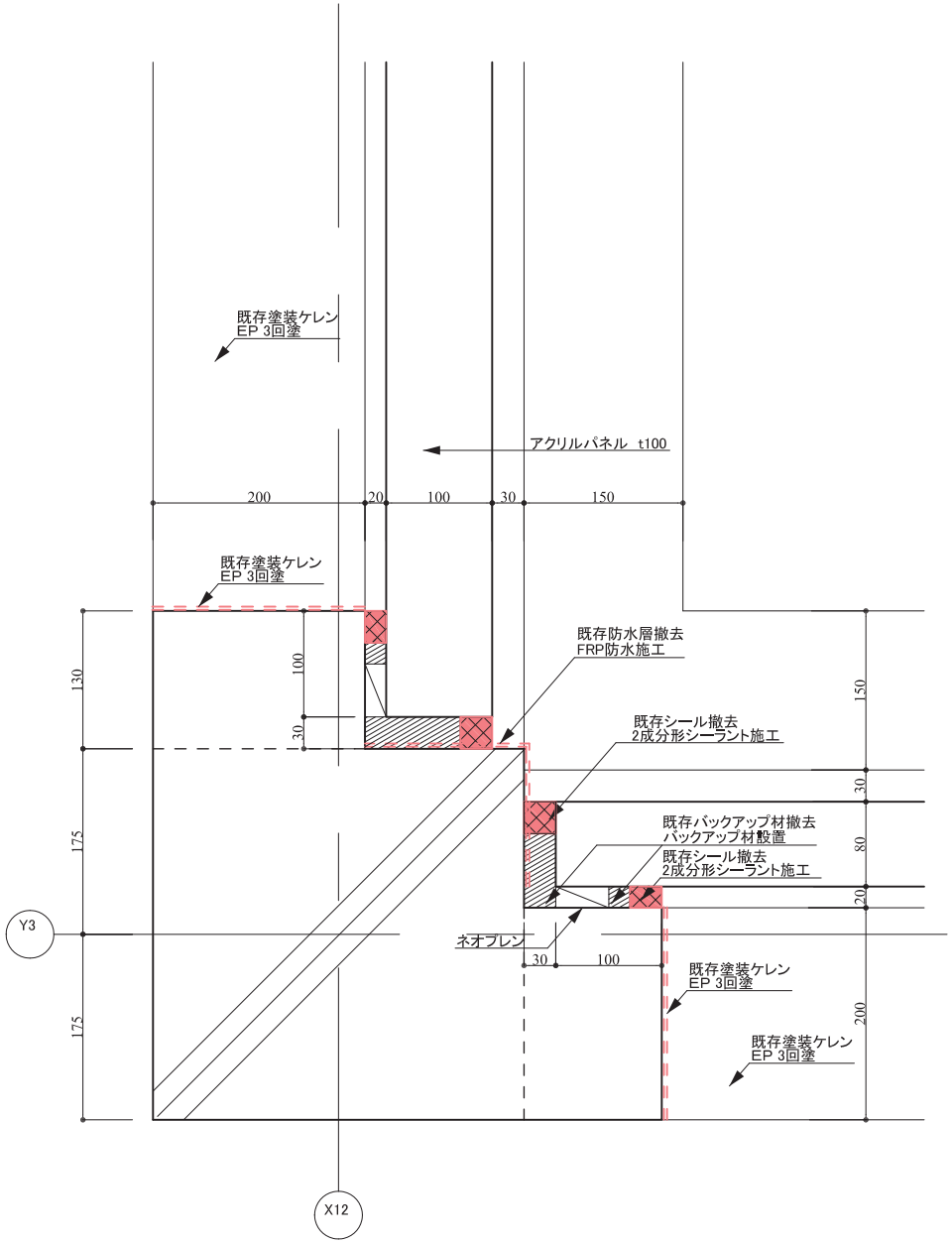
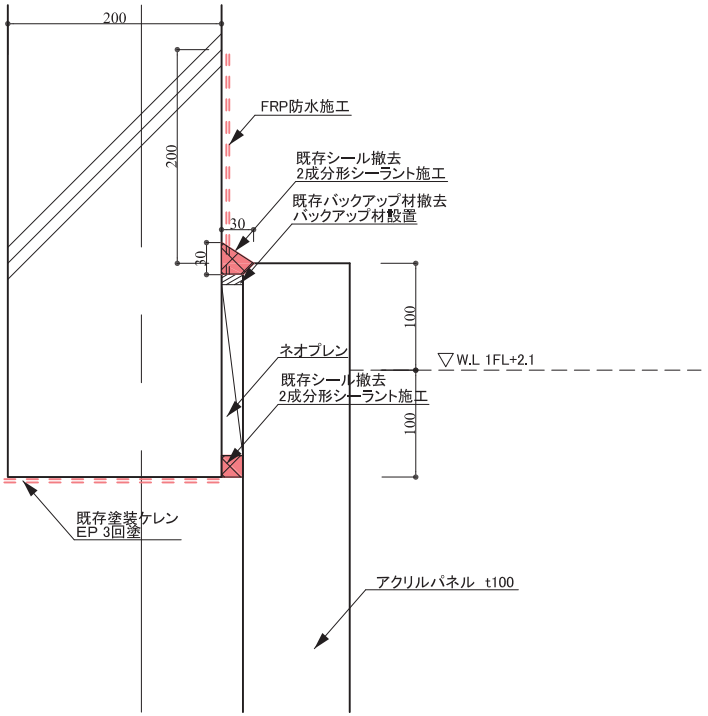
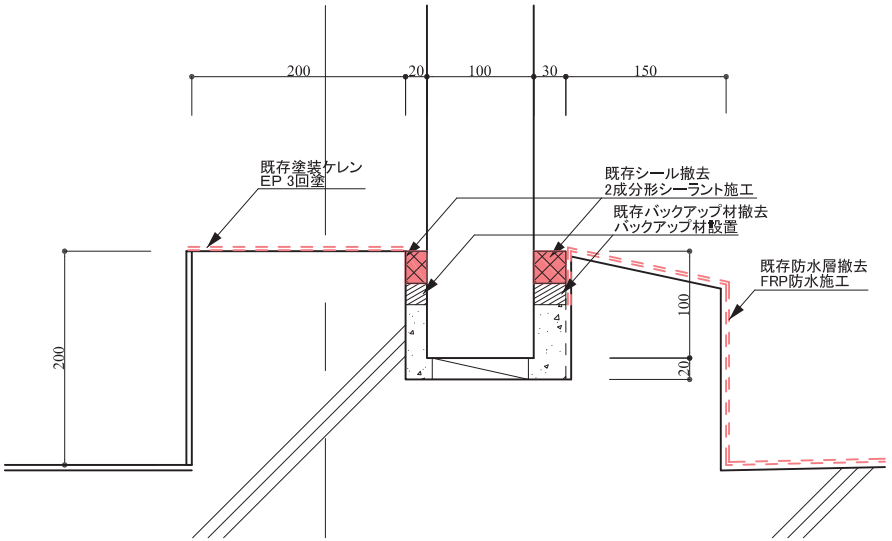
	SSC SYSTEM SCIENCE CONSULTANTS INC. 3-3-4 KOJIMACHI CHIYODA-KU, TOKYO 120-0083 JAPAN TEL +81-3-3265-8311 FAX +81-3-3265-8316 URL http://www.ssc-tokyo.co.jp	Drawn by : Date : Checked by :	PROJECT NAME: パラオ国 国際珊瑚礁センター建設計画 フォローアップ協力	SHEET TITLE : G水槽の漏水改修（防水工事）-1	SCALE : 1/50	DRAWING No: A-2-1







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